GARDEN of EDEN

The Shamanic Use of Psychoactive Flora and Fauna, and the Study of Consciousness

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FOREWORD

Greetings, reader! The book you are holding was born, initially, as a hobby of sorts. After developing a strong interest in the ethnobotany, chemistry, preparation and beneficial useage of psychoactive plants and other gifts from nature, it did not take long to realise that reliable information regarding these topics was anything but easy to come by. I encountered frustration at attempting to avoid the many inaccuracies and ignorant assumptions portrayed through media, government, and many mainstream publications in this field [as well as the internet, and 'underground' publications]. There is, however, a wealth of relevant literature that has been published in scientific journals and obscure books, which are unfortunately inaccessible to many. Searching for such information randomly, with no references to start from, is a time-consuming task that could not be accommodated in the lives of most working people. Due to the tendency of journal articles to become forgotten in the sands of time, there was a need for some academic excavation [and continuation of excavations begun by others] to ensure that much valuable information was not lost from public knowledge.

Also of tremendous importance are the numerous personal communications that have been exchanged with a wide array of knowledgeable folk. Many have chosen to remain anonymous, some have chosen pseudonyms, and others have stepped out into the open entirely. All have contributed valuable information regarding their own observations or experiments, much of which has never been published before. The unfortunate unwillingness of many science-related authors to publish the reports of 'amateurs' has historically resulted in many gaps in our holistic understanding. Such gaps have also arisen from the frequent lack of communication or understanding between practitioners of different scientific, academic and/or 'mystical' disciplines. In my own explorations of the realms of ethnobotany and consciousness, it quickly became apparent that here was an area of study in which all of these disciplines [and many other things beyond] are inter-related in a fascinating way. Being a lover of the gathering and analysing of obscure and interesting information, I set to work on assembling this ever-growing project, not suspecting it would take over more than a decade of my life.

In short, this book began as a private project for my own reference. After a year or so, it became clear that this would be a book that should be shared with others. So, part of the mission of this book was to retrieve a great deal of this information for public perusal, attempt to filter out old errors and make sense of points of confusion, and establish a substantial bibliography to aid the reader in further research of their own. Also, a multidisciplinary approach was taken in an attempt to harmonise fields of knowledge that are usually treated as unrelated. Further, perhaps more important, motivations for writing this book are discussed in the Introduction. This resulted in what you are now reading – a compendium of knowledge intended to aid both personal and academic research into the shamanic and spiritual useage of natural substances. I cannot claim this book will tell you everything you may want or need to know on the subject, of course – I drool to think of any single book which could, whilst simultaneously doubting such a book could be written – yet hopefully it will at least serve its stated purpose.

Information from the past is constantly being rediscovered, and fresh research is constantly being carried out by many scientists and noble amateurs the world over. Many thousands of plants are still unknown to us, both chemically and ethnobotanically, and it should be expected that we will learn of 'new' psychoactive plants and substances in the natural world with increasing frequency over the coming decades. Whilst writing, so much information has passed before my eyes, that there have been many topics and avenues of discussion I have been unable to pursue further in this volume. Also, the size of the endeavour has meant that some more recent new developments, as well as some old ones, have slipped through my net and are not reported here. Even if everything regarding these topics that is known to this point in time were compiled, the result would consist of a small library full of texts and images. In addition, there are some fields of knowledge which seem exceedingly difficult to confine to static words or images, and must remain as knowledge obtained via direct experience. As is reflected in the dazzling complexity of nature, any line of intellectual inquiry can be found to expand exponentially – a question becomes a thousand questions!

I hope this book helps you find the answers to some of your questions.

[Please note: regretfully there are some layout anomalies that could not be resolved without creating worse problems. These became apparent too late in the final editing process, and fixing them would have required reassembling the whole thing from scratch, altering the layout, and re-doing the index numbering (which due to the complex nature of the book had to be done manually rather than automatically, and took literally weeks of work). As the book has already been delayed for so many years, stress has mounted, and other aspects in life are calling to be attended to, I took the difficult decision to continue and publish the book 'as is' despite these flaws. Hopefully you'll be so busy reading you won't even notice!]

Snu Voogelbreinder, April 2009

DISCLAIMER

Unfortunately, some of the plants and naturally occurring chemicals discussed within are illegal to possess, process, or consume in many countries across the globe. It is strongly advised that the reader become familiar with the laws of their country in this regard, as failure to abide by such laws frequently results in serious disruption to the lives of individuals, who may face distressing invasion and ransacking of the home, fines, loss of income, confiscation of property and/or incarceration.

Besides this risk, some of the substances and practices described within may be risky or harmful under some circumstances, and are usually noted as such when mentioned in the text. Some individuals may also be particularly sensitive to these influences, and have adverse reactions which are not experienced by the majority. The author can not assume responsibility for any harm resulting from the use or mis-use of the information within this book. Readers are advised to act with their own responsibility in mind and to make their own informed choices.

A NOTE ON CROSS-REFERENCING AND FORMAT

For conciseness and simplicity, the properties of chemicals appearing in the text in italics [eg. this species has been found to contain *nicotine*] are mentioned in the *Chemical Index*. Titles appearing in italics refer to the title of a separate chapter of this book. Genus names listed in the text in bold [eg. **Cannabis** has also been used in conjunction with this plant] refer to an entry for that genus elsewhere in the A-Z listings of the main text [ie. part two]. Such genus names are not in bold type when found in their own entry, except in the case of species listings at the start of the section, and when introducing a species or genus description at the end of the section. Genera or species which are mentioned elsewhere in the text but without a main entry are marked individually as appropriate [eg. This fungus may be confused with Ustilago spp. (see *Endnotes*)]. Colloquial names are generally given in inverted commas when first appearing in a section of text.

In part two of this book, organisms [plants, animals] are discussed under individual entries arranged alphabetically by genus [the first part of a scientific name or Latin binomial; ie. Acacia (genus) baileyana (species)]. Each of these entries follows a similar pattern of formatting, depending on the depth of information available. A typical genus entry will be arranged as follows:

GENUS

(Family, sometimes including alternate or obsolete family names, and subfamilies where applicable)

Species names *with authors* **(and synonyms)** – and common names
[Such lists of species names consist of those important species discussed in the text, and do not comprise a list of all known species within a genus]

General discussion on uses and folklore.

Discussion on special methods of preparation and consumption.

Discussion on the nature of the effects of the consumed substance.

Discussion of the chemistry of these species and/or their close relatives, usually listed alphabetically by species. All yields of chemicals are from dry weight [d/w] source matter unless stated otherwise. Some information may seem contradictory or conflicting due to differing source material and methodology used by different researchers; the author has tried to analyse and compile the data and present it in a way that makes sense, but some confusing points remain.

Representative species with a detailed botanical or zoological description, including information on habit and habitat.

Discussion of possible confusion with other species or subspecies.

Cultivation requirements for this representative species and/or other members of the genus, in the case of plants.

PART ONE

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INTRODUCTION

I feel it is necessary to be blunt. We have reached a point of crisis.

Whilst the human race has made huge leaps in technological advancement, most of us have failed to grow in how we relate to ourselves, other people, and the environment we live in – rather, we have largely atrophied in those areas. With the homogenisation and commodification of culture based on consumerism continuing to spread its influence, straining natural resources and smothering individual expression, many scientists and others sensitive to our environment are realising that the lifestyles and choices of much of humanity are destroying the natural balance which allows life as we know it to exist. It is unfortunate that in today's politico-economic climate these truths are incompatible with the increasingly myopic 'economic rationalism' which governs most nations. As a result, scientists who wish to remain in long-term employment often have their urgent messages stifled. The comforts of life in relatively affluent societies shelter us so much from the problems of the world, that it seems easier for most people to accept the reassurances from our governments and peers that we will continue to grow and prosper forever if we continue with current trends and ways of thinking.

For too long, we as a technological race have been blindly damaging links in ecosystems we are only beginning to understand. What we are now learning tells us that even minor alterations in such systems can have massive consequences for the system as a whole. Our economy, which seems to have become somewhat of a god unto itself in these times, dictates the actions of individuals, companies and governments, and makes environmental destruction desirable and profitable. It allows some of us to live in relative luxury, obsessing about the latest fashions and celebrities and complaining about the price of petrol, while the less fortunate may starve or be driven from their land at gunpoint. We act as though this can go on forever if we look the other way, though there are voices from all sides reminding us that we can not survive for long as a race without a healthily functioning ecology of the mind as well as of the planet. We can't control the weather, so to speak. When nature bites back hard, there is usually little we can do about it. This is the price we pay for turning our backs on nature and its ways – for treating it as something to be conquered, tamed and exploited, rather than as something to love, learn from and be part of – which we are whether we want to be or not.

Our relationships with, and awareness of ourselves, other beings, and our environment are in great need of repair. It could be said that the way we treat our environment is in direct relation to our degree of awareness. Psychedelic plants [and other psychoactive substances from nature] are largely functioning in this day and age as our emergency wake-up call. Their wise use offers direct experience of these relationships, and can help us find paths to healing the broken connections in the web of life, encompassing spiritual growth in the process. It is unfortunate that today's busy lifestyles do not leave most people with the time to truly find themselves, and consequently learn how to bring harmony into their lives. Many people become impatient with the more culturally-acceptable approaches to self-discovery [and the resultant re-discovery of the worlds we exist in], or are suspicious of spirituality that is not self-evident.

This is where the plants and other organic life-forms, which are the focus of this book, come into the picture. We must admire the way in which they manage to survive, with the relative simplicity and self-reliance that we have grown to lack in our ever-complex technological world. Of course, such organisms are also interdependent within the entire ecosystem [and thus, not truly 'self-reliant' – by the same extension, perhaps nothing can ever truly be considered 'self-reliant' unless the whole of 'reality' and all that it contains are considered as one organism], yet humans like to imagine themselves as being removed from this web – a dangerously false notion, both for ourselves and the non-human organisms we affect every moment. In humans, the notion of self-reliance often takes the form of fighting against nature, including other people, in order to survive and thrive, rather than flowing with it in order to live harmoniously.

We must also admire the powerful transformations of consciousness that can occur when the biochemistry of particular plants or animals is introduced to our nervous systems. Some of these chemicals are powerful catalysts which have the potential to reveal, sometimes in one session, that which may take years or a lifetime to discover by other means. This is not to say such 'other means' are without value, for in many ways they are ultimately more valuable, as using them can establish a self-discipline that may be difficult to achieve with psychedelics alone. Such practices are also discussed in this book. However, the psychedelics enable glimpses of facets of reality undreamt of, which can provide the impetus and foundation for a journey of healing and rediscovery that would not have otherwise come about. [I use the term 'rediscovery' because for many people, wisdom or revelations perceived in such altered states often may have the strange feeling of being things we once 'knew' but had long-forgotten.] Through befriending these life-forms, as well as through respectfully utilising their biochemicals and our own, we access a vast reservoir of learning that can not be found in any text book. In doing this, we also take the first steps in re-establishing our long-lost relationship with the planet that gives us life. It seems generally accurate to observe that people who consume psychedelics may frequently develop an increased empathy with the earth and its inhabitants, become active in attempting to protect and nurture our environment, and begin making positive contributions to society [or at least to their own mental/spiritual wellbeing] where before they did not.

It is seldom remembered that we depend on plants and other forms of life for our very survival. Without them, we would ultimately have no food, no water, no oxygen, no consciousness, no life – let alone the inspiration that can derive from a living being beholding natural beauty. With that fact in mind, it may seem a little less alien to adopt such a close relationship with other organisms, especially plants, which many people do not appear to even think of as being living things, let along possessing consciousness. I am not claiming that plants necessarily have a consciousness like our own, but I do believe plants to have their own kind of consciousness equally as 'real' as our own. Given the debt we owe them for our existence, it seems only fitting that we respect and try to learn from them with open hearts and minds.

Few people will openly admit, even to themselves, that most of us experience spontaneous alterations in consciousness in the course of our everyday lives, however subtle. It may be that we seldom pay them much attention simply because they are such a common part of life. These changes may be triggered by external causes, such as the occurrence of a traumatic or joyous event. They may be linked to inward emotional processes not directly related to the above. They may even seem to be truly spontaneous, occurring for no discernable reason. This is without even mentioning the states experienced semi-consciously during the different stages of sleep. We are constantly driven to alter our consciousness in ways that we find desirable and/or useful, rather than remaining at the mercy of pre-programmed or involuntary hormonal and neuronal reactions. For example, if we feel sad, upset or confused, we will usually try to find ways to feel happy, content, and in greater control of our thoughts. If needing to concentrate on a difficult problem and find solutions, and experiencing difficulty in doing so, we will usually try to find ways to sharpen our focus and/or broaden and add greater depth to our modes of thought. The psychotherapeutic ingestion of psychoactive plants and other substances, or the practice of exercises designed to alter consciousness are not recent or exceptional phenomena (see also Weil 1972). Drug prohibition on such a wide scale as we see today, *is* a very recent phenomenon.

If used wisely, the access of altered states of consciousness at will can be a highly useful tool for expanding awareness, or directing awareness into areas usually ignored. This is not to say expanding awareness is always as simple as ingesting a given substance. Some people display the ability to consume psychedelics repeatedly simply for enjoyment, and never experience any lasting insight. Others appear totally [or at least relatively] immune to the effects of some such substances. The successful application of altered states requires good health, hard work, dedication and purpose. It is an intention of this book to discuss the use of such plants, animal secretions and natural techniques in an overall holistic approach to life, rather than as relatively shallow recreation [which, in itself, is not without value]. Although this book carries a strong emphasis on the potential values of natural psychedelics, other natural substances which affect consciousness in more subtle ways are also discussed.

We will explore a great variety of substances with differing effects, some of which may overlap qualitatively. To outline these briefly, I will attempt a basic categorisation. Starting at the lower end of the spectrum, some substances produce an effect that may be called sedative – also included here are narcotics, soporifics, depressants, tranquillisers and hypnotics [consult the *Glossary* for definitions]. In moderate doses these substances can be very useful in facilitating meditation or trance, by relaxing the body and mind. They can help to calm the straying thoughts and fidgeting that often prevent a beneficial altered state from occurring. Stimulants can conversely help one to stay awake during meditation sessions that are long and arduous. During such sessions, exhaustion and mental relaxation may reach a point where sleep comes at an inappropriate time. Euphoriants can help one reach a state of 'ekstasis' where sudden realisations often occur, or may be used to reverse severe depressions. Aphrodisiacs may encompass different permutations of sedative, stimulant and/or euphoriant effects, and can be of use in instances where enhancement of sexual union is approached as a means towards illumination [i.e. tantric yoga]. Psychedelics [see also hallucinogen, entheogen, psychoptic, visionary in *Glossary*] are undoubtedly the most useful of all. Their potential beneficial uses have been briefly mentioned above, and are further discussed in the chapter *A Primer in Tripping*. Their properties and potential applications are particularly plastic, allowing access to the subconscious mind and indescribable states of reality. They have a strong history of successful use in

problem-solving, especially in cases where conventional means have been inadequate. Their potential for catalysing positive personal growth is vast, if the person is willing, and should never be underestimated. However, as with all drugs [and other things], they can be dangerous if used carelessly or arrogantly. Psychedelics may also encompass sedative, stimulant, euphoriant and/or aphrodisiac effects. Finally, we have the tonics and 'harmony herbs', or adaptogens, which can help restore physiological and psychological balance within the organism, promoting good health and resistance to stress and infection. Some have mild psychoactivity of their own or in combination with other herbs. Most are extremely non-toxic if used properly. These substances are often of use simply in everyday life, faced with the stresses and pollutions of the modern world. They are invaluable to those using psychoactive substances, which may exhaust the body due to the great energies being channelled, particularly if they have been used to excess, or after a powerful session.

In learning about natural psychoactive substances, it seems most fitting to first approach the ancient cultures worldwide who have worked with altered states of consciousness for thousands of years. It is rarely acknowledged what an important role psychoactive plants appear to have played in the history of our species, and the extent to which they have been [and continue to be] widely used for positive means. Humans have the potential to misuse anything with great power – as has also been done with these plants, when they have been used to influence, dominate, and even kill others. The parallel of 'drug abuse' in our modern societies, where substances are often used excessively and habitually with negative physical, psychological and social effects, is likewise the side often present in the public mind when 'drugs' are mentioned, except only in reference to illegal drugs. The official stance of the last hundred years or so has been that *any* use of illegal drugs is 'drug abuse'. This tendency to categorise all psychoactive substances into one group – or two, legal and illegal – is the major barrier towards a wider understanding of the fact that many psychoactive substances can be therapeutic and highly positive in their influence if used wisely. However, few people in our societies know how to use any drug wisely.

So we turn to the shamans of indigenous cultures, the original experts in the use of psychoactive plants and altered states. Yet we must first understand that shamanism is and has been practiced in a much wider context than that of simple consciousness-alteration. The states experienced by the shaman encompass a vast array of unlimited potentials which relate to all aspects of life, and particularly integrate a sense of spirituality or cosmic and sub-molecular awareness which bond the tribal group with each other and their surroundings, aiding psychological survival, increasing the quality of life-experience, and increasing possibility of physical survival via learned enhancement of perceptual, intellectual and physical skills (see also Fericgla 1995). This is not to say that all indigenous peoples of the world are necessarily enlightened angels as a result – simply that many such groups of people have learned to use 'shamanic technologies' in ways that are beneficial [rather than harmful or neutral in effect] to the group as a whole.

The shamans were/are often the 'doctors' and 'politicians' of the tribal group, resolving problems medical and psychological, as well as divining for information on other matters and settling disputes. Through access to 'spirit realms', as they are often called, via alteration of consciousness, shamans may acquire and master an impressive field of esoteric knowledge that constitutes the science with which they perform their duties and explorations (see Narby 1999). They are respected members of the group and considered wise because of the relative success of their cures and advice. Shamans are usually selected when young, if they show an unusual degree of potential in this field; sometimes the responsibility is simply passed on down family lines. In some groups, almost everyone is a shaman. Extended life-threatening sickness and/or insanity early in life are often deemed as good indications of a shamanic future. Whatever the origin, the 'apprentice' shaman is taken under the tutelage of an elder shaman and trained or initiated over many years in the shamanic practices of the group, encompassing also local mythologies and spiritual beliefs. They may be kept in isolation from the group for long periods, acquiring knowledge and undergoing tests in the wilderness. A notable feature of the lives of many native North Americans has been the vision quest, which involves retreating to a remote and secluded 'power spot' (a geographic location deemed to be particularly well-endowed with cosmic energies) for days with no food. This ordeal usually culminates in a vision or series of visions which may give the seeker useful and inspiring relevant information, and aid in development of connections with the 'spirit' realms [see also *Influencing Endogenous Chemistry*]. The years of initiation usually involve a combination of instruction from the elders in ritual, secret knowledge, medicinal plants etc., keeping of special diets [see *A Primer in Tripping*], abstaining from sexual contact, practicing meditation, undergoing ascetic ordeals or tests [see *Influencing Endogenous Chemistry*], consumption of different psychoactive substances of increasing degrees of potency and intensity, and learning of other means of altering consciousness and healing. These are practiced until the apprentice has gained a working relationship with a wide array of plants and mental states, and can use them positively and effectively in relation to this 'earthly' reality, which is often not seen as separate to other 'realities'. It is these means by which shamans cure the sick and produce correct divinations on matters, skills usually largely taught by the plants themselves. Much time is often spent developing empathy, recognition and communication with different plants, which are usually seen as entities in their own right. The spirit of the plant is communed with by ingesting it, or by simply living in its presence for a period of time. Shamans are often 'told' or 'shown' by the plant spirits which plant to pick from the environs to treat a specific disorder, and the prescription is usually effective (for more on these last points see also Bear & Vasquez 2000; Luna 1984).

Often, all boys at a certain age [rarely girls, it seems] are initiated in a briefer and less intense version of the above, to transit them into full 'adulthood' and to show them 'the way to live'. On other occasions, it is usually only the shaman who ingests the more potent plants, but sometimes the plants are consulted by all or any in need of guidance. More rarely, they are used almost casually, though this usually refers only to the less mind-altering substances [e.g. tobacco (**Nicotiana**), coca (**Erythroxylum**), coffee (**Coffea**), betel nut (**Areca**)]. A notable exception is the casual use of visionary snuffs, which has often been observed in some parts of S. America [see **Anadenanthera** and **Virola**] amongst tribal groups such as the Yanomamo.

Along the way, we can also learn from some of the ancient healing arts, such as those which constitute Traditional Chinese Medicine [TCM], and the Ayurvedic system from India, which have evolved over thousands of years of self-experimentation, trial and error, and practical observation of the properties and effects of many varied natural products, consumed both alone and in complex combinations. The effectiveness of these systems in treating health disorders speaks for itself, yet they have only recently gained acknowledgement and acceptance in the west as 'real' medical practices. Up until perhaps 10 years ago, herbal medicine and most other natural therapies were widely considered to be 'quackery', and many in our societies are still stuck in this erroneous belief [though exaggerated claims of efficacy often abound when such therapies encompass a financial interest]. Such methods invariably involve a holistic approach to health, and as such, TCM and Ayurvedic practitioners have become masters of restoring harmony in the organism – encompassing mental as well as physical health, in acknowledgement of the dynamic interplay that all the organs [divided into 'meridians' in TCM] and subtle energies of the body exist in. That is to say, a disorder in one part of the body may cause other organs to dysfunction; and conversely, a disorder in one part of the body may be indirectly caused by a disorder or imbalance in another part. Psychological disorders can also manifest physically, and vice versa.

Throughout our history, cultures have existed almost worldwide who employed psychoactive substances from nature to experience other aspects of reality, and to help propel their lives in positive directions. Today, few of these cultures have survived, due largely to the corrupting and genocidal influences of 'western civilisation' and the accompanying puritanical demonisation of the use of most psychoactive plants. We will quickly span the globe to gain an impression of the diversity in psychoactive plant useage, discussed in more detail throughout the book.

The Australian Aborigines, probably the oldest surviving group of indigenous cultures, are also amongst the least-known when it comes to shamanic plant useage. This much-abused racial grouping is comprised of many separate tribal clans with their own languages, beliefs, and social structures. Unfortunately, this is usually not recognised as such, and 'Aborigines' or 'Aboriginals' are often mistakenly thought of as a single, uniform culture. Due to the fact that 'aboriginal' does not necessarily refer to the Australians, I have chosen to use the term 'indigenous Australian' in the remainder of the text, where the names of relevant tribal groups are not known to me. [The same general rule will be used in other cases where inappropriate epithets have been the norm, such as the use of 'Indian' to refer to indigenous people of the Americas.] Some groups used various herbal preparations such as those known as 'pituri' [see **Duboisia** and **Nicotiana**], as well as meditational and 'magic' shamanic techniques, to enter the dreaming – a timeless and 'mythical' aspect of reality where both helpful and harmful entities may be encountered, as in all classical shamanic states. Other plant substances with psychoactive properties far greater than those of pituri have been used shamanically, but their details are kept secretive from outsiders (pers. comms.), and are probably only known by a few of the remaining shamans.

North of Australia, the inhabitants of Papua New Guinea [PNG] have used a vast array of plants with reputed 'intoxicating' properties, in ritual applications encompassing most aspects of life. Many are still unidentified botanically, or unknown to us entirely, and this area still bears plenty of fertile ground for exploration. It has been little penetrated in a thorough sense, due to fear of the reputedly aggressive culture of many of the jungle inhabitants, coupled with near inaccessible terrain. See, for example, **Galbulimima**, **Homalomena**, **Kaempferia/Alpinia**, **Castanopsis** and **Boletus**.

Inhabitants of the Pacific Islands and Pacific s.e. Asia make regular use of 'kava' [see **Piper 2**] and 'betel nut' [see **Areca**]. **Psilocybe** and **Panaeolus** mushrooms are often found on sale for tourists, though apparently the locals rarely indulge, and a traditional useage of the fungi in these areas is not known of. It has been suggested from analysis of remnant ritualistic art that the original inhabitants of Easter Island [Polynesia] used **Datura** and psychoactive mushrooms (Claypool 1977).

The rest of southern Asia is home to such familiar substances as the 'opium poppy' [see **Papaver**] and **Cannabis**, two plants with an ancient history of human cultivation, thought to date further back than cultivated food plants. It has been suggested that agriculture began as a result of knowledge gained from centuries of learning how to successfully cultivate drug plants, these two in particular. Some interesting obscurities such as 'kratom' [see **Mitragyna**] are in use today in some parts of s.e. Asia, of which the history of human use is less clear. China is traditionally known to have a repressive attitude towards intoxication, though in some periods of Chinese history this has not been the common case. Intoxicating properties of many of their medicinal herbs taken in excess are known [e.g. **Caesalpinia**, **Ephedra**, **Nelumbo**, **Peucedanum**], and early Taoists and Buddhists experimented a great deal with the properties of natural substances.

Such a keen attitude towards experimentation also accompanied the early practitioners of Ayurvedic medicine in India. Here, the Hindu religion was originally based on inspirations received from the mysterious 'soma', which is only used today in the form of non-psychoactive or weakly active substitutes. Its original identity has been proposed to have been, amongst many other suggestions, **Ephedra** spp., **Peganum** harmala [unlikely candidates alone], **Nelumbo** nucifera, **Amanita** muscaria or possibly a species of **Psilocybe** mushroom. Of all proposed to date, the most convincing arguments put forth have been in favour of **Amanita** muscaria, though not all agree with this, and the matter is still thoroughly in dispute. However, it may be that soma was never one plant, but referred broadly to plants that could bring one into contact with the divine, as well as to the state itself. The word has also been applied by some to pineal secretions [see *Neurochemistry*, *Influencing Endogenous Chemistry*] from a person in an 'enlightened' state, generally in association with yogic practices. Indeed, yoga itself is thought to have arisen from knowledge gained through early ingestion of psychoactive plants, and as an attempt to reach those same states of consciousness without the use of the plants. An array of Indian plants are recognised as having some of the virtues of soma, or to be 'rich in soma juice' – including **Cannabis** and **Desmodium**. This is interesting in light of the variety of psychoactive chemicals found in some **Desmodium** species, which are also found in the mammalian nervous system! Ritualised use of psychoactive substances is mainly confined to saddhus and aghoris, the ascetic 'monks' or sages of Hindu society, who have made use of **Cannabis**, **Datura**, 'nutmeg' [see **Myristica**] and even the cobra [see **Naja**]!

In west Asia and the Middle East, 'haoma', which may or may not have been identical to soma, was the inspirational plant central to the Zoroastrians, though its use is no longer observed, or even its existence as a real substance acknowledged. It has again been claimed to be referable to **Peganum**, which is widely used in this part of the world. **Cannabis**, 'khat' [see **Catha**] and 'opium' from **Papaver** are also popular substances in these areas. Africa has a vast tradition of plant useage, and **Cannabis** is much used there, though its date of introduction is unclear. It is the home of 'iboga' [see **Tabernanthe**], 'yohimbe' [see **Corynanthe**], **Sceletium** and **Leonotis**, as well as many more obscure plants. **Panaeolus** and other mushrooms are now thought to have been once more widely used in religious practices here, beginning at least 9,000-7,000BC in north Africa, when the land there was more fertile (Samorini 1992; Walters 1995-1996). Egyptian mummies, dating from 1070BC-395AD, have raised confusion due to the finding of minute though significant traces of *THC*, *nicotine* and *cocaine* in the hair, bone and soft tissue, clear pointers to the consumption of these drugs (Balabanova et al. 1992). Currently, no *cocaine*-containing plants are known from the area, being confined to South America [see **Erythroxylum**], and tobacco [see **Nicotiana**], the best-known and richest source of *nicotine*, is also generally considered a contribution of the Americas. Could there have been ancient trade-links, or lost plant species present to explain these discrepancies?

The early Christians may possibly have used psychoactive mushrooms, as suggested by some examples of Christian art in frescos and architecture (Fabbro 1999; Samorini 1998) and some interpretations of historical texts (Allegro 1970). However, Allegro's speculations are widely accepted as leaping beyond the available evidence, and Samorini's scholarly observations make no assumptive claims. The 'manna' of the bible has been proposed to have been 'ergot' [see **Claviceps**], or at the very least, another powerfully-psychoactive substance, by researcher Dan Merkur [see his books 'The Mystery of Manna' (1999) and 'The Psychedelic Sacrament: Manna, Meditation, and Mystical Experience' (2000), both from Park Street Press, which unfortunately, I have not read yet]. It is not unlikely that early Christian teachings, particularly of those sects driven underground, such as the Essenes, were originally derived from insights gained through the use of psychoactive plants. Even if this was not the case, it is clear that they had access to the same kind of knowledge through some means of consciousness exploration.

Russia and Siberia have a sparser environment with less potential for psychoactivity, though plants that have been used include **Lagochilus**, **Ledum** and **Amanita** muscaria, the latter widely so. Extending into Europe, records of shamanic plant use are now scarce or non-existent. 'Pagan' cultures once flourished across Europe, though with the advent of Christianity as a major force there, most such groups were extinguished or repressed failing conversion to the new form of Christianity. Knowledge of plant and animal properties became a dangerous asset, as such knowledge could cause a person to be considered a witch. As a result of this, herbalists and 'magicians' alike learned to work in secret, and often lived secluded in wilderness. Plants and creatures known to have been used by European 'witches' include **Datura**, 'darnel' [see **Lolium**], **Hyoscyamus**, **Amanita** muscaria and toads [**Bufo**]. Intoxicating plants, such as **Hyoscyamus** and **Laurus**, have been thought by some to have been used at the Oracle of Delphi in ancient Greece [see **Laurus** for discussion of modern theories]. These, and many related substances, were used more casually by the Greeks, Romans and other cultures, diluted in beers and wines [see *Methods of Ingestion*]. Ergot [see **Claviceps**] has been suggested to have been the basis for the 'kykeon' potion consumed at the Greater Mysteries of Eleusis, an initiation which many famed philosophers are known to have undergone. Psychoactive plants such as **Amanita** muscaria, **Ferula**, **Datura**, 'mistletoe' [Viscum spp. and others], 'wolfsbane' [Aconitum spp.] and 'larkspur' [Delphinium spp.] [see *Endnotes* and *Methods of Ingestion*] frequently play integral roles in the interpretation of many Greek myths (Heinrich et al. 1999a, 1999b; Ruck & Staples 1999).

Celtic shamans, including druids and bards, of Britain and Europe were likewise driven underground in the advent of Christianity, and their more esoteric plant practices are practically unknown today. Reclusive and secretive witches, wizards and sorcerers, many of whom may have simply been herbalists or alchemists rather than spell-casting diabolists, later became keepers of some of this local knowledge of natural substances and their magical use. The druids used mistletoe [only that growing on oak; see *Endnotes*] and many mildly psychoactive herbs [such as **Anthemis**, **Scutellaria**, **Verbena** etc.], but may have used **Amanita** muscaria and **Psilocybe** mushrooms also. It is now thought that 'smoking cults' were common in more ancient times across Europe, making use of plants such as **Hyoscyamus**, **Cannabis** and **Papaver**. These were apparently superseded by the 'drinking cults' [who made use of alcoholic beverages fortified with psychoactive herbs], better known today as a component of early European history (see Rudgley 1995). Scandinavian peoples of the Viking tradition used a number of plants to help induce their pre-battle 'berserker' state of rage, as well as in feasts and celebrations, diluted in beer, such as **Ledum** and possibly also **Amanita** muscaria and **Psilocybe** mushrooms (for clues to the latter, see also Kaplan 1975).

The 'Eskimos' [Inuit and other groups] apparently had little or no psychoactive plant useage, due to the barrenness of their surroundings. The conditions in their part of the world are so extreme, it would be expected that some kind of altered state would result in daily life, without encouragement from psychoactive substances. There are some obscure examples, however [eg. see **Oplopanax**]. Travelling south in the Americas, we encounter the use of **Amanita** muscaria again, as well as **Datura**, tobacco [see **Nicotiana**] and a wide array of psychoactive smoking mixtures, collectively called 'kinnikinnick' in some areas [eg. see **Arctostaphylos**, **Eriogonum** and **Artemisia**]. Further south, into Mexico and other countries of Central America, brings us to the home of the ancient Aztecs, Mayans and other cultures, who dwelled in a virtual garden of delights [and horrors!] of psychoactive substances. Between them, these cultures made extensive use of medicinal and psychoactive plants, such as 'balché' [see **Lonchocarpus**], tobacco, **Psilocybe** mushrooms, 'peyote' [see **Lophophora**], 'morning glory' [see **Ipomoea** and **Turbina**], and **Datura**. The barbaric behaviour of the Aztecs in regards to ritual human sacrifice [some current belief has it that the Mayans probably did not share this practice after all] may draw objection from many, or lead to suggestions of evidence that drug use produces unbalanced minds and evil deeds. However, the possible psychology of culture and circumstance in the matter is a topic beyond the scope of this book [see also *A Primer on Tripping*], and it seems sensible to simply mark this as one probable historic example of the destructive use of drugs and interpretation of visionary states, due to the gory outcome – depending on which ideological tunnel you look through.

This cornucopia of psychotropes continues southward into the Amazon, where 'yajé' or 'ayahuasca' [see **Banisteriopsis**], **Virola**, **Anadenanthera**, tobacco [see **Nicotiana**] and poison arrow frogs [see **Phyllomedusa**] are used, amongst many other substances. The complex pharmacopoeias of the peoples of this large area are noteworthy, though unfortunately they are vanishing. Deforestation, pollution and 'westernisation' of indigenous peoples continue to diminish the extent to which traditional knowledge can be passed on to concurrent generations, whilst 'unknown' plants disappear before they can even be classified. Other parts of South America, such as the Andes, see much use of 'coca' [see

Erythroxylum], **Brugmansia** and **Trichocereus**. The Incas, and cultures before them, made use of these plants, as well as **Anadenanthera**.

Clearly, there is a strong shamanic tradition amongst the human animal – having survived through centuries of oppression and persecution from dominant power structures, only to face being lost entirely in the modern age. It appears, to many people, bad enough that today there is a concerted effort [stemming largely from the U.S., on behalf of the rest of the world] to eliminate 'illegal' psychoactive plants from the face of the earth. As experienced shamans grow old, they now face the difficulty of finding suitable candidates from the younger generation to whom they can pass on their knowledge. The allure of 'western civilisation', and all of its toys and trappings in developing nations is a primary factor in the manifestation of this problem, which might not seem so unjust if indigenous people entering city life were not guaranteed a position at the absolute bottom of the social ladder, not to mention those factors which kill, intimidate or drive indigenous people from their traditional homelands against their will.

It is at this point that we encounter a unique situation in cultural history. 'Westerners' from all walks of life are rejecting the ethics of consumerism, and embracing those of experiential spirituality and grass-roots community. They are seeking that which has for too long been denied to them. Amongst these people are the new shamans, a fact acknowledged and welcomed by many of the 'old school'. That the meeting cultures are totally removed from each other is of little importance. Nor is the lack of contact with an actual shaman to learn from gravely important [although it can certainly help], as their scarcity demands that the new shamans once more learn directly from the plants themselves. It is not the form, but the underlying content that is significant, and this is something that transcends and transforms cultural barriers.

In modern societies, the task of the shaman may require some redefinition, along with the metamorphosis in form. The problems faced by shamans in tribal societies, though not totally removed from our concerns, are often quite different to those met in the modern developed world. Shamans still must go within, and interact in the 'spirit realms' of mind, to reach the source of their healing potential, and inner strength and vision. However, rather than healing solely individuals, they are faced with the greater task of healing humanity as a whole. This process must always start at home to have any lasting effectiveness. Thus, shamans must first heal and transform themselves before they help others. Although many modern self-appointed shamans lack much true ability in their chosen field [admittedly, partly due to the lack of experienced and proficient 'real' shamans to give guidance, and partly due to culturally ingrained traits and beliefs which tend to prevent ease of shamanic efficacy], the modern shamanic/spiritual resurgence is still in its infancy. Hopefully with conscientious practice this art and science may redevelop to the new heights required in these troubled times. I believe we need to take in the accumulated wisdom of human history and create a synthesis which can reunite us in understanding, and carry us beyond the destruction and unhappiness which have followed us around for the last few millennia. It is humbly hoped that this book and its multidisciplinary approach may contribute to the future development of such a synthesis. It should be mentioned that this book is not a manual on how to be a shaman – far from it. This book contains much useful information regarding the chemical technologies involved in shamanic practices. Much can still be learned by the use of these natural technologies without one becoming a 'true' shaman – an undertaking which is extremely difficult for the average westerner without tutelage by a truly talented shaman, and totally altering the way we have been taught to think.

With this current resurgence, we have an opportunity to rediscover our roots, and to guide humanity towards a more harmonious existence – ideally, the whole in equilibrium. Whether we currently realise it or not, the old ways are dying, and we are entering a new, and hopefully improved, chapter in human consciousness. The future of our race, and of the planet, depends on it.

To quote from Paul Hawken (1976. The Magic of Findhorn. p.164. Fontana/Collins) – "Roc [Robert Ogilvie Crombie] sees mankind as enacting the biblical edict to exercise dominion over everything without understanding the spirit of the world. Dominion does not mean to dominate by force, to make things do what you think they *ought* to do. Neither does it mean to force or exploit something, or to distort its impulses for self-gain through manipulation. To have dominion means to understand completely, to have sympathy, to love, to enter into a state of wholeness and perfect harmony with all of creation."

SNU VOOGELBREINDER, 1998

QUESTIONS AND ANSWERS – SOME MISCONCEPTIONS DISCUSSED

The following section has been necessitated by the widespread public ignorance surrounding the nature of 'drugs'. We live with the unfortunate fact that the general public, as well as [in most cases] the officials who claim to be keeping us informed, are actually grossly mis-informed about psychoactive substances, or are knowingly suppressing the dispersal of frank, factual information. Such official figures and institutions tend to use the falsehoods so gained, under the guise of 'drug education' and 'public safety', to persecute and demonise users of illicit drugs, exaggerate and/or falsify potential dangers whilst mentioning positive effects in only the vaguest and most misleading terms [generally making positive effects sound like symptoms of mental and physical illness], and otherwise stifle the sense of need for informed public debate. Some may not even realise they are doing this, blind to the socially- and scientifically-destructive results of such bias. As some who read this book will have come from such a background, this chapter has been prepared in an attempt to inject what I believe to be a more honest perspective into an otherwise publicly clouded issue. Although discussing some drug issues in general, the primary emphasis here is held on plant psychedelics, unless specifically noted otherwise.

Aren't illegal drugs dangerous and addictive substances?

This question alone may be fraught with potholes, as the illegal drugs are clearly not in that legal status because of their relative health risk. If they were, then drugs such as alcohol and tobacco [see **Nicotiana**] would surely be illegal also – these latter substances being known to be just as damaging and addictive, if not more so, than most of the drugs currently prohibited. As a clear example, **Cannabis** ['marijuana'] and *THC* [its main active ingredient] are known to be clinically safer than Aspirin™. Indeed, in 1988 in the US, DEA [Drug Enforcement Administration] judge Francis Young [who was apparently quite conservative], after reviewing all the evidence from both sides of the argument and taking medical testimonies for 15 days, concluded that "marijuana is one of the safest therapeutically active substances known to man." This observation was conveniently ignored, however, as is routinely the case with any finding that makes marijuana appear less than a danger. [For more on this topic, and the roots of the illegalisation of marijuana, see the entry for **Cannabis**.] Known naturally-occurring psychedelics [excluding those plants of the family Solanaceae] have never been shown to be either addictive or physically dangerous in doses that would realistically be consumed, and generally have a very wide margin of safety. Some powerful plants from the Solanaceae such as **Brugmansia** and **Datura** could certainly be said to pose a public health risk, if risk of harm is the real issue, and they have been used in western societies most often by teenagers 'looking for a high'. Yet these plants and their active constituents are not illegal to possess or consume. Also, the effects from plants such as these are frequently unpleasant and frightening, besides being potentially lethal, with a low margin of safety and high risk of death or injury by misadventure. From this, one could conclude that the current drug laws are not intended to protect public health, but to hinder the pursuit of relatively safe and useful types of consciousness-alteration that are not approved of. Rather than protecting anyone, current government attitudes towards such illegal drugs and states of consciousness appear determined to make pursuing them as dangerous as possible by promoting disinformation, fear, uncertainty, and the threat of incarceration. Curiously enough, such 'disapproved' experiences tend to be those that are usually pleasurable, and more importantly, have a tendency to expand processes of thought and perception. Such substances, simply put, also happen to compete successfully with the legal drugs – particularly alcohol – which make fortunes for corporations and governments alike.

While this book was being written, there had been news reports of deaths connected to a new 'anti-smoking' drug that had entered the market. It is strange that totally new chemical creations, whose pharmacological properties and potential side-effects are still relatively barely known, are routinely released for mass consumption after only a short period of human testing, whilst a natural drug such as **Cannabis**, which has been used without much incident as a source of medicine, relaxation and inspiration for thousands of years by an even greater number of people [with NO reported deaths from its use that have any scientific credibility], remains firmly illegal to grow, possess, or consume in almost every corner of the globe, legally stamped as a dangerous drug having 'no therapeutic value'.

Even substances said to be carcinogenic by health authorities sometimes reveal seemingly hidden motives for suppression, upon closer inspection. Essential oil components such as *asarone*, *estragole* and *safrole*, precursors to psychedelic amphetamines, were claimed by the US FDA [Food & Drug Administration] to be carcinogenic and hence unsafe for human consumption, and more or less banned to the public. Essential oils rich in such desired precursor compounds have subsequently become difficult to obtain in some cases [see also **Sassafras**]. Yet the dosages of these chemicals used to reveal carcinogenic activity were greatly incomparable to any degree of realistic human consumption. These compounds were generally applied to test animals daily, often by injection, in massive amounts until tumour growth was induced, rather than giving regular and 'realistic' oral doses, and observing to see if tumours resulted. Humans apparently even lack the enzymes required to metabolise *safrole* into the toxin which is actually believed to be the responsible carcinogen in test rodents [which do contain these enzymes] (Shulgin pers. comm.), although *safrole* itself may still act directly as a carcinogen in high doses. Many common and otherwise innocuous compounds may be carcinogenic in large enough quantities [including ethanol], and in comparison these essential oil components appear to pose relatively little public health risk (eg. see Ames et al. 1987). In any case, most people would never directly ingest essential oils, particularly not in large amounts.

It is also often noted that the effects of whole herbs or crude extracts thereof are usually not equivalent to the effects of purified or selective extracts [such as standardised pills or essential oils], and that toxic effects manifested by one portion of a plant's chemistry may be effectively counteracted by another portion. Hence, it also seems premature to make such judgements on the toxicity of herbs based simply on the ambiguous knowledge surrounding single chemicals in the laboratory [and usually in non-human, non-primate animals or parts of animals], rather than on more empirical, holistic and practical evidence.

Psychedelics cannot logically be illegal simply because of the fact that they are psychoactive, because the three most heavily-consumed legal western 'recreational' drugs [not including Valium™ (*diazepam*) and other pills which are widely abused by 'normal' people of all class-groups, or betel nut (see **Areca**), which is widely used in south-east Asia], *caffeine*, *nicotine* and alcohol, are all psychoactive in different ways, the latter sometimes excessively so [being commonly associated with domestic and social violence, sexual assaults and road fatalities]. However, let's look briefly at each, as on closer inspection they all may be seen to be very suited to mass-consumption in a worker/drone society. *Caffeine* and *nicotine* are short-acting cerebral stimulants, each qualitatively different to the other, ideal for getting started first thing in the morning, and for brief drug-breaks at work. They don't really noticeably alter consciousness very much in low doses, and may actually improve the performance of monotonous or repetitive work. Alcohol acts as a 'social lubricant' in low doses, and produces initial euphoria; at higher doses, it is more intoxicating and can greatly impede cerebral and motor functions, as well as causing nervous system depression [sometimes to the point of death]. In both dose ranges, it is considered ideal for after-work or weekend recreation, to wind down from the busy mode and have some fun. It can also sometimes be a means of social bonding, and reinforcement of the common work-ethic, with after-work drinks and work-parties. In higher doses, which are not officially approved of [but often encouraged in practice], there is even the opportunity for 'proving' machismo or social status by demonstrating the ability to consume more alcohol than anyone else. Generally speaking alcohol does not expand consciousness, either, for the majority of people who consume it. In rare cases where it does, the individual will usually quickly forget whatever revelation it was they had. Rarer still is the person who can use alcohol to open the mind and still remain relatively lucid. Rather, for most people large amounts of it deaden consciousness and keep it at the most base level of awareness. It should be noted that as just hinted there are important exceptions, when alcohol is sometimes consumed by competent shamans in a shamanic setting. In these cases, the power of the shaman is such that the effects of the alcohol are usually not apparent to observers. *Nicotine* is also used in such cultures [in the form of potent tobacco – see **Nicotiana**] but rarely in the extremely tame forms or doses used in 'civilised' societies.

It must also be acknowledged, of course, that due to the widespread social acceptability of these legal drugs, and the mighty influence held by the tobacco and alcohol industries in particular, any move to illegalise or further restrict access to these drugs based on a realistic recognition of their dangers [as would be required if drug prohibition is really necessitated by the dangers of drugs] would be met with the fiercest opposition. Governments know this, as well as being aware of the vast amounts of money they make from these industries, and as a result the anti-drug laws are morally bankrupt, as well as being irrational in every sphere except that of politics.

If you are a member of the rat race with little free time or opportunity to realise your own dreams, these aforementioned drugs seem to be relatively ideal [short of mind-control] for keeping you in acceptance of

that lifestyle. This appears to be because when used in such a socio-political context, and as the major legal options for pursuing consciousness alteration, they can help to limit the possible horizons of any expanding consciousness, and reinforce the common group-notion that "everything is just fine the way we're going". The drugs don't *cause* such a mindset, but can subtly reinforce the mindset already in place when alternatives are denied. Most people do not even think of these substances as drugs, a blanket term used to designate either 'legitimate' medicines or [more often] illicit or illegal substances which affect the mind. *All of these things are drugs*, and it could even be argued that we drug ourselves every time that we eat – and especially, that our brains and bodies are full of natural drugs through every moment of our lives. We are walking drug factories! That this does not appear clear to most people is partly the reason for the lengthy discourse you are now reading. Also, as this book will show, we can rarely find a neat dividing line between drugs of medicinal virtue and drugs which affect the mind – and drugs from both false groupings can be dangerous under some conditions, or quite safe under others.

Psychedelics however, although still drugs, operate on a completely different level to most recreational and/or functional stimulants, sedatives and inebriants. It becomes apparent to anyone who investigates psychedelics seriously and personally [that is, experientially] that rather than deadening or distorting consciousness, or simply producing crude 'intoxication' and/or 'hallucinations', they can actually enliven consciousness and show that other aspects of 'reality' exist in overlap and can offer valid experiences of deep significance. They can offer us a realisation of almost unlimited horizons for expanding our awareness and capabilities. If used wisely, they can help us understand and utilise the concepts of possibility, choice and consequence with more purpose and intelligence, hopefully to work towards a better world for all. As has been said in the *Introduction*, this is certainly not to say that psychedelics are the only route to such ends, but in a time when most people are impatient with gradual change [and indeed, when there may not even be time for us to wait for gradual change] and seem psychologically 'stuck' in repeating unconsciously self-destructive thoughts and actions, they are certainly a powerful and well-needed catalyst, remedy, or if I may repeat from the *Introduction*, a 'wake-up call'. So, it might be said that these drugs are illegal because of their propensity for creating an awareness of truths that engender a moral denial of the authority wielded by current corporate, governmental and most importantly, dominant *human* power structures, and of an entire conditioned form of thinking and living. In other words, psychedelics show people that the Emperor has no clothes, and those with power have gone to great lengths to try to ensure we don't fnd out for ourselves.

Psychedelics offer such potential for expanded awareness of self and its place in the cosmic whole [or even the awareness of no self but the cosmic whole], that those who partake of such drugs subsequently often choose to not remain loyal to a system that stunts their personal growth, the health of society, and of the planet itself. Indeed, they may actually choose to work actively against such a system, hopefully with their hearts and minds rather than with hate and weaponry. Psychedelic drugs, by means of their potential and likely effects, can be seen as a factor diametrically opposed to power structures based at their core on domination, greed, deception, manipulation and the perpetuation of ignorance, and in many cases, the oppression or suppression of those without adequate economic means, who often justifiably hold such anti-establishment sentiments.

Psychedelics cannot reasonably be illegal for creating a public threat – even if many users of psychedelics turn against 'the system' in varying ways, this does not make them terrorists. Most users of psychedelics appear to be overwhelmingly peaceful, intelligent, well-intentioned and otherwise law-abiding citizens [though not, of course, in all cases, as with any group of individuals]. Violence from such people is rare, and generally occurs only with those already predisposed to violence. Incidences of assault and robbery, burglary, and other theft related to illicit drug-users have only significantly been linked to users of 'powders' such as heroin, *cocaine* and *amphetamine*s. Such antisocial behaviour is mostly made possible by the inherent high addictive potential of these drugs, coupled with high price, which is a result of criminalisation. In the long-term, these factors [probably also including neurochemical changes brought about by constant use of such drugs] often appear to motivate a dissolution of the user's moral standards and powers of judgement to the point where they may think nothing of breaking in to their best friend's house to find something to steal and sell, as obtaining the drug becomes virtually all that matters. It should be noted that this is not always the case, as many users of such substances do not necessarily exhibit these behavioural characteristics. These are often people who exercise some degree of control over their habits, possess stable financial means to support same, and make an effort to remain healthy, active and sane. Some people may be geneticall predisposed to addiction/intense habituation, and in such cases the person could perhaps just as easily become addicted to sweets, television, religion, shoplifting, hang-gliding or heroin, depending on individual tastes.

Keeping certain drugs illegal seems to be a profitable game for governments. When examining the relationships between illicit drugs and most governments of the world, the existence of entrenched corruption, and in some cases actual conspiracy to traffick illegal drugs, becomes rather difficult to deny (eg. see De Rienzo et al. 1997; Herer & Jiggins 1995; Lee & Shlain 1992; Shulgin & Shulgin 1997; Stevens 1987). Many incidents have been uncovered and continue to show up in newspapers for all to see, yet the public has a very short memory for the implications of such things and tends to dismiss them as isolated and unusual incidents. The following brief selections are a matter of public record, obtained by researchers through Freedom of Information requests and journalistic investigations.

The CIA is known to have been involved in long-term secret projects – which it is claimed the US Presidents did not even know about – involving the testing of psychoactive drugs [including LSD, *psilocybin*, *mescaline*, and many drugs never tested before on humans] on unsuspecting individuals as well as sometimes themselves, for the purpose of researching processes of brainwashing, hypnosis and other forms of 'mind-control'. Other, non-drug techniques were also explored, however these will not be discussed here. Those involved knew after a while though, from their own experiences, that the psychedelics generally did not leave any real psychological scars, and, if anything, healthy subjects tended to develop a more global, compassionate consciousness, not in keeping with any CIA or national security agenda. Some subjects, however, developed difficulties or committed suicide, due to existing psychological imbalances, or simply due to the fact that subjects did not know they had been given a psychedelic drug, and thus could not rationalise what they were experiencing [actually, recently revealed evidence strongly suggests that the most famous suicide by a CIA LSD-user may have actually been murder, due to his desire to go public about their unethical experiments]. Later, either purposely or inadvertently, factions from the CIA began gradually leaking these drugs, especially LSD, into the mainstream throughout the 1950's and 1960's. The intended purpose of these leaks can only be guessed at. Signs that the experiment [if that is what it was] was getting out of control [or going according to plan?] in the late 1960's might likewise be connected to the sudden increased availability and use of heroin and *methamphetamine* observed near the end of that decade, and the subsequent rise in the level of street crime, incidence of violent revolutionary groups [many of which, it has become known, were apparently put together by the CIA and FBI, or at least infiltrated by their agents and agitators] and apparent dissolution of the 'hippie dream'. [However, these factors could probably have arisen by themselves without covert encouragement, and could be the subject of a lengthy and complex discussion not entirely warranted here.] The CIA and the US military complex have also conducted testing of both psychedelic and 'chemical warfare' compounds on exposed, un-informed US citizens in subway stations, by releasing such substances into the air in gaseous form. We are told such experiments no longer occur, though it is unlikely we would be told about it if they do still take place in any form. Some sources state with conviction that the experiments are no longer taking place as such because they have progressed beyond research and development to the 'operational' level. Only a small portion of information requested, in relation to government-funded 'mind-control' projects, has actually been released to the public, and it is known or at least believed that many of the files in question have been destroyed. If this is all we have been allowed to know in this matter, it is somewhat chilling to imagine what we *haven't* been told. Here we see a historic example of drug-abuse of the highest order.

Police the world over have been and continue to be caught on many occasions dealing in illegal drugs obtained from 'busts', and I have known people who lived in areas where it was common knowledge amongst heroin-users when and where they could buy their drugs from certain members of the local police force. It is also not unknown for seized drugs to be consumed by the officers who seized them. Hardly a year seems to go by without reports of police officers being convicted of selling and/or using illicit drugs, not to mention aiding in their successful importation and distribution. This perhaps pales in comparison with the covert importation of heroin from Indo-China by factions of the US military and CIA during the Vietnam War, the evidence that the CIA introduced cheap 'crack' *cocaine* to predominantly black ghettoes [though there are other stories about who was responsible], or the numerous *cocaine*- and weapons-related dirty dealings by the US Government and military in Latin America.

Evidence strongly suggests that industrial and pharmaceutical giants in the US have, in cooperation with government officials in prominent positions, been involved in suppressing, outlawing and spreading misinformation regarding both **Cannabis** and, to a lesser and more recent extent, *ibogaine* [from the iboga shrub – see **Tabernanthe**]. Closer analysis of these situations reveals that such behaviour appears to be associated not with some desire to help society, but with the fact that these natural plants and drugs compete strongly with products manufactured and endorsed by factions of the above groups, further complicated by the controversial psychoactive properties of these natural substances, and the perceived benefits of prohibition to governments, law enforcement agencies and society in general. These complex allegations have not had the opportunity to be brought up in a court of law [for reasons outlined below], yet are very strongly implied when the available evidence is examined in detail,

especially in the case of **Cannabis**. See the entries for those two plants for more discussion on particulars.

There is the case of *tryptophan*, a popular, cheap and effective antidepressant [a naturally-occurring amino acid, which of course can not be patented], banned shortly before the introduction of Prozac™ [fluoxetine], which subsequently cornered almost the entire antidepressant market. This synthetic drug was also rushed into circulation without the proper long-term testing requirements being met – and many adverse and common side effects have since been reported. *Tryptophan* was supposedly banned due to a string of deaths and other complications traced to impurities in some contaminated batches. The problem was identified and removed, but *tryptophan* is still difficult to obtain except as a minor component of some dietary supplements. Prozac, however, with all its faults, remains a widely prescribed drug for virtually anyone who requests it, despite recent studies showing it to be no more effective than a placebo. Coincidence or conspiracy? [See *Neurochemistry* for more discussion regarding the banning of *tryptophan*.]

Regarding Prozac, this commonly used drug has a mode of action similar in some ways to that of the illegal drug MDMA [3,4-methylenedioxy-*methamphetamine*, a.k.a. 'ecstasy'] and its long-term toxicology is unknown. Although MDMA has been the focus of much government-funded research which has supposedly shown it to be neurotoxic, most if not all of this research has been faulty in terms of unsound scientific methodology and questionable conclusions, such as with **Cannabis**. [Meaningful human data is still sketchy at best, and although apparently quite safe for the majority of consumers, some people advise that MDMA, if used, should be used infrequently and in moderate doses.] In addition, most of the deaths resulting from 'ecstasy' ingestion appear to be related to the dance party environments in which it is often taken [of course in combination with the effects of the drug], interactions with other drugs, or the fact that a pill sold illicitly as 'ecstasy' could and often does contain a variety of sometimes potentially dangerous substances and no MDMA at all. This last factor is another illustration of how drug prohibition can lead to more danger in experimenting with psychoactive drugs, because people don't know what they are getting, or how much. Interestingly, Prozac has not been researched nearly as much as MDMA yet is routinely prescribed to an increasingly large portion of the population, despite much evidence that it can produce drastic behavioural side effects (see Concar 2002).

The current recognition of the anti-scientific effects of industry sponsoring research brings into doubt the true state of knowledge regarding many new drugs. "Academic researchers backed by biomedical companies are much more likely to produce pro-industry findings than are independent groups... industry-backed studies are much more likely to compare drugs with placebos or poorly chosen drugs rather than the best competitor, boosting the chances of getting positive results" (Matthews 2003). Some recent studies claiming a range of natural remedies to be ineffective often have such a bias at their core, as well as using selective and often ill-informed logic to support their claims – the presumed motive being to suggest the superiority of various new synthetic drugs and of 'conventional medicine', and reduce demand for 'alternative therapies' and competing natural products which can not be patented [and are thus far less profitable]. Often the test methods devised are simply inappropriate for evaluating the activity [or lack of activity] of medicinal plants or other natural remedies, and are likewise slanted to give the best chances for a synthetic product to display its positive effects. Once such reports find their way to mainstream media, the distorting powers of journalists [who often do not appear to understand what they are reading in the case of scientific or 'scientific' papers, and simply accept and repeat the gross points from the conclusion or abstract, usually spliced with a sensationalist spin] ensure that what most people may read or hear about regarding such matters is already a distortion of a distortion. The same goes for government-sponsored research into illegal psychoactive drugs.

Consider also in Australia, the recent case of kava [see **Piper 2**] becoming regulated, and the herb stripped from the market, to be replaced almost immediately by pharmaceutical extracts in over-the-counter form. Most people familiar with the herb itself agree that these extracts are weak and produce inferior effects, compared to good quality, properly prepared kava. The excuse for legal regulation given at the time was a vague reference to kava-abuse by some groups of indigenous people in northern Australia, in which case it had been serving as a substitute for alcohol. Hardly a situation demanding of such drastic national measures, especially as many people can't stand the taste of the kava beverage, and that with moderate use it is quite safe. The current domination of most of the global commercial kava supply by pharmaceutical companies has also had the added asocial effect of causing shortages, and driving up the price.

Australian Customs somehow has the power to 'ban' and sometimes burn books found on importation that they deem to be unsuitable [and yes, this power is sometimes exercised]. They apparently have the power to decide what books they want to ban on the spot, without any public banning notification or legal processes. Thus the censorship whims of government employees are currently being casually applied to many factual and rather harmless books on psychedelic substances, and people's experiences with them. This is hardly the kind of thing we associate with living in a free and fair society.

The influential US organisation Partnership for a Drug Free America [PDFA] is sponsored by a long list of influential corporations and 'moral outrage' groups, including alcohol, tobacco and pharmaceutical companies – and one of their stated goals is to foster intolerance of illegal drugs and those who use them. [On a side-note, the PDFA used to be situated at a 666 Third Avenue, but relocated due to negative and embarrassing address-associations brought up regularly at pro-**Cannabis** rallies – though their parent organisation, an advertising corporation, has remained at that address.] They are notorious for spreading misinformation and outright fabrications regarding the dangers and effects of illicit drugs, with a strong bias against **Cannabis**. When 'caught' lying, they have failed to offer retractions or corrections to the public, or to anyone else, yet continue to be a respected institution. It is an unfortunate fact also, that groups attempting to approach governments to discuss these issues, with view to possible law reform, are blatantly ignored and treated as though their concerns and opinions were irrelevant or ridiculous. Public opinion has been so successfully shaped by selective misinformation that it still appears relatively easy to ensure that reform of drug laws is not seen as an important enough issue to even consider putting into action. Most 'anti-drug' groups, which are almost invariably backed and fostered by governments, consistently refuse to have public debate with **Cannabis**- or other drug-legalisation groups, and sometimes mockingly and falsely accuse them of the same cowardice [easier for them to do and be heard, as drug law reform activists do not have a voice in mainstream media – except perhaps in some of the more egalitarian and liberal nations of Europe]. Why shy away from open discussion, unless they know their arguments will not stand up to open scrutiny? [And I don't mean the *Donahue*-type scrutiny many people seem to prefer when it comes to examining controversial issues!]

It is next to impossible to even bring many of these allegations of mass-corruption to court. When the wrong-doers are protected by a wall of wealth, influence and/or government secrecy, such charges simply are not taken seriously, without the evidence even being considered. Also, such cases will usually not even be heard unless they can be raised in conjunction with a relevant case that is already pending hearing. Even then, almost no judge will pass a verdict that could effectively end their career by displeasing powerful people, and the few who might have the courage to do otherwise [if available facts seemed to call for it] would not be likely to be allowed near such a case in the first place. Few people are able to raise the kind of money needed to carry such complex issues thoroughly through the legal system, and again, economics fall in the way of justice. This is particularly mirrored in the case of asset-seizure from 'suspected' drug-traffickers, as practiced rampantly in the US and recently adopted on a more realistic scale in Australia, where there is strong potential for the greed of financial gain in underpaid police forces to override the fair balance of justice. What is needed to constitute 'suspicion' of being involved in trafficking illegal drugs is a very grey area, open to much subjective plasticity and amazingly, sometimes not requiring definitive proof. In some documented cases it is known that drugs have been planted in order to obtain an asset-seizure. Even if the defendant is subsequently not proven to be guilty of any crime their seized assets [which usually include cash, house, land, and all other possessions of value], unbelievably, are often not returned. Examples such as these make our democracies appear, in part, closer to dictatorships when it comes to drugs and money. Of course, many police and government officials are honest and would not knowingly take part in the corruption of justice; however, few would deny that their dishonest counterparts are numerous and powerful.

So, the supposed reasons for the prohibition of certain drugs and plants seem pretty flimsy and full of hypocrisy. Reducing harm hardly seems to be a top priority. What, then, does it mean to say something is dangerous and addictive? Addiction can conceivably result from anything that provides some degree of pleasure and becomes part of one's routine – which, as mentioned above, can range from eating sweets, to driving fast, to sex, to science-fiction novels, to smoking crack [which is, admittedly, much more addictive than most other fun things you might do]. If the routine can not be broken without strong cravings and some kind of noteworthy physical/psychological withdrawal symptoms taking place, then for that person in those circumstances the routine had become an addiction. In an extreme sense, it could be argued that we are all addicted to food and water! It is important to know that there can be many types of 'addiction', and that whilst some addictions can be harmful, some may be benign or even necessary. Psychedelics are not addictive [if anything, the more strongly-acting ones have the opposite effect], although anti-drug crusaders sometimes choose to believe that they are – because some people like the experience and choose to do it again! Of course, the same logic could be applied to anything that people may do more than once because they liked it the first time. **Cannabis** can be strongly habituating over time, particularly when smoked with tobacco, but is not [pharmacologically-speaking] addictive; that is, psychological symptoms of addiction may be observed if a regular supply is interrupted [mostly mild craving and some irritability – more so if smoking with tobacco], but physical

symptoms of addiction are absent. Tobacco [containing *nicotine*] and alcohol [ethanol] are addictive in all senses of the word [as are *caffeine*, heroin, *methamphetamine* and *cocaine*], although some people fare better than others in using these drugs but apparently avoiding addiction.

What, then, is dangerous? Contrary to what anti-drug propagandists would prefer us to think, anything is potentially dangerous or even deadly at a high enough dose or when used under appropriate [rather, inappropriate] conditions. Drinking enough water can kill you, though it may take a concerted effort to consume that much in a short enough time [presuming that you're not dancing all night in a hot, crowded nightclub after having taken some purported MDMA]. Many people die each year from overdosing on prescribed or over-the-counter chemicals – sometimes from a normal dose – which are approved for use; these deaths far outnumber those resulting from illegal drugs. Illegal drugs [a term which, along with the terms of more technical legal classifications, generally implies that they have no known or possible medical usefulness – often blatantly false] are not approved and said to be more dangerous, but the psychedelics [ie. **Cannabis**, **Psilocybe** mushrooms, **Lophophora**, **Banisteriopsis**, **Salvia**] have a wide 'therapeutic window' of safety, it being practically impossible to overdose to the point of injury. For matters of psychological safety, see below. Heroin, *amphetamine*s and *cocaine* can be physically dangerous in dose ranges not far removed from the normal 'recreational' dose [especially allowing for the sometimes surprising individual hypersensitivities that may be observed in some people who try such drugs]. For these substances the arguments become even more complex, but that is also the case with **Nicotiana** [tobacco] and alcohol, on the other side of the legal fence. However, street drugs like heroin, *amphetamine* and *cocaine* do not really concern the intentions of this book, though the occurrence of *amphetamine*s [in doubt] and *cocaine* in some plants is discussed [see **Acacia** and **Erythroxylum**].

Still, though, people are afraid of psychedelics – a fear probably rooted mostly in some of the following – a) negative media and government propaganda, b) stereotyped thoughts of 'crazy, spaced-out hippies and drug freaks' as a threat to the safety and wellbeing of all 'decent people', (c) personal bad experiences due to using psychedelics in inappropriate ways, and (d) fear of the unknown or 'occult'. For more on this line of thought, see both the section below and the *Primer on Tripping*.

The debate on the legal status of psychedelic drugs can be expounded over many more pages, but has been done admirably elsewhere (particularly see Forte ed. 1997; Ott 1993, 1997; and Shulgin & Shulgin 1997). We end this section with a suitable quote from Stuart Mill's 1859 essay "On Liberty" -

"The only purpose for which power can be rightfully exercised over any member of a civilised community, against his will, is to prevent harm to others. His own good, either physical or moral, is not sufficient warrant."

Can't psychedelic drugs make you go insane?

Again we enter some turbulent waters, as there is no concrete definition of what constitutes insanity, and definitions of sanity can sometimes seem to define a common kind of insanity or collective mental disorder, when analysed in detail. To make matters worse, most psychiatrists and/or psychologists appear to have little or no real understanding of the mental conditions in which their patients may mostly reside. Schizophrenia, for example, is defined by a wide array of symptoms which can not be consistently diagnosed or defined as one specific disorder, yet many psychiatrists still act as though they know what it is. Their inability, in many cases, to understand the mental state of the patient, and the heavy reliance on 'antipsychotic' medications [which usually make matters worse in the long run, and may substitute one psychic aberration for another] are reflected in both the largely unsuccessful results of treatment (see also Farber 1993 and Mender 1994) and the rising incidence of such disorders, which may also be very much a mental reaction to these troubled and hectic times. It should fairly be stated, however, that some people with serious mental disorders may need to rely on psychiatric medication to abate their symptoms, as little else seems to help make their lives liveable. Regardless, such medications should not be regarded as cures, or even necessarily as therapeutic in the long run.

I feel, as do many others, that for such scientists to experience a variety of psychedelic states themselves is probably the only way in which they could relatively safely hope to gain a greater insight to the conditions of their patients. The two broadly conceived states, 'insanity' and 'psychedelic inebriation', bear many similarities in the short term, and parallel many of the symptoms experienced as schizophrenia. This does not really mean that to ingest a psychedelic is to go insane. It means that such ingestion can allow the individual to access some of the same realms but with a short-term, reversible nature. There is also the important difference of knowing that one has ingested a powerful drug, which can lend a greater sense of security to the experience. People with mental disorders are usually either born that way, or the characteristics develop during the first 20 years or so of life. The long-term exposure to such 'abnormal' phenomena with no backing network of social understanding or acceptance of their implications, often results in what we would call 'insanity'. Negative feedback from the person's family and friends, and sometimes members of the public, only serves to further convince the person of their insanity. They live in a state that they can not rationally comprehend, and are thus forced to adopt unusual belief systems in an attempt to make sense of it all [see *A Primer in Tripping* for more on the influences that can play a part here].

However, some rare individuals are born or develop into this state and show the ability to function within it effectively, as opposed to becoming overwhelmed and confused – in short, although having a radically different experience of 'reality' to most people, being 'mentally well' as opposed to 'mentally ill'. Such people develop a balanced awareness of these phenomena in relation to the world around them, and often devote their energies to healing others and the world, be it directly through shamanic healing, or by more abstract means such as art and spiritual practise. Often such people go through the early years of life struggling with these forces until they gain an understanding – sometimes they are hit with it suddenly at a later point in life. In both cases, the individual's handling of the situation will determine whether the long-term result is relative 'insanity' or 'wisdom'. There are, of course, many points in between...

To return to the original question, I have known a small number of people [including myself] who have managed to temporarily make themselves what some would classify as 'insane' or mentally ill, partially as a result of psychedelic experience(s). In most cases, I believe this result was ultimately mentally self-inflicted. I have observed a common tendency for people to blame the drug, rather than their own deeply-buried psychodramas, when something 'goes wrong' in such a fashion. In the course of a psychedelic experience that seems too strong or disorientating for the user, there come many mental opportunities to just 'give-up', and believe that they have gone mad and will never come down. There may be ample opportunities to get so drawn into believing a possibly delusional idea or series of ideas [see *Primer in Tripping*] that they completely restructure their perceptions and beliefs in such a way that they do not emerge from this self-created 'psychosis' for some time, if ever. In such cases, the outcome is very much reliant on the choices of the person involved. However, it would be unfair not to acknowledge the fact that a fragile psyche may occasionally be shattered by a particularly strong psychedelic experience. Even most people who have taken psychedelic drugs have no idea just how deep these states can go, as few explore deeply enough or for long enough to truly 'have the pants scared off them'. A 'seasoned tripper', confident with some 100 LSD experiences behind him, may still be 'blown away' by a single, ample dose of *DMT*. The power of the mind is vast, and 'reality' seemingly infinite, and this can be a terrifying thing for the unprepared to witness. For some, terrifying enough to traumatise for life. There are also sometimes reports of individuals who have become 'burnt-out', or suffered long-lasting 'LSD-psychoses' due to abuse of psychedelics, and often other drugs as well, including alcohol. People who are already suffering mental problems, or have a family or personal history of them, should probably not use psychedelics, as their existing or underlying symptoms can be exacerbated. As it is possible to induce one's own insanity, it is also possible to heal one's self from these negative states. However, for those genetically predisposed to mental disorders, this may merely mean adapting to circumstances so that one is able to cope [or ideally, to focus the phenomenon and use it constructively], rather than a full elimination of the symptoms.

If someone is undergoing such difficulties in relation to drug experiences, it is advisable for trusted friends to step in and offer some non-dramatic assistance. Usually, all that should be required is personal support and protection from harm in a reassuring atmosphere, until the person returns to stability. In most cases, this will be a very short time. I believe that usually, psychiatric intervention should only be considered as a very last resort [that is, if the effects of the drug have subsided but the person is still in a highly disturbed state more than a week or so later – and if you can't find a proficient shaman]. Being confined to a mental institution is not conducive to good mental health, and counselling from doctors not sympathetic to the real effects of psychedelics is likely to do more harm than good. These things may be even more psychologically harmful or distressing if the patient is still strongly under the effects of the drug. See Strassman (1984, 1995) and *A Primer in Tripping* for further discussion on adverse reactions to psychedelic drugs.

Many otherwise harmless inspired geniuses or eccentrics have been incarcerated in mental institutions, because they could not be understood by psychiatrists or others – or, because someone with enough power wanted them put away as a nut – and thus confined and drugged for purposes of 'public safety'. If we were to closely examine the 'average' person, in most cases we would find them to be crammed full of repressed and/or deeply ingrained neuroses, fears and insecurities. Persons leading a less 'conventional' lifestyle, exhibiting these same traits more openly, may sometimes be handed over to psychiatric 'care' because they appear to represent more of a threat to the norm. This does actually happen [in some countries more than others], though less so now than in the recent

past. Yet the greed, powerlust, backstabbing and inflated egotism of many of the men and women who influence the world economically and politically goes unrecognised as a disease – a severe mental aberration (see Forbes 1992).

So, again we do not have a black-and-white answer. Psychedelic drugs themselves can not make a person insane. They can, however, bring the psyche to a point where 'insanity' can be explored, and some few choose [whether consciously or subconsciously] not to return from it. The choice can be from one moment, or it can grow in conviction over time. Once this choice has been made, it can sometimes be difficult to undo. This is an important reason why the use of psychedelics, or for that matter, any type of psychoactive drug, is ultimately a personal choice, that if undertaken should be with full knowledge of the potential risks involved. When exploring the mind and beyond, one must take full responsibility for the consequences.

Lastly, I stress again that the neurochemistry or genetics of some people are just not cut out to handle psychedelics – they may already be teetering on a fine edge, and a psychedelic drug could be the catalyst that pushes them over unsuspecting. Anyone interested in psychedelics who suspects they may be potentially unstable enough to experience severe difficulty in coping, or who has a previous family or personal history of 'mental disorders', should definitely think twice before actually ingesting anything of that nature. If such a person is still undeterred and curious, it may be advisable to sample a small amount to determine if there might be problems, similar to testing to see if one has an allergy to any substance, before proceeding with caution [but preferably not fear].

Aren't drug users merely escaping into a world of fantasy and delusion?

That is what our governments, and most other people with no direct experience, would have us believe. In contrast, anyone who has seriously investigated psychedelic drugs via personal experimentation will agree that this is certainly not the case. The potential for escapism may appeal to some who approach these substances, but such people usually turn away unsatisfied, or scared out of their wits, because these drugs do not offer escape. In contrast, they tend to amplify reality, and to magnify one's own problems and their causes to the point where they can not be avoided. This is one major reason why psychedelics are used as shamanic sacraments, as well as in some types of psychotherapy. Other, more recreational drugs, may afford some degree of escapism for a while, but if they are used habitually for such means, the walls will eventually come crashing down, so to speak. You can't run away from yourself forever. This is apparently a fact of life [but for some rare exceptions], and this is one reason why I strongly suggest that psychoactive substances be used, if at all, with intelligence and respect.

As to what constitutes delusional fantasy, there can be no completely successful argument that we are not hallucinating all of this right now. Whether or not an idea is a delusion depends largely on the judgements of others, who may be unequipped to do so and simply dismiss it on the basis of 'common sense' [which as will hopefully be shown, appears to be simply another potential delusion]. If common sense was always listened to there would be practically no important breakthroughs in science, or growth in understanding. Indeed, many such leaps initially make mince meat of common sense, and thus human concepts of 'reality' expand once again – not that the every-day person usually finds out about such changes in parameters. The notion of 'common sense' as having any practical meaning suggests that we already know everything, which is clearly not so.

It currently still appears impossible to prove that there is any one true 'reality', or that we can always distinguish which is which. Psychedelics have shown many people how alternate realities can overlap, for example. This is particularly vivid with substances such as *DMT* and *salvinorin A*. People ingesting strong doses of these drugs have been known to enter realities seeming as real or more real than the one most of us consider to be 'consensus reality', or to inhabit more than one plane of reality at the same time, and to exist in them for extended periods [subjectively, even days or longer] before returning to the 'original' reality [after perhaps 10mins 'normal' time, 'objective' time being an illusion anyway], and reverting to a cohesive state of usually more heightened awareness, once the amazement has worn off! This is all due to largely uncomprehended [ie. scientists have observed and named many of the mechanisms, but don't really understand why or how they lead to such incredible subjective effects] and relatively minor adjustments in neurochemistry. The keys, the locks, the doorways, are all present in the human body.

It is particularly in the field of psychedelic exploration that we become aware of how little is known about anything. Anyone who has been keeping up to date with the sciences, including quantum physics and chaos mathematics, will appreciate that the institution of science in general is finally, and perhaps reluctantly, acknowledging that 'reality' is much stranger stuff than most people had thought; the remaining few who were already aware of this being composed largely of shamans, artists, mystics and the insane.

"'Reality' is the composite report of sentries. Eyes see; ears hear; nose smells; tongue tastes; hands touch. Each sends complicated coded messages to the brain, but consciousness receives only simplified summaries. Our reality is illusion: we don't know for sure what's out there" (Frankel & Whitesides 1997). Many animals perceive the world in a very different way to us, yet we do not consider their conscious experiences of sensory data to be illusions or fantasies simply because we can not perceive these things. So it is with psychedelic states, which allow us to perceive things we are normally closed to.

Consider also these interpretations of consciousness and modern physics – "We construct our own individual realities; each individual universe construction also contains an indefinite number of other universes, with all variations and all other possibilities[...]in constantly changing patterns, each individual universe forms all others, and each universe is connected to each other and all others[...]each reality is constantly forming and affecting all other realities beyond time[...]for each of us, an indefinite number of universes exists simultaneously [each universe may be a slight variation of the next one, or may be entirely unrelated][...]the 'ordinary' reality we perceive is not one universe – it is the harmony of phases of movements of an indefinite number of universes[...]there is an indefinite number of harmonies constructing an indefinite number of possibilities" (Toben et al. 1975 – emphasis in original text). 'Reality' may, in one analogy, be viewed as a multidimensional fabric, from which complex harmonic ripples emerge, to form self-organising patterns of perceived matter. This may be the 'veil of illusion' or 'maya' referred to in Hindu religion. I suspect, however, that it's not nearly as simple as that [or so simple that we miss the point entirely!].

Here is a simple and fairly obvious observation to contemplate, regarding the 'reality' of matter. Nothing is really physically solid, since individual particles [ie. electrons, protons, neutrons] are separated by a relatively huge space, though their vibrations and energy fields appear to interact to form a more or less cohesive form, such as a piece of wood. You can hit someone over the head with it, and it will still result in pain and perhaps a wound, but the wood is not solid in the sense that we usually would, according to 'common sense', consider it to be – nor is your unfortunate victim for this experiment, nor even yourself. Even the particles are of questionable solidity, and scientists haven't been able to figure out what these are actually made of. It seems quite amazing that despite these apparent facts we still perceive solidity and form, and that these apparent forms can move or be moved from one space-time coordinate to another without disintegrating. Strange that people can be so doubtful of miracles when closer examination of our universe and our experience of it seems to reveal an enormous bundle of the miraculous that we take for granted!

Also of interest is a condition known as 'Charles Bonnet Syndrome', in which psychologically 'normal' and 'sane' people are known to experience vivid and realistic 'hallucinations', though such persons are usually aware that these are hallucinations. Strangely, only a small proportion of reported cases involve any personal meaning in the visions, whereas so-called 'hallucinations' triggered by psychedelic drugs are often pregnant with personal meaning. The condition has so far mostly been observed in people with poor eyesight or vision defects [such as cataracts], though most such people do not experience symptoms of Charles Bonnet Syndrome (Gold & Rabins 1989; Teunisse et al. 1995, 1996).

Consider some more observations of physics – "There is life in everything – on the submicroscopic level, everything is moving, changing, vibrating, growing, dissipating; [time and space are] not absolute – in a strong gravitational field relative to that of the observer, time goes slower and dimensions contract from the point of view of the observer[...]a particle has no fixed size because gravity distorts space and time[...]mathematicians can describe the limits of space-time, but they can't describe what is beyond – they only know there *is* a beyond[...]every part contains the whole – one electron is all electrons, one particle is all particles" (Toben et al. 1975). This last observation is also suggestive of the holographic concept of reality implied by the brain studies of Karl Pribram, and put forth largely by Pribram and the noted physicist David Bohm. See also McKenna & McKenna (1975), Miller et al. (1990) and Wilber ed. (1985), for in-depth discussions on the details and implications. The basic idea relates to a well-known property of holograms – that if broken, one fragment is observed to contain the information constituting the whole image. As the old saying goes, "all is one"! This has become such a cliché in modern times that many people seem able to repeat it without even thinking about what it might mean.

So, who can even really say at this point what reality 'is'? What exactly are 'fantasy' and 'delusion' when dealing with things practically no one really understands? It is noteworthy that people using psychedelics purposefully, or people dreaming, have been able to access information they otherwise could not have known, but which, upon later research and verification, turns out to be accurate. Due to the spontaneous and often secretive nature of most such occurrences [at least partially due to legal complica-

tions, with many of these drugs being prohibited substances in most countries], this is rarely witnessed by 'authorities' with any capacity to judge and report on the validity of such claims, and the majority of such cases go unreported. For reasons of personal privacy, many users of psychedelics would probably prefer it that way. Those who have experienced this [both myself and many others – see also Harman & Fadiman 1966; Masters & Houston 1966; McKenna 1993; Rätsch ed. 1990; Stafford 1992] know beyond a doubt that the potential is there for great learning, as mentioned in the *Introduction*. Forward-thinking psychotherapists and allied researchers were only just beginning to glimpse the vast potential of psychedelic substances for expansion of awareness and successful self-psychoanalysis (eg. see Frederking 1955) before all human research was banned, including personal use [October 6, 1966 in California for LSD and other psychedelics]. Psychedelics can also be of enormous value to artists and the creative process – many great artists have either been directly inspired by the use of psychotropic substances, or by equivalent endogenous spontaneous 'mystic states' [see Grey 1998 for a wonderful insight into this subject]. It has recently been postulated that the 'hallucinations' resulting from ingestion of chemicals or plant preparations [such as *DMT* and ayahuasca – see **Banisteriopsis**] may originate from amplification of 'information transmissions' from the DNA of one's own body and surroundings (Narby 1999). Even though it is a theory which could be difficult to prove or disprove for some time [if ever], if shown to be true, illegalisation of such sacraments and persecution of their users, effectively a violent denial of our connection to all life, would be widely seen to constitute a monumental crime against humanity, one which passes by largely unrecognised. I personally regard this latter point to be the case regardless of whether Narby's eloquent ideas hold true. See also Forte ed. (1997).

For further reading on matters of 'reality', see also Abraham & Shaw (1982-1988), Barbour (1999), Brooks (1999), Brown & Novick ed. (1993), Buchanan (1997), Capra (1983), Chown (1998a, 1998b, 2000), Concar (1998b), Grey (1990, 2001), Hameroff (1994), Harvey (1978), Henbest (1998), Kaku (1994), Murray (1993), Narby (1999), Seife (1998), Spinney (1998), Watson (1973), Weil (1972), Wilber ed. (1985) and Wilson (1977) [practically all works by Robert Anton Wilson are recommended, both 'fiction' and 'non-fiction' (these definitions tend to lose meaning with some of his books)]. Although classified as a science-fiction novel, Heinlein (1961) offers profound insights into human concepts of reality and spirituality, as well as offering some interesting [and, if 'grokked fully', quite mind-blowing] alternatives. Likewise, almost anything by Philip K. Dick is recommended reading in this regard, though too much at once may result in some depression and paranoia!

Aren't shamans and witchdoctors frauds?

No doubt some are, but this should be considered the exception, not the rule. Fraudulent so-called 'shamans' may be found perhaps in greater numbers today than in the past, in areas such as the Amazon, where native and non-native peoples alike, sometimes with little or no background in working with shamanic plants, are cashing in on tourist demand for ayahuasca ceremonies and/or shamanic workshops. There is little room to further explore those points [see also **Banisteriopsis**], so we will return to the original question.

Some shamans who probably do not deserve that status claim to possess abilities beyond their grasp, in order to capitalise on, or to exert influence over, others in a tribal group. The term 'witchdoctor', as often used derisively in 'civilised' lands, is perhaps more suited to describe this kind of person, essentially a 'quack' taking advantage of a flair for showmanship, higher intelligence put to devious ends, and the gullibility of others. Such people generally wouldn't be able to get away with it indefinitely, and when discovered as frauds would have had to flee or face the anger of the tribe. Honest shamans are usually somewhat more modest when it comes to boasting of their prowess, and earn their status because others confer it to them, in recognition of the effectiveness of their advice or healing capabilities. In many cases, though, the means of curing and/or of contacting 'spirit realms' for divine information are not visually or rationally apparent to the unawakened anthropologist, hence the large grounds for doubt of such abilities in the general collective 'western consciousness' [which brings us back to 'common sense']. Indeed, the very methods by which most anthropologists usually operate function to prevent them from ever learning anything substantial about the people whom they are attempting to study [see Narby 1999, for a good discussion of this point]. Quantum physics has something to say about this too, with its recognition of the fact that observers affect that which they are observing, simply by the act of observing with the senses or with instruments.

Shamans may be 'shown' in visions which plants to collect and administer to the sick patient as an effective treatment. If this were not based in some kind of 'reality' then shamans would probably inadvertently kill or harm as many people as they cured. In some cases treatment may also consist of what could be called psychosomatic means [eg. 'sucking out' a malignant spirit from the sick person], which aid in the healing process presumably through deep trust and belief in the shaman's healing powers – presuming, that is, that the shaman does not know something about the nature of illness which we don't, a premature and probably foolish assumption. There is nothing fraudulent about psychosomatic medicine, if it works, and given how little we know, it is unwise to insist that 'unseen forces' do not exert any influence. It is unknown to us whether these methods are truly psychosomatic in function [the mind has a remarkable influence on health – eg. see Rogers et al. 1979], or whether 'real' shamans are actually doing something here we do not comprehend, or [most likely] a combination of the two. At least in the case of healing songs often used by proficient shamans, we know that sound waves can exert physiological effects on different parts of the body, and that music can strongly affect state of mind – especially if the patient is already in an altered state of consciousness. It is now becoming more known that we are capable of directing our body to heal itself, by cultivating and utilising a greater realisation of self-awareness. This was drawn to attention in the western world largely by experimental monitoring of eastern spiritual adepts who can regulate their body temperature, heart rate, brainwaves, pain perception, consciousness and some aspects of physiological morphology at will, aided by meditational practices and focusing consciousness inwards to specific body parts or organs (eg. see Anand et al. 1961; Das & Gastaut 1957; Kasamatsu & Hirai 1963; Wenger et al. 1961; Yatri 1988).

So, if seemingly 'metaphysical' explanations are unpalatable, even if a shaman resorts to symbolic performance to help heal the patient, in many cases s/he will be doing this with full immersion and belief in the shamanic healing process, and with the knowledge that if the patient believes in it as well, it will most likely have a positive effect on attitude, leading to a boosted immune system and hopefully a state of 'wellness'. Ultimately, though, regardless of the explanation, a shaman is judged by results – if these are not forthcoming, then the shaman is accorded no such respect. Clearly, if all shamans were frauds, then shamanism would never have lasted as long as it has.

CATEGORIES OF PSYCHOACTIVE CHEMICAL COMPOUNDS

The naturally occurring chemicals which affect the nervous system can be divided for convenience into groups related to their chemical structures. Here these will be outlined briefly, in the form of a very basic guide, to be read in conjunction with the next chapter. For more specific information on the properties of italicised compounds, as well as their chemical structures, refer to the Chemical Index located in the appendix. Text books on organic chemistry should be consulted for more informative discussion on the physical properties of these groups of compounds.

Alcohols and solvents

These are simple compounds which are part of a larger broad category, the carbohydrates and lipids. Alcohols are reduction products of several different types of sugars [saccharides]. Although ethyl alcohol [ethanol] is a well-known inebriant, it can be made from a wide variety of plants which would not otherwise be considered psychoactive, and will not be discussed in depth here. There are several excellent books and articles available which cover this topic (eg. Buhner 1998; Müller-Ebeling et al. 2002; Pendell 1995; Rätsch 1999b). Some shamans use alcohol in various forms sacramentally. Even when large amounts are consumed, such shamans claim to transmute the alcohol into a non-toxic substance, so that they do not appear to be inebriated. It could indeed be said that they convert it into 'fuel for the journey'! For most people, though, alcohol may be a hindrance rather than an aid towards the expansion of consciousness, as well as being very toxic when used in excess.

Solvents are generally liquid or gas compounds obtained from a variety of sources, eg. petroleum distillates, and may be inhaled for psychoactive effects. These chemicals are not discussed further in this work [except for the purposes of phytochemical extraction], due to their inherent toxicity, and the long-term destructive nature of their effects on the nervous system [as well as the bodily organism as a whole]. They are often easily absorbed through inhalation of vapours, or through skin contact. [More generally a solvent is simply any medium that dissolves something else.]

Alkaloids

For most of the course of investigations into plant chemistry, attention has focused on the alkaloid group for their potential as bioactive compounds. As a result, in the mass screening of plants for psychoactive or therapeutic compounds, those not shown to contain alkaloids were routinely discarded. The hastiness of this approach is now slowly becoming appreciated, as other chemical classes have shown great therapeutic potentials in recent years. However, the alkaloids remain some of the most powerful chemical agents in use. Here, they will be divided into several groups relevant to this study. Alkaloids are usually recognised by their carbon-ring; as a rule they contain nitrogen, and are usually basic on the pH scale in their natural state, hence known also as bases.

Indole alkaloids

The indoles include many of the most important compounds discussed in this book – some of the best known indoles certainly offer the most useful altered states that can be obtained through substance-ingestion. Their effects are broadly categorised as psychedelic, with mental excitation yet physical sedation [with some exceptions]. Others are more tranquillising, some reputed to be aphrodisiac, some producing physical stimulation. In general they affect a variety of neurotransmitter-systems, mainly *serotonin*, but also *norepinephrine*, *dopamine* and others [see *Neurochemistry* chapter]. Here we find the *tryptamine*s, including *DMT* [N,N-dimethyltryptamine] and its close relatives *5-methoxy-DMT* [5-MeO-N,N-DMT] and *bufotenine* or 5-OH-DMT [5-hydroxy-N,N-DMT], all found in a wide variety of plants as well as in some amphibians [and debatedly in some fungi]; *psilocybin* [O-phosphoryl-4-hydroxy-N,N-DMT] and *psilocin* [4-hydroxy-N,N-DMT] from a relatively large number of higher fungi, particularly amongst the family Agaricaceae subfamily Strophariaceae [eg. see **Psilocybe**]; the ergoline- and clavine-type alkaloids, such as lysergic acid amide [LSA; LA-111; *ergine*], *ergonovine* [ergometrine] and *elymoclavine* distributed amongst certain 'morning glory' species of the Convolvulaceae [eg. see **Ipomoea**] and simple fungi such as 'ergots' [Clavicipitaceae; see **Claviceps**]; the β-carbolines, including *harmine*, *harmaline* and *tetrahydroharman*, which may also be expanded to include substances like *yohimbine*, *reserpine* and *mitragynine*, spread through several diverse plant families; and the iboga- and *vobasine*-type alkaloids, including *ibogaine* and *voacangine*, generally amongst plants of the Apocynaceae ['dogbane' family; eg. see **Tabernanthe**].

Phenethylamine alkaloids

This group contains compounds largely stimulant in effect, some with more psychedelic effects of high-standing, such as *mescaline*. They are primarily found in the families Cactaceae [cacti] and Leguminosae [legumes, such as **Acacia** and **Desmodium**], though their distribution spreads further in the plant kingdom. In general, they affect primarily the *norepinephrine* and *dopamine* neurotransmitter systems in the brain [see *Neurochemistry*], though *mescaline* also strongly affects *serotonin* receptors. Broadly, this group contains stimulants such as *ephedrine*, *cathinone* and *amphetamine*; as well as more interesting compounds such as *mescaline*, and the amination-products of some of the phenylpropenes discussed below, these amination products including MDA [3,4-methylenedioxy-*amphetamine*] and TMA-2 [2,4,5-trimethoxy-*amphetamine*]. The *phenethylamine* 3,4-dimethoxyphenethylamine [*DMPEA*; a neurochemical common in cacti] and its N-methylated [but not β-hydroxylated] derivatives have been shown to inhibit MAO degradation of *tyramine* and *tryptamine* [see next chapter] in rat brain (Keller & Ferguson 1976a) – this is now thought by myself and others to possibly explain the psychoactivity of some ritually-used cacti not containing active amounts of *mescaline*. As many naturally-occurring simple *phenethylamine*s have not been found to be active orally, some are presumed to be active with MAO-B inhibition (Shulgin pers. comm.; pers. obs.). The use of *phenethylamine*-type drugs generates free-radicals in the body; to prevent potential oxidative damage, and to reduce adverse after-effects, antioxidants should also be taken with such drugs (Leibovitz 1993).

Tropane alkaloids

The tropanes are mostly contained in plants of the family Solanaceae [eg. see **Datura**, **Brugmansia**, **Atropa**], and are quite toxic, though used in small doses for certain medical purposes, eg. to produce mydriasis and to combat motion-sickness. Some of these compounds produce a very powerful delirious hallucinatory state, accompanied by loss of motor-coordination and memory loss, associated with the powerful anticholinergic effects [see *Neurochemistry*] of these drugs. After-effects can include temporary blindness and temporary 'insanity'; larger doses can lead to death due to respiratory paralysis. These substances are difficult to work with, and possess a particularly malevolent nature; they are generally favoured by practising witches. The major examples are *atropine*, *hyoscine* and *hyoscyamine*. Some other tropane alkaloids, such as *cocaine* [see **Erythroxylum**], are local anaesthetics as well as central nervous system stimulants and euphoriants, affecting *dopamine* and *norepinephrine* systems in the brain [see *Neurochemistry*].

Isoquinoline alkaloids

These alkaloids may be derived biosynthetically in plants from basic amino acids such as *phenylalanine* and tyrosine [see *Neurochemistry*], and display a wide array of pharmacological effects. Many are found in plants of the family Cactaceae, such as *gigantine* and *pellotine* [which are 1,2,3,4-tetrahydro-isoquinolines – THIQs]; some are represented in **Peganum** harmala of the Zygophyllaceae, such as vasicinone; and many are found in the poppy family, Papaveraceae [eg. see **Papaver**], including such well-known alkaloids as *morphine* and *codeine*, which affect the brain's neuropeptides [see *Neurochemistry* chapter]. Isoquinoline-type alkaloids have been reported to possess anticholinergic and antihistamine properties (Capasso et al. 1997). Some THIQs have been shown to inhibit MAO and COMT enzymes; some isoquinolines found in the Papaveraceae, such as berberine, coptisine, chelerythrine and sanguinarine, inhibit the enzyme AChE [acetylcholinesterase; see *Neurochemistry*] (Bembenek et al. 1990; Deitrich & Erwin 1980; Ulrichová et al. 1983).

Pyrrolidine and piperidine alkaloids

Our representatives in this group are generally central nervous system stimulants affecting cholinergic neurotransmission [see *Neurochemistry* chapter], and many display high toxicity. Examples are *nicotine* [eg. see **Nicotiana**], *lobeline* [eg. see **Lobelia**], *coniine* from **Conium** maculatum ['hemlock'], and *arecoline* from **Areca** catechu ['betel nut']. Alkaloids such as piperine and piperidine are best known from **Piper** spp.; piperine acts as a CNS-depressant [see also **Piper 1**] (Bruneton 1995). Recently, piperidine alkaloids have been found in some fir [Abies spp.], pine [Pinus spp.] and spruce trees [Picea spp.] [see *Endnotes*] (Stermitz et al. 2000).

Isoxazole alkaloids

These are a small group of chemicals that have been detected in some fungi, most notably the 'fly agaric' mushroom, **Amanita** muscaria, and are represented here primarily by *ibotenic acid* and *muscimol*. They are *GABA*-agonists in the central nervous system [see *Neurochemistry*, and *Chemical Index*], and produce a peculiar dissociative-visionary state in the consumer.

Purine alkaloids

The chemicals of this class represented here are stimulants, found most notably in tea [**Camellia** sinensis] of the Theaceae, coffee [**Coffea** spp.] of the Rubiaceae, 'kola nuts' [**Cola** spp.] of the Sterculiaceae, some **Ilex** spp. of the Aquifoliaceae and 'guarana' [**Paullinia** cupana var. sor-

bilis] of the Sapindaceae. The best known of these stimulants are *caffeine*, *theobromine* and *theophylline* [they are also referred to chemically as xanthines]. Simple purines such as guanine and *adenosine* are the basis of nucleic acids fundamental to life, such as DNA and RNA. *Caffeine*-type purines exert their stimulant effects largely by inhibiting the actions of *adenosine* receptors [see *Neurochemistry*].

Quinolizidine alkaloids

This final class of alkaloids are concentrated in the Leguminosae [eg. see **Lupinus**], and are quite toxic. Their psychoactivity in humans is debatable and accompanied by potentially dangerous side-effects. Common examples are *cytisine* and lupanine. These, as well as N-methyl-*cytisine*, show a marked affinity for nicotinic *acetylcholine*-receptors, while the related 3β-OH-lupanine, sparteine, angustifoline and multiflorine showed a greater affinity for the muscarinic *acetylcholine*-receptors [see *Neurochemistry*] (Schmeller et al. 1994). A little-studied sub-division of these chemicals is found in 'club mosses' [**Lycopodium** spp.]; another example is *cryogenine* from **Heimia** salicifolia, less toxic than many other quinolizidines.

Pyrones, lactones, phenols, terpenes and iridoids

Here is a very broad grouping of compounds which can overlap to varying degrees. Firstly, I will mention compounds found in 'kava' [**Piper** methysticum – see **Piper 2**], the kava-pyrones or kava-lactones. Generally speaking, they are anaesthetic, tranquillising, anticonvulsant and produce inebriation without hindering clear-thinking. Examples are *methysticin*, *kawain* and *yangonin*. Iridoids include the sedative *valtrate* from 'valerian' [**Valeriana** officinalis] and the euphoric iridoid-lactone *nepetalactone* from 'catnip' [**Nepeta** cataria]. There are sesquiterpene-lactones that intoxicate in varying ways, such as *lactucin* from wild lettuce [**Lactuca** spp.] and *tutin* from **Coriaria** spp. The phenols and terpenes are widely found in the oils of aromatic plants. Some, such as *borneol*, *camphor*, and limonene affect the nervous sytem in ways little studied in humans, and are known to have toxic potential. Others, such as thujone from **Salvia** officinalis, **Tanacetum** vulgare, **Thuja** occidentalis and **Artemisia** absinthium, and cannabinols such as *THC* from **Cannabis** spp., have unique psychoactive properties which are well-known. The mint family, the Labiatae, is abundant in interesting diterpenoids, the most interesting by far being the neoclerodane diterpenoid *salvinorin A* from **Salvia** divinorum, which displays tremendous psychedelic power unlike any other compound yet discovered. Triterpenes are structurally similar to the steroidal saponins, which are discussed below.

Coumarins

Coumarins are aromatic lactones which are fairly common in the plant kingdom, especially the ubiquitous coumarin itself [1,2-benzopyrone], which is the parent compound of all coumarins. They include umbelliferone, angelicin, xanthotoxol, aesculetin [or esculetin – see **Aesculus**], *scopoletin* and the aflatoxins [see **Aspergillus**]. Some, such as coumarin and *scopoletin*, are hypotensive and can show hypnotic effects at high doses (see MacRae & Towers 1984b for a review of natural coumarin pharmacology). Some coumarins have been shown to inhibit the enzymes MAO and XOD [xanthine oxidase]. Metabolism of coumarin is inhibited by grapefruit juice [see **Citrus**] (Runkel et al. 1997; Yun et al. 2001). Coumarin has shown liver toxicity in dogs and rats, but not in humans, for whom it is relatively non-toxic. Coumarin is often found as an adulterant of vanilla extracts, and as an additive to tobacco [see **Nicotiana**], to add flavour and aroma (Hall 1973; Marles et al. 1987). Some synthetic coumarins, such as warfarin [used as a rat poison], act as powerful anticoagulants, and are highly toxic.

Phenylpropenes

These phenolic compounds are treated separately here both for their primary CNS effects, and for their potential to be converted in the body to *amphetamine*-type *phenethylamine*s. They are found in many essential oils, and are generally sedative in effect [with other therapeutic activities also], yet with addition of a molecule of ammonia they become *amphetamine*s and display stimulant and some psychedelic activity (Braun & Kalbhen 1973; Shulgin et al. 1967; Shulgin & Shulgin 1991). They are listed as follows, with their corresponding potential metabolites:

- *estragole* and *anethole* → 4-MA [4-methoxy-*amphetamine*]
- *eugenol*, *methyleugenol*, isoeugenol and *methylisoeugenol* → 3,4-DMA [3,4-dimethoxy-*amphetamine*]
- *osmorrhizole* and *isoosmorrhizole* [nothosmyrnol] → 2,4-DMA
- *safrole* and *isosafrole* → MDA [3,4-methylenedioxy-*amphetamine*]
- *myristicin* and isomyristicin → MMDA [3-methoxy-4,5-methylenedioxy-*amphetamine*]
- *croweacin* → MMDA-3a [2-methoxy-3,4-methylenedioxy-*amphetamine*]
- *asaricin* and *carpacin* → MMDA-2 [2-methoxy-4,5-methylenedioxy-*amphetamine*]
- *elemicin* and isoelemicin → TMA [3,4,5-trimethoxy-*amphetamine*]
- *asarone* → TMA-2 [2,4,5-trimethoxy-*amphetamine*]
- *apiole* → DMMDA [2,5-dimethoxy-3,4-methylenedioxy-*amphetamine*]
- *dillapiole* and isodillapiole → DMMDA-2 [2,3-dimethoxy-3,4-methylenedioxy-*amphetamine*]
- *exalatacin* → DMMDA-3 [2,6-dimethoxy-3,4-methylenedioxy-*amphetamine*]
- and *1-allyl-2,3,4,5-tetramethoxybenzene* → TA [2,3,4,5-tetramethoxy-*amphetamine*].

Flavonoids

This group of plant constituents often contribute flavour and colour to herbs and foods. They usually occur as glycosides, and are very widespread. Some, such as *apigenin* from chamomile [see **Anthemis**/**Matricaria**], and chrysin from 'passionflower' [see **Passiflora**], show antidepressant and anxiolytic effects, at least in part due to binding with benzodiazepine [BZ] receptors in the *GABA*-neurotransmitter system [see *Neurochemistry*]. In general, they are wide-spectrum enzyme inhibitors (Bruneton 1995), and some [such as *apigenin*, chrysin, genistein, kaempferol, isorhamnetin] show a degree of MAOI activity, particularly inhibiting MAO-A [and to a lesser extent, MAO-B] (Hatano et al. 1991; Sloley et al. 2000) [see *Neurochemistry*, and **Hypericum**], which is enhanced by interaction with other similar compounds. Some, such as hyperforin, inhibit the re-uptake of important neurotransmitters (Chatterjee et al. 1998), increasing their duration of synaptic circulation.

Xanthones

Xanthones and xanthone glycosides are closely allied to the phenols and flavonoids, and are mostly found in the plant families Guttiferae [eg. see **Hypericum**] and Gentianaceae. Their pharmacology is still little known, but some, such as *mangiferin*, decussatin, bellidifolin, gentiacaulein and isogentisin, have demonstrated MAO-inhibiting activity in vitro (Harborne & Baxter ed. 1993; Hostettmann & Wagner 1977; Suzuki et al. 1981).

Peptides

Peptides are small chains of amino acids [see *Neurochemistry*], characterised by a bond [the 'peptide bond'] between the amino group of one amino acid, and the carboxyl group of the next. They may be considered 'mini-proteins'. Many have varied psychoactive or other physiological effects. Some peptides act as hormonal substances in the nervous system, such as β-*endorphin* and *oxytocin*. Many species of frogs [see **Phyllomedusa**, *Endnotes*] contain potent peptides such as caerulein and *dermorphin*, and *apamin* is a similarly potent peptide from honey bees [see *Endnotes*] with excitant and neurotoxic effects.

Cyanogenic glycosides and glucosides

These compounds, present in many plant tissues, break down enzymatically to release hydrogen cyanide or hydrocyanic acid [HCN] when the plant cells are ruptured, or from hydrolysis. Other chemicals released in this process include sugars and other compounds such as benzaldehyde (Conn 1973). HCN smells of bitter almonds [see **Prunus**] and is a potent respiratory depressant, lethal in humans at 50-250mg. However, HCN is highly volatile, and much of it is quickly lost in crushed and/or heated plant material. For this reason, plants known or suspected of containing cyanogens should be crushed after harvesting, then dried, and even briefly aged for good measure. Small amounts of HCN, when smoked in plant form, can give a mild, subtoxic inebriation, though this is not recommended, due to a low window of safety. According to The Merck Index, in low doses HCN may cause headache, vertigo, nausea and vomiting. Higher doses are lethal. In most cases of reported plant occurrence, the actual identities of the parent-cyanogens found in plants have not been pursued, though HCN was detected as the tell-tale metabolite.

Steroidal and triterpenoid saponins

This last group of compounds are important for their varied therapeutic and adaptogenic effects, and are found in many of the tonic plants discussed in this book, such as ginseng [**Panax** spp.] and sarsaparilla [**Smilax** spp. – see **Endnotes**]. Some of them can be converted into useful steroid hormones (Coppen 1980). Saponins are a class of glycosides, which exhibit frothing when mixed vigorously with water. Consult individual plant entries, as these compounds are too numerous to name briefly here.

If more interested in the chemistry of these compounds, the reader should consult more detailed sources on organic chemistry.

NEUROCHEMISTRY

To greater appreciate this study, it is invaluable to have at least a basic understanding of our nervous systems and how they appear to operate. Obviously, the state of current knowledge in this area is vast and intricate, while still not by any means complete, and can not be adequately resolved in the space available here. It should also be noted that our current accepted understandings of brain function are still woefully inadequate, when it comes to explaining the phenomenon of consciousness. I will attempt to give the reader a brief overview of the nervous system, with special reference to areas most important to this study. This will include focus on some areas of neurochemistry which are usually not discussed, due to the unanswered questions raised by them – particularly, the presence of *DMT* and other psychoactive substances in the brains and blood of normal people. Also, many areas are 'glossed over' here, or not covered at all. Technically inclined readers should also consult their local university library for greater depth of information on the nervous system, bearing in mind that some of the information you read here will be omitted from most standard textbooks written for study purposes.

Neural Anatomy

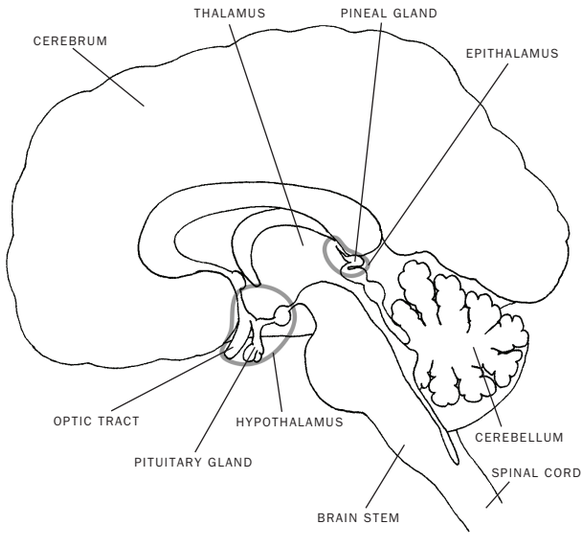
Our nervous systems can be divided into two parts – the 'central nervous system' [CNS] and the 'peripheral nervous system' [PNS]. The CNS is broadly divided into the brain and the spinal cord; the spinal cord is the centre for communication between the brain and the PNS. It is a mass of spinal nerves which exit through notches between each vertebra in the spine. The brain is divided into the main mass, the 'cerebrum', which is split down the middle into two hemispheres or lobes – the right hemisphere controlling the left side of the body, and vice versa. The right side of the brain is associated with spatial orientation, and abstract, artistic thought-patterns; the left hemisphere is associated with verbal language and rationalistic thought-patterns. The smaller 'cerebellum' ['little brain'] sits behind the cerebrum, and is said to be primarily a movement control centre; its hemispheres control the same side of the body instead of opposite, as in the cerebrum. The 'brain stem' connects the spinal cord to the cerebrum and cerebellum, and regulates vital functions. There are also 12 pairs of cranial nerves arising from the brain stem, most of which innervate the head. The PNS is divided into the 'somatic nervous system' and the 'visceral', or 'autonomous nervous system' [ANS; includes sympathetic and parasympathetic nervous systems]; the former comprises nerve cells that connect with skin, joints and muscle, and those of the latter connect with internal organs, blood vessels and glands.

Back to the CNS, however, as this part of the nervous system is of primary importance here. The brain and spinal cord are covered with a tough layer called 'dura mater'. Beneath this is found the web-like 'arachnoid layer', which connects in turn to the 'pia mater', a thin membrane adhering closely to the brain; along this run blood vessels which enter the brain itself. The walls of the brain capillaries have a layer that constitutes what is known as the 'blood-brain barrier' – this limits the passage of some substances into the brain from the bloodstream. The space in between the pia mater and the arachnoid layer [the 'subarachnoid space'], is filled with what is known as 'cerebro-spinal fluid' [CSF]. This fluid also fills the 'ventricular system' [the cavities inside the brain]. It enters the bloodstream at points in the subarachnoid space, and disruption of its flow can cause brain damage.

Experimental data show that 'hallucinatory phenomenon' often occur when the inhibitory functions of the 'higher', and more recently evolved parts of the brain [the 'neocortex'], over the older 'lower' brain structures [the 'limbic system' and the 'reptilian complex' in the centre of the brain] are decreased.

Endocrine [ductless] glands

In the centre of the brain in the brain stem, lies the tiny 'pineal gland', in the 'epithalamus' of the 'diencephalon' along with the 'thalamus' and 'hypothalamus' [see diagram]. The pineal translates light and dark periods into physiological functions coinciding with day-night rhythms, as well as translating sensory stimuli into informational neurotransmitter-substances. It has no blood-brain barrier and can release chemicals directly into CSF. It inhibits premature sexual development; stabilises and synchronises electrical activity in the CNS; promotes normal sleep and dreaming patterns; modulates proper immune function; inhibits and modulates the 'adrenal glands' [via the 'pituitary gland'] and the 'thyroid gland'; and lowers arterial blood pressure. The pineal is connected directly by neural pathways [the 'SCN' – super chiasmitic nucleus – via the 'superior colliculi', and to the inner ear via the 'inferior colliculi'] to the optic nerves. It appears to be an actual remnant eye in primitive vertebrates, and acts as a true photoreceptor with cornea, rods and cones. It is particularly prominent in the 'tuatara', a rare New Zealand reptile. The hypothalamus includes the pituitary gland [which, along with the adrenal glands, is regulated by the pineal] and is involved in nearly all aspects of behaviour, as well as temperature regulation, movement, feeding and proper function



control of the other endocrine glands.

Other endocrines are located along a downward plane from the pineal and the pituitary. Just below the larynx is the thyroid gland, which consists of two lobes on either side of the windpipe, connected just below the 'Adam's apple'. It is influenced by the 'gonads' [sexual glands] and controls growth of body tissues and normal metabolism, as well as normal mental and physical development. The 'parathyroids' are four tiny glands connected to this system. The 'thymus gland' sits above the diaphragm, next to the heart, which itself shows many of the characteristics of a gland. The thymus is involved with childhood growth, and inhibits the gonads until puberty. It is important in controlling the immune system, and is linked closely to the circulatory system. The 'pancreas' is found in the solar plexus area; it controls digestion and induces the liver to secrete sugars into the blood for energy. There are two adrenal glands, one on top of each kidney, and these regulate the body's reaction to stressful situations, with the "fight or flight" syndrome. The gonads [ovaries in females; testes and prostate gland in males] secrete the hormones necessary for sexual functions.

The Neuron

Now we turn to the 'neuron', or 'brain cell', which will conclude the focus of our anatomical discussion. The main body of the neuron is termed the 'soma' [usually about 20μm diam.]; radiating out of it are thin tubes called 'neurites', which are divided into 'axons', the main neurites, which are long [up to a metre or more] and occasionally branch off at right-angles; and 'dendrites', which are short [up to about 2mm long] and branch out mainly from the soma. At the centre of the soma is its nucleus, which contains your chromosomes, which contain your DNA [deoxyribonucleic acid], in which is inscripted your entire genetic blueprint. DNA forms itself into an uninterrupted double braid, and will be briefly discussed again later. DNA is 'read' by a process known as 'gene expression'. 'Messenger ribonucleic acid' [mRNA] is a chain of four different nucleic acids arranged in sequences, which is assembled as a transcript of the DNA expression to carry the message into the 'cytoplasm' [everything inside the soma except the nucleus]. Once there it is translated into protein synthesis by 'ribosomes' [dense globules which cover the 'smooth endoplasmic reticulum' (smooth ER), membrane-enclosed structures that float in the cytoplasm (one type of several, collectively called 'organelles')], from amino acids. Having mentioned organelles, another important type of organelle is the 'mitochondria', which consumes pyruvic acid [from sugars, digested fats and proteins] and oxygen from the 'cytosol' [the salty, potassium-rich fluid that fills the soma and contains electrically-charged atoms ('ions') in solution] and uses them to provide the energy to produce *adenosine* triphosphate [ATP], the energy source of the cell, which is then pumped back into the cytosol. These features are common to all body cells.

Axons, found only in neurons, extend from the soma and end in a swollen disc called the 'axon terminal'. The point where the terminal contacts other cells is called the 'synapse'. The axon terminal is filled with tiny bubbles called 'synaptic vesicles', which store and release 'neurotransmitters', chemical agents which will be discussed later. They also contain 'secretory granules', which contain soluble protein. The synapse consists of two sides, pre- and post-, the post-synaptic side being the soma or dendrite of another neuron; the space between the two is the 'synaptic cleft'. When the axon terminal receives an electrical impulse through the axon,

it induces its synaptic vesicles to release their neurotransmitters, which are received by 'receptors' at the post-synaptic cleft and re-translated into an electrical impulse. This is how neurons communicate with each other to operate the nervous system, and the bodily organism as a whole; this also controls the way in which we perceive our reality, through our thoughts and sensory inputs. The dendrites constitute the 'antennae' of the cell, and are covered with thousands of postsynaptic sites housing receptors to receive neurotransmitters from the synaptic cleft. We will return to the important topic of neurotransmission later. It should be mentioned briefly here that the eye contains 'photoreceptors' which translate light information into neural activity; these neurons synthesise and concentrate 5-methoxyindoles [see below], as does the pineal gland to which the optic nerve is connected.

Ions and electricity in the brain

Now we turn to the purpose of ions in the neuronal cell, mentioned earlier as being dissolved in the cytosol. The most important ions here are Na+ [sodium], K+ [potassium], Ca_2+ [calcium] and Cl- [chloride]. Changes in the concentrations of these ions on either side of the cell membrane through 'ion-channels' and 'ion-pumps' affect the electrical charge of the neuron, which has a resting voltage ['resting potential'] of about -65 millivolts. A functioning nervous system must have this negative resting voltage. If the cell becomes less negative it is said to be 'depolarised'. The resting neuronal membrane is most permeable to K+, elevations of which can cause depolarisation, though this is largely controlled by the blood-brain barrier. However, excessive elevations of K+ can still adversely affect cells in the body. An 'action potential', or positive cell voltage, occurs when the nerve cell depolarises rapidly past a threshold to peak at a positive voltage, before falling back to the negative resting potential. This is, in effect, what you are watching when you see an EEG ['electroencephelogram'] machine drawing peaks when hooked up to electrodes on the scalp. The frequency, or rate, that these action potentials occur if stimulus is continuous is directly related to the magnitude of the depolarising current. The action potential is passed along the axon as an electrical pulse, and terminates at the axon terminal, there initiating neurotransmitter release into the synapse. The stimulus to produce the action potential may be caused by any sensory input, ranging from a pin-prick on the finger to light waves reaching photoreceptors in the retina of the eye. It should be mentioned that as well as synapses that work with neurotransmitter chemicals, there also exist 'electrical synapses', where ions are passed directly from presynaptic- to postsynaptic-membranes. However, these are relatively uncommon in brain cells except in early embryonic stages of our lives.

The brain activity measured by an EEG can be divided into different frequencies:

'gamma waves' [30-c.80Hz] – occur in the 'background' of other wave activity, and though their function in consciousness is still unclear, it is thought they may be important in coordinating and organising neural activity

'beta waves' [14-29Hz] – the normal alert mind; usually apparent in the middle and front of the brain; related to sensory motor functions

'alpha waves' [8-13Hz] – associated with deep relaxation; mostly in the back of the brain

'theta waves' [4-7Hz] – observed in some sleep states, and deep stages of meditation; most prominent between ages 2-5

'delta waves' [1-3Hz] – observed in deep sleep, early infancy and in the enlightened mystical state of 'samadhi'

Neurotransmission

Broadly, the known neurotransmitters are certain amino acids, amines [alkaloids] and peptides [made from proteins]. Amino acid and amine neurotransmitters [NTs] are released from synaptic vesicles, whilst peptide NTs are released from secretory granules. When the neurotransmitter reaches the postsynaptic membrane, it binds to its receptor-site in a way analogous to fitting a key into a lock. Receptors can also be affected by chemicals which mimic the structures of NTs, but which are not native to the CNS. Such exogenous chemicals may then exert their effects by activating the postsynaptic receptor; by blocking the postsynaptic receptor [so that no NT can bind], but not activating it; by blocking re-uptake sites, thus maintaining a high level of NT in the synapse [see below]; or by other means less understood. Similar chemicals may exert different effects due to the complex variations in receptor-binding profiles, affecting different receptor subtypes in different ways in different areas of the nervous system. This is without even considering effects on ions, enzymes and other essential elements of nervous system funtion. However, an important fact to note here is that exogenous psychoactive drugs, when introduced into the brain, can generally only trigger responses that are already built into the capacity of the nervous system. With this in mind, a 'psychedelic trip' seems less an alien experience imposed on one's own nervous system, than a slight re-tuning or altered calibration, due to affecting receptors in novel combinations. This, at least to me, makes the curiosity of the presence of *DMT* [and related psychoptic alkaloids – see below] in the brain, as apparent endogenous neurochemicals with which the brain is most familiar, all the more fascinating.

There also exist receptors on the presynaptic membrane, called 'autoreceptors', which generally regulate the concentration of NT in the synaptic cleft by inhibiting further release or synthesis. Apart from synaptic neurotransmission, recent evidence suggests that 'volume transmission' can occur, ie. the transport of NT molecules to synapses relatively far away from the point of release, via the CSF. After synaptic interaction, or neurotransmission has taken place the NT is cleared from the synapse either by presynaptic-reuptake [followed by re-storage or enzymatic destruction], or destruction by enzymes in the synapse. The input received at the postsynaptic receptor is again translated into an action potential, initiating a chain of biochemical events that in effect are a translation of the original message. The chain of events that follows involves complex interactions with other neurons, enzymes, proteins, ions and 'second-messenger compounds', and is too complex to be covered further here. In many instances, these interactions are poorly understood, at best.

Enzymes

Enzyme activity in the body is essential in catalysing chemical reactions which metabolise the substances discussed here. One of the most important is adenylate cyclase, which catalyses the conversion of ATP to cAMP [cyclic *adenosine* monophosphate], a 'second messenger' chemical which mediates hormonal response. Adenylate cyclase is activated by β-adrenoreceptors, some *serotonin* receptors, some *histamine* receptors, and D1 *dopamine* receptors [these are discussed below]. cAMP is broken down to non-cyclic 5'-AMP by enzymes called phosphodiesterases. Phosphodiesterase-inhibition potentiates and prolongs β-adrenoreceptor stimulation. Cytochrome P450 enzymes [mostly in the gut] metabolise a wide array of drugs, and exist in various isoforms, including [with selected examples of substrates] 1A1 [acetaminophen], 1A2 [*caffeine*, *theophylline*], 2A6 [coumarin], 2C19 [*diazepam*, progesterone], 2C9 [ibuprofen, warfarin], 2D6 [*5-methoxy-DMT*, *5-methoxytryptamine*, *pinoline*, *codeine*, dextromethorphan, haloperidol, desipramine], 2E1 [acetaminophen, ethanol], 3A4 and 3A5 [*diazepam*, *ergotamine*, haloperidol, methadone, vincristine, lidocaine, cyclosporin]. Most inhibitors of P450 enzymes that have been found so far are synthetic pharmaceuticals, with the exception of grapefruit juice [see **Citrus**], which has been shown to inhibit types 1A2, 2A6 and 3A4. Another major enzyme is monoamine-oxidase [MAO], which exists in two forms, A and B. It oxidises amines to prevent them from reaching vital organs when inappropriate. MAO-A is found in small intestine, liver, some peripheral nerves and in the brain; its preferential substrate is *serotonin* and other indoles, but it also acts on *dopamine* and *norepinephrine*, as well as other amines to a lesser degree. MAO-B is found mostly in the brain and blood; its preferential substrates are *tyramine*, *dopamine* and *norepinephrine*, as well as *tryptamine*, but it also acts on *serotonin* and other indoles to a lesser degree. The body also contains its own endogenous MAOIs, sometimes referred to as *tribulin* [and including *isatin* – see *Chemical Index*], though these are little-known indole bases derived from uncertain metabolic routes, not enzymes. The potential of MAO-inhibition [MAOI] is discussed in the next chapter. While on the subject of oxidation [or oxidisation], it should be mentioned that whilst oxygen is essential for the life of our cells, sometimes particles that become unstable due to the loss of an electron ['free-radicals'] cause damage to other cells by 'scavenging' their electrons, causing a chain-reaction of oxidative damage. This situation may be brought about by stress, smoking, pollution, eating food cooked in overheated or rancid oil, and other unhealthy influences. Free-radicals are destroyed by anti-oxidants, which are represented by many vital nutrients and other chemicals.

Other enzymes will be mentioned under the NT system in which they operate.

Amino acids

Amino acids in the body are generally derived from food sources, as they are found in all plants and animals, and are the basic building blocks from which the nervous system synthesises its neurotransmitters – in foods, they are joined together to form proteins. The 'essential' amino acids are those which can not be manufactured by the body, and must be obtained from food – these are isoleucine, leucine, lysine, *methionine*, *phenylalanine*, threonine, *tryptophan* and valine. The amino acids discussed here are a representative selection of a larger group.

L-Alanine aids in obtaining energy from glucose, and maintaining skin condition. It can aid in treating diarrhoea.

L-Arginine helps in detoxification, release of growth hormones, and maintaining a healthy immune system. It is used in energy production. Good sources are nuts, carob, chocolate, brown rice, oatmeal, raisins, sunflower and sesame seeds, and whole wheat.

L-Carnitine is made in the body from L-lysine, iron, vitamins B1 and B6. It aids in weight loss through its role in fat metabolism, and increases energy production, as well as enhancing the antioxidant activity of vitamins C and E. It can aid in some cases of mental retardation and muscle weakness.

Choline is primarily important as a precursor to *acetylcholine*, and is also used in the body as a fat metaboliser, due to its emulsifying effect.

It aids the liver in eliminating toxins, and it has been taken to treat memory loss, movement disorders, artherosclerosis and liver cirrhosis. It has been shown to improve performance in intelligence tests, and has a calming effect. For most efficient metabolism to *acetylcholine*, it should be taken with vitamins B5 and B1. *Choline* can be synthesised by the body from phosphatidylaminoethanol, which has N-methyl groups added until phosphatidylcholine [PC] results; PC is the main store of available *choline* in the body. This process occcurs mainly in the liver, with the products then distributed through the bloodstream, though it also occurs in the brain. Good sources are soy beans, bean sprouts, egg yolk, milk, lentils, peanuts, split peas, green beans and fish.

Glutamic acid [L-glutamate] is the precursor to L-*glutamine*, and shares many of its properties. Taken together, they detoxify excess ammonia in the body. It is essential to the body for energy. May comprise 20-35% of food proteins. It is derived from *pyroglutamic acid* via the enzyme 5-oxoprolinase; *pyroglutamic acid* is also found in vegetables, fruits and molasses.

L-Glutamine is the most abundant amino acid in the CNS, and can be synthesised in the body from *glutamic acid*. It excites nerves, and may itself serve to relay sensory information. It can increase mental and physical alertness, treat epilepsy, benefit impotence and senility, and reduce cravings for sugar and alcohol. It improves nutrient absorption.

L-Histidine is the precursor to *histamine*, and is useful in treating dermatitis and rheumatoid arthritis. It is important for protecting skin from UV rays, tissue growth and repair, and production of red and white blood cells. It controls gastric acidity, and is important for proper digestion as well as healing of ulcers. It has been shown to potentiate opiate-induced catalepsy. Also, administered alone [i.p.] it causes bizarre behaviour and some catalepsy in rats, produced by interaction with the H1 *histamine* receptor.

L-Leucine regulates blood-sugar levels, promotes tissue healing, suppresses pain, and regulates energy availability. It should be taken in combination with L-valine. An excess can produce hypoglycaemia. It has been shown to have a sedative effect in chicks.

L-Lysine is essential for all protein. It helps calcium absorption, tissue production, and antibody production. It also aids in fat metabolism, and in obtaining energy from glucose. A lysine deficiency results in irritability, loss of energy, lack of concentration, retarded growth and hair loss. Good sources are dairy products, lima beans, yeast, eggs and soy products.

L-Methionine acts as a methyl-group donor for other chemicals, by reacting with ATP to form S-adenosyl-*methionine* [SAM], the main methyl-donor in creating substances such as *5-methoxy-DMT*. Its activity may be due to its metabolism products, L-cysteine and L-homocysteine, which may also aid in production of such N-methylated indoles, and increase activity in the brain. L-*methionine* is also involved in fat metabolism. Good sources are apples, Brussels sprouts, cabbage, cauliflower, chives, cottage cheese, egg, garlic, milk, pineapple, soy beans and watercress.

L-Phenylalanine is found in proteins at levels of about 4%, and is a precursor for catecholamines. It is used to elevate mood in treatment of depression [DL-*phenylalanine*, a mixture of the natural and synthetic forms, is used as a painkiller for cases of menstrual pain, migraines and arthritis, as it apparently aids in production of *endorphin*s, and prevention of their destruction]. It also plays a part in forming melanin, the skin pigment. Phenylketonuria [PKU] is a disorder in *phenylalanine* metabolism occurring in some people, where the amino acid is instead converted to phenylpyruvic acid, phenyllactic acid, phenylacetic acid, phenylacetylglutamine and/or O-hydroxyphenylacetic acid. This disorder is characterised by severe mental retardation and presence of an unusual 'mousy' odour. Good sources of *phenylalanine* are soy products, cottage cheese, almonds, peanuts, lima beans, pumpkin and sesame seeds.

L-Proline is inhibitory in the CNS; it is also used in energy metabolism, and maintenance of skin and connective tissue.

L-Taurine appears to act as a minor neurotransmitter with depressant effects. It is antiepileptic, and anti-arrhythmic to the heart. It aids in cholesterol degradation and fat absorption.

L-Threonine is important in liver and fat metabolism, and formation of collagen and elastin. It can help control epileptic seizures.

L-Tryptophan usually makes up 1-1.5% of natural proteins. It was withdrawn from the health supplement market in 1988 after a contaminated batch from Japan [resulting from an impurity caused by an untested shortcut introduced to the manufacturing process] caused deaths in consumers [the now infamous 'eosinophilia-myalgia syndrome']. Due to the psychoactive potential of this amino acid, and due to the fact that Prozac™ was introduced and promoted as an antidepressant soon after *tryptophan* was withdrawn, it seems at least possible that it was not re-introduced after the problem was resolved because both a) it is a *DMT* precursor, and b) it is a safer and natural antidepressant, and thus serious competition for Prozac™ sales. Also, a popular 'underground' publication by Gottlieb (1992 – though other versions have been around for decades) told how one could ingest 5-8g of *tryptophan* on an empty stomach to produce "drowsiness, euphoria and mental changes similar to mild dose of *psilocybin*" [the comparison to *psilocybin* an exaggeration]. When available, it was used as an antidepressant and sedative-hypnotic to promote sleep. It is essential in the production of niacin. Good sources are cheese, milk, bananas, dried dates, cashews and peanuts.

L-Tyrosine is found in proteins at about 3% concentration. It can be formed from *phenylalanine*, and is precursor to the same neurotransmitters, as well as 'thyroid hormone' [TH]. It is also used in making melanin, and helps control appetite and body fat levels. *Caffeine* can lower its plasma levels. Highest concentrations are found in yoghurt.

L-Valine is a stimulant, and an important component of muscle tissue protein.

Neurotransmitters and their intermediary products

Here we will discuss the key known neurotransmitter systems.

The Serotonergic system is usually stated to be the most important of all [if such a ranking has any true meaning whatsoever], and is based on *serotonin* [5-hydroxy-*tryptamine*; *5-HT*]. It uses L-*tryptophan* as its precursor, which may be either converted to the indole alkaloid *tryptamine* [by aromatic L-amino acid decarboxylase], or to *5-hydroxytryptophan* [*5-HTP*] [by tryptophan hydroxylase]; alternately it may be converted to kynerenine [via formylkynurenine] by tryptophan 2,3-dioxygenase. In mammals, *tryptamine* is usually not used in the biosynthesis of *5-HT*, but may still be used as a precursor to other endogenous tryptamines [see below]. Vitamin B3 deficiency in the body will tend to cause conversion of some *tryptophan* to this vitamin, producing hepatotoxic metabolites such as formate and quinolinic acid [an NMDA-receptor agonist – see below], as well as kynurenines and kynurenic acids [kynurenic acid is an agonist of NMDA, quisqualate, and kainic acid receptors], in the process; thus, taking *tryptophan* with a B3 supplement is recommended. Also, if taken without adequate carbohydrates, much of the *tryptophan* will be converted to glucose. *Tryptophan* and kynurenine have recently been shown to stimulate the expression of nerve-growth-factor [NGF] in mouse experiments. Kynurenines and kynuramines can also be produced in the body from *tryptamine*, *5-HT*, *5-HTP* and *melatonin* [see below]. *Tryptamine* given intravenously produced mild perceptual distortions, accompanied by pupil dilation, increased blood pressure, heavy limbs, sweating, dizziness and nausea. In the rat cerebral cortex, it depresses the firing of most neurons; in mice and cats it produces excitation. *5-HTP* is a slight sedative and an antidepressant, similar to its parent *tryptophan*, but more active. In large doses, it has produced excitation in animals. It is converted to the neurotransmitter *5-HT* by aromatic 5-HTP decarboxylase [which requires vitamin B6 and copper, as does the *tryptophan* to *tryptamine* decarboxylation; vitamin C and folate also help]. *5-HT* is a slight sedative and can promote a content mood and decrease aggression [some antidepressants such as Prozac™ work partly as selective *serotonin* re-uptake inhibitors (SSRIs), which prevent *5-HT* from being re-absorbed into the axon terminal, and thus, keep high levels of the neurotransmitter circulating in the synapse]; it does not cross the blood-brain barrier, and therefore must be synthesised in the CNS from more lipid-soluble precursors [such as *tryptophan* and *5-HTP*]. It causes bronchoconstriction in asthmatics, vasoconstriction, smooth muscle contraction, reduced cerebral blood flow and decreased body temperature. It can cause nausea in high amounts, as well as reducing sex drive. It is also involved in the perception of pain. *5-HT* depletion generally causes hypersensitivity to psychedelics that affect these receptors [ie. LSD, *DMT*, *psilocin*, *mescaline*]. Also, prolonged ingestion of an SSRI can cause hypersensitivity to LSD, DOM and *ibogaine*, though not significantly with *5-MeO-DMT*. *5-HT* fires in a slow, regular pattern.

There are many *5-HT* receptor subtypes – 5-HT1 types [divided into 1a, 1b, 1d, 1e and 1f subtypes] in the brain are generally inhibitory; 5-HT2 types [divided into 2a (2), 2b (2f) and 2c (1c)] in smooth muscle and platelets, as well as brain, are excitatory in CNS and cause vasodilation and contraction of gut, bronchi and uterus, as well as decreasing cAMP activity; 5-HT3 types, in CNS as well as sensory and digestive nerves, are excitatory and can cause pain and vomiting; 5-HT4 in CNS, heart and GI tract increases cAMP. There are also 5-HT5, 6 and 7 types that are still little known – however LSD is also known to be an agonist at these sites. 5-Substituted tryptamines are mostly selective for 5-HT1a and 1b receptors; 4-hydroxy-tryptamines are selective for the 5-HT2a receptor. *5-MeO-tryptamine* shows a high affinity for the 5-HT3 receptor. Indole psychedelics are believed to work by binding to their preferred receptors and inhibiting *5-HT*, combined with an array of secondary NT effects. *Tryptamine* is also now known to have its own receptor sites [T receptors].

After transmission, *5-HT* is either reabsorbed, or metabolised by the enzyme monoamine-oxidase [MAO] to 5-hydroxyindoleacetaldehyde, which oxidises to 5-hydroxyindoleacetic acid [5-HIAA], in which form it is excreted from the body. 5-HIAA was shown to have CNS sedative activities in newly hatched chicks. MAO also degrades other *tryptamine*s. *5-HT* may alternately be converted to *melatonin* [N-acetyl-*5-methoxytryptamine*] [with

N-acetyl-*5-HT* as an intermediary, by N-acetyl-transferase (NAT), hydroxyindole-O-methyltransferase (HIOMT) and SAM], the major chemical of the pineal gland, which regulates the body's reaction to light, inducing sleep when light levels are low or absent. *Melatonin* is also a NT and has its own receptor site, the ML-1 *melatonin* receptor. *Melatonin* is a strong antioxidant; it also protects DNA in white blood cells from radiation, and decreases MAO activity in the pituitary and hypothalamus. Pineal *melatonin* rises 2-12-fold at night. Incidentally, HIOMT activity is increased by psychoactive chemicals such as *DMT*, *mescaline*, *ergine*, *DMPEA* and *amphetamine*; its activity also peaks in January and July, and troughs in March and October.

Methyltetrahydrofolic acid [MTHF] can act as an alternative methyl donor to S-adenosylmethionine [SAM] in catalysing the O-methylation or N-methylation of the indoles [see below], although SAM usually works best as donor.

Tryptamine and *5-HT* are also sometimes converted to any of a range of other indole alkaloids, whose individual activities are discussed elsewhere. These include *5-MeO-tryptamine* [*melatonin* deacetylated = *5-MeO-T*; or, *5-HT* + HIOMT = *5-MeO-T*], *N-methyltryptamine* [*NMT*][*tryptamine* + indole-N-methyltransferase (INMT) = *NMT*], *DMT* [*NMT* + INMT = *DMT*], *5-MeO-DMT* [*5-HT* + INMT = N-methyl-*5-HT*, + INMT = *bufotenine* (*5-OH-DMT*), + HIOMT = *5-MeO-DMT*; or, from *5-MeO-T* by two actions of INMT, as above, with 5-MeO-*NMT* as an intermediate], *5-OH-DMT* [from *5-HT* by two actions of INMT, with 5-OH-*NMT* as an intermediate], *norharman*, *harman*, *tetrahydroharman*, *harmalan*, tryptoline [1,2,3,4-tetrahydro-β-carboline (THβC)][*tryptamine* condensed with acetaldehyde = THβC], *pinoline* [6-MeO-THβC], *6-MeO-harmalan* [tentative], *adrenoglomerulotropin* [1-methyl-*pinoline*], 2-methyl-THβC [*NMT* condensed with acetaldehyde = 2-Me-THβC], 6-OH-THβC, 6-OH-1-methyl-THβC and *tetrahydroharmol*. Many of the β-carbolines have MAOI activity, and some inhibit AChE activity and muscarinic *acetylcholine* receptor binding [see below]. As described above, they may be formed from condensation with tryptamines and acetaldehyde, catalysed by INMT, SAM and 5-methyltetrahydrofolate [5-MTHF]. Indole-N-methylation has been shown [in guinea-pig brain] to also create 2[β]-methylated β-carbolines and 2,9-dimethylated β-carbolines, with SAM as a methyl-donor. Some endogenous β-carbolines have been proposed to be neurotoxins, possibly involved in initiating or precipitating Parkinson's disease. However, their occurrence in the mammalian nervous system has not yet been adequately demonstrated. These are of the 2,9-dimethyl-β-carbolinium cation type, such as 2,9-dimethyl-norharmanium cation [see **Phalaris** for more discussion]. β-Carbolinium cations have been shown to inhibit *dopamine* reuptake, and the enzyme tyrosine hydroxylase. The 6-hydroxylating mechanism has been proposed to possibly produce 6-OH-*DMT* and/or 6-OH-N-acetyltryptamine, but this remains to be shown in humans; in rabbit liver, incubated *DMT* produced *NMT*, *DMT*-N-oxide, 6-OH-*DMT* and 6-OH-*DMT*-N-oxide. However, in rat brain it produced *T*, *NMT*, *DMT*-N-oxide, THβC, 2-methyl-THβC and indoleacetic acid. In human blood, *DMT* is partly converted to N,N-dimethylkynuramine [DMK], of unknown activity; kynuramine inhibits α-adrenoceptors, and along with 5-OH-kynuramine, 3-OH-DMK and 5-OH-DMK, antagonises *5-HT*.

The Catecholamine system in general is associated with arousal, alertness and excitement, and is based on *dopamine* [*DA*], *epinephrine* [*Ep*; adrenaline] and *norepinephrine* [*NE*]. Their synthesis begins with L-*phenylalanine* and/or L-tyrosine. L-*phenylalanine* may be made into *phenethylamine* [*PEA*] by the enzyme aromatic L-amino acid decarboxylase, or into tyrosine by phenylalanine hydroxylase. *PEA* has *amphetamine*-like effects when administered i.v. in large doses, or with an MAO-inhibitor. It has a high turnover rate, and relatively short half-life in the body [1-5 min.]. After action, it is degraded by MAO-B to phenylacetaldehyde [a sedative], or by dopamine β-hydroxylase [an enzyme which requires calcium and vitamin C] to phenylethanolamine [a weak stimulant]. Tyrosine is converted by tyrosine hydroxylase [which inhibits cAMP] to 3,4-dihydroxyphenylalanine [L-*DOPA*], which decreases brain *5-HT* and causes mental and physical excitement, mimicking the effects of *DA*; or alternately may be converted to either o-, m- or p-*tyramine* [2-, 3- or 4-hydroxyphenethylamine], which induce *DA* and *NE* release, as well as inhibiting *DA* re-uptake. In higher doses or with an MAO-inhibitor *tyramine* can cause hypertension. *Tyramine* may be converted by dopamine β-hydroxylase to octopamine, which acts as a minor neurotransmitter in the sympathetic nervous system [released with *NE*], raising the blood pressure; its CNS effects are debatable. This compound may be converted by N-methyltransferase to synephrine, a decongestant and stimulant which is an agonist at α- and β-adrenoceptors and raises blood pressure in the sympathetic nervous system; in mice it appears to have antidepressant activity without *amphetamine*-like stimulation. *Tyramine* can also be converted to *PEA* or *DA*; octopamine to *NE* or phenylethanolamine; synephrine to *Ep* or N-methylphenylethanolamine; and vice versa, for each. *DA* [from either *DOPA*, via DOPA decarboxylase, or *tyramine*, via ring DOPA hydroxylase] is excitatory, producing pleasure, as well as increasing sex drive and promoting orgasm. It increases heart output, and in larger amounts produces vasoconstriction and hypertension. It fires in a rapid, irregular pattern, and its release is calcium-dependent. High amounts inhibit tyrosine hydroxylase. *DA* may be converted to *NE* by dopamine β-hydroxylase, which in turn may be converted to *Ep* by phenylethanolamine-N-methyltransferase [*DA* may sometimes be converted to 3,4-dimethoxyphenethylamine (*DMPEA*), which has no intrinsic psychoactivity, but inhibits MAO activity on *tyramine* and *tryptamine* in the rat brain]. These are excitatory and are associated with the arousal of the "fight or flight syndrome", and in high amounts can cause hypertension. *NE* is found in the pineal gland, as is *DA*, as well as other parts of the CNS; it stimulates activity of the enzyme N-acetyltransferase [causing *melatonin* synthesis for later use – thus, an active lifestyle during the day can help normalise *melatonin* production], as well as that of cAMP. *Ep* is made primarily in the adrenals, as well as in the brain, and acts peripherally as a hormone, and as a NT in the CNS. It is associated with regulating temperature, food and water intake, and cardiovascular and respiratory control. Nicotinic acid may reduce its levels.

There exist α-1 [with a, b, c and d subtypes], α-2 [a, b, c and d], β-1, β-2 and β-3 adrenoceptors, which are affected by *Ep* and *NE*; *Ep* affects mostly β-types, and *NE* affects mostly α-types; *DA* affects α-types to a lesser degree, as does phenylephrine. α-1 activity is excitatory, and produces peripheral vasoconstriction. It facilitates the action of *DA*, *acetylcholine* [*ACh*] and testosterone. α-2 activity is inhibitory, and antagonises α-1; agonists of this receptor have hypnotic, anaesthetic and analgesic effects. It also produces peripheral vasoconstriction, and inhibits *ACh* and adenylate cyclase activity. α-Adrenoceptors also cause pupil dilation and uterine contraction. β-1 activity causes tachycardia and palpitations, as well as decreased GI motility; these receptors are found primarily in the heart. β-2 activity is excitatory and promotes nervousness. It produces vasodilation, bronchodilation and uterine relaxation. β-3 is little known. β-receptors also increase available energy by stimulating production of glucose for the brain, and fatty acids for skeletal muscle.

DA receptors are divided into D1 [subdivided into 1a (1) and 1b (5) subtypes] and D2 [subdivided into 2a (2), 2b (3) and 2c (4)] types. D1 receptors stimulate the enzyme adenylate cyclase, which stimulates cAMP. In the parathyroid gland, D1 receptors are involved in the release of parathyroid hormone. Little is known of their CNS effects. D2 receptors produce the excitatory effects typical of *DA*, and excessive stimulation may cause psychedelic effects, or schizophrenic-like syndromes in those already susceptible. Octopamine also has 4 known receptor subtypes – OA1, OA2A, OA3 and fat-subtype OA-receptor. Also known to be associated with [though quite distinct from] noradrenergic receptors located on mitochondrial MAO are the I1 and I2 imidazoline receptors. To my knowledge, the primary endogenous ligands for these receptors have not yet been discovered or confirmed, although *imidazole-4-acetic acid* [see below] would seem to be a candidate. I1 receptors are known to mediate hypotensive effects, though little is known about the properties of these receptors, apart from possible inhibition of *NE* release, stimulation of insulin secretion, and modulation of ion flux.

After transmission, these amines are either reabsorbed, or enzymatically degraded. Methyltetrahydrofolic acid [MTHF] can act as a methyl donor to catalyse the O-methylation or N-methylation of the catecholamines. *DA* may be attacked by MAO to produce dihydroxyphenylacetic acid, then by catechol-O-methyltransferase [COMT] to homovanillic acid [HVA]; or by COMT to 3-methoxytyramine, then by MAO to HVA. *NE* may be degraded by MAO to dihydroxymandelic acid, then by COMT to 3-methoxy-4-hydroxymandelic acid [VMA]; or by COMT with S-adenosyl-L-*methionine* [SAM] to normetanephrine, then by MAO and aldehyde dehydrogenase to VMA; or by MAO and aldehyde dehydrogenase to 3,4-dihydroxyphenylglycol, then COMT and SAM to 3-methoxy-4-hydroxy-phenylglycol. *Ep* is sometimes oxidised to form *adrenochrome* [immortalised in an exaggerated fashion by Hunter S. Thompson in "Fear and Loathing in Las Vegas"], an unstable product which, when given intranasally or sublingually, produces 'LSD-like' effects that are not very visual, and adrenergic effects. This may be further converted to *adrenolutin* [to which it is converted in blood plasma], which has similar effects, or to dihydroxy- and trihydroxy-indoles, such as 5,6-dihydroxy-N-methylindole [DNMI], which has anti-anxiety effects. Similarly, *DA* and *NE* can be oxidised to form dopachrome and noradrenochrome, respectively, which are little known but probably have similar effects to *adrenochrome*. In this vein, *NE* can also be converted to 5,6-diacetoxy-N-isopropylindole [DIN], which produces disruption, and later promotion, of sleep as well as improving mood during waking hours. *Ep* is protected against oxidation to *adrenochrome* by vitamin C, which also catalyses the conversion of *adrenochrome* to dihydroxy- and trihydroxy-indoles. *Adrenochrome* levels are also reduced by L-cysteine. Fresh haemoglobin, or high oxygen intake, catalyse the reaction of *Ep* to *adrenochrome*. 2-OH-4,5-dimethoxyphenethanolamine has been proposed as a possible endogenous 'psychotogen', and is psychoactive, but its presence in mammals remains to be demonstrated.

Some of the catecholamines can also be metabolised in the body by condensation with aldehydes [such as acetaldehyde, a metabolite of alcohol] or pyruvate, to form tetrahydroisoquinolines [THIQs] of largely unknown human activity – *PEA* can give rise to THIQ [which can

cause symptoms of Parkinsonism], 1-methyl-THIQ [prevents symptoms caused by THIQ] and 1-benzyl-THIQ; *DA* can give rise to norsalsolinol [6,7-dihydroxy-THIQ], *salsolinol* [6,7-dihydroxy-1-methyl-THIQ; potent *dopamine* uptake-inhibitor, increases *5-HT* in the striatum, inhibits COMT & MAO] and 6,7-dihydroxy-2-methyl-THIQ. Some stimulate catecholamine release, and some also have shown very weak tyramine hydroxylase and MAO-B inhibiting activity. High levels of these endogenous THIQs are thought to be correlates of alcoholism, phenylketonuria [see above], Parkinsonism and diabetes.

The Cholinergic system is based on *acetylcholine* [*ACh*], formed from *choline* and acetylcoenzyme A [AcCoA][an intermediary product in metabolism of carbohydrates, fatty acids and some amino acids; present in all animal cells], by the enzyme *choline* acetyltransferase [ChAT][which has a high *glutamine* content] using glucose and acetylcarnitine as acetyl-group donors. *ACh* synthesis is inhibited by omission of Na+. *ACh* is essential in the PNS for controlling muscle contractions, and thus, movement. If present in excess at the skeletal-neuromuscular junction, it can cause relaxation instead. In the CNS, it is important in modulating learning, memory, mood, REM sleep, energy conservation, attention span and behavioural arousal; it generates theta-EEG rhythms. *ACh* also inhibits high-affinity *choline* carriers, as a regulatory factor.

There are two main types of cholinergic receptors – nicotinic [subdivided into c-10 (muscle type), c-6 (neuronal type; ganglionic) and neuronal α-bungarotoxin binding site (neuronal type; α-bungarotoxin-sensitive)] and muscarinic [M1, M2, M3, M4 and M5]. Nicotinic receptors produce rapid and typically brief excitation. They induce release of *Ep* and *NE*, and initiate muscular contraction. Their blockage produces skeletal relaxation. Presynpatic nicotinic receptors modulate *DA* release in the striatum. Muscarinic M1 receptors produce excitation which is slower in onset and more prolonged. M2 receptors are inhibitory. M3, M4 and M5 are little known. Muscarinic receptors slow heart-rate, produce vasodilation, constrict the pupil and relax the lens of the eye, increase the tone of GI smooth-muscle contraction, contract the urethra and bladder, and increase secretions in salivary glands, sweat glands, intestinal enzyme-secreting cells, parietal cells in stomach, and mucous glands in bronchi. In the CNS, they are responsible for promoting and/or regulating short-term memory, vomiting, and resting body tremors. Their blockage can cause relaxed eye muscles [resulting in lack of ability to focus], pupil dilation, increased heart-rate, reduced secretions, reduced gastrointestinal tone, delirium and hallucinations – and sometimes death from respiratory paralysis.

After transmission, *ACh* is broken down by either acetylcholinesterase [AChE] or butyrylcholinesterase [BuChE, or pseudocholinesterase]. AChE is predominant in brain and muscle, and hydrolyses only *ACh*; BuChE is a second-rate enzyme found in the serum, and hydrolyses *ACh* as well as other esters of *choline*. High concentrations of *ACh* inhibit AChE. *ACh* metabolism results in acetic acid and *choline*, which can be reutilised.

The Histaminergic system is based on *histamine* [*Hi*], produced from L-histidine by the enzyme histidine decarboxylase [HDC], which also acts on N-methylhistidine at a lesser rate. *Hi* is an important mediator in regulating gastric acid secretion in the gut, and is also involved in motion sickness. An intestinal barrier prevents more than 99% of *Hi* from reaching the circulation. It has weak direct effects, but strongly potentiates excitatory signals. It is excitatory in the CNS [at least in part due to its ability to stimulate *NE* release], facilitating arousal, sensitisation and blood flow, as well as powerfully stimulating cAMP. It may aid in memory retention. Given i.v., it dilates cerebral arteries; it can cause increased heart rate and tachycardia; it activates suppressor cells and reduces antibody secretion. Centrally administered, it elevates plasma levels of corticosterone, *vasopressin* and *adrenocorticotropin* [*ACTH*] [discussed later] and the opioid peptides β-*endorphin* and β-lipotropin. *Hi* release is induced by *morphine*, *codeine*, dynorphin, β-*endorphin* and α-neoendorphin. Its production is enhanced by vitamin B12; vitamin C has an anti-*histamine* effect.

H1 receptors mediate inflammation, which is observed in the case of an allergic reaction or a nettle sting [see **Urtica**]. Antagonism of this receptor results in sedation, analgesia and impaired vigilance. H2 receptors mediate anti-inflammatory action, and their antagonism may result in antidepressant activity. H3 receptors regulate *Hi* production.

After use, *Hi* is metabolised in any of a number of ways. In the brain, it is usually converted to t-N-methyl-imidazoleacetic acid [t-Me-ImAA], by the enzyme histamine N-methyltransferase [HMT], which produces t-N-methylhistamine from *Hi*, which is oxidised by MAO-B to t-N-methyl-imidazoleacetaldehyde, and further stripped by either aldehyde dehydrogenase [ALDH], aldehyde oxidase [ADO] or xanthine oxidase [XO] to t-Me-ImAA. It may also alternatively be converted along a similar route [starting with indolethylamine N-methyltransferase (IMT)] to pi-Me-ImAA. N-methylhistamines strongly inhibit HMT, as do quinine-type antimalarial drugs, *5-HT* and its methylated-derivatives, and the catecholamines *DA*, *tyramine*, *PEA* and 3-methyltyramine. Another route of destruction, usually in the gut and elsewhere in the periphery, uses the enzyme diamine oxidase [DAO; found in the intestine, kidney and plasma] to produce imidazoleacetic acid [*imidazole-4-acetic acid*; ImAA; IMA], which has hypnotic and possibly analgesic activity in rats and mice; some seizure activity has also been observed, and it also attenuates arterial pressure. It potently inhibits neurons in the cerebral cortex, and mimics some actions of *GABA*, also inhibiting release of DAO. It enhances benzodiazepine-binding to *GABA*a receptors [see below], binds to *GABA*c receptors as an antagonist [and possibly a weak partial agonist], and also binds to I1-imidazoline receptors [see above]. ImAA has been detected in brain, CSF, and plasma, though its formation and function in the nervous system are still poorly known. *Hi* may also be converted to γ-glutamylhistamine by γ-glutamyltransferase, or to N-acetylhistamine by acetylcoenzyme A and N-acetyltransferase [NAT].

The GABAergic system is based on *GABA* [*γ-aminobutyric acid*], an inhibitory neurotransmitter produced from L-*glutamic acid* [glutamate] by glutamic acid decarboxylase [GAD], with vitamin B6 as a co-factor in the reaction. It may also be produced from *glutamine*, which can be made from *glutamic acid* by glutamine synthesase and NH_3. *GABA* release is calcium-dependent, and it aids in the metabolism of carbohydrates in the CNS. It is involved in control of spinal reflexes, decreases the firing rate of neurons and inhibits excitatory neurotransmission. Through this activity it also acts as an antispasmodic muscle-relaxant. It is released in males at orgasm, and reduces anxiety and active sexual response, though it promotes active sexual response in females. Despite its inhibitory effects, it can paradoxically have disinhibiting effects on behaviour. *GABA* inhibits *NE*-induced stimulation of N-acetyl transferase activity in the pineal. *Glutamic acid* and *glutamine* also have their own activity within this system, their excitatory actions being opposite the inhibitory actions of *GABA*. Also acting in this system are L-*aspartic acid* [aspartate] and *glycine*. *Aspartic acid* can be synthesised from *glutamic acid*, with aspartate aminotransaminase and oxaloacetic acid, and like L-*glutamic acid*, is excitatory in nature. *Glycine* is found in all body tissues, and is also obtained from the breakdown of proteins, peptides, nucleotides and nucleic acids; it can also be formed from carbohydrates by 3-phosphoserine and serine; in the CNS it can be made from serine by serine hydroxymethyl transferase and tetrahydrofolic acid. It is inhibitory, and aids CNS functions. Both *aspartic acid* and *glycine* are dependent on potassium and calcium for their release. *GHB* [*γ-hydroxybutyric acid*] is also found in the brain in small amounts, though found in highest levels in the thalamus, hypothalamus and substantia nigra of adult humans. It appears to be produced from *GABA*, through the action of GABA-aminotransferase, with succinic semialdehyde as an intermediate metabolite, which is then converted to *GHB* by means as yet unclear. It is metabolically destroyed by reconversion to succinic semialdehyde, and then to succinate via the action of succinic semialdehyde dehydrogenase [SSADH]. Some people have a genetic lack of SSADH, which produces an abnormal increase in *GHB* levels, with symptoms of the disorder including "severe psychomotor retardation, ataxia and convulsions." *GHB* acts as a hypnotic tranquilliser and mild anaesthetic, with euphoriant and inebriating properties. It binds to its own *GHB* receptors, which are associated with some *GABA* receptors, and also shows partial binding to *GABA*b receptors. Its uptake is inhibited by *harmaline* [most potent], 2-OH-cinnamic acid, citrazinic acid and 3-(2-furyl)acrylic acid. N-acetylaspartylglutamate [NAAG], first discovered in the mammalian nervous system in 1965, has only recently been accepted as a neurotransmitter; this is surprising, as it is known to be the most abundant peptide neurotransmitter in the CNS. It is a highly selective agonist of mGluR3 receptors, and is also a low-potency agonist of NMDA receptors [see below]. It suppresses excitotoxicity, inhibits *GABA* release in the cortex, and reduces cAMP levels. NAAG is synthesised from N-acetylaspartate [NAA] and *glutamine*; NAA may also be a neurotransmitter. After use, NAAG is hydrolysed back to NAA and *glutamine*, and further hydrolysed to *aspartic acid* and acetate.

There are several types of *GABA* receptor – the inhibitory receptors, *GABA*a, *GABA*b [subdivided into b1-α, -β, -Δ and b2], benzodiazepine [BZ] 1 and 2, and barbiturate [BARB]; and the excitatory ion-channelled *glutamate* receptors [iGlu], N-methyl-D-aspartate [NMDA][subdivided into *glutamate* and *glycine* sites], quisqualate [quisqualic acid; α-amino-3-OH-5-methylisoxazole-4-propionic acid; AMPA] and kainate [kainic acid; activated by *aspartic acid*, *glutamine* and *glutamic acid*], and G-protein or metabotropic *glutamate* receptors [mGlu; subdivided into mGluR-1, -2, -3, -4, -5, -6, -7 and -8]. Activation of the *GABA* receptors by an agonist increases the binding-capacity of agonists for the BZ receptors. *GABA*a antagonism enhances CNS cholinergic activity, and *GABA*b antagonism does this as well as producing an antidepressant action. BZ receptors are affected by benzodiazepine-type drugs [eg. *diazepam* (Valium™)] and some plant flavones. A natural ligand has not been positively singled out, although *diazepam*, nordiazepam and N-desmethyldiazepam have been identified in human brain and plasma [possibly of plant origin]. They increase *GABA* function by preventing its reabsorption, which inhibits cholinergic neurons. BARB is affected by barbiturate-type drugs [eg. phenobarbitol], and a natural ligand has not been found; it increases the affinity of *GABA* for its receptor and increases the duration of its activity. NMDA receptors may be important in learning and memory processes. NMDA antagonism produces analgesia, amnesia, disinhibition, agitation

and a dissociative state with hallucinations. Excessive antagonism leads to respiratory depression, increased blood pressure and unconsciousness. Examples of NMDA-antagonists include the synthetic hallucinogenic anaesthetics PCP and ketamine. NMDA activity stimulates post-synaptic release of arachidonic acid [see *anandamide* below]. Antagonists of postsynaptic *glutamate*-receptors in the hypothalamus [an NMDA-complex coupled to a nitric oxide/cGMP signalling pathway] block the light-induced suppression of *melatonin*.

GABA is either reabsorbed after transmission, or broken down by the enzyme GABA-aminotransferase [GABA-α-oxoglutarate transaminase; GABA-T] with α-oxoglutaric acid [and vitamin B6 as a co-factor] to succinic semialdehyde, which is oxidised to succinic acid by succinic acid semialdehyde dehydrogenase, which then enters carbohydrate metabolism. *GABA* uptake is inhibited by ketamine, β-alanine, guvacine, nipecotic acid, and even *GABA* itself. *Glutamine*, after use, is usually converted back to *glutamic acid* by hydrolysis. *Glutamic acid* is broken down to α-ketoglutaric acid, by the enzyme glutamic acid dehydrogenase, or it may be reabsorbed, and converted to *glutamine*. A dysfunction of glutamic acid dehydrogenase can result in signs of neurotoxicity, due to increased CNS levels of *glutamic acid*, which in high concentrations is known to cause neuronal death from over-excitation [excessive and prolonged depolarisation].

The Opioid system is based on a group of peptides which, in general, produce analgesia, sedation and sometimes a feeling of well-being. One of these, β-*endorphin*, has been proposed to be important in learning and memory processes, but data are ambiguous and inconclusive. Pro-*enkephalin* is the precursor to *methionine-enkephalin*, leucine-*enkephalin*, octapeptide, heptapeptide, peptide E, peptide F, BAM 12, BAM 18 and BAM 22; prodynorphin is the precursor to leucine-*enkephalin*, dynorphin A, dynorphin B, α-neoendorphin and β-neoendorphin; and proopiocortin is the precursor to *ACTH* [*adrenocorticotropin*; discussed later], as well as α-, β- and γ-*endorphins*, which can also be made instead from β-lipotropin. More recently, endomorphin-1 and endomorphin-2 have been found as endogenous brain opioids. The *endorphin*s and *enkephalin*s are the best known of all of these. Tyrosine seems to be essential for the opiate-like effects of β-*endorphin* and *methionine-enkephalin*, which α-*endorphin* mimics. The latter peptide has been said to possess some *amphetamine*-like effects. β-*Endorphin* release from the posterior lobe of the brain is inhibited by *dopamine*. Opioid peptides impair the release of *ACh*, *NE* and *DA*, and inhibit testosterone, LHRH and LH [see below]; their actions are facilitated by *5-HT*. They are distributed throughout the CNS; *endorphins* are also found in the pituitary gland and in the adrenals. Their release is calcium-dependent. *Enkephalin* release is triggered partly by *GABA* receptors.

μ-Opiate receptors are most potently affected by β-*endorphin*, followed by *morphine* and the endomorphins, *methionine-enkephalin* and leucine-*enkephalin*, respectively. They cause slowed pulse, constricted pupils, respiratory depression, analgesia, and withdrawal syndrome if dependence is allowed to occur. Agonists of μ-receptors antagonise the effects of *DMT* and LSD in low doses; higher doses enhance the effects. δ-Opiate receptors [subdivided into δ-1 and δ-2] are affected most strongly by leucine-*enkephalin*, followed by *methionine-enkephalin*, β-*endorphin* and *morphine*; it has similar actions to the μ-receptor. κ-Opiate receptors are sensitive to dynorphins, neo-*endorphins*, and *salvinorin A*; they elicit some degree of analgesia and diuresis, cause weak respiratory depression, and can produce 'dysphoric pseudo-hallucinations'. They down-regulate μ-receptor mediated analgesia in opiate-naive rats, and potentiate it in opiate-dependent animals. Agonists at this receptor also elevate corticosteroid levels, modulate immune response, decrease pilocarpine-induced seizures and neurotoxicity, and mediate 'aversive' effects of Δ-9-*THC*. (-)-Naloxone, which is a synthetic μ-κ-antagonist, enhanced the effects of *DMT* and LSD in low doses. Activation of opiate receptors also boosts *norharman* [β-carboline] levels.

After release, peptides are broken down by peptidase enzymes, and the fragments diffuse into the extracellular space. *Morphine* and *codeine* have also been found in human milk, urine and CSF, though their metabolic origin is unclear.

The Anandamide system has only recently been discovered, and relatively little is known about it [compared to the other major systems]. *THC* and other cannabinoids from **Cannabis** bind to cannabinoid receptor sites to produce their effects, which may also involve interaction with the opioid and dopaminergic systems. The central receptors which mediate psychoactive effects are known as CB1, and peripheral receptors as CB2, although CB1 receptors are also found peripherally. Activation of CB receptors inhibits the enzyme adenylate cyclase, decreases cAMP levels, produces analgesia for some types of pain, protects against brain ischaemia, ameliorates some symptoms of Multiple Sclerosis, enhances cerebral blood flow, and stimulates feeding in newborns. Agonists of CB1-receptors also inhibit *glutamine* transmission. Some CB1 receptors are also located on presynaptic nerve terminals, and their activation inhibits release of *serotonin*, *acetylcholine*, *norepinephrine*, *GABA* and *glutamine*. Their effect on *dopamine* release is contradictory, with in vitro rat brain studies showing inhibition, and in vivo studies showing stimulation. CB1-mediated sedation is potentiated by D2-receptor agonists, and activation of D2-receptors enhances *anandamide* release in the striatum. *Anandamide* [N-arachidonylethanolamine; AnNH] is one of the endogenous ligands for CB receptors [though with a 30 times greater affinity for the CB1 receptor], and is a long-chain fatty acid amide and neurotransmitter. It partly mimics the effects of **Cannabis**, and is produced from arachidonic acid and ethanolamine, with N-arachidonylphosphatidylethanolamine as an intermediary product, via hydrolysis by the enzyme phospholipase D. It has also been shown to weakly bind to vanilloid VR1 capsaicin receptors [see **Capsicum**], possibly modulating pain response. A second CB ligand in the brain was later discovered, *sn*-2-arachidonylglycerol [2-AG], which is 170 times more prevalent in the brain than *anandamide*, and is a full agonist of CB receptors. 2-AG seems to be present in lower levels in CSF. It is produced from phosphatidylinositol(4,5)-bisphosphate by the action of phospholipase C, resulting in 1,2-diacylglycerol [DAG], which is transformed into 2-AG by the action of DAG lipase. Both *anandamide* and 2-AG have been shown to protect neurons in the cerebral cortex from ischaemic damage, and act as neuroprotectants after traumatic brain injury, as well as modulating the immune system, blood pressure, fever, pain, cognition and memory. Arachidonic acid may be released post-synaptically by NMDA-receptors, and it serves to increase neurotransmitter output of pre-synaptic neurons, strengthening their function. *Anandamide* and 2-AG are metabolised by fatty acid aminohydrolase, or FAAH [a.k.a. anandamide aminohydrolase, or oleamide hydrolase], and/or a monoacylglycerol-like enzyme. Two other endogenous fatty acid amides, oleamide and palmitoylethanolamide, have putative actions on the CB receptors. Oleamide is a hypnotic, soporific and analgesic, which interacts with CB1 and CB2 receptors to a small degree, 5-HT2a receptors and benzodiazepine-sensitive *GABA*a receptors to a higher degree. It mimics the behavioural and analgesic effects of *anandamide* in mice, despite its lack of significant CB-receptor binding. Palmitoylethanolamide mediates analgesic, antiinflammatory and antioxidant activities, which may also interfere with the metabolism of *anandamide*, and has binding activity at CB2 and putative CB receptors. Recently it has been shown that schizophrenic patients have higher levels of *anandamide* and palmitoylethanolamide in their CSF, as compared with non-schizophrenic controls.

The Purinergic system only recently came to be considered a NT-system – it is based on *adenosine*, a purine alkaloid which is released by neurons and received by its own receptors [the required criteria for a neurotransmitter]. When activated, they produce behavioural sedation, bronchospasm, and dilation of cerebral and coronary blood vessels, as well as regulating oxygen supply to cells, and decreasing the force of heart contractions. These receptors also cause inhibition of the release of *NE*, *DA*, *ACh*, *GABA* and *glutamine*. Purinergic receptors are classed as P1 [subdivided into A1, A2a, A2b, A3 and A4 types] or P2 [subdivided into P2x, P2y, P2z, P2t and P2u types]; the former react with *adenosine*, the latter with ATP-derivatives.

Other minor receptor types

Endothelin ETa, ETb and possibly ETc receptors

σ ***[Sigma], σ-1 and σ-2 receptors [once putative opioid receptors]*** – mediate some of the actions of PCP and ketamine [these are powerful dissociative-anaesthetics with some 'psychedelic' activities].

Somatostatin SSTR1, SSTR2, SSTR3, SSTR4 and SSTR5 receptors - see GHRIH below.

Tachykinin NK1, NK2 and NK3 receptors

Trace amine [TA] receptors - recently discovered in central and peripheral nervous systems, causes cAMP production and may mediate anxiolysis; ligands include many human trace amines including *tryptamine*, *DMT*, *tyramine* and *phenethylamine*, and the non-endogenous *amphetamine*, *methamphetamine*, MDMA and LSD.

Vanilloid VR1 receptors – ligands include capsaicin, N-vanillyloleamide [olvanil] and *anandamide*. Activation increases peptide release, modulates pain, causes vasodilation.

Vasopressin V1b receptors – ligand is *vasopressin* [see below]. Mice lacking these receptors were found to be less aggressive, though with deficits in social recognition, suggesting that antagonists of V1b receptors may also act as 'anti-aggression' agents.

Hormone substances and co-transmitters

The following are substances which are not thought to be true neurotransmitters, yet have neurotransmitter-like activities, or aid in the regulation of consciousness and physiological function. They are usually secreted into the blood or bodily fluids to be dispersed to other areas distant from the point of release.

Adrenocorticotropin [ACTH] stimulates the proliferation of the adrenal cortex, and activates release of hormones from the adrenal cortex. It is important in initiating and mediating complex behaviours, and improves learning, memory, and skill retention.

Androstenol or 5α-androstenol [5αandrost-16-en-3α-ol] is a pheromone made in the testes, and secreted by men in armpit sweat; it is also found in female urine. It may have some sexual arousal effects in humans.

Androstadienone is a male steroid hormone which may act as a pherom-

one; it appears to stimulate and improve mood in women, while acting as a sedative in men.

Angiotensin II is a brain peptide which controls peripheral blood pressure, and drinking behaviour. It stimulates *vasopressin*, *oxytocin*, *ACTH* and LHRH release [see below]. Angiotensin has receptors, divided into ATa and AT2 types; they are activated by angiotensin II and III.

Arginine vasotocin [AVT] is a peptide synthesised by the pineal. Its release into CSF is triggered by *melatonin*, and it seems to be responsible for some of *melatonin*'s effects on sleep [increasing REM sleep, and colour and intensity of dreams].

Bradykinin is a peptide which when injected into parts of the brain caused analgesia and raised blood pressure. It has B1 [BK1] and B2 [BK2] receptors.

CART [*cocaine* and *amphetamine* regulated transcript] peptides are forms of messenger RNA found in the brain and gut. CART 55-102 is a form which has been found to mediate [at least partially] locomotor and CNS effects of *cocaine* and *amphetamine*. It appears to act as an agonist at D2 *dopamine* receptors.

Cholecystolkinin [CCK 8] is a brain peptide that may aid in *DA*-regulation. It seems to be involved in improving learning and memory. CCK-8 sulfate ester is a sedative. There are cholecystokinin receptors – CCKA [CCK1] and CCKB [CCK2; gastrin receptor].

Cortisol is an adrenal steroid, secreted along with progesterone and *DHEA*. It is excitatory, but long-term stimulation causes depression and exhaustion. Its release is triggered by brain peptides, mediated by *ACTH* from the pituitary gland, as well as [indirectly] corticotropin-releasing factor [CRF] and *vasopressin* from the hypothalamus. CRF is anxiogenic and causes arousal; it may improve memory.

Dehydroepiandrosterone [DHEA] is the most abundant steroid in the blood, and is produced by the adrenal gland from cholesterol, which is converted to pregnenolone, then either to *DHEA* or progesterone and cortisol. Its secretion is stimulated by *ACTH*, and possibly prolactin, and it is released episodically throughout the day, along with cortisol. It also seems to be made in the brain, where it is excitatory and prevents degradation of neurons. Here it shares some properties with its precursor, pregnenolone, as they are both excitatory in areas of the brain that promote active sexual arousal; they inhibit *GABA* and BZ binding. Increase of *DHEA* production protects immune function, inhibits carcinogenic tumours, promotes bone growth, promotes weight loss, boosts energy utilisation, lowers conversion of energy to stored fat, lowers cholesterol, opposes the toxicity of glucocorticoid steroids, increases EEG theta wave amplitude, and reduces prolactin and *5-HT*. It is metabolised to estrogens, androgens, androsterone, and possibly pheromones in the skin. *DHEA* levels usually decrease after about age 30, and continue to decline.

Delta-sleep-inducing peptide has been found in the brainstems of sleeping and sleep-deprived mammals. Little is known about it, but obviously it is a peptide, and aids in inducing delta-wave sleep.

Diazepam-binding inhibitor [DBI; 'anxiety peptide'] is a brain peptide which binds to the benzodiazepine receptor in the *GABA*-system, blocking its effect and causing anxiety.

2-Dimethylaminoethanol [DMAE] is present in small amounts in the brain, and enhances the production of *ACh* [it is a precursor to phosphatidyl-*choline*]. It is a mild stimulant which elevates mood, increases intelligence, improves memory and learning, increases physical energy, and may help extend life-span, as well as improving sleep.

Estratetraene is a female steroid hormone which may act as a pheromone; although reputed to attract men, it appears to stimulate and improve mood in women, while acting as a sedative in men.

Estrogens [oestrogens] promote sex drive in females, by increasing desire, responsiveness and lubrication. The estrogen estradiol inhibits MAO; estrogens also facilitate the actions of *5-HT*, opioids, prolactin and *oxytocin*.

Growth hormone [GH] supports the growth of body tissue, as well as generating a calm and confident mood.

Growth hormone release inhibitory hormone [GHRIH; somatostatin (SOM)] prevents release of GH and *ACTH*, and inhibits TRH [see below]. It blocks the release of VIP [see below], insulin, glucagen, gastrin and renin in the gastro-intestinal system.

Luteinising hormone [LH] stimulates ovulation, progesterone synthesis in the ovaries, and testosterone synthesis in the male gonads. It appears to initiate sexual attraction and approach.

Luteinising hormone releasing hormone [LHRH] is a peptide released from the hypothalamus, which triggers release of LH from the pituitary. It has some effects on spatial orientation processes associated with learning.

Neurophysins I & II are proteins which are bound to *oxytocin* and *vasopressin*, respectively, and they are stored with them in the pituitary.

Nitric oxide [NO] is a gas which acts as an intra-cellular messenger, or neuromediator. It is formed from L-arginine by the enzyme nitric-oxide synthase [NOS], which produces L-citrulline and NO. NO is thought to be important in learning and memory, and it is formed mostly in areas of the brain important for these functions. Inhibition of NOS has been shown to impair learning and memory processes in primates. NO diffuses from nerve terminals, and forms covalent linkages with several potential targets. It activates the enzyme guanyl cyclase [this converts guanosine triphosphate (GTP) into cyclic guanosine monophosphate (cGMP), which work very similarly to ATP and cAMP, respectively], causing vessel-dilation; and regulates secretion of LHRH, prolactin, *oxytocin* and *vasopressin* [see below]. Carbon monoxide works as a neuromodulator in a similar way.

Oxytocin is secreted from the pituitary gland and has its own receptors, and is now regarded by some as a true neurotransmitter. It controls milk ejection, and speeds uterine contractions during labour; it is also a key substance known to be released in large amounts during orgasm, in short pulsatory bursts, followed by a rest period. Because it reaches its saturation levels rapidly, excessive or prolonged doses block its effects. It is involved in interpersonal bonding, and facilitates attraction and touch sensation. It may have a negative effect on memory retention. It increases circulation of *DA*, *Ep*, *5-HT*, prolactin, VIP, *vasopressin*, testosterone, estrogen, prostaglandin [see below] and LHRH, as well as increasing *glutamate*, α-1 adrenergic and cholinergic activity.

Pre-pro-opio-melanocortin [POMC] is a precursor to *ACTH* and the *endorphins*.

Progesterone is a sexual depressant, reducing sensation and neural excitation. It can cause depression and irritability, and lower testosterone levels. Its actions are facilitated by *5-HT*, and it facilitates opioid activity.

Prolactin is an inhibitory hormone secreted by the pituitary gland. It is involved in sperm production, and lowers sex drive.

Prostaglandins are fatty acids derived from arachidonic acid, catalysed primarily by cyclo-oxygenase enzymes [which are inhibited by aspirin and paracetamol]. They are synthesised and released as needed, and modulate *NE* release, as well as causing ANS stimulation. In the hypothalamus, they may be associated with producing fever caused by bacterial toxins. Also derived from arachidonic acid in this process are prostacyclin [very unstable; potently inhibits platelet aggregation; a potent vasodilator which can cause hypotension] and thromboxane A2 [very unstable; enhances platelet aggregation; released from tissues following injury]. Leucotrienes are metabolites of arachidonic acid, and are also released locally in response to injury, or antigen-antibody reaction.

Sleep-Promoting Substance A [SPS-A] is also known as uridine; it has been found in sleeping and sleep-deprived mammals, and enhances slow-wave sleep and dream-sleep.

Sleep-Promoting Substance B [SPS-B; GSSG] is oxidised glutathione, or γ-glutamyl-cysteine-*glycine* disulfide; see SPS-A above. This compound has also been shown to inhibit *glutamic acid*-binding.

Substance P is a neurokinin peptide found in the CNS and other parts of the body. It modulates the sensations of pleasure and pain, causing a pain reaction, inflammation, and some vasodilation; it also facilitates memory. It causes smooth-muscle contraction in the gut, and is the endogenous ligand for the neurokinin-1 [NK-1] receptor.

Taraxein is a protein complex which has been isolated from the blood serum of schizophrenics. Injected into 'normal' subjects, it produces many symptoms of schizophrenia; administered to a schizophrenic patient in remission, it caused a return of symptoms. It also renders *adrenolutin* active in smaller amounts than usual. Human subjects comparing it to LSD, *mescaline* and *psilocybin* all found taraxein to have the most unpleasant CNS and peripheral effects [for the record, most subjects reacted favourably to the other psychedelics]. This substance has, for some reason, received little further study, and I am not aware of the active principles ever being isolated.

Testosterone promotes sex drive, assertiveness and aggression. It inhibits MAO; facilitates the action of *DA*, *Ep* and *vasopressin*; and inhibits *5-HT*, opioids and prolactin.

Thyrotropin-releasing hormone [TRH] is a peptide which controls release of TSH [see below] from the pituitary gland. It stimulates release of prolactin, GH, *DA* and *NE*, causing central stimulation [along with excitation and hyperactivity]. Its release is calcium-dependent, and is caused by potassium or electrical stimulation.

Thyroid-stimulating hormone [TSH; thyrotropin] is released from the pituitary, and stimulates thyroid gland activity, such as thyroid-hormone secretion, essential for normal metabolic processes, and mental and physical development.

Vaso-intestinal polypeptide [VIP] is found in the alimentary canal, pancreas and gall bladder. It relaxes most smooth muscle, causing vasodilation, hypotension, bronchodilation and relaxed intestinal muscle. It induces the pancreas to release insulin, glucagen and GHRIH; and the adrenals to create steroids. It causes excitation in CNS neurons, where it stimulates release of prolactin, LH and GH from the pituitary; it also has *ACh*-potentiating activity at some muscarinic *ACh*-receptors, and increases *choline* acetyltransferase activity. In the pineal, it stimulates cAMP and N-acetyltransferase activity. VIP release is calcium-dependent.

Vasopressin [anti-diuretic hormone] is also released from the pituitary – it prevents water and salt depletion by inhibiting urination, stimulating thirst and stimulating water reabsorption in the kidney. It is excitatory, and facilitates sexual arousal in combination with testosterone; it also improves attention, concentration, memory retention and memory recall. In some parts of the brain, it may sensitise cholinergic and *glutamate* activity. It is facilitated by α-1 adrenergic receptors, and increased by *ACh*, *DA*, testosterone, estrogen, dynorphin, substance P, angiotensin II, *nicotine*, and *yohimbine*; it is decreased by *5-HT*, opiates, *endorphins*, *GABA*, α-2 adrenergic activity, progesterone and alcohol. In some neurons, it can enhance response to *glutamic acid*, though in others it inhibits the response. It also has some *ACTH*-releasing capacity. It potentiates both cAMP and *melatonin* production in the pineal induced by moderate *NE*-stimulation.

Zinc is a trace mineral nutrient discussed here as an exception – for other nutrients, see the next chapter. It is involved in sperm manufacture, and is excitatory, reducing *GABA* and opioid levels.

This chapter was compiled with the aid of the following references:

(Agoston 1988; Ameri & Simmet 2000; Arbo et al. 2008; Axelrod 1961; Axelrod et al. 1964; Baker 2000; Balemans 1981, 1985; Banerjee & Snyder 1973; Barchas & Usdin ed. 1973; Barker 1982; Barker et al. 1981; Baslow 2000; Bear et al. 1996; Beaton et al. 1975; Beck & Jonsson 1981; Bhattacharya et al. 1995; Biel & Bopp 1978; Binkley 1983; Binkley et al. 1979; Boger et al. 2000; Boulton & Juorio 1982; Bräuner-Osborne et al. 1997; Brenneman et al. 1993; Brossi 1993; Buckholtz & Boggan 1977; Callaway 1988; Callaway et al. 1995; Cardinale et al. 1987; Carpéné et al. 1995; Chahl 1991; Chowdhury et al. 1975; Christian et al. 1977; Claus et al. 1981; Coghlan 2002; Cohen et al. 1974; Collins 1983; Cottrell et al. 1977; Crenshaw & Goldberg 1996; Cryer 1992; Dean & Morgenthaler 1990; Deitrich & Erwin 1980; De Maio & Pasquariello 1964; De Rienzo et al. 1997; Devane & Axelrod 1994; Dickenson 1989; Di Marzo et al. 1996, 1999, 2000; Di Tomaso et al. 1996; Domino 1986; Dong-Ruyl et al. 1998; Dresser et al. 2000; Fagan 1997; Feenstra et al. 1983; Fillenz 1984; Finnin 1979; Franzen & Gross 1965; Fuhr et al. 1993; Garattini & Valzelli 1965; Garrett & Holtzman 1993; Gifford et al. 2000; Gillin et al. 1976; Glover 1998; Grady et al. 1992; Guchhait 1976; Haber et al. 1999; Hagen & Cohen 1966; Harborne & Baxter ed. 1993; Hartley & Smith 1973; Hattori et al. 1995; Haubrich et al. 1981; Hazum et al. 1981; Heath et al. 1957; Herz 1980; Hoffer & Osmond 1960; Holden 1999; Honegger & Honegger 1959; Houser et al. 2000; Hryhorczuk, L.M. et al. 1986; Hucklebridge et al. 1998b; Jacob & Presti 2005; Jansen 1990; Julien 1995; Kaplan & Sadock ed. 1989; Kapp 1958; Katzung & Trevor 1995; Kebadian & Neumeyer ed. 1994; Keller & Ferguson 1976a, 1976b; Kety 1961; Kimmel et al. 2000; Kolb & Whishaw 1995; Komoda et al. 1990; Kovacs & De Wied 1994; Krnjevic 1988; Kruk & Pycock 1983; Kveder & McIsaac 1961; Lambert & Di Marzo 1999; Lea 1955; Lee et al. 2005; Levi et al.1991; Leweke et al. 1999; Lewis & Clouatre 1996; Louw et al. 2000; Lyttle 1993; Madras 1984; Malitz ed. 1972; Mandell & Walker 1974; Mandell et al. 1969; Mantegazzini 1966; Mårtens et al. 1959; Martin ed. 1996; Martin & Sloan 1970, 1986; Marx 1985; Maslinski & Fogel 1991; Matsubara et al. 1992, 1998; McCormick & Tunnicliff 1998; McIntyre & Norman 1990; McIsaac et al. 1961; McKenna et al. 1990; Medina et al. 1989; Medvedev 1996, 1999; Medvedev et al. 1995a, 1995b; Melander & Mårtens 1959; Mendelson & Basile 1999; Meschler et al. 2000; Mess et al. ed. 1985; Minami et al. 1999; Mindell 1982; Mitchell 1999; Moore 1978; Moore & Klein 1974; Moore-Ede et al. ed. 1992; Moret & Briley 1988; Müller 1987; Murphree et al. 1960; Musalek et al. 1989; Nakazi et al. 2000; Nathan 1998; Neale et al. 2000; Nyham 1987; Oon et al. 1977; Osvaldo 1974; Panikashvili et al. 2001; Parthasarathy 1999; Pavel et al. 1980; Peroutka 1993; Pevet 1983, 1985; Pfeiffer et al. 1957; Phillips 2000; Phillis et al. 1986; Piomelli et al. 2000; Prendergast et al. 1997; Rabin et al. 1997; Rakhshan et al. 2000; Relkin 1983a, 1983b; Rodnight 1983; Romijn 1978; Rosengarten & Friedhoff 1976; Rothwell 1996; Runkel et al. 1997; Saavedra 1989; Saavedra & Axelrod 1973; Sabelli & Giardina 1972; Sabelli et al. 1978; Sánchez-Blázquez et al. 1999; Sanger et al. 1999; Schwartz et al. 1991; Seiden & Dykstra 1977; Shulgin & Shulgin 1991, 1997; Silva et al. 1960; Sinor et al. 2000; Skup et al. 1983; Smith & Prockop 1962; Smith & Lane ed. 1983; Smythies et al. 1979; Song et al. 1996; Sprince 1970; Squires 1978; Stella et al. 1997; Stone 1993; Strassman 1990, 2001; Szara 1961a, 1961b; Szekeley et al. 1980; Szekeley & Ronai 1982; Szolcsányi 2000; Takeda et al. 1995; Tanimukai et al. 1970; Tasaka 1991; Tucek 1988; Tunnicliff 1992, 1998; Unseld et al. 1989; Vanderwolf 2000; Vayda 1992; Wachtler 1988; Watanabe et al. 1991; Webster & Jordan ed. 1989; Welch & Eads 1999; Wildmann et al. 1987, 1988; Wiley 1999; Winter et al. 1999a, 1999b; Wurtman 1987a, 1987b; Wyatt 1972; Wyatt et al. 1973; Yamatodani et al. 1991; Yatri 1988; Young 1983; Yu et al. 2003; Yuwiler 1983, 1990).

INFLUENCING ENDOGENOUS CHEMISTRY

Apart from the obvious techniques of drug consumption, our neurochemistry may be altered in a number of ways. For greater detail on some of the procedures discussed below, see also the enjoyable and accessible work of Wells and Rushkoff (1995). The practices outlined here are often used together in combination, and are usually more effective that way (Prince 1980; pers. obs.). They are also often used in combination with ingestion of sacred plants. Due to the often great synergy resulting from such combinations, minimal dosages of psychedelic sacraments are often suggested as being preferable, allowing one to focus whilst still reaching great depth. The reader is encouraged to find out more about the practices outlined here, as this can only be a summarisation, particularly in fields related to yoga and meditational practices. Yoga and Tai-Ch'i, in particular, are easiest to learn in a group situation with a teacher that you like.

Dietary influences

The diet is crucial to any CNS activity taking place, for without foods our vital organs, including the brain, would not function [possibly with adept 'Breatharians' excluded!]. Vitamins and mineral nutrients can have subtle influences on consciousness, as well as being important in physiological functions, some of which are involved in the regulation of neurochemistry. Some are vital as co-factors in the manufacture of neurotransmitters, while some aid in other processes necessary for consciousness, such as maintaining proper circulation [distributing, amongst other things, oxygen, which is essential for cells and neuronal function]. Nutrients are best absorbed in the form of food, rather than as supplements. Supplemental nutrient mega-dosing may sometimes do more harm than good, and should not be employed for extended periods. Here is a run-down of nutrients and their potential roles in CNS function, bearing in mind that these summaries are not complete:

Vitamin A [β-carotene; retinol] aids vision, builds resistance to respiratory infections, shortens duration of diseases and promotes healthy growth. Good sources are carrots, green & yellow veges, eggs, dairy products, yellow fruits, meats and fish liver oils.

Vitamin B1 [thiamine] keeps nervous system, muscles and heart functioning normally, and positively affects mental attitude. Needed most in stressful situations. It is also a powerful antioxidant. Good sources are dried yeast, rice husks, whole wheat, oatmeal, peanuts, bran, milk, seafood and most veges.

Vitamin B2 [riboflavin] is also needed in stressful situations, and benefits the vision, as well as inhibiting AChE. It has an important role in metabolism [particularly for that of B6], as well as aiding growth and reproduction. Good sources are milk, yeast, cheese, leafy greens, eggs and meats.

Vitamin B3 [niacin, or nicotinic acid; and another form of B3, niacinamide, or nicotinamide] can be made in the body from *tryptophan* by the enzyme tryptophan oxidase, requiring also B1, B2 and B6; it is also essential for the synthesis of cortisone, insulin and sex hormones. It is necessary for a healthy nervous system; a lack of it can bring about negative personality changes. Niacin can enhance memory, and nicotinamide has benzodiazepine-like activity [sedative, hypnotic, anticonvulsant in large doses; see *diazepam*]. Large doses [in the gram-range] should only be used under medical supervision, as they can cause liver damage, diabetes and other health problems. Good sources of B3 are whole wheat, brewer's yeast, eggs, roasted peanuts, avocados, dates, figs, prunes, fish and lean meats including poultry.

Vitamin B5 [pantothenic acid; pantothenol; panthenol] is vital for proper adrenal function, and helps in cell building and CNS development. It is needed in the conversion of *choline* to *acetylcholine*, and conversion of fats to energy, as well as antibody synthesis. Also a powerful antioxidant. Good sources are whole grains, wheat germ, bran, green veges, brewer's yeast, nuts and crude molasses.

Vitamin B6 [pyroxidine] is needed for proper absorption of B12, protein and fat. Helps convert *tryptophan* to niacin. Helps prevent nervous disorders, though too much [2-10g a day] can cause them [ie. mental overactivity]. It alleviates nausea, and promotes proper synthesis of anti-ageing nucleic acids. Can enhance dream-recall. Good sources are brewer's yeast, wheat bran and germ, cantaloupe, cabbage, milk, eggs, crude molasses and meats.

Vitamin B12 [cobalamin] needs calcium and a properly functioning thyroid to aid absorption. It increases energy and maintains a healthy nervous sytem – it can relieve irritability, as well as improving concentration, memory and balance. A deficiency, in time, can cause brain damage. Reported anecdotally to intensify dream colouration [in 1mg doses]; 3mg a day increases sensitivity to bright-light induced *melatonin* suppression. Good sources are fermented yeast, eggs, milk, cheese, mushrooms, fish, beef, pork and organ meats such as kidney and liver.

Vitamin B15 [pangamic acid] is an antioxidant, working best with vitamins A and E. It can speed recovery from fatigue, aid protein synthesis, protect against toxins and stimulate the immune system. Good sources are brewer's yeast, whole brown rice, whole grains, pumpkin seeds and sesame seeds.

Vitamin C [ascorbic acid] is important in growth and repair of cell tissue, and helps iron absorption, as well as being an antioxidant. It is used up rapidly during stress periods, and aids in preventing infections and allergies. It acts as a *dopamine*-receptor blocker. Good sources are citrus fruits, berries, green leafy veges, capsicum, tomatoes, cauliflower, potatoes, sweet potatoes, and rosehips.

Vitamin D [ergosterol; calciferol] may be produced in the skin with sunlight, or may be obtained from the diet. It aids in assimilation of vitamin A, calcium and phosphorous. Good sources are fatty fish, liver, egg yolks and dairy products.

Vitamin E [tocopherol] is an antioxidant stored in the adrenals, pituitary, testes, heart, blood, liver, muscles, uterus and fatty tissues. It is a vasodilator and anticoagulant which enhances the activity of vitamin A. Good sources are wheat germ, whole wheat, soya beans, vegetable oils, broccoli, Brussels sprouts, leafy greens, whole grain cereals and eggs.

Biotin [Coenzyme R; vitamin H] is essential for fat and protein metabolism. Deficiency causes extreme exhaustion. Good sources are nuts, fruit, brewer's yeast, egg yolk [without egg white, which prevents absorption], milk, unpolished rice and organ meats.

Calcium [Ca] maintains strong bones and teeth, and aids in iron metabolism. It aids impulse transmission in the nervous system, and can help alleviate insomnia. Good sources are dairy products, soy beans, peanuts, walnuts, sunflower seeds, dried beans, leafy green veges and salmon.

Folic acid is important for RNA and DNA production. It can ward off anaemia, and act as an analgesic. Good sources are dark-green leafy veges, carrots, tortula yeast, egg yolk, melons, apricots, pumpkins, avocados, beans, whole wheat, dark rye flour and liver.

Iodine [I; iodide] is mostly stored in the thyroid; it can improve energy and mental reaction times, as well as help in burning excess fat. Good sources are onions, seafood and kelp.

Iron [Fe] is needed for proper metabolism of B vitamins, as well as production of haemoglobin and some enzymes. It can prevent fatigue, and promote resistance to disease. Good sources are meats, fish, soybean hulls, dried peaches, egg yolks, nuts, beans, asparagus, spinach, molasses and oatmeal.

Magnesium [Mg] can reduce stress and depression, and is essential for nerve and muscle function. It is also needed in converting blood sugar to energy, and in metabolism of vitamin C, calcium, phosphorous, sodium and potassium. Good sources are figs, lemons, grapefruit, corn, almonds and other nuts, seeds, apples, dark-green veges, dairy products, meats and fish.

Phosphorous [P] requires vitamin D and calcium for proper utilisation. It is needed for the transference of nerve impulses, and is involved in virtually all physiological reactions. Good sources are whole grains, nuts, seeds, eggs and dairy products.

Potassium [K] works with sodium, and regulates water balance and heart rhythms. It is decreased by stress; deficiency of potassium and sodium together diminishes proper functions of nerves and muscles. It can aid in oxygenating the brain. Good sources are watercress, citrus, sunflower seeds, bananas, potatoes, green leafy veges and mint leaves.

Sodium [Na] helps with proper nerve and muscle function, and helps keep other mineral nutrients soluble for use. High intakes deplete potassium levels. Good sources are salt, carrots, beetroot and artichokes.

Zinc [Zn] can promote growth and mental alertness, and may be vital in DNA synthesis. It ensures efficient metabolism [especially of vitamin A], and maintenance of cells and enzymes. It is depleted by corticosteroids, and renders cells more resistant to toxins and oxidation. Good sources are wheat germ, brewer's yeast, pumpkin seeds, eggs, ground mustard, meats and seafoods.

Besides nutrients, the food we eat also contains trace amounts of other compounds which are either psychoactive, potential precursors, neurotransmitters or of interest due to their relation to chemicals in these criteria. However, many of these substances are weakly active at best, and do not easily cross the blood-brain barrier – also, they are concentrated in foods at relatively low levels. Thus, this information is presented primarily to illustrate the widespread nature of these chemicals. To be used practically, they would [in most cases] need to be extracted under laboratory conditions. In many of these plants, this would not be practical. Some of the hidden secrets in common foods are broadly summarised below. Bananas [see **Musa**], **Citrus**, passionfruit [see **Passiflora**], plums [see **Prunus**], eggplant and potatoes [see **Solanum**] will be discussed under

their own entries in the second part of this book.

Apple [Malus domestica] – *melatonin* [47.6 pg/g], AChEI's, *narcotine*; *phenethylamine* in leaves of an unidentified Malus sp.

Asparagus [Asparagus officinalis] – *melatonin* [9.5 pg/g]; shoots are regarded as aphrodisiac (Rätsch 1990) [see also *Endnotes*]

Avocado [Persea americana] – *serotonin* [5-HT] [10 µg/kg], *tyramine* [23 µg/kg], *dopamine* [DA] [4-5 µg/kg] [see also *Endnotes*]

Barley [Hordeum vulgare] – *melatonin* [378.1 pg/g], *gramine* [535 mg/kg fresh 14-day old plant shoots (var. Champlain)], *tryptamine* [2.18 mg/kg from same plant], *tryptophan* [46 mg/kg from same plant], 3-aminomethylindole, N-methyl-aminomethylindole, *5-HT* [in barley malt, along with N-methyl-*5-HT*, indole-3-acetic acid, 3-aminomethylindole, *gramine*], *tyramine*, N-methyl-*tyramine*, *hordenine*

Beetroot [Beta vulgaris var. cruenta] – *tyramine* [160 mg/kg], *DA*, AChEI's

Brewer's yeast [Saccharomyces cerevisiae] – indole-di-β-indolylmethyleneindolenine

Broad bean [Vicia faba] – *L-DOPA* [up to 0.25%, either in free-form or as a β-glycoside], epinine

Cabbage [Brassica oleracea] – *melatonin* [107.4 pg/g], *tyramine* [440-800 mg/kg], *narcotine* [0.00004%] [see also **Brassica**]

Carrot [Daucus carota] – *melatonin* [55.3 pg/g], *tyramine* [0-230 mg/kg] [see also **Daucus**]

Cucumber [Cucumis sativus] – *melatonin* [24.6 pg/g], *tyramine* [250 mg/kg] [see also *Methods of Ingestion*, *Endnotes*]

Ginger [Zingiber officinale] – *melatonin* [583.7 pg/g], acetone, benzaldehyde, *GABA*, *aspartic acid*, *borneol*, *camphor*, 6-gingerol [sedative and anti-*5-HT*], glucose [acetylcholinergic, memory enhancer], *glutamic acid*, *glycine*, histidine, iso-*eugenol*-methyl-ether, lecithin [source of phosphatidyl-*choline*], *methionine*, niacin, thiamine, *phenylalanine*, tyrosine, 6-shogaol [sedative, anti-*5-HT*], β-*thujone* [and many more] [see also *Endnotes*]

Grape [Vitis vinifera] – *tyramine* [24-1400 mg/kg], trans-1,2,3,4,5-pentahydroxypentyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid [0.43-0.85 mg/L in juice], and the cis-isomer [1.5-3 mg/L in juice]

Indian spinach [Basella alba] – *melatonin* [38.7 pg/g]

Japanese butterburr [Patasites japonicus] – *melatonin* [49.5 pg/g]

Japanese radish or ***Chinese cabbage*** [Brassica campestris] – *melatonin* [657.2 pg/g], *tryptophan*-indoleacetamide, *tryptophan*-1-MeO-indoleacetonitrile, *tryptophan*-4-MeO-indoleacetonitrile [see also **Brassica**]

Kiwi fruit [Actinidia chinensis] – *melatonin* [24.4 pg/g] [see also **Actinidia**]

Lentils, brown [Lens esculenta] – desmethyl-*diazepam* [0.008-0.02 ng/g]

Mushroom, edible [Agaricus psalliota brunnescens] – *diazepam* [0.002-0.003 ng/g]

Oats [Avena sativa] – *melatonin* [1796.1 pg/g], *tryptamine* [0.03 mg/kg fresh] [see also *Endnotes*]

Onion [Allium cepa] – *melatonin* [31.5 pg/g]

Pea [Pisum sativum] – *5-HT* [0.0001% in stems, 0.00009% in tendrils], *tyramine*, *norepinephrine* [NE] [14 day-old plants – 0.00008% in stems, 0.00018% in tendrils, 0.0001% in leaf]

Pineapple [Ananus comosus] – *melatonin* [36.2 pg/g], *serotonin* [in juice], trans-1,2,3,4,5-pentahydroxypentyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid [0-0.48 mg/L in juice, 0.0000089% in jam], and the cis-isomer [0.036-1.7 mg/L in juice, 0.000019% in jam]; eaten with 'chili' [see **Capsicum**] or taken in rum with honey, it is regarded as an aphrodisiac (Rätsch 1990)

Purslane [Portulaca oleracea] – *DA*, *NE*

Radish [Raphanus sativus] – *tyramine* [200 mg/kg], *melatonin* [112.5 pg/g]

Rice [Oryza sativa japonica] – *melatonin* [1006 pg/g], *diazepam* [0.006-0.05 ng/g], desmethyl-*diazepam* [0.003-0.004 ng/g], peptide opioid ligands in albumin

Soy beans, yellow [Glycine max] – *diazepam* [0.006-0.05 ng/g], desmethyl-*diazepam* [0.004-0.006 ng/g]

Spinach [Spinacia oleracea] – *tyramine* [up to 680 mg/kg], *DA*, rubiscolin-5 and rubiscolin-6 [opioid peptides derived from the common plant enzyme Rubisco (d-ribulose-1,5-biphosphate carboxylase/oxygenase); rubiscolin-6 has shown learning improvement and anxiolytic activity in mice, and appears to be an agonist at D1, sigma-1 and delta opioid receptors]

Strawberry [Fragaria magna] – *melatonin* [12.4 pg/g], trans-1,2,3,4,5-pentahydroxypentyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid [c.0.000008% in jam], and the cis-isomer [c.0.000031% in jam] [see also *Endnotes*]

Sweet corn [Zea mays] – *melatonin* [1366.1 pg/g], *tryptamine* [0.05 mg/kg fresh], N-(p-coumaryl)-*tryptamine* [140 µg/kg], N-ferulyl-*tryptamine* [40 µg/kg], *tyramine*, desmethyl-*diazepam* [0.005-0.015 ng/g] [see also *Endnotes*]

Taro [Colocasia esculenta] – *melatonin* [54.6 pg/g] [see also *Endnotes*]

Tomato [Lycopersicon esculentum] – *tryptophan* [12 mg/kg from fresh 6-week old plant shoots], *tryptamine* [4 µg/g], *5-HT* [12 µg/g], *melatonin* [32.2 pg/g], *tyramine* [4-51 µg/g, leaves], 3-formylindole, indole-3-acetic acid, *narcotine*, traces of *nicotine*, AChEI's in leaves, trans-1,2,3,4,5-pentahydroxypentyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid [0.06-0.43 mg/L in juice, c.0.000035% in ketchup, 0.000129% in tomato concentrate], and the cis-isomer [0.27-1.89 mg/L in juice, c.0.000121% in ketchup, 0.000519% in tomato concentrate]

Walnuts [Juglans regia] – *5-HT* [170-340 g/kg], *tyramine* [0.0095% in leaf]

Watermelon [Citrullus vulgaris] – *tyramine* [460 mg/kg]

Welsh onion [Allium fistulosum] – *melatonin* [85.7 pg/g]

Wheat [Triticum vulgare] – *tryptamine* [0.2 mg/kg fresh], *hordenine*, *diazepam*, N-desmethyl-*diazepam*, deschloro-*diazepam*, 2-chloro-*diazepam*, 7-deschloro-2'-chloro-*diazepam*, delorazepam, lormetazepam, exorphins A4, A5, B4, B5 and C [opioid peptides in gluten; A5 has improved learning in mice]

(Applewhite 1973; Bell 1973; Culvenor 1970; Ehmann 1974; Hanson 1966; Hartmann et al. 1972; Hattori et al. 1995; Herraiz & Galisteo 2002; Hirata et al. 2007; Husson 1985; Lovenberg 1973; Lundstrom 1989; Rimpler 1965; Schneider et al. 1972; Schulick 1996; Smith 1975; Teschemacher 2003; Udenfriend et al. 1959; Usneld et al. 1989; Wheaton & Stewart 1970; Whitaker & Feeney 1973; Wildmann et al. 1988; Yang et al. 2001; Yoshikawa et al. 2003).

Overindulging in cheese has long been said to result in nightmares, though whilst a recent study found a variety of cheeses to improve sleep and apparently increase and influence dream activity and content, nightmares were not reported. Interestingly, different types of cheese seemed to produce different kinds of dreams in the majority of test subjects. The pharmacology behind this is unknown, but often attributed to *tryptophan* for want of a better explanation (British Cheese Board 2005). Some cheeses use potentially psychoactive mould fungi in their manufacture [eg. see **Penicillium**], which might play a role in the phenomenon (pers. obs.). Also worth noting is the presence of traces of *morphine* in human and cow milk (Hazum et al. 1981; Teschemacher & Koch 1991), which would presumably also be present in cheese. Likewise, proteins present in milk may fragment to yield opioid peptides such as casoxin D or α-casein exorphins [from α-casein], β-casomorphins or β-casorphins [from β-casein], casoxins A. B & C [from κ-casein], α-lactorphins [from α-lactalbumin], β-lactorphin [from β-lactoglobulin] and lactoferroxins [from lactoferrin]. These act as opioid agonists, except the casoxins and lactoferroxins which act as antagonists (Teschemacher & Koch 1991; Teschemacher et al. 1997).

Morphine has also been found in hay and lettuce [2-10 ng/g] [see **Lactuca**] (Hazum et al. 1981). Peptides with opioid activity have been found in bovine serum albumin and hemoglobin, which may be present in meat (Teschemacher 2003). *Histamine* is found in large amounts in poorly stored fish [up to several g/kg], some ripened cheeses [up to 400 mg/kg], wine [generally below 10 mg/L], dry fermented sausages [400 mg/kg], soy sauce [220 mg/kg] and tamari [2393 mg/kg]. Oral ingestion of large quantities of *histamine* can cause typical symptoms of allergic-reaction, such as flushing, intense headache, nausea, vasodilation, constriction of chest, etc. (Slorach 1991). It may be that the "Chinese Restaurant Syndrome" that has been sensationalised by the media in the past, is due not only to MSG [monosodium-glutamate, a form of *glutamic acid*; flavour-enhancer 621], but also to *histamine* (pers. obs.). Soy sauce and sake [rice wine] also contain β-carbolines [THβC-3-carboxylic acid, 1-methyl-THβC-3-carboxylic acid, *harman* and β-carboline (*norharman*)] (Shulgin & Shulgin 1997); some of these [as well as *tetrahydroharman*] are also found in red wine (Allen & Holmstedt 1980; Shulgin & Shulgin 1997), as well as *anandamide* (Rätsch 1999b). Red wine, but not white wine, was shown to inibit cytochrome P450 3A4, but with only 16% of the efficiency of grapefruit juice in this regard [see **Citrus**] (Chan et al. 1998). Beer contains traces of 6-OH-THβC (Shulgin & Shulgin 1997), amongst other things [see also **Humulus**]. The β-carbolines can be formed from *tryptophan* by pyrolysis, as has been demonstrated in charred egg yolk [*harman*, *norharman*, 1-isopentyl-β-carboline and 1-(1-methyl-butyl)-β-carboline] (Tsugi et al. 1973) and roasted chicory root [Cichorium intybus] [*harman* and *norharman*] (Proliac & Blanc 1976), the latter of which also contains *lactucin*, lactucopicrin [see **Lactuca**], and related compounds [in both leaf and root, though some studies found no *lactucin* in roots], and has a sedative action antagonistic to *caffeine* (Balbaa et al. 1973; Kisiel & Zielinska 2001; Sessa et al. 2000). Chicory, incidentally, is said to be narcotic in India (Nadkarni 1976). The β-carbolines can also be formed under conditions that may occur during food processing, resulting from *tryptophan* reacting with glucose or other reducing sugars. These include 1-acetyl-β-carboline and (1R,3S)-1-(D-gluco-1,2,3,4,5-pentahydroxypentyl)-THβC [which may be transformed into 1-(D-gluco-1,2,3,4,5-pentahydroxypentyl)-β-carboline with oxidation] (Rönner et al. 2000). Processing is thought to be behind the formation of β-carbolines [*harman* and *norharman*] found in reasonably high levels in cooked fish and meat [especially when well-done], sauces such as soy sauce and Tabasco, fermented alcoholic bev-

erages, toasted bread and coffee [see **Coffea**]. Raw fish also contained THβC-3-carboxylic acid, with levels it and of 1-methyl-THβC-3-carboxylic acid increasing in cooked or smoked fish and meat; both act as precursors to *harman* and *norharman* (Herraiz 2000b, 2004). See also *Endnotes*.

Recent research has found that foods rich in fats and sugars [such as most 'fast food' and 'junk food'], despite being unhealthy, are mildly psychoactive and probably addictive, triggering release of brain *endorphin*s and *enkephalin*s which in turn induce *dopamine* release. This is a path of action shared by strongly habituating drugs such as heroin and *cocaine*, though of a lower magnitude than such drugs (Martindale 2003).

Alcohol and *caffeine*, which many people regularly consume with their meals, interfere with absorption of some of the vital nutrients, and should preferably be avoided or consumed at least 1-2 hours apart from meals. Alcohol was long thought to destroy brain cells by causing the withdrawal of necessary water from them (Dean & Morgenthaler 1990; Lewis & Clouatre 1996; Mindell 1982; Vayda 1992). Although it now appears that alcohol consumption does not markedly destroy neurons, it can still destroy white matter and cause other kinds of reversible brain damage in alcoholics (Tyas 2001). To avoid the majority of negative after-effects from alcohol, consuming an equal amount of water between drinks is recommended - although moderation is still best.

Alcohol [or ethanol] consumption may also result in endogenous formation of tetrahydroisoquinoline and β-carboline alkaloids, from the condensation of endogenous *phenethylamine*s or indoles with acetaldehyde, a metabolite of ethanol [see above for discussion of similar reactions in food processing, and substances found in alcoholic beverages]. Such alkaloids include *salsolinol*, O-methylsalsolinol, *harmalan*, 6-OH-*tetrahydroharman*, *harman*, and possibly 1-methyl-β-carboline and *pinoline*. However, similar reactions and metabolites may be observed without alcohol consumption (Collins 1983; Deitrich & Erwin 1980; Shulgin & Shulgin 1997).

The foods we eat also supply most of our essential amino acids [see *Neurochemistry*], either in free form or bound in proteins. After consumption, a portion is transported into the brain and metabolised to produce neurotransmitters, or otherwise influence physiological functions. The 'abnormal' metabolites of some of these neurotransmitters [especially of *dopamine*, *epinephrine*, *norepinephrine* and *serotonin*] have been proposed in the past to contribute to types of schizophrenia, in the case of genetic enzymatic defects causing excessive production of some of these metabolites (eg. see Rodnight 1983; Rosengarten & Friedhoff 1976; Wyatt & Murphy 1976). Although no conclusive evidence has yet been found to support the validity of any of these assumptions, in connection to mental illness, it would not seem unlikely if such metabolites were involved in some way in the symptoms of some people. Given the effects of some of these powerful substances [such as *DMT*], imagine the reaction of a person feeling such effects, who had not taken any drug, nor had access to any logical explanation for this potentially terrifying state of mind. Continuing negative reactions, manifesting in a psychosis or other aberrations, would be expected. This is contrasted with the usually positive experiences of those who consciously choose to ingest such substances, with a good set and setting, or of those who deliberately awaken such endogenous biochemical changes through other means. To the informed psychonaut, who is attempting to induce such a state intentionally, and is not making any permanent metabolic alterations in order to do so, a somewhat more brief and positive outcome could be hoped for.

[Also, as mentioned in *Neurochemistry*, the protein substance taraxein has been implicated in schizophrenia, apparently with a stronger correlation than has been reported for any of the abnormal metabolites mentioned above, and is chemically unrelated to them. It is unclear why taraxein has been the focus of so little scientific enquiry.

Part of the confusion in this issue no doubt also arises from the fact that many scientists have persisted in viewing schizophrenia as effectively a unified, defined disease, which it is not – rather, it serves as a label given to a loose assemblage of symptoms, most of which may or may not apply in any given case. To establish a single endogenous metabolite as being responsible for all of the symptoms of 'schizophrenia' seems a goal destined to failure.]

Amino acids compete with each other to varying degrees, and for any one amino acid to gain prominence in the metabolism, its concentrations must be raised above those of competing amino acids. One way this can be approached is by obtaining preference over either indoles or catecholamines through regulating carbohydrate and protein intake. As *tryptophan* is usually the least-prevalent amino acid in proteins, consumption of a high-protein meal will not favour *tryptophan* crossing the blood-brain barrier in preference to tyrosine; however, consumption of a high-carbohydrate meal induces insulin secretion, which lowers the levels of other amino acids, boosting the relative levels of *tryptophan* available to the brain (Fernstrom & Wurtman 1973; Lieberman 1987).

Another approach, which allows for a broader range of amino acids to manipulate, is known as precursor-loading. It involves oral ingestion of either foods particularly rich in a particular amino acid, or the amino acid in pure form, as well as vitamins and minerals crucial for the required biosynthesis. Relatively large amounts usually must be consumed, to allow for the fact that only a small portion will reach the brain; also, effects may be rather delayed in onset. This then either allows the amino acid as it is to elicit effects, or for it to be affected by enzymes and converted to its related neurotransmitters. It should still be borne in mind that feeding precursors in one end and hoping the desired reaction results [see below] is still somewhat of a 'crap-shoot', and the potential explorer should, as always, be very careful! Cyclic and/or chaotic changes in the metabolism and biochemistry of an individual can make the results highly unpredictable.

It is known that preloading with *methionine* can increase the production of N-methylated derivatives; for example, if given with *tryptophan*, then *DMT*, *bufotenine* and/or *5-methoxy-DMT* may potentially be produced, resulting in a state characteristic of those chemicals in the CNS. This process is greatly exacerbated with the co-administration of an MAO-inhibitor [MAOI], which prevents immediate degradation of these metabolites (Beaton et al. 1975; Cohen et al. 1974; Kety 1961; Sprince 1970). Inhibition of both MAO-A and MAO-B is required for full elicitation of the 'psychedelic indole syndrome', when *tryptophan* is given, though MAO-A inhibition is most crucial (Kruk & Pycock 1983; Squires 1978); this is also reportedly a requirement for the full development of '*serotonin* syndrome' [see below] (Sternbach 1991).

One underground publication described a theoretical method to boost endogenous production of *5-methoxy-DMT*, by consuming chocolate bars [to boost carbohydrate levels] along with a large oral dose of L-*tryptophan* and an MAOI (Most 1986). However, Most did not note whether he had actually tried this method himself [I believe he probably had not], or if he knew of anyone who had. Care should be taken when combining large amounts of *serotonin* precursors with an MAOI, as excessive central levels of this neurotransmitter can cause a potentially dangerous disorder known as '*serotonin* syndrome' [see below].

MAOIs can also be used to increase and modify the effects of some other drugs [such as **Psilocybe** mushrooms, *5-hydroxytryptophan* and LSD] (Kent 1995/96; Squires 1978; pers. comms.). An MAOI given with *reserpine* results in an excited state reminiscent of LSD in animals, and MAOIs also potentiate *amphetamine* and *ephedrine* (Squires 1978). MAOIs, particularly inhibitors of MAO-A, allow for *DMT* [which would normally be metabolised before reaching the brain] to express oral activity (McKenna et al. 1984a; Ott 1994; Sai-Halasz 1963). This is the basis of what is known as the 'ayahuasca effect' [see *Methods of Ingestion*, **Banisteriopsis**].

Some MAOIs have been shown to induce pineal N-acetyl transferase activity (Finnin 1979); and MAO-A inhibitors also increase pineal levels of N-acetyl-*serotonin* and *melatonin*, an effect which was negated by coadministration of propranolol, a β-adrenergic antagonist. High doses [or chronic administration of low doses] of MAO-B inhibitors also inhibit MAO-A (King et al. 1982; Nathan 1998; Oxenkrug 1999). Inhibition of MAO-B results in a rise in catecholamine concentrations, including *phenethylamine* [PEA] and *tyramine*. *PEA* is largely inactive if MAO-B is not inhibited (Sabelli et al. 1978).

Strong or 'irreversible' MAO-B inhibition [or non-selective MAOIs] can be a problem, particularly with foods high in *tyramine* or tyrosine [such as banana peel or essence (see **Musa**), aged products such as meats or cheeses, yeast products, and fermented foods – consult your physician for a full list] as a hypertensive crisis can result, in which there is a massive rise in blood pressure which can cause cranial haemorrhage and even death. This is mostly only a concern with 'irreversible' MAOIs, which are synthetic pharmaceuticals, and generally non-selective as to MAO-type. Caution should still be exercised with short-term MAOIs, as such foods can still initiate a hypertensive crisis if eaten in quantity on the same day as taking a short-term MAOI (Julien 1995; Mashford et al. 1993; Ott 1994, 1996).

In a similar vein, combination of an MAOI with a selective-*serotonin*-reuptake-inhibitor [SSRI], such as Prozac™ [fluoxetine] or other serotonergic drugs, can result in what is known as '*serotonin* syndrome', due to an over-abundance of synaptic *serotonin* [increased extracellular levels do not necessarily result in this syndrome], causing over-stimulation of central 5-HT1a receptors. The reaction can also occur when combining an MAOI with MDMA [3,4-methylenedioxy-*methamphetamine*; 'ecstasy'], dextromethorphan [DXM], or large doses of *serotonin* precursors, such as *tryptophan* and *5-hydroxytryptophan*. The syndrome seems to be a result of non-specific *serotonin*-receptor blockade, though 5-HT1a subtypes are most important. Symptoms include drowsiness, rigidity, shivering, agitation, restlessness, hyperreflexia, clumsiness, nausea, flushing, diarrhoea, sweating, euphoria, mental confusion, feeling of inebriation, fever, and rarely coma and death. If the responsible chemicals are eliminated from the diet, symptoms usually subside within 24hrs. However, in cases including delirium, symptoms have been observed to last up to 4 days. Combining *L-DOPA* with an MAOI can result in behavioural symptoms similar to those seen with *tryptophan* and an MAOI (Bodner et al. 1995; Gillman 1998; Sternbach 1991).

SSRI's can interfere with the activity of serotonergic psychedelics, though the nature of the interference seems to depend on both the type

of SSRI used, and the psychedelic used (pers. comms.). This is based on both subjective observations in humans [usually spread anecdotally], and observations on experimental animals treated with such drugs. For example, the SSRI (+)-fluoxetine has been observed to potentiate some effects of LSD in both rats and humans [contradicted by most other human experience – see below]. Some people have experienced 'LSD flashbacks' when using SSRI's such as fluoxetine, paroxetine [Paxil™] or sertraline [Zoloft™]. Potentiation between various SSRI's and DOM [2,5-dimethoxy-4-methyl-*amphetamine*; 'STP'] or *ibogaine* has also been observed in rats, though not with *5-methoxy-DMT* [except at high doses, with fluoxetine] (Winter et al. 1999a). However, psychonauts also report that SSRI's can block the effects of many psychedelics. A recent overview of psychonautic reports indicated that fluoxetine decreases the effects of LSD, MDMA and ketamine, without altering response to *psilocybin*, although a friend of mine has found that for her, fluoxetine decreases the effects of **Psilocybe** mushrooms. Sertraline decreased the effects of LSD and MDMA only at high doses [of the former], whilst normal doses did not affect the response to LSD or *psilocybin*. Paroxetine and trazodone [Desyrel™] decreased the effects of LSD. Conversely, tricyclic antidepressants such as imipramine [Tofranil™], desipramine [Norpramine™] and clomipramine [Anafranil™] increased the effects of LSD, and lithium increased the effects of LSD and *psilocybin* (Bonson 2002).

Some people have a mutation in the structural gene for MAO-A; the resultant permanent neurochemical imbalance has been observed to manifest, in those males studied, as aggressive and antisocial behaviour, as well as 'borderline mental retardation' (Brunner et al. 1993). Chronic, but not acute, schizophrenics have been observed to have low platelet MAO levels, but brain levels were normal. MAO abnormalities appear to be at least partly due to genetic inheritance (Rodnight 1983; Wyatt & Murphy 1976).

Consumption of an AChE-inhibitor [AChEI] such as physostigmine can increase *acetylcholine* [ACh] levels (Seiden & Dykstra 1977); see also *huperzine A* and *galanthamine*. AChE-inhibitors can cause sedation, subjective internal agitation or jitteriness, confusion, impaired concentration and short-term memory, and sometimes nausea and vomiting. Central effects are often more predominant in those who get little in the way of nausea or vomiting. Nightmares may be more frequent in the first sleep after other symptoms have subsided (Bowers et al. 1964). AChE-inhibitors can be hazardous in overdose, acting as convulsants and causing symptoms associated with cholinergic receptor stimulation; death may result from respiratory paralysis. Many pesticides and nerve poisons are AChE-inhibitors; these are much more dangerous because their activity is highly potent and 'quasi-irreversible' rather than moderate and short-term. *Atropine* and similar anticholinergic drugs are used as emergency antidotes to AChEI poisoning (Katzung & Trevor 1995).

It should be mentioned briefly that overeating or poor digestion, combined with a diet high in animal protein and fat, can cause [besides bowel cancer] a build-up of bowel toxins [such as indole, indican, skatole, guanidine, phenol, *histamine* and clostridium perfringen enterotoxin] from overgrowth of putrefactive bacteria in the intestines. This is called intestinal toxaemia, and symptoms can include mental disturbances [hallucinations, delirium, loss of mental co-ordination, etc.], mood disorders, fatigue and other physical problems (Cousens 1996).

Many of the following procedures or conditions may fall into the collective category of 'asceticism', mostly known to us from the practices of Hindu saddhus in India, where lengthy and sometimes painful ordeals are pursued as a route to enlightenment.

Fasting

Fasting, of course, involves not eating for any extended period of time, and fluids such as water may or may not also be excluded from the diet. So, here we are dealing with the withdrawal of dietary influences. Fasting eventually depletes the body of energy and nutrients, causing psychological and physiological disturbances. Fasting for short periods, however, is not as drastic a procedure, and if done in moderation can actually be good for clearing accumulated toxins from the system. Here, also, psychological symptoms may manifest when stored toxins resurface to be excreted.

Starvation is accompanied by an increase in the brain of *tryptophan*, and 5-hydroxy indoles (Young 1983). With prolonged starvation, activity of the enzyme glutamic acid dehydrogenase is decreased, and blood-brain barrier permeability is increased to some chemicals [such as *cocaine*] (Yuwiler 1971). This practice [inducing malnutrition] may also cause abnormal metabolism of nutrients and neurotransmitters (Cousens 1996), which could have rather unpredictable effects. Oxidised catecholamine products, such as *adrenochrome*, may be produced in greater amounts than usual as a result of anti-oxidants being excluded from the diet, including vitamin C depletion. Fasting can also increase the effects of other drugs, due to more rapid absorption and lack of competing substances [and, perhaps, reduced efficiency of toxin-clearing functions in the long term]. This is partially the rationale for most shamans fasting for at least one day before ingesting a sacred plant.

Stress

This is a fairly broad heading, as many things [such as fasting and sleep deprivation, covered above and below, respectively] can be interpreted as causing stress. This may refer to getting angry and upset from an argument, running a marathon, being shot at, or ascetic practices such as exposure to the elements. Many readers may recall the Biblical accounts of Jesus going alone without food into the desert for 40 days, and being besieged by visions of temptation [Matthew 4:1-11; Mark 1:9-13; Luke 4:1-13]. This is an example of fasting combined with isolation and exposure to the elements.

Long-term stress produces more drastic side-effects than a brief moment of stress. A primary function in stressful situations is activation of the adrenal glands, with a subsequent rise in blood-sugar [caused by release of glucocorticoids] to provide extra energy, and excretion of *epinephrine* and other adrenal hormones (Vayda 1992). Vitamin C levels drop greatly during stress, and thus formation of *adrenochrome* and related products could be expected, however, the adrenal cortex contains the highest concentrations of vitamin C in the body [except for the brain] – also, *adrenochrome* levels in plasma drop more rapidly in people with nervous tension (Hoffer & Osmond 1960). Plasma levels of β-*endorphin* are elevated during acute emotional or physical stress; the concentrations are highest in people who can withstand such stressful periods without disturbed function of the peripheral organs (Teschemacher et al. 1980). *Endorphin*s are released during stress from the pituitary gland along with *adrenocorticotropin* [ACTH], as well as from the adrenals with the catecholamines (Kruk & Pycock 1983). Stress can also increase the turnover of *dopamine*, reduce concentrations of p-*tyramine*, increase concentrations of m-*tyramine* (Boulton & Juorio 1982), deplete *norepinephrine* (Hellriegel & D'Mello 1997), and increase levels and turnover of *tribulin* (Doyle et al. 1996; Glover 1998; Glover et al. 1987; Medvedev 1996). Levels of endogenous *DMT* are also increased by stress (Barker et al. 1981), as is the activity of the enzyme N-acetyl transferase in the pineal (Finnin 1979). Rats subjected to acute psychic stress [my regrets to the rodents involved] used up more *tryptophan*, and in another experiment with rats stress increased the synthesis and release of *melatonin*, which as well as properties already mentioned, has antistress and immune-stimulating functions (Maestroni et al. 1989; Relkin 1983a). Psychic stress such as is experienced in an emergency or crisis, or in cases of life-threatening illness, has been known to induce 'hallucinations' (Dronfield 1995). Physical stress increases *vasopressin* levels, though emotional stress produced by fearful conditioning suppresses its secretion. Stress also lowers *dehydroepiandrosterone* levels (Crenshaw & Goldberg 1996).

Exposure to cold reduces the release rate of *norepinephrine* (Fillenz 1984), stimulates pineal *melatonin* synthesis, and increases *tribulin* production (Oxenkrug & Requintina 1998). Acute cold exposure [in adult rodents] raises the levels of peripheral cortico-steroids, adrenal cortico-steroids and pituitary *ACTH*, as well as decreasing adrenal vitamin C and adrenal cholesterol. In humans, if the temperature is lowered gradually, there is no change in cortico-steroids. Also [again with acute cold-exposure] the autonomous nervous system [ANS] immediately releases catecholamines, and the brain activity of MAO, and levels of *glutamic acid*, are decreased (Yuwiler 1971). Excessive exposure to heat [also when coupled with complete fasting] depletes the organism of water and sodium, which decreases the efficiency of waste removal [leading to build-up of potenially psychoactive toxins], and decreases efficient nerve function (Mindell 1982), which can cause a delirious state. Taken further, the risk of heat stroke and consequent organ failure and death is present. However, the sweating that occurs before waste removal is hindered is itself a form of heightened waste removal, so under controlled conditions [such as sweat lodges led by an experienced practitioner] heat exposure can be beneficial. The intense moist heat encountered in native American sweat-lodges, which are carried out ritually for both health and shamanic purposes, can produce an altered state that some people experience as psychedelic. This may be aided by *endorphin* production, flushing of psychoactive toxins from the body, ritual intent, social isolation and darkness [see below] within the tent or lodge, rhythmic chanting [see below], and fumes from psychoactive plants which are sometimes burned and/or smoked inside the lodge. Although unquestionably an ordeal for most people, this turns to feelings of euphoria and profound well-being once the ceremony comes to a close and participants leave the lodge, naked or semi-clad, to the cool outdoors (Weil 1976b; pers. obs.). Quick alternation between exposure to extreme temperatures, such as very hot and very cold water, can also produce some interesting alterations in consciousness, but may be contraindicated in some medical conditions (Wells & Rushkoff 1995).

Stressful anxiety resulting from drug withdrawal [*morphine*, *nicotine*, ethanol and lorazepam, but not **Cannabis**] increased *tribulin* levels (Bhattacharya et al. 1995). Sufferers of migraine headaches sometimes experience visual disturbances, and even hallucinations (Dronfield 1995).

Procedures for causing pain and letting blood have also been practiced by some traditional cultures, either simply to show spiritual devotion, or also to create an altered state. The Mayans practiced ritual bloodletting, often by drawing strings of sharp objects [eg. see **Urolophus**] through the

tongue, genitals or other body parts, in order to experience visions from the 'vision serpent'. This is probably mediated by release of *endorphins* and other neurochemicals in response to pain and blood loss (Schele & Miller 1986). Levels of endogenous *anandamide* also rise in suppressive response to pain (Boger et al. 2000).

Sleep and dreaming

The state of dreaming is a powerful, vivid and meaningful realm of consciousness, accessible nightly to almost anyone. While it may provide us with a greater understanding of ourselves, its function and neurological mechanisms are still barely understood. Dreaming generally occurs in periods of rapid-eye-movement [REM] sleep, which occur in a beta-wave brain state; non-REM sleep is characterised by theta- and delta-rhythms, slowing to 2Hz or less (Bear et al. 1996). There are few concrete theories regarding the neurochemical origin of dreams, but one with some credibility suggests that *5-methoxy-DMT* and 6-MeO-β-carbolines [such as *pinoline*] may be integrally involved (Callaway 1988). The 'twilight zone' just before falling asleep is also often characterised by symptoms of an altered state of consciousness [apart from drowsiness], as well as muscular relaxation. Imagery ['hypnagogic hallucinations'] is often experienced, of a disjointed nature; the intensity and complexity increase as the subject enters the deeper theta wave states, when approaching sleep. Similar experiences also occur when awakening from sleep, termed 'hypnopompic hallucinations'. These are both also reported to be induced by the use of 'khat' [see **Catha**] and 'hashish' [see **Cannabis**] (Ohayon et al. 1996; Richardson & McAndrew 1990; Stoyva 1973). Lucid dreaming, the phenomenon of becoming aware in dreams and being able to influence them, also offers interesting possibilities for exploring altered states of consciousness (eg. see Wells & Rushkoff 1995). Brain levels of *acetylcholine*, *melatonin* and *serotonin* are highest during sleep. Brain levels of the catecholamines are highest during waking hours, beginning just before waking, and subsiding again to a minimum at the end of the day. Salivary *tribulin* levels are highest at waking, and rapidly decrease, followed by a rise in cortisol (Balemans 1981; Hoffer & Osmond 1960; Hucklebridge et al. 1998a; Lewis & Clouatre 1996; Mandell et al. 1969; Wyatt 1972).

Sleep deprivation

Forcing one's self to remain awake for more than a couple of days at a time can result in peculiar mental changes. Such a practice is known to produce 'schizophrenic-like' symptoms, or aggravate existing schizophrenia, and can sensitise the individual to the effects of other drugs, such as LSD [which under these conditions is active in doses normally considered 'non-hallucinogenic']. After 2-3 days of no sleep, there is usually a turning-point, as visual and auditory alterations and hallucinations first manifest. For some people, this turning point may not eventuate until the 5th or 6th day of sleep-deprivation, which for most people would mark a second turning-point, after which symptoms become much more pronounced. Other common symptoms include irritability, emotional instability, disorientation, feelings of being in two places at the same time, motor incoordination, paraesthesia, time distortion, delusional thinking patterns, depersonalisation, sensations of a band of pressure around the head, and eye strain. When called upon to perform important duties for brief periods, subjects often show no sign of mental fatigue and perform to some semblance of normality, though at other times disorganisation and fragmentation of thoughts may be observed. Strange behaviour and hallucinations may occur in 90-120 minute cycles, as though dream-sleep was trying to re-assert itself in the enforced waking state. There is usually complete recovery after 8-15 hours of sleep, though sometimes it may be difficult to initiate sleep at first. This first sleep is often highly enriched in its dream content. For some people, up to a week or more may be required to recover fully (Bliss et al. 1959; Hoffer & Osmond 1960; Katz & Landis 1935; Luby et al. 1960, 1961; Mauriz 1990; Morris et al. 1960; Safer 1970; Vogel 1975; West et al. 1961). A friend of mine and his brother once deprived themselves of sleep for 5 days, and experienced "sinister shadow-like hallucinations", and bizarre and vivid auditory hallucinations of voices and sounds. No drugs other than small amounts of food were consumed (pers. comm.).

Sleep deprivation causes levels of endogenous oleamide [see *Neurochemistry*] to accumulate in cerebro-spinal fluid [CSF], in animals (Boger et al. 2000). In rats, there was an intial increase in brain MAO activity, followed by a decrease (Thakkar & Mallick 1993). In humans, there was an initial rise in ATP activity in red blood cells [see *Neurochemistry*], after which there was a large decrease, coinciding with a decrease in sympathetic nervous system response. EEG readings generally show a decline in alpha-wave activity (Luby et al. 1960, 1961).

Near-death experience

There are many examples of 'near-death experiences', or 're-emergence phenomena', recorded in the medical literature. The person in such a state often later reports having had 'transcendental' experiences, featuring elements such as out-of-body-experience [OBE], time-distortion, accelerated thoughts, review of life events, sudden profound realisations, feelings of joy and cosmic unity, precognition, encountering spirits or entities and 'unearthly realms', and encountering a barrier or brilliant all-pervading white light (Greyson 1985). Those who return to tell the tale often speak of moving towards this light, but being pulled away again before returning to life. Presumably, full death entails actually merging with this light, and to whatever is beyond. It has been suggested that the near-death experience is mediated by the NMDA and sigma receptor sites, in reference to similar effects induced by ketamine (Jansen 1990). Others consider the described experiences may be more similar to those potentially induced by *DMT* (Strassman 1997) or *5-methoxy-DMT* (pers. obs.).

Isolation and sensory deprivation

Isolation from others has long been used to initiate visions or other psychic alterations, most notably in native North American vision quests. Such vision quests combine isolation in the wilderness [preferably in a spot felt to be particularly endowed with natural energy] with fasting and exposure to the elements, and sometimes ingestion of sacred plants. Isolation from the community is also used in initiation procedures in many tribal groups around the world, to aid in the undisturbed re-arranging of the senses that is considered necessary for transition into fully-aware adulthood. In rats, social isolation has been found to induce enlargement of the pineal gland (Relkin 1983b).

Isolation by sensory deprivation is a well-known means of inducing altered states of consciousness, sometimes with 'hallucinations' (eg. Ziskind & Augsburg 1962). Subterranean constructions of religious importance, such as have been found in parts of Britain, were likely used in sacred rites in part due to the sensory deprivation which would be experienced within (see also Dronfield 1995). Ancient Taoists and other mystics have also been known to isolate themselves in caves for varying periods of time, as an aid to developing spiritual awareness (pers. comms.). In Tibet, seclusion in caves is a relatively common form of spiritual practice, known as 'muntri' or 'dark retreat'. Amongst the Bonpo and Nyingmapa, this seclusion may last for 3 years or more. In the words of Lopon Tenzing Namdak, "If we remain in darkness, we will discover the radiance of the natural state. If we take that as the basis of practice, we will quickly attain Buddhahood... The wisdom eye opens and we will be able to see everything in the three worlds. This is the purpose of dark retreats" (Dunham et al. 1993). Darkness as a crucial element is further discussed below.

Also, much work has been done on sensory-isolation in flotation-tanks, most notably by Dr John Lilly, inducing dissociative-visionary experiences both with or without the co-administration of psychedelic substances (Stafford 1992). A well-known 'science'-fiction film, 'Altered States', was very loosely based on this work. People often come out of the tanks feeling refreshed, positive and vibrant, and notice enhancement of sensory perceptions, including heightened awareness of colour, and mild psychedelic symptoms. Flotation tank experiences can increase alpha- and theta-waves in brain EEG activity; synchronise activity between the hemispheres of the brain; reduce secretion of catecholamines, *adrenocorticotropin* and cortisol; increase secretion of *endorphins*; decrease blood pressure, heart rate, oxygen consumption and muscular tension; and increase circulation to the extremities and gastro-intestinal system (Brain Mind Bulletin 1984; Deikman 1963; Hutchison 1984, 1994).

Day and night fluctuation

It has already been mentioned that darkness increases *melatonin* production in the pineal gland and other neurons. Alteration of natural light periods, either through artificial lighting, abnormal sleeping patterns, or jet lag, can hinder normal *melatonin* synthesis, giving rise to symptoms described under sleep deprivation. However, the intensity of artificial light is usually not sufficient to have a major contribution (Lewy 1983), though individual sensitivity varies greatly and some people are affected by some spectrums of artificial light (Nathan 1998). Problems generally may arise when one has little or no exposure to natural light during the day, but is instead exposed only to artificial light not bright enough to effectively influence pineal rhythms (Lewis & Clouatre 1996). Strong artificial light has also been shown to cause a stress-related rise in *adrenocorticotropin* and cortisol levels (Mahnke & Mahnke undated). Light of shorter wavelengths [blue (470nm) to green (525nm)] was most effective in suppressing *melatonin* production (Wright & Lack 2001). Pineal N-acetyl transferase is also influenced by diurnal rhythms, its activity rising at night (Binkley et al. 1979). Continuous light pulses of up to 10hr duration have been shown to suppress night-time N-acetyltransferase activity; such light pulses can also be used to rest the diurnal rhythm of this enzyme. The rhythm has been shown to persist as normal after 24hrs in constant darkness (Binkley 1983). Use of extended darkness-periods can boost *melatonin* production, leading to a greater concentrated supply of precursor material for *5-methoxy-DMT*, if combined with other appropriate manipulations. In rats, constant darkness is known to reduce MAO activity in the pituitary, and to a slightly lesser degree in the rest of the hypothalamus (Relkin 1983a) as well as increasing HIOMT activity (Finnin 1979).

Sympathetic neurons increase their firing rate at the onset of night-darkness, and the levels and turnover rate of *norepinephrine* increase in the

pineal. Pineal *norepinephrine* is taken up by pineal β-adrenergic receptors, which stimulate N-acetyl transferase activity [increasing it by at least 20-fold at night; HIOMT increases 2-fold at night] (Lewy 1983).

Intermittent light stimuli

Intermittent light stimuli [ie. flickering fire, strobe lights, and 'mind machines' (opaque goggles with a light/LED facing each closed eye, flashing at varying frequencies)] have been shown to cause behavioural changes, including psychotic reactions, as well as epileptic seizures or convulsions in individuals susceptible to epilepsy. It should be noted that epileptics commonly experience altered states of consciousness during their seizures. More often, in 'normal' individuals such stimulus produces positive effects [visual alterations and enhancements, 'hallucinations' which are often dream-like, sensations of movement, tingling on the skin, disturbed sense of time, emotional and mental involvement] which can translate into improved day-to-day functioning, and other benefits that meditation and trance can bring [see below]. Intermittent light stimuli are thought to work by entraining the EEG rhythms of the brain to the rhythm or frequency of the stimulus. Darkness enhances these effects. One experiment using two light sources with independent flash frequencies produced particularly vivid 'hallucinations' [see 'binaural beats', below under Rhythm and Percussion]. A rapid variation of flash frequency between 10 and 15Hz caused "unpleasant 'swimming' sensations". Blue light produced more effective entrainment than red light, and monochromatic light was more effective than neutral light of equivalent intensity. The visual component of these effects is more prevalent at frequencies of 6-10Hz and lower, particularly in theta frequencies (Dronfield 1995; Halstead et al. 1942a, 1942b; Hutchison 1994; Knoll & Kugler 1959; Richardson & McAndrew 1990; Rouget 1980; Ulett 1953; Walter & Walter 1949; Walter et al. 1946; Wells & Rushkoff 1995), and this effect can be exacerbated by drugs, such as LSD. Intermittent light stimulus in the alpha-range was shown to induce "striking subjective visual effects" with eyes closed, in people who had taken a sub-threshold dose of *mescaline* (Wheatley & Schueler 1950). In other tests, intermittent light stimulus in the range of 4-24Hz was shown to enhance the activity of LSD, as well as to encourage its effects in individuals normally insensitive to LSD (Fischer et al. 1961).

As a word of caution, there is plausible suggestion from a one-time friend of the infamous and legendary guitarist Syd Barrett [of the original Pink Floyd] that strobe lighting, combined with a large dose of LSD [given apparently without his knowledge, on top of a previously-consumed large dose], appeared to have triggered the beginning of the 'negative' personality changes that Syd is, unfortunately, now better known for (John 'Twink' Alder, in Watkinson & Anderson 1991). This may be more an observation of coincidence or individual differences in reaction than any concrete analysis of the matter, but should perhaps be borne in mind, nonetheless.

Colour

Experiments with humans comparing a grey, 'sterile' room and a colourful, 'diversified' room, showed that the colourful environment produced less alpha-wave EEG activity, and lower heart rate, than the grey room, in which subjects became restless and agitated. Subjects in the colourful room felt 'silent and subdued'. Red is regarded as stimulating, and red objects or images give the impression of being closer than they really are. Green and blue are relaxing; green is the most comfortable colour for the eyes, as green wavelengths focus exactly on the retina. Purple is regarded as 'subduing', and yellow as positive and 'cheering'. Strong hues of a single colour, however, usually do not produce a sustained effect, once the nervous system becomes accustomed to it [or irritated by it]. Visible light received through the eyes is known to stimulate the pineal and pituitary glands (Mahnke & Mahnke undated). Green light is the most effective wavelength in suppressing retinal HIOMT (Finnin 1979). Some experiments stimulated the pineal gland with blue-green light at 509nm (Lyttle 1993), and as noted above, wavelengths in this part of the spectrum are more effective in suppressing *melatonin* production (Wright & Lack 2001). It has even been shown experimentally that exposure to different colours can greatly enhance production of *serotonin*, *norepinephrine*, β-*endorphin*, *melatonin*, AChE, *oxytocin*, growth hormone, luteinising hormone and others, as well as increasing the effectiveness of some enzymes by up to 500%. Varying frequencies of light projection can also alter these effects. Beneficial combinations [for general cognition and feeling of well-being] include violet, green, or red at 7.8Hz and 31.2Hz, and varying shades of yellow, orange, and red at 12-15Hz or higher. 'White' light can also be used beneficially by constructing a simple goggle device, consisting of two ping-pong ball halves, fitted over the eyes [it is important to get a comfortable fit that completely blocks out sidestream-light] – when fitted, the subject gazes at a bright beam of light directed at the goggles. The desired effect initially is the perception of a white, homogenous, empty field, progressing into deeper states of consciousness [this is a form of sensory-deprivation – see Isolation, above]. However, ping-pong balls can be imperfect in that bright spots may be perceived, instead of a uniform light, though experimentation with different semi-opaque materials would smooth out such problems. This simple technology has been known and used for some time now, with developments mainly in the commercial field (Hutchison 1994).

Art and art appreciation

'Art' can be construed to mean many things, depending on who is talking about it. In this discussion, art is defined as any form of creative expression. This definition first leads to the obvious appreciation of the intricate and mind-boggling art of nature. In the natural world, everywhere we look we find evidence of inherent creative expression, whether or not one believes in a greater creative force. Contemplation of nature, its inherent beauty, its order and form within seeming chaos (or chaos within seeming order and form), and the observation of the wild patterns and connections underlying these perceptions, may be seen as one ancient route towards the expansion of consciousness in subtle, yet penetrating ways. This contemplation is vastly potentiated when the observer is already in an altered state of consciousness, eg. having consumed *mescaline* or *psilocybin*.

Our other major point of consideration is that of art created deliberately by humans. The actual creation of art – from initial conception of the piece, through to its completion and appreciation by self and others – can be a deep learning experience in itself, when the artist is committed to the integrity of the work. In such a case, the entire process may be one of prolonged meditation, as the artist opens up to their creative energies and the art becomes manifest. Alex Grey (1998) has written extensively on the sacredness of great art, and calls for us to consider the truest potential of art – that is, as a reflection and communication of higher consciousness or mystic revelations perceived through the artist. Many great artists throughout history have been inspired mystics – those who experienced visions of other realms, and tried to capture them in their art, so that they could be shared with the world. This is the end reward of great art – it gives a vision back to the world, so that it may heal and inspire those who are exposed to it. This is also where the artist has the greatest responsibility – to go beyond commercial or egotistical concerns, and use their given talents to create a reflection of ultimate reality. Having realised profound states of being, it is only natural for the visionary artist to channel this glimpse of the divine into form, and the creation of art is a very appropriate funnel for such noble aspirations. Apart from the impact the resulting work will have on its audience, the act of creation is also a transformative process for the artist. Even dark art has its place here, when the art seeks to explore the realms of the soul we may rather not contemplate. It is essential to know darkness in order to truly know light. Both constitute the unidifferentiated whole that is the paradox of life. For those particularly interested in these avenues of artistic endeavour, it is highly suggested that you read Grey's books and witness his art.

Art as created by humans takes many forms, and has become increasingly diverse over the last few decades. As technology has grown, art has grown with it, seizing every new opportunity for greater avenues of expression. The mixing of different forms of art has evolved to create true multimedia spectacles. Painting, sculpture, dance [see below], performance and installation art, poetry, film, computer animation, and many other art forms have been combined effectively with music [another potent art, when used well – see below for more] to produce a greater impact. As mentioned with nature above, the appreciation of human-made art whilst already in an altered state of consciousness can greatly increase the profundity of the experience.

Below is a selection of some 20th century visionary artists who have produced visual works which attempt [with success] to express aspects of the ineffable. Seeking out their works will hopefully be of value to the interested reader. It should be pointed out that many of these artists have produced works of greatly differing style and intent throughout their careers, and not all of the work by a listed artist will necessarily be of relevance here.

Ruary James Allan [see http://www.sacreddance.org/ruary/]
Pablo Amaringo [see Luna & Amaringo 1991;
also http://www.egallery.com/amazon.html for related artists]
Max Bill
Emil Bisttram
Alice Boner
Uwe Bremer
Salvador Dali
Gerardo Dottori
Max Ernst
M.C. Escher
Brian Froud
Clint Gary
George Graham
Alex Grey [see Grey 1990, 2001]
Allyson Grey [some of Allyson's and Alex's work can also be viewed at http://www.alexgrey.com/]
Rick Griffin

Ruth Harwood
Louise Janin
Maulsby Kimball
Mati Klarwein [has also illustrated some amazing album covers]
Hilda Klint
Columba Krebs
Pierre Maluc
Andre Masson
Roberto Matta [see http://www.jps.net/trock/matta/]
Ivan Meštrović
Johannes Molzahn
Philip Moore
Susan Morris
Buell Mullen
Erwin Don Osen
Paulina Peavy
Agnes Pelton
Serge Ponomarew
Ethelwyn Quail
Mario Radaelli
Ainslie Roberts [see the wonderful Roberts & Roberts 1981]
Joseph Earl Schrack
Hubert Stowitts
Stanislav Szukalski [see http://www.protong.org/]
Yves Tanguy
Pavel Tchelitchew
Henry Valensi
Remedios Varo
Victor Vasarely
Robert Venosa [see Venosa 1999]
Matthew Wigeland
Robert Williams
Gustav Wolf
Patrick Woodroffe

As well as 'modern art', much contemplative satisfaction may be found in ancient arts from around the world. Noteworthy examples are south-east Asian mandalas, Australian aboriginal 'dot' paintings, South American indigenous art inspired by the visionary experience ['San Pedro' (see **Trichocereus**), ayahuasca-related art (see **Banisteriopsis**), as well as snuff-tray designs – see **Virola** and **Anadenanthera**], Huichol yarn paintings and bead masks [see **Lophophora**], art of the Aztec, Maya, and Inca cultures, carvings and statuettes by native North Americans ranging from Alaska and Greenland to northern US, Japanese 'Zen paintings', Celtic rock carvings and metalwork, and north African cave art. This, of course, is only a small selection from some diverse world cultures past and present.

Massage, acupuncture and acupressure

It is known that stimulation of certain points on the body can induce *endorphin* release, whether this be from manual stimulation, electrical stimulation, or application of needles in acupuncture. These points are located all over the body, and a few can be easily located without more detailed instruction:

- draw your thumb in towards your hand, and locate the point at the summit of the skin folds that crease together between thumb and index finger on the top of the hand [but massage the point with the hand relaxed]
- point where the lines on the palm converge, under the base of the index finger
- point near the corner of the eye, just above the tearduct [stressed or tired people often instinctively rub these points]
- point on the neck just behind the earlobe [behind the jawbone]
- point in the hollow shell of the ear

This last region directly stimulates the peripheral nervous system via the vagus nerve. Stimulation here generally produces a tranquil feeling. Apparently Roman slaves used to stand behind their masters to manually stimulate their inner ears with warm water while they ate.

Electroacupuncture stimulation increases *endorphin* levels in the cerebrospinal fluid, related to the frequency of electrical current used. A frequency of 2Hz increased *endorphin*s; 15Hz increased *endorphin*s and *enkephalin*s; whilst 100Hz increased dynorphins (Abbate et al. 1980; Kruk & Pycock 1983; Pomeranz 1977; Ulett & Nichols 1996; Wells & Rushkoff 1995).

Massage of the feet and hands in specific areas is said by reflexologists to influence different parts or organs of the body. For instance, the toes stimulate the head, brain and sinus area, and the underside of the big toe stimulates the pituitary.

Magnetic fields

It has been known for a few decades that magnetic fields can produce altered states of consciousness. This can occur naturally, due to changes in geomagnetic activity. Geomagnetic storms, periods of deviation from the normal, stable magnetic field of the earth, can sometimes last for weeks at a time, and have been observed to affect insect behaviour, disrupt the homing skills of homing pigeons, and reduce *morphine*-induced analgesia in animals at night. Geomagnetic storms seem to be linked with solar activity, and have their highest activity from January to February, and June to July [lowest in March to April, and October to November]. 'Geomagnetic variation anomalies' usually act over less extended periods, and are often associated with underground basins, channels and deposits that affect conductivity. Sometimes geomagnetic variation anomalies are induced by changes brought about by geomagnetic storms. Extremely low frequency [ELF – 300Hz and below] electromagnetic fields propagating between the earth's surface and the ionosphere appear to be able to affect mood in humans by entrainment with brain EEG patterns [see Intermittent light stimuli, above]. The diurnal variations of these ELF fields are also suspected of being related to the control of human circadian rhythms, the disruption of which can result in behavioural and physiological anomalies (Persinger 1987). ELF fields associated with electric power generation and transmission have been shown to negatively influence pineal *melatonin* production, as well as decreasing immune and sexual function, causing emotional depression [all changes probably due to disruption of *melatonin*], increasing cancer risk and changing brain morphology in animals (Adey 1975; Moore-Ede et al. ed. 1992).

Geomagnetic storms have been associated with reduction of the convulsive threshold in susceptible humans [also observed from a geomagnetic variation associated with a solar eclipse] (Persinger 1987), and increases in reported poltergeist activity (Gearhart & Persinger 1986). Sensations of fear and perceived paranormal phenomena have been experienced by some people in a house with poor electrical grounding, particularly in an area dense with 60Hz magnetic fields varying irregularly in amplitude between 1-5 microT (Persinger et al. 2001). Geomagnetic variation anomalies in the weeks or even months leading up to major seismic activity have also been linked to odd behaviour, possible hallucinations and forms of mass hysteria. Some studies suggest that people [particularly females] born at the time of high geomagnetic activity are more likely to suffer from high anxiety. Very small variations in electromagnetic fields can affect DNA synthesis and bring about morphological changes in unborn children.

Humans are able to detect some degree of change in geomagnetic fields [with some individuals more sensitive than others], and it is suspected that the same applies for animals in general. This may be due at least partly to the responsiveness of magnetite [bio-organic iron] complexes in the body. Small changes in the geomagnetic field can significantly affect electrical activity in rat and pigeon pineal glands (Persinger 1987).

Spiritual experiences, fear, the sense of a 'presence' in the left peripheral visual field, and other altered states of consciousness have been reported from many human experiments involving weak [1 microT] complex pulsed magnetic fields applied to the temporal lobes of the brain, particularly when applied to the right hemisphere, or equally to both hemispheres. Opaque goggles were sometimes also used. Results were obtained with sine-wave magnetic fields applied in various ways at frequencies of 5, 7 and 40Hz, with the 40Hz treatments being most pleasurable, and 5Hz treatments being more visual in subjective effect. 5Hz treatments, and 40Hz treatments phase-modulated at 5Hz, also increased alpha-wave activity n the temporal lobes. These psychic effects have been hypothesised to be related to low-level endogenous *DMT* production and secretion, although this remains to be demonstrated (Booth et al. 2003; Cook & Persinger 1997; Hill & Persinger 2003; Persinger & Healey 2002; Sculthorpe & Persinger 2003).

Movement, exercise and dance; music and rhythm

Many of us will remember practices we utilised as children to produce altered states through movement aimed at producing dizziness, such as twirling, or rolling down slopes, a simple way of altering our perceptions momentarily (McKim 1977; Weil 1972). The simple act of sitting up in bed increases secretion of catecholamines such as *epinephrine* (Hoffer & Osmond 1960); changing from a lying to a standing posture increases the plasma levels of *melatonin*, cortisol, prolactin, aldosterone, *ACTH*, *norepinephrine* and β-*endorphin* (Nathan 1998).

Exercise also affects neurochemistry, as any athlete will know. Vigorous exercise raises levels of *dehydroepiandrosterone* [DHEA] (Crenshaw & Goldberg 1996) and *tribulin* (Glover et al. 1987), as well as those of catecholamines [*epinephrine*, *norepinephrine* and *dopamine*], which also increase with static exercise, such as Tai-Ch'i. Increasing the intensity of exercise elevates *norepinephrine* levels above those of *epinephrine*, and its plasma concentration remains raised for at least 30 minutes after exercise has ceased. Levels of *endorphin*s and *enkephalin*s are also raised with vigorous exercise (Jin 1992; Kruk & Pycock 1983). Another interesting effect noted with long-term exercise in rats was increased sensitivity of 5-HT2 receptors (Dey 1994).

Dance can awaken expressive and creative energies within the dancer, probably linked at least in part to those changes just mentioned. Ritual

rhythmic dancing is an integral part of group spiritual practices in many traditional tribal groups world-wide, usually closely linked with music, involving percussion instruments, 'wailing' and/or 'droning' reed or wind instruments [such as shahnai, horns, flutes, bagpipes], and/or stringed instruments [such as the sitar], and often also the human voice, released spontaneously in non-verbal rhythmic and tonal expression, or as repetition of mantras. Music played for such intent has been claimed to operate by distracting or overloading the nervous system in such a way as to cause dissociation or trance. This may be a contributing factor, with some kinds of music, but the whole phenomenon is much more complex, and still little-understood. It is usually the dancers, however, not the musicians, who enter the deeper trance-states [though the shaman is often capable of reaching trance whilst playing a drum at the same time]. This is probably largely due to the dancers not being constrained by the necessity of maintaining control over a musical instrument (Kovach 1985; Rouget 1980; Wells & Rushkoff 1995; pers. obs.). An interesting example of trance-dancing is the spinning 'whirling dervish' dance of the Sufis.

These rhythmic practices are used in some tribal groups to awaken the 'kundalini' energy [discussed below], particularly amongst the Kung Bushmen of the Kalahari, who do so to 'heat up' the 'n/um' or 'ntum', the 'spiritual potency' or kundalini energy. They say this energy resides in the pit of the stomach, and rises up the spine and into the head, where it causes them to 'lose their senses', being so overwhelmed by the energy that they often collapse, helped to the ground and comforted by the others for the duration of the trance. Older, more experienced 'ntum masters' often do not go into this semi-comatose state, as they have learnt to control the energy to some greater degree, and better utilise it for channelling into healing purposes. The quality of ntum is also attributed to shamans, as well as other things of importance, such as the sun, falling stars, rain, bees and honey, blood, sacred fires, 'medicine songs' and certain plants and fruits. The purpose of kindling ntum is to attain the '!kia' state, the state of transcendence, where one can 'see' all and heal.

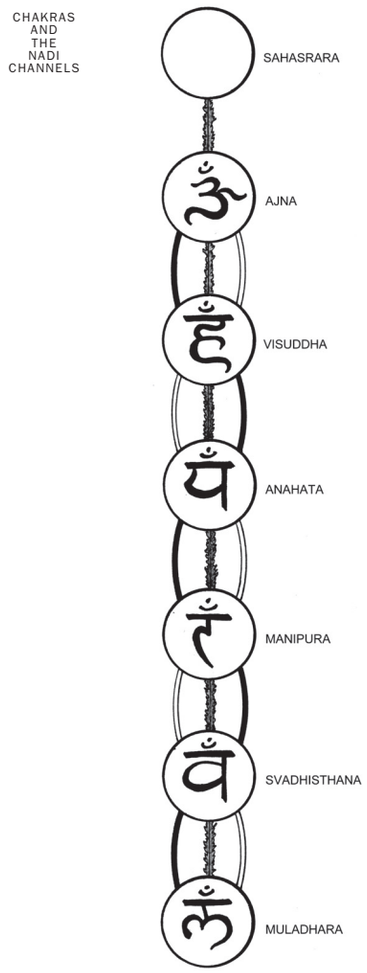
Ntum ceremonies may take place 3-4 times a month, and begin spontaneously when a group of women light a fire, sit tightly around it, and begin singing and clapping rhythmically. The men gather around in a line and begin dancing in a vertical, pogo-like motion; rattling ankle-bracelets stress the beat, as do the heavy footfalls. The rhythms are in complex 5- and 7-beat phrases; the arms are held close to the side, slightly flexed, and the body slightly hunched forward; they stare at their feet, or straight ahead, to avoid distractions. As the dance continues, the body becomes tense and rigid, with a heaving chest, profuse sweating, and prominent veins in the neck and forehead. If the dancer feels ntum rising too soon to be useful, he may stop dancing for a while and is refreshed by water from the women. The women, it should be noted, also control the ntum by their control over the pace of the dancing; thus, the ritual is in a sense a complementary one between both sexes. Some dancers may come dangerously close to the fire to help the heating up of ntum [exposure to the elements; see above]. Ntum may rise gradually, or suddenly – they say "their spirits fly along threads of spider silk to the sky", where they interact with normally invisible forces, before returning to the body. The ntum-masters blow a powder in the face of the trancer to revive him – it is said that if this is not done, death can result (Campbell 1984; De Rios 1986; Rouget 1980; Sannella 1977).

As mentioned, rhythm can play a vital role in aiding trance induction. In cultures who have been using such methods for thousands of years, there are several factors that may be aimed for in trance-rhythms: 1) monotony or repetition, 2) predominance of bass frequencies, which can deliver more energy to the brain via the ears without causing hearing damage, and 3) spontaneous and complex changes of rhythm [which aids in disorientating the system, shifting it to new levels of consciousness]. Rhythms are often relatively fast, with a rapid and pronounced beat, usually around 8-9 beats per second. In my experience, slower rhythms, around 1-4 beats per second [or slower, to a point], may be conducive to achieving a more relaxed trance state, though care should be taken not to fall asleep! Shamans of some cultures often use a drum, to which they attribute great spiritual power, to help reach the healing trance-state. Rhythmic beats in repetition seem to act on the brain through synchronising EEG rhythms [as with intermittent light-stimuli] with the rhythm of the drum-beat and/or chanting and other music, altering them to a frequency conducive to trance. This process is called entrainment, where an external frequency is maintained to induce brain frequency to harmonise with it. [Bio-feedback is a process in which people train themselves to alter their own dominant brain-wave frequencies, via connection with a monitoring device which alerts the subject, via a beep or other cue, when their EEG rhythm is synchronised with the chosen frequency.] Also of interest is the phenomenon whereby frequencies of small amplitude, applied steadily, will gradually 'build' to create harmonic overtones of far greater intensity. Music as a whole, if geared to such a purpose, can act as a focus [such as used in meditational states] to entrance the mind and aid the shift to an altered state. The topic of sound frequency also brings us to discuss binaural beats – this phenomenon rests on the output of two or more frequencies, fed into different ears, which have a small difference [eg. 200Hz and 206Hz] – when this occurs, the brain detects mainly the difference in frequency, and synchronises with it [the beat frequency – 6Hz, following our example]. This often brings about entrainment much more readily than when using single frequencies. Knowledge of this can be used to construct complex frequency-overlays, aimed at inducing an altered state of consciousness (Bear et al. 1996; Bentov 1977; Hutchison 1994; Neher 1961, 1962; Prince 1980; Rouget 1980; Wells & Rushkoff 1995).

Many examples of modern music should not be ignored for their ability to alter consciousness, especially in conjunction with consumption of psychoactive plants and/or other practices as outlined here. Whatever your tastes, there is plenty to choose from, particularly if you avoid major commercial music stores. One should choose with care, however, as music can potently affect the mood and content of an experience. This is something that Amazonian 'ayahuasqueros' have evolved to a fine art, with their skilled use of the voice to alter and direct consciousness [see below].

Perhaps the ultimate way of appreciating music and sound in connection with consciousness exploration is the ancient observation that everything is sound – although it can require a lot of quiet attention to actually realise this.

Breathwork and chanting



The breath supplies oxygen to the body, without which we have no life. The Hindus consider the breath to be a primary source of 'prana', or vital life energy [see ch'i in *Glossary*], and the practice of breath control is called 'pranayama'. Control of the breath is very important for effective meditation, and inducing trance states in general. In the 'etheric body', prana is said to flow along the 'nadis', the nerve-channels that, when in harmony, can liberate the kundalini energy [which we will discuss below, along with the 'chakras']. According to this model there are three main nadi currents, which can be visually conceptualised in relation to the physical body. With the spine as a central axis, the 'ida nadi' extends from the base of the spine to end in the left nostril; the 'pingala nadi' extends up to the right nostril; and the 'sushumna nadi' is the central nerve-channel of the spinal cord, culminating at the pineal and pituitary axis, merging into an up- and out-ward energy flow from the top of the head, called the 'sutratma'. There are seven major chakras [the exact number may differ depending on how you look at it – see below] ascending the sushumna, and the other two nadis [ida and pingala] intertwine in an opposite fashion between them, like opposing sine-waves or a DNA double helix [see diagram]. [Also, if you take the Kabbalistic 'Tree of Life'

and condense it vertically (uniting each opposing 'sefiroth' as one) you see a practically identical 7 chakra system, complete with nadis.] These nadis can be strengthened by practicing exercises to control nasal breathing. It is now known that breath from either nostril leads to dominant activity in the opposite cerebral hemisphere; ie. if inhaled breath is strongest through the right nostril [only one nostril being dominant at any one time], then the left hemisphere of the brain will be the most active at that time. Alternating nasal air intake, either by applying pressure to the opposite nostril while inhaling, or by more forceful inhalation, can bring about a balance or synchrony with EEG activity in both hemispheres (Brain Mind Bulletin 1983). Such a balance is noted in deep, harmonious stages of meditation (Hutchison 1994). Breath-control, in conjunction with meditative focusing of awareness towards parts of the body, can also be used for entrainment of physiological processes [see above].

Ideally, breathing should be at an even pace, inhaling [through the nostrils] and exhaling [through the nostrils or mouth] deeply and smoothly, whilst in between holding the breath for a few seconds. This is suitable for meditation or simply to become mentally calm and energised. As a trance state deepens, breathing usually becomes more shallow and rapid. Sometimes forms of extended hyperventilation are used to aid entry into trance, such as 'rebirthing' and Stanislav & Christina Grof's 'holotropic breathing', which can induce powerful psychedelic states (see Wells & Rushkoff 1995). I suspect these may have something to do with accumulation of carbogen in the blood; carbogen is a mixture of oxygen and carbon dioxide [usually 70/30%] that some people champion as a safe and legal powerful psychedelic drug. The drawback is that inhalation of psychotropic amounts is unpleasant and initially induces strong feelings of suffocation, despite sufficient oxygen being present (pers. comms.).

Chanting a 'mantra' [a brief phrase, word or 'seed sound' repeated rhythmically] can also aid greatly in achieving trance, both through harmonising brain waves, and by channelling vibrations through the skull and brain, particularly the pineal-pituitary axis, as the blood circulation of the nose and the base of the brain are intimately connected. The pineal-pituitary axis can be stimulated by deep nose breathing, or by singing or chanting that vibrates the base of the nose and the roof of the mouth (Kapp 1958). The consequence of this will be discussed later. Vibrations of the skull produced in this way can also exert a massaging effect on the brain, facilitating elution of neuro-chemicals into the cerebrospinal fluid (Jindrak & Jindrak 1988). According to these authors, our evolution to our present mental capacity was crucially linked to the thinning of our cranial bones, which makes them more sensitive to vibration.

Mantras are in some ways analogous to the 'icaros' sung by Amazonian ayahuasqueros; likewise, each has specific effects. A suggested simple mantra to start with is OM or rather AUM [meaning 'I am' according to some], "the sound of the universe" or the "primordial sound", which is very conducive to producing a low, monotonous vibration cycle, appropriately evoking the eternal oscillation of matter and aiding deep trance. A commonly-used extrapolation on this is OM MANI PADME HUM [translated by some as 'I am the jewel in the lotus' – see **Nelumbo**]. There are many other possible mantras that can be used, and nothing is stopping you from improvising or constructing your own. Chanting of harmonic overtones, such as practiced by some Tibetan monks, achieves the same effect on a more dynamic level. Mantras can be very powerful tools. The human voice has the potential to be developed as a healing agent in its own right, both for one's self, and for others (eg. see Garfield 1987). Interesting discussions of the power of mantras can be found in Berendt (1987) and Müller-Ebeling et al. (2002).

The control of heart-rate through breath-control may have consequences for consciousness, also. According to one hypothesis (Bentov 1977), aimed at explaining part of the kundalini phenomenon [see below], if the heart system is induced to produce an oscillation of about 7Hz vibrating through the skeletal system, the skull accelerates the brain up and down, producing acoustic plane-waves which reverberate throughout the brain, being focused in the brain ventricles, particularly the lateral- and third-ventricles, which lie above the pineal gland. The resulting stimulation may produce looped currents around each hemisphere of the brain, producing a pulsating magnetic field, with fields of opposite polarities. This radiates from the head, possibly interacting with environmental energy fields. See the section on magnetic fields above for more discussion. Also, it should be noted that many people competent in meditational practices at some point in the process experience an audible vibrating tone frequency [called the 'holy nad' or sound current] which seems to run through the middle of the head, apparently intersecting and focused through where the pineal gland would be situated. This is frequently noted also after ingestion of *DMT* or *5-methoxy-DMT* [and sometimes β-carboline alkaloids such as *harmaline*]. This has been suggested to originate from a phase-locking of oscillating standing-waves in the brain, occurring in a deep meditative state [occurs with high frequency spectrum of heart sounds, above 2000Hz] induced via the process summarised above. These harmonic changes may possibly stimulate the release of neurochemicals from the pineal gland (Bentov 1977; Chaney & Messick 1980; Strassman 1991; pers. obs.).

Meditation

Meditation is probably the best-known non-drug means of achieving an altered state, and is a relatively passive practice utilising breath-control, and often chanting, as aids. Meditation has long been acknowledged as an effective way to induce deep relaxation, improve mental outlook, and promote a healthy immune-system. Many people find it helps them give up bad habits, including the use of drugs they wish to quit. Meditation should be practiced at the same time each day for best results. Initial attempts may be frustrating, but persistence will pay off. Most people who attempt meditation give up before they have really given it a dedicated shot. People who have meditated for many years often may enter a quasi-meditative state as soon as they take position and close their eyes [or simply whenever they wish], quickening the transition into deeper states. In other words, it should become easier the more you keep at it.

Position of the body is the first important factor – this is known as 'asana' – and the classical posture for most people is sitting cross-legged with a straight back and neck. Some prefer to lie down flat on their backs – whatever is most comfortable, without being so comfortable as to induce sleep, should be appropriate. 'Mudras', or hand-gestures, may also be used. Many spiritually-inclined people, particularly healers, perceive prana, or vital energy ['ch'i'], as flowing in and out of the fingertips and palms, as well as through the nadis. Mudras thus help control this circulation of energy to concentrate it within the body, or to harmonise its flow. An easy to learn mudra is to rest each hand on the knee or thigh, palm facing upwards, with the thumb and forefinger [or index finger] touching at the tips. The efficiency of these methods in aiding meditation will speak for themselves with practice, as the sensitivity to subtle influences increases.

Meditation can be a means of entering trance or contemplative trance-like states, but there are some differences between these and the trances used by shamans, some healers, or [for example] followers of the Vodoun religion. Meditative trances are often [but not always] focused inwardly [if one believes in any real difference between inner and outer], and usually are intended to lead the meditator to stillness of mind, sometimes even to enlightenments. This is not to say that meditation is always a peaceful or even boring affair – in the course of regular meditation, the mind may have to pass through great turmoil and intrigue before reaching stillness. Shamanic or healing trances, on the other hand, are usually more active affairs requiring close involvement between both the spirit dimensions [encountered in trance] and the world of the patients [who require the efforts of the shaman in trance to produce some tangible and helpful result].

To aid the transition into trance, you must gradually relax the whole body to the point that you are no longer aware of it, and relax the mind by cutting out mental 'noise' distractions – this can be quite difficult to do at first, and for success you must train yourself to use the power of single-pointed concentration. Gaining control over this will aid you greatly in your explorations of altered states, and help give you the mental discipline that is needed to successfully utilise the benefits. Many suggest mentally relaxing each part of the body systematically, until total relaxation is achieved. The mind can be calmed by focussing on one image, object, or a visualised mantra. Chanting that same mantra also amplifies this effect; with time, one does not even need to vocalise the mantra – just thinking it will serve virtually the same purpose. It has been observed that for a trance-like altered state to occur, it is desirable for the muscles to be relaxed, and for the person to be in a receptive state of mind – this has been called 'passive concentration' by some. Actually 'trying' to enter this state usually prevents it from happening [the same goes for a lot of things!].

Meditation can induce a wide variety of states after mental stillness is achieved, ranging from pronounced calm and relaxation, to dissociation, euphoria and 'hallucinations'. More extreme states can also be reached, which will be discussed below. The meditative state is usually characterised by alpha-wave EEG activity, with theta activity in deeper stages of the experience – though some yogis have been shown to enter higher frequencies [c.20Hz] when in deeper states. When in deep meditation, advanced yogis were exposed by scientists to various external stimuli [strong light, loud banging, touching with a hot glass tube, touching with a vibrating tuning fork], though these were unsuccessful in disrupting the alpha-wave state.

Meditation should continue for as long as possible – at first, people usually find it hard to maintain the necessary attention for more than 5 minutes or so, though more experienced people can continue for hours. Generally, 20-30 minutes is a good time-period to aim for. When coming out of meditation, you should not move suddenly, as this can instantly dissipate most of the benefits you have just reached – analogous to filling a bucket with water, only to kick it over. It is advised to sit still in silent contemplation for at least 5 minutes or so afterwards (Anand et al. 1961; Chaney & Messick 1980; Das & Gastaut 1957; Deikman 1963; Kasamatsu & Hirai 1963; Shafil et al. 1974; Stoyva 1973; Temple 1972; White ed. 1990; Williams & West 1975; pers. obs.). It should be noted that some people react adversely to the mental detritus that is brought to the surface during meditation and yoga practices, developing psychotic symp-

toms or simply experiencing altered states and seeing them as abnormal, and may go on to seek psychiatric help rather than processing these experiences and pressing on through them (Brundage & Teung 2002; Lu & Pierre 2007). It is important that teachers of these practices are themselves well-versed in helping people work through these stages, or can refer their students to someone who is, so that potential positive transformation does not instead become a psychiatric disorder, as it most likely will if cut off in mid-stream and dragged to a conventional 'head shrinker' for rationalisation, categorisation and medication (pers. obs.).

Transcendental meditation [TM] can reduce prolactin and *serotonin* levels [due to increased *serotonin* uptake], cause increased alpha- and [later in the meditation, with skilled practitioners] theta-wave power in EEG readings, and increase blood levels of *dehydroepiandrosterone*, and prevent its decreases with ageing (Crenshaw & Goldberg 1996; Hutchison 1984). With TM and other periods of deep relaxation, blood levels of pineal indoles are raised (Lewis & Clouatre 1996).

For more interesting information on trance-states and their induction, have a look at this web-site if it still exists – http://www.trance.edu/

Sexual intercourse

Amongst the most widely enjoyed means of altering consciousness is, of course, sex and the ecstatic release of orgasm, achievable alone or with a partner or partners. Unfortunately, most people are still quite prudish about the subject or have various sexual hang-ups, which can inhibit their capacity to really get the most out of it. Others may see sex as something to be enjoyed only by married couples, and even then, only for the purpose of procreation, which has the side effect of contributing overly to the population crisis, because let's face it, even Catholics find it hard to resist their biological urges. The fact is, good sex between loving partners is one of the best ways to [at least temporarily] relieve stress, create feelings of profound wellbeing and goodwill, and even kiss the face of God. It is sad that a large portion of adult humanity has never had truly great sex. Part of the secret to doing so is to understand sexual intercourse not as mere screwing, but as a divine or spiritual act; this also requires shedding notions of sex as 'dirty' or 'shameful', and seeing it and our flawed bodies as beautiful things with which we can express the rapture of the cosmos and become one with it once again.

Given this perspective, it shouldn't be too surprising that sexual union is used ritually in some of the most powerful forms of yoga and magic. Sex can be seen both as a form of meditation [see above] and as a yogic means of awakening our kundalini energy [see below]. The purposeful awakening of kundalini is an extension of some meditational practices designed to allow one to attain 'samadhi', enlightenment, realisation, completion or self-actualisation. It is the ultimate goal of all yoga practices, 'yoga' meaning union. This rediscovery of union is most obvious in the practice of tantric sex yoga [sometimes referred to as 'sex magick', often involving little movement and sometimes avoiding male ejaculation altogether], in which the participants experience their partner as the literal embodiment of God/Goddess, and culminating in an ecstatic total union of energies – that is, becoming one being rather than remaining as two. This, however, is but one way of describing the process and interested readers should consult books or competent practitioners for more information on the practice of tantric sex yoga. Tantra [which is more than tantric sex yoga alone] and its relationship with shamanism is explored in Müller-Ebeling et al. (2002), an excellent work that is highly recommended – and also includes mention of some Nepalese shamans who are able to apparently raise kundalini at will almost instantaneously in themselves or others [with the aid of mantras and other ritual components] in order to enter a healing trance or to travel shamanically.

On a more mundane level, we can identify some of the neurochemicals which accompany 'regular' sex. *Oxytocin* plays a large role, from the initial pleasurable touch through to its peak at orgasm and the 'afterglow'. This hormone interacts with a host of other chemicals released during the act, including *dopamine*, *epinephrine*, LHRH, prostaglandin, estrogen [in women], testosterone and *vasopressin*. In male rats, *GABA* levels are increased after orgasm, reducing *vasopressin* levels; this, along with the action of *oxytocin*, may explain why some men are so liable to want to roll over and go to sleep immediately after sex (Crenshaw & Goldberg 1996)! When going much deeper through tantric sex, it is likely that neurochemicals more associated with kundalini, such as *DMT*, also come to the fore.

Kundalini

It is very difficult [and inappropriate] to generalise or reach conclusions about the nature of kundalini and its many manifestations, which I ask the reader to take into account. Try to ingest as many different viewpoints as possible to gain a better idea of what kundalini may mean to you. In one concept, the kundalini may perhaps be seen as a manifestation of the fundamental energy that gives rise to life and consciousness, which is everywhere. It also carries the information 'matrix' that is briefly discussed in the next chapter. It is when this potential energy is aroused from dormancy in the human organism, concentrated and making its presence felt by a variety of manifestations as it flows through the body [all involving a profound alteration or expansion in consciousness], that we know it as kundalini. No doubt others have different interpretations, and I do not regard my own as solid, but a transitory definition for the sake of discussion. Kundalini may inspire healing and creative potentials, as well as great depths of insight, though to those who do not understand what is happening to them, and in whom the kundalini has manifested unintentionally, it can bring about torment, 'delusion' and 'insanity'. There is a fine line – "the awakening encompasses both the state of being in harmony with Tao and the knife-edged path with its violent purifications and sudden, catastrophic perils...unless one understands the symbolic language of the psyche very well, one may be drawn into a labyrinth from which it is very hard to get out. And where is the [psycho]analyst who has reliable knowledge of the workings of kundalini?" (Tontyn Hopman, in White ed. 1990).

Usually considered important to the kundalini process is an understanding of the 'chakras', or 'energy discs', that escalate the central nadi [see above]. There is variation between traditions as to the number of major chakras, though 7 is often seen as a standard model, and the existence of many minor chakras is also acknowledged. These major chakras [not material in the usual sense] seem to correspond with the endocrine glands [as well as major nerve centres] in their positioning. Their positioning, as well as brief descriptions of their representations and properties in tradition, are as follows:

Root chakra ['muladhara'] – mantra: LAM; represented by 4 red lotus petals; corresponds with the base of the spine; represents the physical form, basic survival instincts; this is usually where the kundalini energy is said to lie coiled at rest

Naval chakra ['svadhisthana'] – mantra: VAM; represented by 6 vermilion lotus petals; corresponds with the gonads; represents the 'etheric' form, territoriality

Solar plexus chakra ['manipura'] – mantra: RAM; represented by 10 grey lotus petals; corresponds with the pancreas and adrenals; represents the 'astral' or emotional form, formation of language and ideas

Heart chakra ['anahata'] – mantra: YAM; represented by 12 vermilion lotus petals; corresponds with the heart and thymus; represents compassion, personality

Throat chakra ['visuddha'] – mantra: HAM; represented by 16 smoky purple lotus petals; corresponds with the thyroid; represents the 'causal', neurosomatic form

Brow or Third-eye chakra ['ajna'] – mantra: OM; represented by 2 white lotus petals; corresponds with the pineal and pituitary [which work in union to awaken the brow and crown chakras; they, of course, also act to regulate all the other endocrine glands]; represents the Buddhic form – the state of awareness and enlightenment

Crown chakra ['shoonya', or 'sahasrara'] – mantra: silence, or a thunderous roar; does not correspond with any endocrines, or is seen as merged in union with the 6th chakra – it is the culmination of the awakened kundalini, and usually perceived as extending outwards and upwards through the top of the head, some of the energy circulating down again around the front of the head, looping down into the heart chakra – directing the energy back to the heart chakra is sometimes said to be the most important step, to complete the process.

In most people, most of the time, kundalini rests more or less dormant in the root chakra. The kundalini energy is often depicted as a serpent, and here it lies coiled at rest. When roused, this energy [often referred to as a kind of 'holy fire'] usually flows upwards, following the nadis described previously, meeting chakras along the way. Sometimes, the energy is reported to enter the body from above, and such experiences are usually prolonged and painful, both physically and psychologically. This seems to occur more frequently when the kundalini is roused unintentionally, or forcefully without adequate preparation, or when its manifestation is resisted [see below].

Each chakra represents, to the individual, specific aspects of physical, psychological and spiritual existence that must be brought into harmony, or 'opened', so that kundalini may pass through. In many people, most [if not all] of the chakras are in a state of major disorder or 'blockage'. This usually goes unrecognised until such a person starts exploring states of consciousness and spirituality. Awakening kundalini without first clearing the blocks of each chakra can result in a very uncomfortable, even painful and psychologically-distressing experience, as this potent energy requires a clear path to flow freely and become fully actualised. Yoga consists of exercises geared towards making the awakening of kundalini more natural and painless, linked with meditational practices and personal psychological work that aim to systematically evolve the practitioner through each chakra. However, this does not always occur in chronological order, from root to crown, but differs in each person with individual circumstances.

Due to the overall delicacy and depth of the kundalini process, and to the fact that patience is an important lesson of this process, it is generally considered best to work on the kundalini gradually over a long period of time, letting it rise when it is ready, and when you are ready for it. This is the way of Raja yoga. Forcing the kundalini to rise more rapidly via physical and meditational exercises, with the important element of breath-control, is the way of Hatha yoga, which carries more physical and mental

dangers for the unprepared. In meditation, the third-eye chakra is often focused on, and short, rapid violent breathing is practiced along with specialised asanas, mudras, kriyas, mantras and other techniques. Although I initially intended to, the details of some of these methods will not be covered here, as I feel I could not reproduce them fully and safely in the space given. I also don't believe it is beneficial to tempt people into forcing the kundalini process. The path in itself is vital in preparing for the awakening of kundalini, and just as important as a learning process. Striving for kundalini arousal as a goal, as with striving for visions and becoming attached to them, can ultimately be counter-productive, even destructive. Seeking 'experiences' themselves rather than seeking to learn through experience is a very common pitfall, both with psychedelics and with kundalini yoga. The experience of enlightenment is not enlightenment itself, except as a glimpse of what can be. The premature and forced arousal of kundalini may also result in pride in the mistaken assumption of enlightenment, without having learned the discipline required to maintain it and apply it, and thus anything that was gained is quickly thrown away. This is also true for the use of psychedelics without an accompanying framework of spiritual practice.

However the information, though hard to find, is out there, and if you think you wish to attempt Hatha yoga, you should pursue it with caution and respect [see some of the references below for further reading]. These are life-changing events being evoked, not games for the curious. Some 'New Age' folk seem to believe kundalini is manifested as a kind of pleasant tingling sensation in the spine. This is wishful thinking. Kundalini actualises a vital energy so intense that it can [according to many] literally knock you dead or at least drive you mad if you are not ready for it and channel it too intensely, though such extreme results are very rare. I wish to stress again, that to work with the energy of kundalini [or equally with any techniques of altering consciousness], it is highly recommended that you be in good to excellent physical and mental health. Inability to deal with the results through impatience, lack of proper groundwork, and poor health can result in physical injury and/or insanity.

When this energy is fully realised and harnessed, which may take many years of learning and practice, the practitioner has theoretically taken the kundalini process as far as it can go without crossing the veil to physical death [due to the intensity of energies channelled]. The common idea is that, at this point, there is nothing further to learn, being able to reside in eternal bliss and all-seeing wisdom. This is a somewhat romanticised view, depending on how the resultant healing force is used. This path does not end in a glorious plateau, where one can sit back and say, "okay, so here I am, now I'm enlightened forever!". There is always further to go – in this path, to stop means stagnation, and eventually, regression. Indeed, this is the fate of most people who pursue spiritual paths, because the above notion of what 'enlightenment' is all about is so prevalent. The 'fall from grace' that usually follows often occurs so gradually that it is not even noticed. 'Enlightenment' is relative, and is not a fixed point – one should not become complacent with perceived 'enlightenment' and undo progress with the pride of the ego, or unfitting words and actions. There are already enough religious zealots who do not practice what they preach, without adding more to the world. As stated earlier, having a 'kundalini experience' does not automatically make one enlightened. A glimpse of the absolute does not automatically make one enlightened. You must live your learning in every moment, spread the seeds of light for others, and commit your life to this purpose, in whatever way is appropriate. Only then will it stay with you, and you will still never stop learning. If you are running around telling everyone that you are enlightened, then that's a good sign that you probably are not!

It is now believed in some quarters that a fair number of people in our society appear to be experiencing spontaneous kundalini-awakenings, either gradually over time or rapidly and intensely all at once. The symptoms, not being recognised in most societies, are often misinterpreted by subject and physician alike as manifestations of schizophrenia and biological disorders, deemed as unnatural and in need of suppression.

Both adverse and positive symptoms of sudden or impending kundalini-awakening can include many of the following phenomena:

- cramps, muscle twitches
- itching, vibrating, tingling, or crawling sensations on the skin
- intense sensations of heat [sometimes felt as burning] or cold
- headaches and pressures in the head, often like a steel band around the head
- racing heartbeat, chest pains
- digestive disturbances
- pains or blockages in back and neck, particularly where chakras are located
- numbness
- involuntary body movements or compelling forces
- energy rushes, particularly up the spine, or feelings of immense electrical energy flowing in the body
- overwhelming fatigue, or conversely, hyperactivity
- alterations in eating habits, and sexual drive [increase or decrease]
- spontaneous vocalisations, or speaking in tongues
- emotional outbursts and rapid mood shifts
- hearing of inner or distant sounds, or buzzing in the head
- visual distortions and hallucinations
- expansion of consciousness and blissful sense of union and harmony
- development or manifestation of psychic phenomena and extra-sensory perception

Of course, many of these symptoms, in isolation, may have little or nothing to do with kundalini and more to do with simple physical illness or poisoning, depending on individual circumstances. It is when many of these symptoms are seen together, that kundalini might be considered as a cause. Some of these symptoms are likely to be physical manifestations of chakra-blockages. As well as by the methods or circumstances mentioned above, kundalini may be roused by the use of psychedelics over time in some individuals. Such experiences can also serve to prepare the mind for kundalini, so that the progression of expanded consciousness is not as much of a shock as it would otherwise be (Chaney & Messick 1980; Collie undated; Hannigan 1997; Johari 1987; Rele 1960; Sannella 1977; Temple 1972; White ed. 1990 [highly recommended]; Yatri 1988; pers. obs.).

It is relevant here to mention that *DMT* potently stimulates pineal function, and *mescaline* enhances the pineal's synthesis of *serotonin* (Lyttle 1993; Prince 1980). The pineal [see brow or third-eye chakra, crown chakra], in conjunction with the pituitary and [to a lesser, but important extent] the other endocrines, seem to be intricately involved in secretion of neurochemicals involved in some aspects of kundalini manifestation [see below].

The pineal gland, closely associated with the control of our perceptions of awareness, is often considered to be the 'seat of the soul' in many distinct cultural traditions. It is interesting to note that in Tibetan tradition, after death the soul is believed to transit a 'limbo' period of 49 days, during which it 'decides' on its next incarnation. It is now known that it takes 49 days for the pineal and gonad cells in a human embryo to separate as distinct entities. This could be interpreted as the 'soul' or consciousness entering the new physical being, at the moment of differentiation between the 'poles' of the kundalini-axis.

The pineal is quite capable of synthesising potent chemical substances and releasing them into cerebrospinal fluid, and it is most likely to do so under the influence of the diverse practices outlined in this chapter. The pineal has no blood-brain barrier, and possesses specialised blood vessels which allow the transport and accumulation of large molecules in the pineal. The primary chemical activation in the pineal, in relation to kundalini, most likely involves the *tryptamine*s *5-methoxy-DMT* and *DMT*, with some probable contribution from *bufotenine* and *5-methoxytryptamine*, all in combination with endogenous MAO-inhibiting β-carbolines such as *pinoline* and [possibly] *6-methoxyharmalan*. These chemicals are all known to be synthesised and concentrated in the pineal gland [also contained in blood, urine and cerebro-spinal fluid] of mammals, including humans, although the endogenous presence of *6-methoxyharmalan* still requires further evidence. *DMT*, in particular, is known to be actively transported into the brain, something which occurs for only relatively few chemicals with which the brain is most familiar and in need of. *Tryptamine*s are also synthesised in the retina, and the connection of the optic nerves and the pineal gland bears some food for thought. *Serotonin*, and the enzymes HIOMT and INMT, are all most concentrated in the pineal. The pineal also contains abundant *methionine*, aiding in the conversion of pineal *serotonin* to *DMT*-derivatives using the methyl-donor SAM. The kundalini 'flash' has been compared to smoking *DMT* or *5-methoxy-DMT* by some. The pineal also has neurotransmitter systems for *melatonin*, *norepinephrine*, *dopamine*, *GABA*, *glutamic acid* and *taurine*, and has been found to contain the hormones LHRH, TRH, CRF, somatostatin, *oxytocin*, *vasopressin*, *adrenocorticotropin*, α-melanocyte-stimulating hormone, β-*endorphin*, *met-enkephalin*, *leu-enkephalin*, dynorphins A and B, α- and β-neo-*endorphin*, VIP, cholecystokinin, bombesin, arginine-vasotocin [AVT], substance P and neurotensin. It is quite clear that the pineal is potentially capable of releasing an exceedingly potent cocktail of psychoactive chemicals, and is known to affect the secretions of the other endocrine glands, which could in theory account for the symptoms of kundalini as outlined above (Axelrod 1961; Barker et al. 1981; Binkley et al. 1979; Bosin & Beck 1979; Christian et al. 1977; Ciprian-Ollivier & Cetkovich-Bakmas 1997; Collie 1997; Gillin et al. 1976; Hannigan 1997; Kveder & McIsaac 1961; Lewy 1983; Liss 1989; Lyttle 1993; Pevet 1983, 1985; Pomilio et al. 1999; Relkin 1983; Sannella 1977; Shulgin & Shulgin 1997; Strassman 1991, 2001; Temple 1972; Yuwiler 1983; pers. comms.; pers. obs.).

Some final thoughts

It seems that in many areas science is simply rediscovering and confirming in its own language what mystics and shamans have known for millenia. We think we have come so far in moving away from this ancient knowledge which we have called 'superstition', yet we now appear to find ourselves turning full-circle, returning to whence we came with new layers of understanding in order to begin a new cycle.

The observation of neurochemical correlations to the forms of consciousness-alteration discussed in this book does not diminish the significance of these states. Recognising that stimulation of certain areas of the

brain can induce 'religious experiences', or that activating sub-groups of *serotonin* receptors by smoking *DMT* results in profound changes in consciousness, is only a small part of the picture and does not equate to explaining such phenomena, especially regarding the content and significance of subjective experience. To see such mechanistic reduction as a complete explanation of what is going on simply glosses over the vast gaps in our understanding.

Many people consider the use of psychoactive drugs, and the experiencing of altered states of consciousness, as being unnatural and decidedly harmful. However, it should now be clear that these states are not alien to our nervous systems – rather, they are expressions of neural pathways built into all of us, which only require the necessary conditions or stimuli to be triggered. If you think of your nervous system as a radio antenna, this is analogous to temporarily tuning to a different frequency, or fine-tuning your 'normal' frequency to give a clearer signal. [Certainly, some substances such as lead may affect consciousness as a result of the brain damage they cause, but these are not the kind of drugs we are discussing here.] Following this line of thought, these other frequencies encountered through retuning are not illusory fantasies, but valid extensions of reality, of which we are usually unaware. As mentioned previously, it is impossible to conclusively prove that any reality, including especially what we take to be our 'normal' waking reality, is not fantasy, or conversely, that it is fantasy. I take the opinion that all of these altered states and what we experience in them are valid as their own perspective of a fluid reality. Whether they are made 'real' to us by the very act of perceiving and experiencing them, or whether they exist independent of our attention, is unknown. In the science of physics, too, the question of whether anything exists independent of observers has perplexed many. One current view leans towards acknowledging that 'reality' appears to be a creation of consciousness itself, with the two being unable to exist independently. Whichever model may turn out to be most seemingly accurate is perhaps irrelevant to the truth of the belief held by many people today, that expansion of consciousness is both necessary and integral to our continued survival and socio-spiritual evolution, for us to re-create ourselves and our reality in an image of vibrant harmony.

It is now more widely known that people are capable of learning to exert a degree of control over bodily functions once thought to operate unconsciously [eg. blood pressure, heart rate, immune activation, healing processes, hormone secretion, neuron firing]. The learning of these skills can be enhanced by biofeedback techniques (Hutchison 1994; Rogers et al. 1979), meditation and yoga (White ed. 1990). In other words, our health and state of mind are not mutually exclusive, and are not solely under the control of external or unconscious internal forces over which we have no influence. The fact that we only appear to utilise the information from a small portion of our DNA, and that we only exercise a fraction of our cerebral potential, might suggest that we are built with capabilities that are just waiting to be activated or awakened. Scientists often refer to this mystifying extra genetic material, for example, as 'junk' DNA, and for many years it was dismissed as just that, with the exception of the more curious. Recent theories suggest it is merely 'padding' or 'stuffing', whilst others are finding that these portions have functions we do not yet understand; regardless, nature does not make true 'junk'. Everything serves some purpose in a greater process [that is the basis of understanding ecology] of which we are largely unaware. Whether it be found in DNA or elsewhere, or more likely everywhere, the potential exists to become aware of our place in this process, to re-unite with the whole, and in that process achieve positive transformation.

A PRIMER IN TRIPPING – TAKING THE JOURNEY

Ever since the large-scale rediscovery of psychedelics by western cultures in the mid-1960's, many curious people have been inspired to experiment with them. These pioneers and those few in the decades before them faced what was, for their cultural background, completely uncharted territory. Although some such folk had access to spiritual, philosophical, or other literature from which parallels could be drawn for guidance, or to someone already familiar with the terrain who could offer support and assistance, many did not. Most people would begin the psychedelic path with little or no understanding of what they were getting into, or of the attendant implications, which then were little-known and often exaggerated. The majority of people who approach drugs appear to do so because they desire change without having to put in any real effort themselves. People who expected psychedelics to magically transform them and the world encountered disappointment when they found that the drugs would not do all the work on their own. After experiencing the psychedelic state to some degree, and the initial awe had subsided, most people [but of course not all] realised that they did not have the faintest idea what to do with it. Rather than admit their own deficiencies, many came to denounce the drugs in later years as useless and deceptive distractions.

Little has changed today, except that the average strength of LSD 'hits' [LSD or purported LSD being the only psychedelic that most people ever try, not including **Cannabis**] is much lower than in the mid-1960's. As a partial consequence of this, current generations have a greater number of people who have only ever had relatively mild psychedelic experiences. They often remain unaware of the greater depths, but believe they know all about 'tripping'. This helps the spread of misconceptions, as a strong psychedelic experience that brings up deep psychological and emotional issues, for example, is now often seen as being abnormal, whereas an aesthetically-enjoyable experience with minimal psychological impact is seen as the ideal. It is commonplace to desire all the positive effects without the negative, but when exploring inner space, things simply don't work that way. The paths of personal growth and spiritual development [which are being tinkered with when using psychedelics, whether it is realised or not] are not all rosy. One must pass through both heavens and hells to pursue true transformation. Even if that is not what you are after, you may be pushed in that direction anyway by a particularly powerful experience. Unlike the general mood of psychedelic experimentation in the 1960's, today it is often seen as unusual and delusional for people to take psychedelics for spiritual purposes, or for that matter, even to believe in anything that happens during a psychedelic trip as being real in any way.

Many who dabble with these drugs do so looking for a good time, today largely in association with dance culture, or to enjoy a spectacular visual show as a detached observer. These people usually abandon psychedelics after a short period of experimentation, sometimes confused and disillusioned, as mentioned above. Indeed, LSD [except in very low doses] seems to have lost much of its popularity in dance culture to MDMA, or 'ecstasy', which is not even generally considered to be a true psychedelic, and rarely brings one into contact with the darker sides of the mind [not to deny that MDMA has usefulness]. Others try to use psychedelics earnestly, but still end up being disappointed by the difficulty in integrating these experiences for long-term benefit.

The aim of this chapter, therefore, is to discuss some of the things that may be expected from a psychedelic experience, and some of the known ways in which psychedelics can be used more effectively. It is important to remember, however, that every psychedelic experience is different and exceedingly complex in content. At best, this information should be seen only as a collection of fragmentary observations and convenient analogies, rather than a comprehensive guide to the psychedelic experience. And as the old saying goes, "the map is not the territory" and ours is only a fragmentary map. It is almost universally reported by psychonauts that our current verbal means of expression is inadequate to describe accurately what is being experienced in these states. Even if new words are created for these purposes, they will still be self-limiting tools, as it is a seemingly intrinsic characteristic of words that they attempt to separate and define. This is a tendency largely alien to the psychedelic realm [which tends to expose the continuous whole], and usually does not help much in understanding what is going on. This is at least similar, at most identical, to notions of Zen and Taoisim, in that the Tao or Zen which can be described in words is not the true Tao or Zen. Words are at best pointers, but the essence is beyond words. Having said that, words will have to suffice for us, for now, or else we might as well just throw this book out of the nearest window!

Setting the Stage

Psychedelics offer such profound potential for learning, positive change, and ultimately an evolution of consciousness, that it seems [to those who have explored deeply] to be a virtual insult to use them casually for entertainment. Deeper aspects of reality can be highly disturbing to those who are not prepared for such a psychic confrontation. [Most people are not prepared, even amongst those who think they are, so it's nothing to be ashamed of!] The *tryptamine* psychedelics in particular, as well as *salvinorin A*, show the ability [in moderate to large doses] to reprimand those who attempt to use them casually, in no uncertain terms. This is not to mention the great power of the tropane hallucinogens such as *hyoscyamine*, with plants containing them [such as **Datura**] sometimes being used in tribal cultures to reprimand unruly children! At lower doses, one may be able to evade such psychic confrontation for some time, but the unpredictable potency of, let's say, **Psilocybe** mushrooms, make it a relative certainty that one will eventually have a torturous experience if one continues to use these substances for idle entertainment or attempted escapism.

A proper respectful approach is thus essential if one is to have good results. One should approach the psychedelic experience as one would approach the most sacred oracle. A purpose is required for consuming these sacraments, a context into which to frame the experience. Failing to provide a clear purpose often results in a vague, unfocused experience of little apparent meaning, compared to what can be achieved otherwise. On the other hand, doing so does not at all guarantee an 'easy' or pleasant trip, but it does help ensure that you get something meaningful from the experience. Indeed, these more difficult experiences are often the most useful.

Peoples of the world who use these plants regularly generally do so in a ritualistic setting – that is, their purpose and expectations of the experience and their way of approaching it are intricately interlaced with their spiritual beliefs and cosmological worldview, in a way that creates, for the group or the individual, a safety net to help ensure a successful visionary journey. Unfortunately, most westerners have been conditioned to feel pretty silly doing anything approaching 'ritual', a word that has a decidedly negative occult connotation for the average person. This might not be a problem if less people believed what they saw in movies or on television, and more people realised that 'occult' simply means that which is hidden, or beyond ordinary human understanding, rather than just puerile satanism and black magic. Of course, this is still a problem to those who refuse to believe in the existence of anything that might be 'beyond ordinary human understanding'. As I see it (and this may anger some), the kinds of 'mystical groups' who do for example actually dress up in fancy robes, adopt titles of elitist spiritual authority, perform elaborate and stereotyped 'magical rituals', and take themselves very seriously, are just as lost as almost everyone else, and use the external cloakings of secrecy and man-made occult dogma to mask their lack of genuine insight from others, as well as from themselves. [It should be noted that not all practitioners of ritual magic have missed the point, and such practices can be of value if undertaken wisely.] The awakening of consciousness that can be brought about with the aid of psychedelics or other means is a process of removing the veil of secrecy, of bringing the ineffable into human awareness, rather than keeping it as the claimed secret property of an elite few. So, we have no need here for secrets, spiritual pomposity, and unnecessary physical props. What is meant here by ritual is that one makes a conscious, formal entry into the 'otherworld' with displays of respect and declarations of intent, whether these be expressed internally or externally. This mode should be adhered to throughout the journey, but that does not mean you must remain deadly serious as though attending a funeral. Happiness and laughter may be quite appropriate! You should not feel that you need to follow a ritual that someone else has set out, as this may not be appropriate to you, your culture, or your beliefs. Find something that feels right for you. This is firstly about developing control over and honestly understanding yourself, something that is difficult to accomplish when following the rules of others without thought.

I prefer to create ritual more or less spontaneously, leading up to consumption of the chosen sacrament. However, there are some constants I have chosen which are used as a basic framework. Firstly, the time of the ritual is usually planned at least a few days to a week in advance, to give time to mentally and physically prepare for the experience. I prefer to fast at least for the day, or most of the day before the experience, as do many traditional shamans, though the fasting period may be extended for longer if so desired. This ensures a degree of physical cleansing, as well as more rapid assimilation of the substance consumed. According to some, it also reduces the severity of any potential nausea or vomiting, though some find it easier to hold the contents of their stomach if a small amount of light food is eaten beforehand. Nevertheless, vomiting once the substance has been sufficiently absorbed can be therapeutic in some instances, if treated as an opportunity for a kind of purifying, 're-birthing' catharsis. Vomiting after consumption of 'ayahuasca' [see **Banisteriopsis**], 'peyote' [see **Lophophora**] or 'San Pedro' [see **Trichocereus**], in particular, is often considered quite a normal part of the experience, though some are lucky enough to experience little nausea and no vomiting. In the case of San Pedro, K. Trout suggests that this is almost entirely related to the

method of preparation, with the exception that regular beer drinkers will generally vomit regardless (Trout pers. comm.). Some report that with ayahuasca, excessive fasting can actually diminish the effects, and they prefer instead to abstain from food for the second half of the day before the consumption.

Bouts of meditation throughout the day, but particularly immediately preceding and following the ingestion, are also recommended. This gives time to focus on your intentions for the experience, as well as to induce a state of calm [to counter the jitteriness and tension that often come with the anticipation and fear of an impending psychedelic experience] and reduce mental 'noise' and distractions, including the distraction of nausea. I find it also places me into a more receptive state to learn from the experience. I usually make use of incenses with 'purifying' and calming effects, both to 'cleanse' with smoke the plant or beverage to be consumed, as well as to purify the area and centre myself with the vapours. Some examples are 'frankincense' [see **Boswellia**], 'sandalwood' [see **Santalum**] and 'white sage' [see **Artemisia**, **Salvia**]. The sacrament is handled carefully and respectfully at all times, and any parts not used, or residue left from a tea, are never simply discarded as waste. The discipline involved in following ritual procedures, including the discipline involved in consuming and keeping down foul-tasting sacraments [at least until sufficient absorption has taken place], ensures to a degree that one is serious about learning from the plants, and prepared to earn wisdom rather than be handed it on a platter.

Getting to Know the Plants – the Amazonian approach

It is worth mentioning here an interesting practice in parts of the Amazon. Shamanic initiates, or others seeking knowledge or in need of deep healing, often will undergo diets in which a 'plant teacher' is consumed. This is done in order to become imbued with the spirit of the plant, to learn its properties and 'icaros' [sacred songs; see the previous chapter], and gain healing knowledge. Once one has undergone this process, singing the icaro of the plant can be used to call upon its healing powers, without the plant itself actually being used. Diets are completed in seclusion in the forest, and the initiate abstains from sexual relations, focusing their energy and intent on the task at hand. In regards to food, the diet is similar or identical to that undergone for consuming ayahuasca [see **Banisteriopsis**, *Methods of Ingestion*]. Foods which are allowed are cooked plantains [see **Musa**], smoked fish [though 'pana' (Serrasalmus natterei, S. rhombeus and S. spilopleura) and 'zungaro' (Trichomycterus spp.) are not allowed], and sometimes rice and manioc. The flesh of only some animals may be eaten – boa constrictors [Boidae family], the caiman 'lagarto blanco' [Caiman sclerops], and the birds 'panguana' [Crypturellus untulatus], 'pungacunga' [Penelope jacquacu], 'perdiz' and 'pava' [unidentified]. All spices, sweeteners, fats, cold beverages and alcohol are prohibited. Diets are often taken in succession, with a different plant being taken for each diet. Many shamans feel diets should be taken in a particular order, but this order varies depending on individual preferences. Usually a short break may be taken between diets, as each may last for up to 1 month [sometimes more]. When one is under the diet, the chosen plant is prepared and consumed. Sometimes the initiate will have been told by his or her shaman how to prepare it – sometimes the initiate will be told by the plants themselves, either during the previous diet, or otherwise through dreams or intuition. It may be taken either only once, at the beginning of the diet, or consumed more or less continuously throughout. Sometimes it may be taken mixed with **Banisteriopsis**. During this time, it is best to be near living specimens of the plant being used, in order to further mingle with its essence. Some of the plants used in diets have direct psychoactive effects, whilst others are psychoactive only with ayahuasca, or have subtle effects that manifest over the next few days, or in dreams. Others are not considered psychoactive, but have mildly toxic effects, which later develop into long-term benefits of improved stamina and spiritual strength (Bear & Vasquez 2000; Luna 1984). This is an efficient method of becoming acquainted with a healing plant. Though the required seclusion and time-devotion may be difficult for many people today, it will be valuable for those who can make the necessary efforts.

Setting the Stage Revisited

The importance of set and setting in the psychedelic experience can not be understated. What is meant by this, is that to give the best chances for a successful trip, it should be done in surroundings you feel comfortable with, with people who you like and trust, and in a good frame of mind. If feeling at all depressed or unstable, taking a psychedelic is generally not a good idea. Sometimes, even if feeling this way, a psychedelic experience may be just what is needed, though it is much more likely to be a difficult one. Unless you are experienced at this, it is not a good idea to trip completely alone. Some people do not like to have company whilst tripping, but it is still a good idea to have a friend within shouting-distance, just in case assistance is needed. You can never know what might happen, even if you are very experienced with psychedelics. If you must do it alone, it is at least a good idea to let someone else nearby know what you are doing, and where you will be.

The sensory input received whilst tripping is greatly amplified and subject to synaesthesia, and can greatly affect the nature and outcome of the experience. If you have control over any of these inputs, use that control wisely with this in mind. Some music that may be enjoyable under normal circumstances may become unbearable or excessively disturbing with psychedelics. It can take a lot of trial and error before gaining a feel for what works best for you in different situations or with different purposes in mind. Excessive sensory input [and output] may sometimes have the effect of 'burning up' a lot of the energy of the trip, resulting in a perceived fading of effects much more rapidly than would usually occur. I have found this to happen particularly when listening to a lot of very intense music, or after making love intensely. Another benefit of moderation, or even minimalism, with regards to sensory input is that it facilitates an easier perception of the subtle, more significant aspects of the psychedelic experience.

A natural environment is highly recommended as a setting. Contact with nature whilst tripping seems to offer far greater potential for a highly positive experience than an indoor or urban setting. Even so, the area should be chosen with an eye for potential dangers, such as slippery rocks and cliffs! Trip with people who you know will not annoy you during the experience, with inane questions or attempts to 'trip you out'. Such people, however well-intentioned, can very much disturb the mood of a trip and make it difficult to focus. Tripping in public or at crowded events may be tolerable for some, but it is generally not conducive to a good experience. I have a few friends who have had severe panic attacks as a result of doing so, one of whom was taken away in an ambulance after collapsing from distress in the midst of a crowd at a rock festival. If you are not inclined to want to interact with people whilst tripping, steps should be taken in advance to ensure some degree of privacy, free from disturbing background noises or unexpected interruptions, while still having a trusted friend somewhere nearby. Taking the phone off the hook is generally a good idea.

The time of tripping may also be considered. Some prefer to do it in the daytime, when colours and visual detail can be best appreciated with eyes open, but many traditional peoples prefer to do it at night, when the surroundings do not cause as much of a distraction from the inner experience. This can also serve to provide a dark 'canvas' on which the visions manifest, or as an excuse to build a fire, which can be meditated on for a similar purpose, and bring the group (if there is one) together in a circle of contemplation. However, with short-acting tryptamines such as *DMT*, *5-methoxy-DMT*, and *bufotenine*, visual phenomena are best perceived in low-light conditions, as opposed to total darkness. In the modern world it is a simple matter to trip at night while still having indoor light available, depending on what is desired at the time. Some people prefer their trips to coincide with phases of the moon.

If at all possible, the inexperienced should undertake the journey accompanied by someone who has successfully used psychedelics for a long time, and who shows a competent handling of psychedelic states. Preferably, such a guide should be present if needed, but should not make his or herself the central focus of the trip. Avoid those who attempt to use psychedelics to exert control or influence over others. These people may be known as 'power-trippers', and do no good for anyone in the long run, including themselves [in the usual sense of the term, a power-tripper is someone who gets off on having power over others and abusing that power, and does not refer to 'tripping' such as on psychedelics]. Look for someone who treats you as an equal, and does not patronise or exhibit self-inflation. These are the kinds of people most likely to be able to help you with the first steps of your path, if you feel you need such a person. Of course, no guide can teach you everything [though some will pretend they can], nor should you expect them to. Ultimately, it is the plants that will show you the way if you choose to walk with them.

It is still possible to more or less ignore set and setting, and have successful trips. Some people feel that this is the best way, as there is no conscious erection of any comfort barriers between the mind and the surrounding world. Although this approach is more risky, it does bring the valuable challenge of coping with the 'real world' and all of its unexpected distractions and dangers, whilst in a strong altered state. After all, what good is it to become awakened on one level while being unable to cope with the mundane, or deal with things you would rather avoid? Ken Kesey and his group of Merry Pranksters are a wonderful example of psychedelic experimenters who took such an approach, with certain rules [such as being out-front with the group, and everyone providing each other with freedom to 'do their thing'], more or less successfully (see Wolfe 1968). A synthesis of these two major approaches may be the best, though individuals should work with whatever they feel most appropriate on each occasion of consuming a psychedelic substance. Remember, however, that the paths we are discussing do not end when the effects of a drug wear off, to resume when the next dose takes effect – we are discussing both a spiritual/magical path and a way of life, in which individual psychedelic experiences are dramatic and catalystic events, but are not the whole path in themselves.

The Turbulence of Lift-Off

After respectfully consuming your chosen psychedelic sacrament, you will need to cope with the first phase, which is sometimes easy, sometimes not. The period until first onset of effects will vary depending on the substance involved, the dose taken, the method of ingestion, and the contents of your stomach. The transition from 'ground-state' can often be turbulent, as you adjust to the changes taking place. What follows is difficult to relate verbally. There will be some generalisation, because many of these substances produce qualitatively different effects, yet with some strong binding similarities. Added to this is the fact that the psychedelic experience is very hard to put into words [see above] that will mean anything to someone who has not been there before by some means, and that it is different every time for every person – thus, the only way to really find out is through direct experience. I will use *tryptamine*-based psychedelics [*psilocybin*, *DMT* in combination with harmala alkaloids, LSD], and the prototypical *phenethylamine*-based psychedelic, *mescaline*, as standard 'reference-psychedelics' for the purpose of this discussion.

Transition is marked initially by physical and mental restlessness, sometimes with odd gastric sensations, and vague body aches that may often be partly relieved by stretching and deep, slow breathing. Some people experience mild nausea, though actual vomiting is rare except with intense-tasting brews such as ayahuasca or those prepared from *mescaline*-containing cacti, for which both nausea and vomiting are relatively common accompaniments [see above]. Pupils become dilated and all of the senses slowly become heightened beyond the usual thresholds of perception, a phenomenon that will increase in intensity up to the peak of the experience. These effects can be rather uncomfortable and disorientating at first, particularly if they are resisted. It is generally best to sit or lie in a comfortable spot breathing deeply, whilst contemplatively adjusting to the changes taking place. It should be said, however, that as the effects increase in strength, the deepest and most intense states can be reached by continuing to remain still and meditating, though it can be difficult to do so at first.

Feeling Out the Territory

Often a profound euphoria is felt, and a sense of awe and wonderment. Visual effects begin from the amplification of colours, shapes and textures, and may progress to actual hallucinations, although the perceiver involved is usually aware at this point that what they are seeing is related to the neurochemical changes taking place, and is not necessarily visible to anyone else. With the eyes closed, visual phenomena seen behind the eyelids are often exceedingly spectacular and vivid, having a tendency to metamorphose so rapidly into different detailed moving images that it can be difficult to keep pace with them. Visual effects often correlate with the equally rapid thought processes occurring in the individual, and with any music or sound that may be present, and may seem laden with meaning and significance. This synaesthesia may extend across all of the senses [ie. seeing sound, tasting colour, etc.].

Thought takes on a dimension not generally encountered in the average waking state. Thoughts are usually directed inwardly towards self-analysis or beyond, with a startling clarity. The thought process is often witnessed as a visual and symbolic one. Here one may have an extraordinary capacity for assessing the 'big picture', temporarily freed from one-dimensional perspectives. Deeply entrenched personal problems and their roots can be accessed from the subconscious into which they had been banished, and consequently viewed and worked out with an honesty and insight that is rarely displayed when 'sober'. It is with carrying these solutions back to the 'sober' state and applying them, that real positive change can occur. If one has no prevalent personal issues to resolve, then this stream of consciousness can be directed towards external problems or tasks, or to the nature of reality itself, down to a subatomic level and beyond. Sometimes, however, one may seem to have little control over the direction things take.

When in a psychedelic state, we become sensitive to things that, due to the editing processes of our brains, we are generally unaware of in everyday life. The human nervous sytem in this state can become a conscious conduit or receptor for, amongst other things, what some refer to as the 'information matrix' – an omnipresence in which can be found all thoughts, psychic 'noise', all the records of everything that ever was, is, or is still to come. Some people refer to it as the 'one mind'. This is a concept difficult to swallow for most people, I am sure, but many of us throughout human history have experienced it as a reality. Developments in physics seem to support the probability of such a system. Its likelihood is also reflected in the 'holographic' theories of consciousness and reality [which may indeed be one and the same!], as mentioned previously (see Narby 1998 for some excellent discussion; also Wilber ed. 1985). Again repeating myself [because the context seems right], there are many accounts of people who have taken psychedelics in clinical studies [or privately], and as a result, gained knowledge about things which they could not have previously known, or reached breakthroughs in problems that had been troubling them for some time in a professional work project or the like. This has occurred with chemists, architects, computer programmers, physicists, and other 'professionals'. The effective prohibition on human research with many of these substances means that there is, unfortunately, a lack of much published data in this field. As was mentioned earlier [see *Questions & Answers*], such events are experienced far more frequently in non-clinical settings, where the results are either dispersed anecdotally, or simply kept in privacy.

It is precisely this aspect of psychedelics, the exposure to valid aspects of reality outside of 'normal' experience, that enables shamans to practise their craft, and its timelessness and universality is what makes shamanism still relevant today. Shamans have learned to use plant psychedelics in order to go where they need in these experiential realms, to find the information required for their task at hand. This is a learned skill that can not be taught in a book. It is also where many psychonauts fail to grasp the greater potentials of psychedelics. The experiences can be so fascinating in themselves, that it is easy to become distracted by sensory phenomena, and to forget that the psychedelic state can be applied to far more useful ends than intellectual entertainment. The most important point to remember when using psychedelics in a shamanic and/or spiritual context is to remember why you came. Focus on your purpose for the ritual, and whenever you notice your thoughts wandering, re-focus. This needn't be a case of forced concentration. It seems best to adopt a degree of detached concentration, which allows a greater flexibility of abstract thought – and this is how thoughts evolve in psychedelic experience, rather than always in linear, logical progression. The successful integration of the experience, which will be discussed below, is in part important because it weds the fruit of abstract thought with that of rational thought, thus bringing the ethereal into the material [or vice versa!]. Become a receptacle for seeds of insight; water them, nurture them, and let them grow and become strong; then share the fruit wherever possible, so that new seeds may be planted.

Stormy Weather

The psychedelic state manifested at higher doses can be very confusing and distressing. There is always potential for negative or unpleasant psychological reactions to psychedelics, usually known simply as a 'bad trip' or a 'bummer'. Such labels unfortunately obscure a very important fact – that a 'bad trip' usually offers the greatest benefit, as it exposes your own weaknesses, which are where the greatest self-work needs to be done. In 'ordinary' consciousness, it is common to suppress awareness of one's own faults and weaknesses, either by projecting them onto others, or simply ignoring them or creating excuses for them. In the throes of a 'bad trip', it is no longer possible to run away from these things. Continuing to deny them at this point, and choosing not to learn from the experience, is a recipe for even greater neurosis and maladjustment in the long-run, as well as a hellish trip. According to Rick Strassman (1984), people "with a fear of closeness of same-sex others" and "primary defensive mechanisms including projection, denial, and tendency towards psychotic thought disorders" are more likely to experience negative reactions. Being exposed to one's darker thoughts, or aspects of the personality or self-image with which one is not comfortable, can also precipitate a negative reaction. Here, I will try to cover the most common things that may go wrong, and some of the ways in which they can be dealt with.

Sometimes the influx of energy and information can become a bit too much for comfort, and 'information overload' sets in. This can result in a state of panic, where the person involved feels everything flooding over them too rapidly, becoming anxious and fearful when they find they can not stop the experience, or escape from it. Sometimes the person may be gripped by fear that is all-consuming, often leading to a paranoid state where delusional ideas are constructed, and one feels they can not ask for help, because they do not trust anyone to tell them the truth. Even if knowing that people around them have truthful intentions, there is still the very real awareness that people may believe they are telling the truth, whilst still being wrong or ignorant of possibilities.

Psychedelics open your awareness to many things, particularly to what some call spirit and 'paranormal' forces, which should be accepted rather than feared. Let them pass through, rather than identify with them as objects of fear – without fear, they can do you no harm. Greet them with love and they may even teach you. Sometimes voices may be heard or imagined, or thoughts seeming not to be your own may enter your mind. This in itself is not necessarily a bad thing, depending on what messages are being received and in what manner you react to them. The problems can arise from forgetting that one is in a highly suggestive state of mind, and coming to believe voices or thoughts that may be misleading or easily misinterpreted. Similarly, it may become difficult to discern the meaning or significance of the visions or inner voices, which can be problematic if the content seems menacing or sinister. Some say that 'only bad spirits' are heard in the left ear. Sometimes actual entities are encountered, which may seem to have visual and/or physical form, or may be purely 'felt' as a presence. Here it is worth remembering that just because an entity or voice in the head presents itself, it does not mean that that entity is necessarily being honest with you or that it has your best interests at heart.

Those experienced with peyote [see **Lophophora**] suggest that it is a noble exception, with the advice or information thus received proving unfailingly to be truthful (Trout & Friends 1999). Still, even in these cases, it is generally best to suspend judgement on information received, until you are better able to assess whether it seems to make sense, or whether it tallies with the ethics that you hold to be honourable. With practice, you will hopefully learn to listen only to the teachings that speak to your heart and offer you truth and love as a path. Whether these perceived entities are simply projections of the human psyche is a matter of debate that may be impossible to settle. One explanation with a ring of truth, in the context of Tibetan Buddhism, is that "the Buddhist deities could be understood ultimately as the mingling of the creative forces of nature and human consciousness, and demons came to be perceived as the dissonant and obsessive forces of greed, fear, and aggression arising from the illusion of a separate self" (Dunham et al. 1993). However you choose to interpret such phenomena, these perceived encounters certainly do occur.

Sometimes, with high doses, you may lose awareness of your body. The feeling of this happening can be very frightening, and often a fear of dying may emerge. Psychotherapist Ann Shulgin has advised that if you wish to let go and fall into 'ego death', promise yourself you will return to your body, and find a safe and comfortable place where you can lie or sit undisturbed whilst going through the process. If you wish to remain rooted on the physical plane, breathe deeply and get active whilst remaining calm – move around, try to talk with a friend who is present, anything to keep your attention on your surroundings.

Psychedelics can bring you to question everything that you had previously accepted as fact, so it is important not to work backwards and erase psychological progress you have already made, by making destructive decisions in an impulsive moment. Only you can know what this means to you. The deeper realms of the mind can become quite a minefield, or a labyrinth from which some never fully return.

You may feel that you have gone insane, and that you will never 'come down' [see *Questions & Answers*]. Sometimes people become overwhelmed by strong feelings of an 'evil' presence, and may believe that they have unwittingly entered into some kind of demonic pact by partaking of psychedelics. Many people from Christian backgrounds have already made up their mind that this is indeed so, without having actually tried these substances themselves. This is understandable, as I can not imagine any Christian choosing to enter a demonic pact, if that is what they believe they might be doing. It is noteworthy, however, that some Christians who have taken the plunge, in settings appropriate to their beliefs, have had profound spiritual experiences as a result! Early accounts from missionaries in the 'New World' frequently described 'Indians' as consuming sacred plants in order to 'converse with the devil'. Unfortunately, because of such ignorance, and the dogma that is fuelled by it [and conversely, the ignorance fuelled by dogma], Christians who do decide to experiment with psychedelics are more likely than others to have trips with frightening and confusing 'evil' overtones. If such people are not scared away by this, these perceptions can take a long time to come to terms with. Having gone through this painful process myself, I believe that this constituted a valuable lesson in understanding the nature of light and darkness and their fundamental interrelation, as opposed to the immobile human constructs of polarised and mutually exclusive good and evil trying to crush each other, which can promote an unhealthy psychospiritual fear of the unknown. To add to that, things are not always as they seem [see also the quote from Dunham et al. 1993 above]. Sometimes a scary facade can be merely a veil behind which truth may be found by those wise enough not to be swayed by gross appearances. However, detailed discussion of this dilemma of good and evil could form a lengthy treatise of its own. An excellent entry into such a discussion can be found from Alan Watts (1978). Rejecting the firm separation of good and evil need not be a rejection of any sense of morality, 'decency' or 'goodness' but rather a recognition and acceptance that fluid and inconstant 'reality' is not bound to such fixed points of view.

Most people in our societies are ruled by subconscious fear and self-loathing, and can not accept themselves for who they are, or communicate with others, without hiding behind masks. Clinging to these masks, and/or allowing fear or despair to cultivate themselves, are the cause of many 'bad trips'. At their roots, nearly all difficulties that may be encountered within a bad trip derive from fear. Everyone has fears of some kind, though in many of us they are mostly buried so deeply within our psyches that it can take a traumatic experience such as a bad trip before we even know that they exist, and what they are. It may help to realise that fear only has the power that you give to it by allowing it to take root and grow. Knowing that whatever will happen, will happen, and that we can do nothing more than live moment by moment honourably and humbly, can sometimes help release the grip of fear. How you deal with these fears as they become apparent is a personal and individual matter, which depends very much on the nature of you and your fears. Psychedelic states of consciousness can give us the opportunity to learn how to discard these shackles of destructive thought, in order to move towards our highest aspirations, rather than stagnate or dig deeper holes for ourselves. The choice is yours, and yours alone.

The Eye of the Storm

A special aside must be made regarding *DMT*, *5-methoxy-DMT* and *salvinorin A*. The effects of these psychedelics are the strongest of any yet discovered, and in moderate to large doses are the most likely to precipitate negative reactions in the unprepared. Despite having a similar time-course, regarding onset and duration, these three substances all have very different effects, and *salvinorin A* is in a bizarre class of its own. When smoked [or more preferably, vapourised], these substances act very rapidly, and their effects subside slightly less rapidly. The intensity of the peak of the experience, when a fully-active dose has been consumed, is indeed awe-inspiring and overwhelming. No awareness [or only vague awareness] of physical surroundings, body or self remains, but from there the effects can differ widely between the compounds, and between different people at different times. These substances can absolutely shred any preconception of 'normal' reality. Often extreme time-distortion is experienced [when there is an ego present to experience it], to the point that the peak may seem to last for hours, days, or rarely even weeks, existing in a reality far removed from the familiar. Do not worry – where your body remains, time moves at a rate by which you will be aware of your physical-self within 5 minutes or so, and relatively 'sober' within the hour. Fortunately, however, many people who have had a terrifying experience during the peak find themselves quite joyful and ecstatic once surroundings begin to return to familiarity, at least in part because of being so happy that the alteration was not permanent! Time-distortion is also a common subjective phenomenon with other psychedelics, though generally to a less-extreme extent. Fischer et al. (1961) gives a very interesting discussion on the nature of time, and its perception as affected by psychoactive drugs.

Don't Panic!*

There are several simple little tricks that can be useful if a person is experiencing problems or difficulties in their trip, such as those discussed above. The principal one is the use of laughter, to dispel gloomy thoughts and break negative thought-cycles. The distracting and healing influence of a good laugh can truly work as wondrous medicine, and the most profound realisations may often be found in the midst of such moments. A comforting foot and/or body massage can also be very soothing and calming to a distressed tripper. They should be encouraged to try to discuss their thoughts and feelings with others present – this act alone can be very reassuring, and can distract the person long enough to break the negative thought-cycles mentioned earlier. Of course, the others present would need to be sufficiently well-adjusted and intelligent not to actually agree with the person that they are losing their mind! It certainly helps if at least one other person present is thoroughly familiar with psychedelics, as discussed earlier.

A simple change of environment can work wonders in improving mood and outlook, which is largely why the importance of set and setting was emphasised earlier. Small things, such as adjusting light levels, vapourising or sniffing your favourite essential oils [or being around scented things that you find comforting], careful choice of music, being around plants, finding pleasing and inspiring things to look at, enjoying some fresh fruit, and doing things that one knows to be relaxing and reassuring, can together help to suddenly lift a cloud of gloom that only a moment ago seemed eternal.

It may be useful to bear in mind the Buddhist philosophy of non-attachment, which is also applied to visions and experiences, no matter how profound. As well as occasionally bringing about negative reactions, attachment to imagery and concepts impedes long-term spiritual progress. Learn from them and appreciate them, by all means, but do not cling to them because they are, like everything, impermanent. This can also be applied to thoughts that are overly distressing. Simply observe them, learn from them, and let them go, rather than becoming absorbed in them to the point of obsession. Such distressing thoughts can easily turn into vicious cycles of despair, fear and/or paranoia that quickly spiral in intensity, and are best dealt with before they develop any further. Maintaining the detached vigilance discussed earlier makes it easier to catch these potential problems and transform them as soon as they arise. It may help to remember that if your mind can think itself into such a sticky situation, it is also capable of thinking its way out, and you will almost certainly learn a lot about yourself in the process. The 'Four Noble Truths' of Buddhism also tie into this line of discussion. The first is the recognition that there is suffering; the second is recognition of how suffering has arisen; the third is recognition that the cessation of suffering is possible; and the fourth is following the path that leads to cessation of suffering. This path is called the Noble Eightfold Path; readers interested in an accessible and insightful discussion on this should see Hanh (1998). [Note – though Hanh takes the most conservative interpretation of the Buddhist stance on drugs, this is not the case with all Buddhists (see Forte ed. 1997), and it may be that Hanh is unaware of the potential positive spiritual uses of psychedelics or entheogens. In any case, his books are recommended for those interest-

ed in Buddhism.]

Drinking large amounts of orange juice [see **Citrus**] is a practice used in Holland to counter mushroom trips that are too intense [see **Psilocybe**, **Panaeolus**], and this is reported anecdotally to have proven effective. I have also heard rumours of this being used in the same manner for LSD, in relation to the vitamin C content of the juice. However, I am not aware of the mechanisms behind this phenomenon, which other psychedelics it is likely to be effective for, or how much orange juice or vitamin C is needed to relieve the effects.

If all else fails, try to remember that you will come down, and that everything will be fine tomorrow. Don't do anything rash, and wait until you are at 'ground-state' before putting into effect any major decisions that will affect your life. You will not always be able to properly assess your feelings when you are still tripping. Remember that unlike your mind, your body can not fly. Remember that public nudity and disruptive behaviour are discouraged, and could earn you a come-down in a prison cell. Even if it all seems too much to bear, don't give up on yourself, and wait it out. You'll be proud of yourself in the end, for going through it and coming out the other side in one piece. Keep a smile on your face, and don't lose faith in what you know to be right for you. If it's appropriate, repeating an affirmation to yourself, such as "I believe in truth and love", can be a positive anchor to lay down, until you are feeling more secure [or until you see God!].

As mentioned earlier, these most intense and frightening of experiences can offer the greatest opportunity for leaps forward, as they can teach you the most about yourself. Some spiritual paths [amongst those often termed 'left-handed paths'] involve travelling into the depths of 'darkness' in order to break through into the 'light', transformed by the journey. In this sense, exploring realms of consciousness that may drive the unprepared or insincere to varying degrees of insanity can, for the truly devoted seeker, be a process of deep cleansing that culminates in an awakening and increased integration. As Gopi Krishna [a well known kundalini researcher] once wrote, "psychophysical stress and storm is a part of spiritual adventure" (in White ed. 1990). Another appropriate quote comes from Lama Chögyam Trungpa (in Forte ed. 1997) – "My advice to you is not to undertake the spiritual path. It is too difficult, too long, and it is too demanding... This is not a picnic. It is really going to ask everything of you and you should understand that from the beginning. So it is best not to begin. However, if you do begin, it is best to finish."

Coming Down

Once you're past the peak of the experience [which generally occurs about 1/3 of the way into the entire duration, or earlier, depending on the substance and circumstances] you enter the 'come-down' phase, which can sometimes seem very long and drawn-out. Some people often choose to use **Cannabis** at this point, to help ease the transition and calm the still-hyperactive nervous system. It is a good time for contemplating and elaborating on what has just been experienced [which also makes it less likely you'll forget important details the next day]. Write down anything which comes to mind, if it feels appropriate. At the end of the trip, one may feel mentally and physically exhausted. Some people, on the other hand, after a particularly constructive trip, feel as good as new, or better, even for days afterwards. Feelings of profound calm and integration often emerge during and following such constructive experiences. After a nutritious meal and a good night of sleep, there is usually no hangover in the sense that alcohol produces a hangover. Near the end of a session involving psychedelics that act on serotonergic and catecholaminergic neurotransmitter systems [see *Neurochemistry*], supplementation with *5-hydroxytryptophan*, *choline*, B vitamins and antioxidants [or simply eating a good, healthy meal and resting] will often help reduce any next-day 'fuzziness' resulting from over-excitation and general system stress from an intense experience. The user may feel sluggish and introspective the next day while the body recovers, and the information from the experience is processed and assimilated. There may occasionally be slight residual psychedelic effects [usually positive] for the next week or so, depending on the dose consumed and the psychological impact experienced.

The most important stage of the experience actually occurs after the bulk of the effects have passed, and that is the stage of assimilation or integration. Successful assimilation of the experience into life is the only way you can get anywhere with altered states, otherwise they are effectively wasted. Many people who use psychedelics skip this last step, preferring instead to evade the implications of the realities which they have been exposed to, pretending after they have come down that it was all 'just a trip', and not attaching any meaning to the experience. I believe that using psychedelics in this way is a sad insult to human potential. It is very important to actualise what you have learnt in the psychedelic state. As stated earlier, integration is the part most people find to be the most difficult. How is it done? The most direct answer is to live what has been learnt – not to cling to it as a permanent form or idea, but to integrate it into your everyday behaviour and use it as a foothold to climb towards your next step. I can not tell you exactly how to do this – you will have to apply it yourself to your own situations, in ways that are appropriate to you.

Responsibility

Incidentally, throughout this chapter, mention has been made in passing about making 'right' decisions, and practicing 'appropriate' behaviour. As a guide to what is meant by this at the simplest level, it is merely suggested that you consider the results of any action from every viewpoint, use a bit of your own moral judgement, and as a result, choose not to do things which unnecessarily interfere with another persons right to peace in their own reality. In other words, do what you need to do to be free, but without harming the freedom of others. In this pursuit it is worth setting an example worth following, so that those who don't live by such guidelines [and harm others in the process] might come to reassess the way they relate to other beings.

In brief, psychedelics can't do the job for you, but they can certainly open up the doors, revealing what is possible and providing valuable lessons. Once the trip is over, it is up to you and your own efforts to implement your enlightenments in this world. It is easy to lose sight of your path by falling back into old ways of being, or forgetting what has been learnt in the past, repeating the same mistakes again and again. Complacency resulting from being overly proud of one's 'spiritual progress' is one of the quickest and surest ways of falling into this trap. The process of learning, and growing, is ongoing. The most can be learnt through admitting that we know nothing, as truly knowing the absolute requires the innocence of an absolutely clean slate.

Some Nuggets for The Road

It seems fitting to quote from Ram Dass (1971) some selected helpful points regarding 'sadhana'. Sadhana is 'spiritual practice', and is a concept that can embrace or define the purposeful use of psychoactive substances, particularly those with psychedelic properties [see also the sections on meditation and kundalini, in the previous chapter].

> "Each stage that one can label must pass away. Even the labelling will ultimately pass. A person who says, "I'm enlightened" probably isn't.
>
> The initial euphoria that comes through the first awakening into even a little consciousness, except in a very few cases, will pass away... leaving a sense of loss, or a feeling of falling out of grace, or despair...
>
> Sadhana is a bit like a roller coaster. Each new height is usually followed by a new low. Understanding this makes it a bit easier to ride with both phases.
>
> As you further purify yourself, your impurities will seem grosser and larger. Understand that it's not that you are getting more caught in the illusion, it's just that you are seeing it more clearly. The lions guarding the gates of the temples get fiercer as you proceed towards each inner temple. But of course the light is brighter also. It all becomes more intense because of the additional energy involved at each stage of sadhana.
>
> At first you will think of your sadhana as a limited part of your life. In time you will come to realize that everything you do is part of your sadhana.
>
> One of the traps along the way is the sattvic trap – the trap of purity. You will be doing everything just as you should – and get caught up in how pure you are. In India it's called the 'golden chain'. It's not a chain of iron, but it's still a chain.
>
> At some stages you will experience a plateau – as if everything has stopped. This is a hard point on the journey. Know that once the process has started it doesn't stop; it only appears to stop from where you are looking. Just keep going. It doesn't really matter whether you think "it's happening" or not. In fact, the thought "it's happening" is just another obstacle.
>
> You may have expected that enlightenment would come ZAP! instantaneous and permanent. This is unlikely. After the first 'Ah Ha' experience, the unfolding is gradual and almost indiscernable. It can be thought of as the thinning of a layer of clouds...until only the most transparent veil remains."

And finally, some humorous and slightly less esoteric tips from Robert Anton Wilson (1977) broadly regarding such matters:

> "Chapel Perilous, like the mysterious entity called 'I', cannot be located in the space-time continuum; it is weightless, odorless, tasteless and undetectable by ordinary instruments. Indeed, like the Ego, it is even possible to deny that it is there. And yet, even more like the Ego, once you are inside it, there doesn't seem to be any way to ever get out again, until you suddenly discover that it has been brought into existence by thought and does not exist outside thought. *Everything you fear* is waiting with slavering jaws

> in Chapel Perilous, but if you are armed with the wand of intuition, the cup of sympathy, the sword of reason and the pentacle of valor, you will find there (the legends say) the Medicine of Metals, the Elixir of Life, the Philosopher's Stone, True Wisdom and Perfect Happiness.
>
> That's what the legends say, and the language of myth is poetically precise. For instance, if you go into that realm without the sword of reason, you will lose your mind, but at the same time, if you take only the sword of reason without the cup of sympathy, you will lose your heart. Even more remarkably, if you approach without the wand of intuition, you can stand at the door for decades never realizing you have arrived." Also, there are "those without the pentacle of valor who stand in terror outside the door of Chapel Perilous, trembling and warning all who would enter that the Chapel is really an Insect Horror Machine programmed by Death Demons and dripping fetidly with Green Goo."

For further reading on the positive uses of psychedelic drugs as sacraments, see Forte ed. 1997, Saunders et al. 2000 and Strassman 1984, 1995.

*In memory of Douglas Adams, r.i.p.

PRODUCING PLANT DRUGS – CULTIVATION, HARVESTING, CURING AND PROCESSING

Organic horticulture

It is quite important to develop a relationship with the plants to be consumed, and preferably, this begins with cultivation of your own plants. In caring for them and maintaining their health, an empathy will emerge that will enhance any experiences gained through later ingestion.

For reasons of purity, overall plant vigour, and soil restoration, cultivation using organic techniques is preferable. Producing your own fertile organic compost is not difficult, and use of permaculture techniques will also prove invaluable and relatively simple once grasped. The reader should consult their local libraries and bookshops to gain a greater footing in these systems. For permaculture, the works of its best-known protagonists, Bill Mollison and David Holmgren, are suggested. However, it should be noted that permaculture often encourages the planting out of invasive weed species with little regard for native ecosystems, and it is suggested that the invasive potential of non-indigenous plants be seriously considered before cultivation. Plants that spread vigorously from underground runners should preferably be cultivated in large pots or other contained areas. Plants that seed profusely should also be watched carefully, and if possible, should be harvested or cut back before seeds ripen and disperse.

Some horticulturalists plant their seeds and time harvest according to the phases of the moon, which can optimise the benefits gained in cultivation by aiding healthy germination and helping in the development of high potency, according to those who go by such methods. Horticultural moon-charts can be obtained from many 'esoteric' and health stores, published yearly. Place your plants in positions and environmental circumstances that emulate their natural habitat. If known to the author at the time of writing, habitat and cultivation details are mentioned under individual plant entries. Regardless, research by the reader is strongly suggested whenever attempting to cultivate a plant with which one is unfamiliar.

Plants in the wild

In cases where cultivation is not practical, plants may sometimes be collected in the wild with relative ease. It is here that at least a basic understanding of botany will become invaluable, as a mistake in identifying a plant can, in some cases, cause poisoning and even death if that plant is later consumed. Some toxic plants do not even need to be directly consumed to be effective, as the active chemicals may be absorbed through unbroken or pierced skin. **Brugmansia**, for example, as well as being absorbed through porous skin, is known to sometimes intoxicate from the scent of the flowers alone! On this last note, see also **Tanaecium**.

Although at first glance, botanical terminology seems alien and cumbersome, it is actually more or less vital in providing a concise and accurate description of a plant, necessary to differentiate it beyond doubt from any other plant species. There are many morphological aspects and traits which are difficult to adequately summarise with everyday language, and for this reason, an attempt should be made to become familiar with some of the most commonly used terms and their meanings. With time, when you become more familiar with some basic Latin and begin to recognise some meaning in the root words that make up the terminology, it will become easier, and botanical names will eventually roll off of the tongue. Remember, even trained botanists sometimes have to refer to their terminology dictionaries. The glossary should be of some minor help in interpreting some of the descriptions provided, however, many terms are not listed, and the serious reader should obtain their own botanical dictionaries for a fuller understanding.

If not available locally in the wild, you may wish to visit your local nursery – you'll be surprised what you might find in some, if you look closely enough. There are a number of specialist herb nurseries that deal direct to the public, also, and investigation of seed company catalogues will also prove fruitful. It is useful to consult libraries to learn about the native vegetation and introduced weeds in your area, as well as to locate local species related to those mentioned in this book, for possible evaluation of activity.

Harvesting

Harvesting of the plant, as with cultivation, should be done with gentle care and respect, as it is this plant that you would be asking to help you, and, as such, should be treated accordingly. Firstly, though, consider the species you think you are harvesting [it is wise to be sure on this point] – do you know its chemistry? Does it have a history of human usage to draw from? Is it likely to react badly with any medical conditions you have, or medication you are taking? Is it known to be physically dangerous, or even lethal? These are all questions which you should ask yourself when considering a plant for consumption. If you are at all uncertain on any of these points, don't consume it! It's better to be safe than sorry, as injury and/or death are distinct possibilities with uninformed experimentation.

Many factors can influence the optimum time and place for harvesting – the time of day or year, the physical location and exposure of the plant, its health, stage of development, amount of rainfall, etc. All of these can positively or negatively influence potency and chemical makeup, varying from species to species – this will be indicated under individual entries, if the data is known. Few plants have been examined chemically with this viewpoint in mind, so this information is lacking in many of the entries. Different chemicals are often found in different parts of the plant, at different stages of growth, and at different times of year. Different specimens from the same area may even yield different compounds, or different levels of compounds. Also, many plant species exist in distinct chemical 'races' or 'strains' within the one species classification, further complicating matters, and occasionally, 'mutants' may be found with exceptional chemical content. For even more confusion, sometimes closely related species may interbreed in the wild, producing hybrids that are difficult to identify and may have different chemistry – this has been known to occur at least with some **Acacia** spp.

Soil acidity can influence levels of alkaloids and cyanogenic glycosides in plants; pH levels affect the ability of the roots to absorb available nitrogen [more available in ammonia-nitrogen fertilisers than nitrate ones], which affects the levels of nitrogenous compounds such as alkaloids. Sugar should be added to free ammonia solutions, to avoid damage from excess fertilisation. Optimum levels differ from species to species – however, here we will look at a selection of genera that have received study in this regard:

Convolvulus – pH 6-8
Cytisus – pH 5-6
Lupinus – pH 6-7
Lycopodium – pH 5-6
Magnolia – pH 5-6
Papaver – pH 6-8
Solanum – pH 5-6
Senecio – pH 5-6
Symplocos [see *Endnotes*] – pH 6-7
Taxus – pH 6-8 (McNair 1942)

Alkaloid levels may also, in general, be increased by shading [though only light shading can actually decrease alkaloid content], and stress by water deprivation or wounding. Increases take place gradually over time, and can not be expected to occur greatly in a few days (Eilert 1998; James 1950; Manske 1950). For the sake of maintaining a positive interaction with the plant, I would personally discourage the use of excessive stress, especially deliberate wounding. I believe they indicate a certain lack of respect towards our plant friends.

If you have a choice, select plants that display particular vigour and good health. In many plants, alkaloids are usually not present in significant amounts in dead plant matter – actively growing plant tissue is usually best (James 1953). It is probably not a good idea to collect from near busy roads, due to the likelihood of heavy metal contamination. If collecting in the wild or in public places, be discrete so as not to make it more troublesome for yourself or other collectors in the future.

In very general terms, the best time for harvest is in the early morning, at a time of the season in which the plant is just beginning to flower, if the vegetation is to be collected. Flowers are often collected at various stages between budding and maturity. Berries are collected when ripe or slightly under-ripe; seeds are usually collected when they are naturally released from the plant. Roots and tubers are often collected after the aerial parts have died back for the season, in the case of annual plants. For others, if there is an extensive root system, roots may sometimes be harvested without digging up the entire plant. Bark is best harvested by removing a branch to strip of bark, rather than cutting bark from the trunk, or from branches which are still attached to the plant. The time of optimum bark harvest varies from species to species. In plants containing volatile oils, content in the leaf usually increases with time and leaf size. In some species, the youngest growth may be the most potent.

Approach the plant with respect, and ask it to give of itself to you, preferably some time before you actually intend to harvest. This is often the preferred method amongst shamans and some herbalists. You may discover that plants will seem to appreciate being sung to or talked to in soothing tones when first approached, and whilst harvesting. If wishing to try this, focus your mind on the plant and project an attitude of tender respect and communion. Open your mouth and let the voice emerge with its song as it comes naturally. This is usually found easier if there are no other people within earshot, unless you are a natural singer! You need not neces-

sarily sing with words, nor particularly loudly [if you have a good feel for this you can simply do it in your head and project it mentally towards the plant], but sincerity is the most important quality here. It may also be appropriate to leave an offering for the plant [or on the place where it grew, in the case of the whole plant being harvested] as a sign of gratitude. In many parts of Central and South America, tobacco [**Nicotiana**] is a customary offering, notably when harvesting peyote [**Lophophora**] or 'yajé' [**Banisteriopsis**]. Otherwise, other herbs, or objects precious to the harvester, may constitute a suitable symbolic offering.

All needed vegetation should preferably be removed with a clean and sharp blade, or clippers. Roots are best recovered with the aid of a small hand-held pick or a shovel, and a stick for finer work closer to the roots. In some cases [eg. **Arundo**, **Phragmites**], heavier tools such as a mattock and crowbar may be needed to excavate roots, though care should still be taken to not damage the plant beyond what is strictly necessary. When collecting bark, never cut from the whole circumference of the branch or trunk ['ring-barking'], as this will kill the upper reaches of that branch. If this is done on the main trunk, the whole tree will die if it can not regenerate from the stump.

You should make all efforts to avoid gouging or damaging the plant, or treating it in a way that will cause it stress and sickness. Never remove too much from one plant, or strip entire branches of their foliage. It is important to leave the plants intact enough to survive and continue to thrive. In some cases, the stress resulting from rough handling may be sufficient to injure the health of a plant. In the case of annual herbs, harvesting an entire plant is less objectionable, provided they are common, or have already gone to seed. It may be advisable in some instances to only harvest from one plant or several from a patch, in order to stabilise the estimation of dosage over time. This is particularly suggested with the Solanaceous tropane alkaloid-bearing plants [eg. **Brugmansia**]. It is not advised to collect plants if they are the only representatives in the locality, or if they are known to be rare or threatened. Always attempt to restore the ground and surrounding area to their previous state before leaving the space.

Mushrooms should be picked preferably when the caps have opened enough to release spores. Many people prefer to lightly tap the mushroom caps, to release a last cascade of spores before harvesting occurs, however, this practice is thought by mycologists to be inconsequential. Mushrooms should preferably be cut off cleanly at the base, taking care not to disrupt the web-like network of mycelium beneath the surface of the growth-medium, unless the bases are to be used for further mycelial propagation. Fungi should always be stored in a porous material [such as paper or cloth bags] when collecting. Other plant matter may be collected into plastic if necessary, though unless the material is dried, it should not be stored for long in plastic as the moisture and humidity generated as the plant material sweats can encourage the growth of moulds and bacteria.

Cacti are harvested in different ways, depending on their growth habit. Columnar cacti are generally cut at a slight incline across a branch, so that when the cut heals, water can run off freely, without collecting in the concave hollow that forms. Small, globular cacti are harvested by cutting off the 'heads' or 'buttons' above ground-level, leaving the rootstock to regenerate. New shoots, often affectionately called 'pups', usually form months later from the areoles near the cut portion. A very sharp and clean knife is strongly recommended for harvesting cacti, to minimise stress to the plant, and reduce the chance of infection. However, some cacti with very tough vascular bundles may require a pruning saw to sever. After a brief drying of the surface, the fresh cut is often dusted with sulphur-dust or charcoal-dust, which keep the cut dry and help deter fungal growth.

Some Quick Field Tests

If harvesting plants of unknown chemistry, a few safety tests can be carried out relatively simply.

Testing for presence of saponins

Thoroughly grind or pound a sample of the plant, and shake it vigorously with water, preferably after a brief boiling and cooling. The appearance of a froth, stable for at least 30 minutes, indicates presence of saponins.

Testing for presence of cyanogenic glycosides

You will need sodium picrate testing paper for this – to make it, dip some blotting or filter paper in a 1% solution of picric acid, and let it dry before dipping briefly in a 10% sodium carbonate solution, and drying again. The crushed plant sample is placed in a small receptacle. A strip of the testing paper is moistened, then inserted into the container to be held in place with a lid or cork for the receptacle. In the presence of prussic acid [which is a substance released when cyanogenic glycoside-containing cells are crushed], the yellow testing paper gradually turns orange-yellow or brick-red after a few minutes to several hours (Cribb & Cribb 1981).

Testing for presence of some amatoxins and some tryptamines

Some mushrooms contain deadly toxins known broadly as 'amatoxins' [see **Amanita**]; the presence of the amanitin-type amatoxins can be tested for with the 'Meixner test', devised by A. Meixner. Juice from a piece of fresh mushroom is dripped onto a piece of lignin-containing paper [not newsprint as it is too thin and usually bears ink, both of which can affect the results]; once dry, a drop of concentrated hydrochloric acid [HCl] is applied to the same spot. Under these conditions, amanitins [when present at 0.2mg/ml or higher] react with lignins in the paper to form a blue or light greenish-blue coloured stain within several minutes. This test may also be done with dried mushrooms, either by soaking and crushing a small piece of the mushroom in a small amount of absolute methanol, and applying this liquid to the paper, followed by HCl treatment; or by directly extracting the contents of the mushroom in a mixture of methanol and concentrated HCl, and applying this solution to the paper. This test should be done away from strong light, which can produce some 'false' reactions. Judgement should be made on any results within 15min., as the colour reaction usually fades and changes hue after this time.

The Meixner test can also be applied to testing for the presence of some *tryptamine*s; though it works best for 5-substituted *tryptamine*s [such as *bufotenine*, *5-methoxy-DMT*, *5-hydroxytryptophan*, *5-methoxytryptamine* and *serotonin*], it does not distinguish between them. After application of HCl, presence of such compounds is indicated by the development of a reddish-brown stain, turning 'greyish-purplish-red', then 'moderate reddish-purple', ending with a bluish colour like that shown with amanitins. *Tryptamine*s with 4-substitution [such as *psilocybin* and *psilocin*] were not tested directly via this method but **Psilocybe** cyanescens was, giving at first a grey stain, within 1 minute turning greyish-blue to pale blue; low concentrations gave a light greenish-blue stain. Although similar to the colour reaction of the amanitins, it could be distinguished by the quickly fading colour and the initial grey hue. However, untrained people may find it difficult to distinguish between such similar colour reactions, especially without known reference standards for comparison, and as such the Meixner test can not be relied upon to identify compounds definitively.

It is advisable to use a 'control sheet' of non-lignin paper [such as filter paper] to check for false reactions, which may be seen when the same colour reaction occurs on both types of paper, indicating the presence of other compounds not undergoing a 'Meixner reaction'. Of course, such a test should not be seen as definitive proof that a mushroom contains no toxins (Beuhler et al. 2004; Beutler & Vergeer 1980), yet in the case of the 5-substituted *tryptamine*s, it could serve as a useful field indicator for plants worthy of further chemical analysis.

Curing

Herbs are usually cleaned and dried after collection. The former involves removing traces of dirt and foreign debris, and stripping away unwanted portions such as stem wood or dead leaves, which should preferably be added to your compost. Some herbs may be, or should be, consumed fresh, and in such cases of course no drying is needed. Most herbs should be dried in a warm, well-ventilated, dimly lit room. Usually, they are either hung upside down in bunches, spread out on a mesh tray, or packed loosely inside a paper bag. Some herbs, however, are preferably sun-dried or dried through baking or heating over a fire, a quicker process often used when it is desirable to halt enzymatic activity in the herb. Roots dry best once sliced or chopped. Drying herbs should be inspected regularly for signs of decay, or insect and fungal infestations; if found, such samples should be removed from unaffected herbage and destroyed or buried. Different herbs take different times to dry [dry here usually meaning still slightly flexible, but not overly brittle or powdery]. Some take a few days, some more than a month. I find wormwood [see **Artemisia**], for example, takes a particularly long time to approach dryness. In general, plants that are naturally aromatic due to active essential oil compounds should not be dried or cured with heat or sunlight.

Curing sometimes also involves sweating, fermenting or even lightly frying the plant matter. These processes are usually done in order to either activate or terminate enzymatic processes within the plant cells that may affect the flavour, aroma and potency of the herb. In instances where this is a specific practice, it will be discussed under relevant plant entries. Fermentation usually occurs when fresh plant matter is stacked and allowed to generate heat; such stacks are turned at intervals, to prevent mould and decomposition.

Storage

Dried or cured herbs are usually kept in a sealed jar or other container, preferably one that is dark or opaque, as light can speed the degradation of many active chemicals. This also applies to heat, oxygen and moisture, all of which should be guarded against in the storage process. Those people living in humid climates may need to store their herbs in open drawers to avoid accumulation of moisture and resultant decay. For most, room-temperature or lower is sufficient, though some herbs with unstable constituents [such as some species of **Psilocybe** mushrooms, which should

be dried as much as possible without crumbling when handled] require freezer storage under airtight and moisture-proof conditions [the herbs should be dried first, especially in the case of mushrooms]. In general, the lower the temperature of storage, the better. Freezer life may be almost indefinite, depending on the chemicals involved, though storage at normal temperatures usually results in considerable loss of potency after several months or longer. This also depends largely on the other ways in which the herbs are stored, as mentioned above. Aromatic plants lose potency more quickly, due to evaporation of active compounds. Conversely, non-aromatic plants often store well for longer periods; many roots, seeds and berries may be kept for years. Herbs will last even longer if plant parts are stored relatively intact until intended for use.

Final Processing

The final processing involves preparing the herb for use. The first stage is usually that of finely chopping, shredding or powdering the herb for further processing into a consumable form. Sometimes herbs are soaked in cold water before processing. This may be to leach out tannic acids, chlorophyll, and other water-soluble compounds that may or may not be desired; or to make them easier to process; or to absorb some water before heating [such as with roots] to allow for better extraction. The next step often may be for the herb to be extracted into another medium for consumption, or further extraction to obtain either crude or pure active chemicals. The following are some common forms of extraction processes that may be used.

Infusions

An infusion is what is accomplished when one steeps tea leaves in a teapot [see **Camellia**] – it basically involves placing the herb in a teapot or similar lidded receptacle, and pouring freshly boiled water over it. The lid is usually closed, and the whole left to infuse for up to 10-15 minutes [much less with teas for culinary purposes], or until it reaches drinking temperature. It should be lightly shaken or stirred every few minutes. Where longer infusions are required, the pot may be wrapped in blankets for insulation. Honey may be added for sweetness and to counteract bitter flavours, or simply for its own health-giving properties [in the case of pure non-heated honey]. Infusion is best suited to aromatic herbs – most active constituents of essential oils are not water-soluble, but boiling will evaporate them in the steam – so the infusion is, when working with just-boiled water, a compromise that will allow a partial miscibility of the oils and the water, and/or a limited suspension of these compounds.

Decoctions

Here the herb is boiled with water in [preferably] a pyrex or stainless-steel receptacle – water is added to the herb, a lid is sometimes placed on top, and the whole brought to a boil slowly over heat. If using dry herbs, they should be allowed to soak in the water beforehand to become rehydrated. Once boiling temperature is reached, heat is reduced and a low boil or simmer is maintained for an extended time, depending on the plant, ranging perhaps from 5 minutes to 8 hours or more. With extended boiling, further liquid will need to be added at regular intervals to avoid burning. With shorter decoctions [say 5-20 minutes], after straining the liquid for consumption, fresh water may be added to the plant matter and up to 2 more decoctions carried out. Stirring will often be necessary to avoid burning, and increase the efficiency of the extraction process. Sometimes lemon juice may be added [c. 30% lemon juice/70% water] to increase the acidity of the water [due to its content of acetic, citric and ascorbic acids], and hence increase the water-solubility of some basic alkaloidal compounds, such as *DMT* and *harmaline*. Where necessary, research should be done to find out what pH level is beneficial for extracting particular compounds.

Tinctures

Tinctures are made by soaking the herb in grain alcohol [45-100%] inside a tightly sealed bottle [which is kept in a dark place and shaken daily] for several months to a year. After this time, the liquid is strained thoroughly [with the herbs being squeezed out, and sometimes washed with fresh alcohol] and stored in a tightly sealed dark bottle, in a cool place. Such tinctures should retain usefulness for a year or more, but this will vary widely with the chemistry involved in individual preparations. This is, in general, a simple and highly efficient technique for extracting plant constituents.

Ointments and salves

These are used for external application. The herb is infused or decocted, and the liquid is strained. Oil or fat [sesame or olive oils, lard, ghee, coconut butter, cocoa butter] is added to the resultant liquid, which is heated in until the water evaporates. Sometimes, the herbs may simply be infused or decocted directly in the oil or fat, then later strained out whilst the mixture is still hot and fluid. Finally, beeswax is added until the desired consistency is reached.

Pills

Herbs may be made into pills to be swallowed. One method involves mixing the powdered herb to a firm consistency with water, syrup or honey, which is pressed into pellets. Or, a decoction may be gently boiled down to a thick gum to be used in the same way. Sometimes powdered herbs [or a concentrated extract thereof] are simply encapsulated and swallowed. Pills or capsules are sometimes coated with powders such as plant ashes, flour, or **Lycopodium** spores if they are to be stored. This prevents them from sticking together and slightly delays degradation.

Distillation

Distillation is the process whereby a tincture, or other plant extract in a volatile solvent medium, is heated in an appropriate glassware flask, the vapours from which are guided into a long, water-cooled condensing-tube, which drips the cooled concentrate [distillate] from the other end. Fractional distillation is where the temperature of the solvent is regulated to retrieve specific chemical fractions from the extract, exploiting knowledge of their boiling points. Steam distillation involves heating water to produce steam, which is then fed into a pre-heated vessel containing the extract. The evaporating essence from this secondary vessel is condensed in the manner described above. Steam distillation is useful in extracting more delicate aromas and essences from plants. The aim of distillation is to provide a concentrated or more purified extract of the original extract.

Alkaloid extraction

Any but the most basic of chemical extractions should not be carried out by the amateur. This author is not a chemist, and does not claim to offer any chemical advice that should be followed. The following is merely intended to describe some of the different approaches used in the extraction of alkaloids, summarised from readily available published works and communications with other researchers. Anyone wishing to pursue chemical extractions should educate themselves further, to ensure they do not encounter disaster. Working with chemicals without proper awareness of their toxicity and special requirements for handling and use, coupled with ignorance of the principles of organic chemistry, is asking for a dangerous accident that could ruin or end your life. Legal implications must also be kept in mind. In some countries, it may be legal to grow a certain plant, but illegal to extract the alkaloids it contains, if any one of those alkaloids is a prohibited substance. Please take the advice that if you don't understand what is written below, then you probably shouldn't be attempting it. If you choose to attempt any method described here, at least educate yourself as to the precautions that must be taken with any chemicals used, and become acquainted with some basic chemical reactions and procedures so that you know what you are doing, and can avoid physical injury through unnecessary error. At the very least, equip yourself with protective gear [for all exposed skin and facial openings], and avoid breathing fumes or splashing chemicals on yourself, into the soil, or into bodies of water.

Equal care must be paid towards disposal of chemicals after use. Wherever possible, distil solvents for re-use rather than simply evaporating them into the air. If chemicals can not be re-used they must be taken to a chemical waste disposal service, never simply poured into the earth or down the drain. Wherever possible, substitute milder or non-toxic chemicals for use in extraction procedures. For example, using tartaric acid or acetic acid rather than hydrochloric acid. Moves towards such low-tech and low-toxicity techniques are vital both in maintaining personal health and reducing environmental contamination.

These methods may differ slightly in practice, as there are alternative ways to achieve the same results, and different examples of plant matter may present unique difficulties in the extraction procedure and require a refinement or modification of the method being used. If beginning with dry herbs, it is usual to allow them to rehydrate in the initial solvent before topping up, as the material will expand as it absorbs moisture.

Extraction of free-base alkaloids in an acidic medium

The pulverised herb is placed in a clean receptacle, and enough water is added to make a pourable soup. An acid [eg. distilled white vinegar, lemon juice (sources of acetic acid) or sulfuric acid] is added to bring the pH to 3-5 [which converts the alkaloids from their freebases to their hydrochloride salts, thus rendering them water-soluble]. This is simmered in a pyrex container for several hours or overnight with the lid on, with the herb being filtered out, and the process repeated 2-3 times; the fractions are combined and strained thoroughly. It is suggested not to squeeze the pulp except after the last extraction. Next, an amount of a defatting-solvent [eg. methylene chloride, petroleum ether, chloroform or naptha] equivalent to 10-15% of the combined fractions [by volume] is added; the mixture is shaken [not too hard, as an emulsion may form – see below], and the defatting-solvent layer [containing unwanted fats and resins] retrieved after it separates, and discarded. Often a small third layer is seen between the other two. This is a portion of emulsified material which should also be kept from the desired portions. In the case of *DMT* [and probably some other alkaloids], if acetic acid is used, with chloroform as the defatting agent, some alkaloid may be lost to the defatting solvent, as

DMT acetate is soluble in chloroform. This might also be the case with methylene chloride. If petroleum ether is used, some *DMT* N-oxide may be lost, as this chemical becomes soluble in petroleum ether, when the petroleum ether also contains fatty material. This process may be repeated to ensure removal of all unwanted lipids. Defatting may not be necessary if the plant material does not contain appreciable quantities of lipids. Sometimes, defatting is performed as the initial step. In that case, the material is moistened with an acid, and defatted directly before extraction.

A base [such as ammonia or ammonium hydroxide, which are preferable to sodium hydroxide; do not use ammonium carbonate] dissolved in a small amount of water is added carefully in small increments to bring the pH above 9, rendering the alkaloids basic, and no longer water-soluble. The desired pH will differ depending on the alkaloid/s being recovered. This critical point is referred to as the pKa, the pH at which the alkaloid is liberated from its salt form to its freebase form. Many alkaloids are not very stable in an alkaline aqueous solution, so once this point has been reached, the final extractions should be performed quickly. *DMT* is an exception in that it is reportedly quite stable under these conditions, though it is still preferable not to leave it sitting for too long in solution as it may form emulsions over time and become more difficult to retrieve.

Sometimes the alkaloids will simply precipitate from the solution and can be retrieved by filtering. Otherwise, the freebase alkaloids are extracted with an organic solvent such as ether – petroleum ether is not the same thing, and works poorly in the case of *DMT*, except when hot, in which case it can be used and later cooled to precipitate the alkaloids out of solution. An amount of the chosen solvent equal to about 10% of the solution is added, and the whole is kept in a tightly sealed glass container, to be shaken twice a day. Extracts high in tannins should not be shaken too vigorously, as a stubborn emulsion may form – it is unfortunate that tannins often form this emulsion with the alkaloids, when in an alkaline medium, making them difficult to retrieve. The emulsion can usually be broken by shaking the mixture thoroughly and filtering. If this doesn't work appreciably, then repeating the acid/base phase may be necessary.

After about 24 hours or less, collect the organic solvent layer and set it aside. The solution is extracted several more times with fresh solvent in the same manner, except the intervening time period is stretched to 1 week for each. The organic solvent fractions are combined, and distilled or evaporated to dryness. The end product will be a crude, gummy mix of freebase alkaloids and should be kept away from air or moisture. If very lucky, pure crystals might be obtained. The crude alkaloids should preferably be recrystallised several times for greater purity, if internal consumption [eg. via capsules] is intended, though this will involve some loss of alkaloid.

Extraction of free-base alkaloids in a non-acid medium

Many of the points made above are also of relevance here.

Extract the powdered herb into an organic solvent [such as ethanol] for up to several weeks, shaking regularly; this procedure can be carried out in a much shorter time if one has access to good reflux equipment. The mixture is filtered, with the biomass thoroughly squeezed out and washed through with a small amount of fresh solvent, before being concentrated by distillation to remove most of the solvent. This last step is very important if using an alcohol, which will mix with the water-based solutions to be used later. Be careful not to distil the solution to the point that it becomes thick.

Lower the pH of the solution to 3-5 with dilute hydrochloric acid [about 20ml per 2 litres of water]; sometimes this step is done before the concentration of the extract, as above. This is then defatted as above, if required. A lengthier, but perhaps more thorough approach to defatting is as follows. The boiled extract, after concentration and acidification, should be set aside and not disturbed for 24 hours, before being placed in a refrigerator for several days. After this period, the aqueous layer can be decanted, and filtered of traces of insoluble substances through charcoal.

Finally, the solution is made strongly basic and the alkaloids extracted as above (De Korne 1994; Manske 1950; Trout 1997-1998; pers. comms.).

For educational purposes, below are several examples of alkaloid extraction tailored for specific plants. These are by no means the only workable methods for extracting alkaloids from these plants, but they illustrate a variety of different simple and fairly low-tech approaches. However, when applied to plants containing prohibited chemicals, such procedures may be illegal to perform. The reader is advised to become familiar with their local laws regarding such matters.

Extraction of mixed alkaloids from Tabernanthe root bark

This procedure is similar to standard alkaloid extractions described above, and may prove useful for future therapeutic use of 'iboga' alkaloids [see **Tabernanthe**].

Powdered root bark was stirred with vinegar or acetic acid [0.5% conc.] for an hour or less, before filtering; heating the mixture impaired the filtering process, and initial extractions longer than 1hr or with stronger concentrations of acetic acid did not improve the yields. Repeated three times and the vinegar extracts combined, c.87% of the alkaloids were extracted. These solutions should not be left sitting for more than a few days as they easily become contaminated with bacteria. The solution was basified with ammonia, resulting in the alkaloids precipitating as solids, which settle at the bottom of the vessel. Filtration of the alkaloids was aided by first siphoning off most of the solution after settling. The mixed alkaloids can then be washed with distilled water, and dried at room temperature or with the aid of a gentle heat source. They can be further purified by dissolving in acetone, which separates a large amount of dark, insoluble material; gradually and incrementally adding concentrated hydrochloric acid to the solution until it becomes acidic precipitates the alkaloids as their hydrochlorides, which can then be filtered, washed with a small amount of acetone and dried [the solution may need refrigeration overnight for precipitation to develop]. However, this does not remove all alkaloids present from solution; the remainder can be mostly retrieved by evaporating the acidic acetone solution, then dissolving the resultant unstable oil in water and basifying with ammonia to precipitate the alkaloids. This procedure was observed to be more efficient than extraction with ethanol or chloroform, and can also be applied to **Voacanga** africana trunk bark (Jenks 2002).

Alcohol extraction of Ipomoea seed alkaloids

This method for avoiding the gastric upset and fogginess of the 'morning-glory effect' [see **Ipomoea**, **Turbina**, **Argyreia**] was retrieved some years ago through the internet, from the old newspage alt.drugs. I have encountered no one who has attempted this method or tested its claims, but it would seem to be a sensible approach, although illegal in many places.

If seeds to be used have been treated with chemicals, wash thoroughly in detergent and cold water. Dry them thoroughly and ensure they are free of residual detergent. Grind the seeds throughly in a coffee-grinder. Place the powder in a clean jar and cover with petroleum ether [about 360-500ml per 500 seeds]. Seal the jar and shake vigorously; let stand for 20 minutes and shake further. Pour the whole through coffee-filter paper [in a well-ventilated area], and set aside the petroleum ether, which can be re-used up to 4 more times for the same purpose. Dry the seed powder thoroughly, and wash and dry the jar before again putting the seed powder inside. Add a drinking-grade alcohol [40% or more], using 1 shotglass for every 30-250 seeds, depending on the desired strength [by volume of alcohol] of the end extract. Soak the seed pulp in the alcohol for at least 3 days, shaking regularly, before filtering it for consumption. If the alcohol solution is taken orally and held in the mouth before swallowing, effects should be rapidly apparent, allowing one to more accurately gauge the dose.

The experience is said to last 8-12 hours, and to be 'cleaner' than from the seeds ingested via simple cold-water extraction, as is done traditionally. The petroleum ether extract is claimed to remove fractions of the seed chemistry which cause side-effects such as headache, blurred 'fish-eye' vision, and counter-action of the psychedelic effects; this fraction is claimed to reside in the seed husks, and to be miscible with petroleum ether, and insoluble in water. Compounds causing nausea are said also to be found in the seed pulp, and are water-soluble and soapy, forming long strands in water; they are not soluble in alcohol or petroleum ether.

As stated above, the accuracy of this latter information is not known to me, though the extraction process described appears to be sound. I once tried this procedure on a batch of commercial 'morning glory' seeds, however the batch used did not seem to be particularly psychoactive and further experiments were not performed. The least I can say is that this method will not produce wondrous effects unless the seeds bear a useful chemical profile. See **Ipomoea** for further discussion.

Isolation of *harmine* and *harmaline* from Peganum harmala

Cover crushed seeds with 3 times their weight of water [containing 30g acetic acid per litre of water] and steep for 2-3 days; the seeds swell to form a dough which is pressed dry. The dry seed-mass is again soaked with twice its weight of a similar solution, macerated, and again pressed out. The filtered liquid is combined, and to this is added sodium chloride [salt – 100g per litre of liquid] – this transforms the desired alkaloids from their acetate to their hydrochloride forms, which are insoluble in cold sodium chloride solutions; they thus precipitate during cooling. The crystalline precipitate is retrieved and thoroughly filtered and dried [preferably with suction] and redissolved in hot water. To this is added further sodium chloride in small amounts until the alkaloids precipitate as a crystalline mush; this is repeated until they have turned a yellow colour.

The next step involves redissolving and separating the major alkaloids, *harmaline* and *harmine*, as bases. Ammonia is added to the solution in carefully incremented amounts, which makes the solution alkaline and causes *harmine* to precipitate as long needles. *Harmaline* does not precipitate until all of the *harmine* present has dropped out of solution. As soon as *harmaline* crystals [plates under a microscope] are detected, the addition of ammonia is stopped, and the *harmine* filtered off. The *harmaline* is recovered from the filtrate by further addition of ammonia. The freebase alkaloids may then be purified by recrystallisation as the hydrochlorides if desired (Marion 1952a).

It should be noted that many amateur chemists have had difficulty in getting these last steps [regarding separation of *harmine* and *harmaline*] to work well, without access to laboratory equipment. However for many people it is unnecessary. A mix of the freebase alkaloids may be obtained by avoiding the attempted separation, and instead simply adding ammonia until no more precipitate forms. The resulting filtered precipitate, which consists of fairly pure alkaloidal material, can then be dried and used either by vapourisation and inhalation of the vapours, or encapsulated and taken internally.

Extraction of *cocaine* hydrochloride from coca leaves [see Erythroxylum]

The following is from a DEA summation of the processes used in illicit *cocaine* manufacture. It will give a further understanding of some of the potential contaminants of 'coca-paste' and 'street' *cocaine*, as discussed under **Erythroxylum**.

The leaves are initially soaked in a solution of sodium bicarbonate and water. Kerosene, petrol or another water-immiscible solvent is added; the coca-alkaloids migrate into the solvent layer, which separates from the water and the leaves. The solvent layer is decanted, and treated with a hydrochloric acid solution. Sodium bicarbonate is added to the hydrochloric acid solution; the precipitate that forms is filtered and dried, and is known as coca-paste [containing up to 40% *cocaine*].

This is next dissolved in a weak solution of sulfuric or hydrochloric acid. Potassium permanganate mixed with water is added to this; a precipitate forms, which is discarded after being filtered out. Ammonia in water is added to the solution, and the new precipitate that forms is dried [often with heating lamps] – this is *cocaine* in its free-base form [up to 90% pure].

The free-base is dissolved in ether or acetone and the solution filtered for purity. Hydrochloric acid diluted in ether or acetone is added to the solution, causing *cocaine* hydrochloride to precipitate, to be filtered and dried with heat and/or fans [up to 99% pure] (Clawson & Lee 1996).

Other Miscellaneous Techniques

Hash oil production

There are various methods of producing hash oil, which is a concentrated oily extract of **Cannabis** that may be smoked, but is preferably vapourised for inhalation. I will discuss a few basic methods here for educational purposes, but for more detailed coverage, the reader should consult any of a number of commercially-available books on the subject (eg. Hoye 1973; Starks 1990). An internet search will also turn up plenty of information on this widely illegal activity.

A good hash oil will probably follow a procedure similar to the following:

Separate seeds from the herb, chop the herb finely, and put in a jar with enough alcohol to cover it well. Put the lid on, shake a few times, and let sit for 2 weeks, shaking several times daily. Filter the alcohol extract through coffee filters, and repeat for 1 further week with the remaining herb. Combine the alcohol extracts. The next step consists of isomerisation of the resins, which in simple terms converts the inactive or lesser-active cannabinols [eg. *cannabinol* (CBN)] and cannabidiols [eg. *cannabidiol* (CBD)] into active forms of *THC*. This procedure is only really necessary for low-quality **Cannabis**. For every ¼ cup of alcohol, carefully add 3 drops of sulfuric acid. Put the whole solution in a glass receptacle that can both a) be heated from below without breaking, and b) allow a glass filled with ice to sit in the opening at the top. Heat to a slow simmer [with the ice-filled glass in place] for 2 hours. Let the mixture cool. Next, for every ½ cup of solvent, add ¼ cup of a water/sodium bicarbonate solution [½ tsp sodium bicarbonate for every ¼ cup of water]. Shake well, and add about ¼ cup naptha [Coleman fuel], and shake well again. Retrieve the top layer when it separates. Repeat this last step on the solution, and combine the two top fractions, discarding the bottom fractions. The remaining combined fraction is evaporated in a glass baking dish until no smell of solvent remains. To further purify the oil by 'washing', it is redissolved in alcohol, with water added [½ as much as the alcohol]. This is shaken well, ¼ cup of naptha is added, and the whole shaken well again. The top layer that separates is evaporated as above. The oily residue that remains is the hash oil (Hoye 1973; Starks 1990).

If not trying to impress anyone, a cruder oil may be made, usually from leaf. The chopped herb is soaked first in lukewarm water for several hours, after which the whole mixture is filtered through a fine cloth, and the water discarded. The herb is spread out to dry completely, before being soaked in alcohol as above for a week or more, with daily shaking. The alcohol is filtered and saved, with the herb being extracted in the same way a second time. The thoroughly filtered alcohol extracts are combined and evaporated, for a hash oil that is less pure and correspondingly less potent than an oil obtained by the previous method (pers. obs.).

Other concentrated extracts for smoking

I sometimes use a simple alcohol extraction, soaking for several days, for aromatic plants such as many **Artemisia** and **Salvia** species, which can then be dried and smoked as above for a more definite effect than smoking the dried herb itself. I find this useful in assaying plants of the mint family [Labiatae] for psychoactivity [see **Salvia** for more discussion]. A very potent smoking extract is often prepared from **Salvia** divinorum, by soaking in high-proof alcohol for only several hours, before filtering the solvent, and evaporating thoroughly onto ¼ the amount of leaves originally used in the extraction. For example, soak 100g of dry, finely-chopped leaf material in alcohol, then, after filtering out the plant matter, add the alcohol extract to 25g of dry, finely-chopped leaf material, and evaporate the alcohol from this in a flat dish. The relative potency of such extracts is termed as related to the amount of leaf material that the extract is evaporated on to – so, the extract just mentioned would be referred to as a '4x' extract – if I had used 1/10th the original amount, the extract would be '10x'. The 4x and 5x are the most commonly used with this exceedingly potent plant. This approach has also been effectively applied to the flowers of **Nymphaea** caerulea. In the 60's and 70's, the usual method of smoking *DMT* was to evaporate it onto a herbal medium - often parsley [**Petroselinum**] - in the same manner. Today this has become a popular method again, often using **Banisteriopsis** leaf, which provides an extra synergy rather than being a relatively inert carrier. Such *DMT*-enriched smoking material is known as 'changa'.

Beginner's Plant Alchemy

Alchemical extraction methods may also be attempted, though the theory behind them is complex and beyond the scope of this work. There are several excellent books available on plant alchemy. One text, 'The Alchemist's Handbook' [by Frater Albertus, publ. Weiser, 1974; unfortunately I've never actually seen this] gives a technique, which was attempted by an internet psychoanut, with 'lemon balm' [Melissa officinalis – see *Endnotes*].

Grind the herb, place it in a glass container, and fill the container 1/2-2/3 full of alcohol [food grade], preferably brandy. The container is then covered, and kept warm to macerate for a few days. The liquid is poured off into a clean glass container, and the remaining herb dried and burned until it is a light grey – the salt or crystals from the herb should be separated from the ashes [there will probably only be a small amount]. While still hot, the ashes are added back to the liquid [which is heated previously to keep the hot ashes from cracking the glass]. This mixture, the liquid essence, is then tightly sealed, and kept slightly warm for about 2 weeks.

A few grains of the salt, together with a teaspoon of the liquid essence, is diluted in distilled water and consumed to produce [in the case of lemon balm] what were described only as 'exhilarating results' (pers. comm.).

METHODS OF INGESTION

Oral ingestion

via the digestive tract

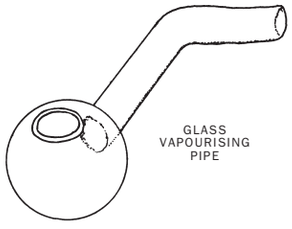
Drugs that are both soluble and stable in stomach fluid may be consumed in this way, where, from the stomach, they enter the intestine and pass into the bloodstream; or, they may enter the blood directly through the stomach lining. Drugs taken in this way are better absorbed if already in solution, rather than in tablets or capsules. Only lipid-soluble particles will diffuse readily across cell-membranes. Generally, about 75% of the drug may be absorbed by the body, over about 1-3 hours. Side-effects noted with some substances taken by this route are more likely to include nausea and vomiting (Julien 1995).

via the mucous membranes

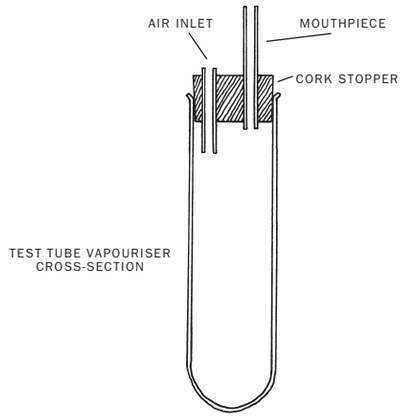
Using this pathway, drugs that may be destroyed by the acidity of the stomach [or enzymatic activity therein] are taken sublingually – that is, chewed and held under the tongue or in the cheek, and the saliva held in the mouth for some time rather than swallowed immediately. This is the preferable route of administration for **Salvia** divinorum – the herb is usually held in the mouth for about 10-15 minutes, before being spat out or swallowed. Other drugs may be used this way purely for more efficient and rapid absorption, as compared to the gastrointestinal-route, such as is practiced with coca leaves [see **Erythroxylum**] and **Areca** nuts. These are usually chewed and sucked for hours with an alkaline reagent, such as calcinated lime, to aid in liberation of the alkaloids from the plant matter. After an initial chewing, the wad may simply be left in place between the gum and the inner lip. Many materials have been used to create this alkaline reagent. Limestone [calcium carbonate] chunks are often heated on a fire until red-hot [releasing carbon dioxide], then cooled suddenly with a small amount of water, causing the stone to fissure and give off a fine, white powder [calcium hydroxide, a powerful alkali]; sometimes seashells are used, yielding an end result also bearing traces of potash; bones may also be used. Sometimes plants are used instead [burnt slowly down to an alkaline ash], where limestone or shells are not available – corn cobs, **Theobroma** pods, **Musa** roots and leaves, cacti fruits, roots and stems of haba beans, and quinoa stalks have all been used. The ashes are usually mixed with agglutinants and flavourings such as dry powdered potato, boiled corn grains, salt, sugar, **Citrus** fruit juice, water, even human urine, and sometimes a little lime if available, to make a fairly dry paste. The mass is then compacted and dried in the sun. In more recent times, some coca-chewing cultures in South America have come to use sodium bicarbonate ['bicarb soda'] as an effective and easily-obtained mild alkaline reagent (Antonil 1978; Davis 1996; Hilgert 2001; Schultes & Raffauf 1990).

Smoking

Here the powdered, chopped or shredded drug is burned or vapourised, and the fumes inhaled, to be absorbed through the lungs into the bloodstream. This is a very rapid and efficient route; effects of administration are felt usually within 5-60 seconds. Smoking has the advantage of quick onset of effects, which allows one to more accurately gauge dosage. Usually, after oral ingestion, if one has taken too much there is little that can be done to end the experience, and vomiting may be required to avoid poisoning with the more dangerous compounds. However, the effects also wear off more rapidly compared to oral administration, where more of the substance may be required for the same level of effect, but effects are more prolonged. Burning plant-matter produces tars and other dangerous substances which can injure the sensitive tissues of the lung, and hot smoke can also irritate the airways. Vapourisation is preferable,

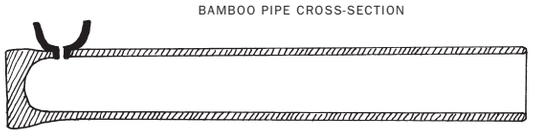


as the finely-powdered plant matter, or extract, is simply heated through glass or metal until the active components reach their boiling points and give off vapours. Hence, no smoke or pyrolysis by-products are inhaled, and no active compounds are destroyed by flame, which occurs partially with burning. Plans to build home-made vapourisers are available on the internet; ready-made vapourisers are also legally available from a number of commercial suppliers. Many people have experienced dissatisfaction with some of these products, particularly home-made devices [due to taking too long to heat up, not getting hot enough to work well, not very suited to efficient group smoking etc.], so anyone considering buying one should shop around, as they are an expensive purchase.

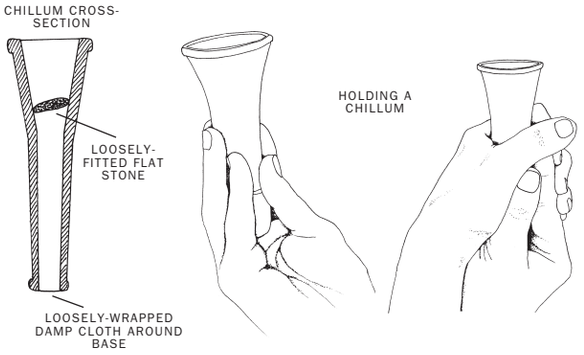


One straight-forward approach to vapourisation is known as 'free-basing', and takes advantage of the low boiling-points of some alkaloids in their free-base form [eg. *DMT*]. This involves the use of a specially designed or conveniently shaped glass pipe or tube, open at each end [see diagram]. The drug is placed inside a chamber or hollow at one end of the pipe, and is heated from beneath the glass with, usually, a gas flame, until the material begins to melt, boil and send off vapours. The vapours are immediately inhaled deeply and slowly, until all the vapour has been inhaled. In many cases, if vapour is allowed to fill the chamber and touch the sides of the glass, it will rapidly cool and re-solidify, making it harder to smoke efficiently. Vapourisation in this manner is often the preferred route of administration for *DMT*, opium [see **Papaver**] and sometimes *salvinorin A*. Alkaloids used in this fashion should both be in their free-base form, and have a low boiling point, for vapourisation to be practical without the use of destructive levels of heat. For maximum effect via this route, at least with the two substances just mentioned, the vapour should ideally be inhaled in one breath, and held in the lungs for as long as possible before being exhaled. Some people say that with *DMT* it is best to only hold the first inhalation briefly, and to hold subsequent larger inhalations for as long as is practical. Breathing vapours out through the nasal passages has also been suggested to increase absorption into the brain.

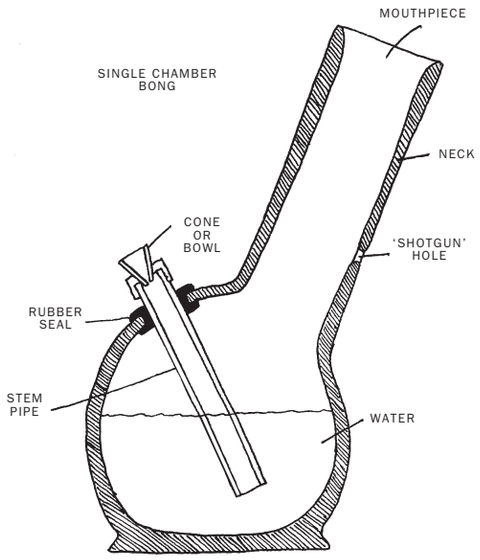
Another straight-forward approach to vapourisation, often applied to hashish [see **Cannabis**], is known as 'hot-knifing'. All that is needed is a heat source [such as the flame of a gas stove-top], a pair of metal knives [or spoons], and something through which the vapours can be collected and inhaled [such as an inverted funnel, or a bottle with the bottom cut out]. The two knives [or spoons] are heated over the flame, and when sufficiently hot, the powdered or resinous substance to be vapourised is placed on one of the knife blades [or in one of the spoons]. The second utensil is pressed against the first, sandwiching the drug between two pieces of hot metal, and the vapours that are emitted can then be collected and inhaled. In more primitive circumstances, plants have been known to simply be thrown on hot coals and the smoke inhaled. Sometimes, this operation is performed within an enclosed structure to maximise retention of the valued fumes.



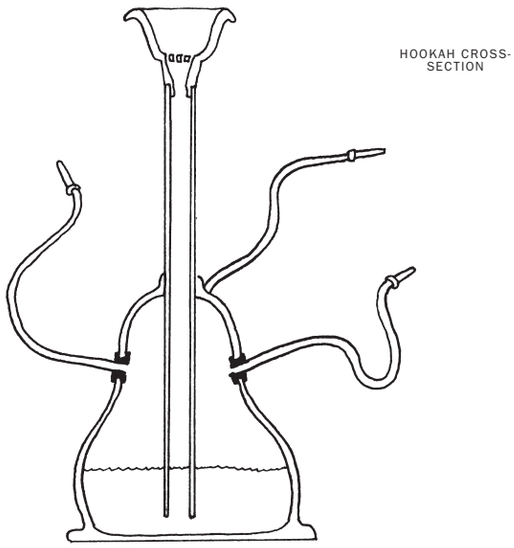
Burning [or pyrolysis] is usually accomplished with a dry-pipe, a water-pipe, or a hand-rolled cigarette. The former is generally the harshest on the lungs. At its most basic, a dry-pipe consists of a hollowed out cone, or bowl, with a small hole in the bottom, joined to a hollow tube that is sealed at one end [see diagram]. The bowl is packed with the herbal material, and with a flame held just above the herb, the smoker seals the mouth to the pipe and inhales [which draws the flame into the herb, setting it aglow but not flaming]. The smoke is either taken in large breaths, held in for a while, and then exhaled; or it is sucked in in increments, or layered, and breathed out in the same manner, in a mild form of hyperventilation. This latter practice gives a more rapid and overwhelming effect, and is usually the preferred means of smoking from a classical 'chillum' [see diagram], much used by Rastafarians and Hindu saddhus [in Afghanistan, straight-stemmed water-pipes (see below) are called chillums].



Water-pipes, commonly called 'hookahs' or 'bongs' [depending on the design; see diagram], bear one or more water chambers, which serve



to filter and cool the smoke. Water-pipes basically involve the dry-pipe design just described, extending downwards into the water chamber. This is open at the top as a mouthpiece, or instead being sealed, with tubes or hoses leading out for multiple-person inhalations. Often a hole, about



0.5cm in diameter, is located on the neck of the final chamber; this is often termed the 'shotgun' hole [sometimes 'shotty' (in Australia), or 'carburettor' (in the US)]. It is covered with a finger or thumb during inhalation [as the smoke is pulled through the water by suction], to be released near the end to produce a final rush of smoke that clears the chamber, due to being pushed out by the incoming air through the shotgun hole. Unexpectedly, in the case of **Cannabis**, water pipes have been found to filter out some of the water-insoluble *THC* from the smoke, as well as being relatively ineffective at filtering out tars (Gieringer 1996). However, it is still clear that such devices do filter out some harmful portions of the smoke. This is self-evident when cleaning a water pipe that has been used with the same water for any extended period! Tars that would otherwise enter the body also collect inside the stem and inner walls of the chamber.

Herbs are most simply smoked by wrapping them [once well-chopped] into a cigarette, which may consist of 1 or more rolling papers stuck together. With many herbs, a double layer of papers is used to slow combustion and make the cigarette last longer. Hand-rolled herbal cigarettes are often called 'joints' [generally when containing **Cannabis**], except if they contain only tobacco [see **Nicotiana**], in which case they are sometimes termed 'rollies' [in Australia]. Herbs for smoking are often chopped with tobacco, both to help the herb burn evenly, and to add extra flavour and potency [and unfortunately, addictive power]. The disadvantage of joints is their inefficiency – a large amount of smoke dissipates into the air between inhalations, being lost to the smoker, and the remaining herb burns away more rapidly due to greater availability of oxygen than occurs in a pipe. This method is just as effective subjectively as the others, yet more herb needs to be used to make up for wastage incurred during smoking.

When smoking herbs, care should be taken not to inhale too forcefully, as this sucks a greater amount of oxygen into the burning herb, increasing the temperature of combustion – thus, more of the active compenents may be destroyed by heat before they can enter the smoke. It should of course be mentioned that smoking anything can cause damage to the respiratory system, and increase the risk of associated cancers.

Amongst enthusiasts of smoking herbs, experimenting with the manufacture of different blends has always been a popular pastime. Often interesting effects are gained which would not be experienced with any of the individual component herbs smoked by themselves. Also, small amounts of each constituent may synergise to provide a potency that would not be expected with such a small amount of the herb alone. Smoking blends are not discussed in depth below, under 'Combinations', as apart from the need to use herbs that are actually smokable and will not burst into flames, the only limits are your imagination! See also Brounstein (1995) and Rätsch (1990) for discussions on blending herbal smoking mixtures.

Aromatherapy

Aromatherapy is a science growing rapidly today, and consists of treating emotional and some physical complaints through inhalation of aromatic vapours from essential oils. This may be accomplished either through smelling the oil at room temperature, or inhaling the fumes from dilute oils heated from below in an essential-oil vapouriser. The mood-enhancing, calming or stimulating properties of aroma, often in the form of incense, have been long known to many indigenous cultures. Modern science still has a relatively poor idea of how essential oils interact with the brain to produce the effects that they do. To my knowledge, several European research groups have been working for quite a while in this area of study, but are only publishing findings in an extremely expensive and difficult to obtain journal. Here is a tiny hint of what the public has been allowed, culled from a poster (Tisserand 1988) circulated through In Essence® Aromatherapy in Australia:

Essential oils of 'clary sage' [see **Salvia**], 'jasmine' [see **Jasminum**], 'patchouli' [see *Endnotes*] and 'ylang-ylang' [see **Cananga**] are aphrodisiac and appear to act on the pituitary gland, possibly stimulating *endorphin* release.

Essential oils of 'bergamot', 'geranium' [see *Endnotes*], 'frankincense' [see **Boswellia**] and 'rosewood' appear to have a mood-regulating effect through the hypothalamus.

Essential oils of 'clary sage', 'grapefruit' [see **Citrus**], 'jasmine' and 'rose-otto' are euphoric, and appear to act on the thalamus, possibly stimulating *enkephalin* release.

Essential oils of 'chamomile' [see **Anthemis**/**Matricaria**], 'orange blossom' [**Citrus**], 'marjoram' and 'lavender' [see *Endnotes*] are sedative, and appear to act on the raphe nucleus in the brain, possibly stimulating *serotonin* release.

Essential oils of 'cardamom', 'juniper' [see **Juniperus**], 'lemon grass' [see **Cymbopogon**] and 'rosemary' [see *Endnotes*] are invigorating, and appear to act on the locus ceruleus, possibly stimulating *norepinephrine* release.

Anyway, it is known that, like other aromas, those of essential oils interact with neurons via the olfactory membranes, in the upper nasal cavity, which offers almost direct interaction with the brain (Battaglia 1995).

Snuffing

Snuffing involves inhalation into the nostrils of a finely powdered herb or herbal extract [sometimes a viscous liquid – see **Nicotiana**], and its subsequent absorption into the bloodstream through the nasal mucosa. Also, from deeper into the nasal cavity, certain blood vessels with no blood-brain barrier interact directly with the cranial cavity, which might offer a very rapid course to the brain. The efficiency of absorption may depend on the force of inhalation – if one is snuffing from the palm of the hand, or through a tube off of a smooth surface [with a finger held on the other nostril], the force is relatively low and little of the substance reaches

the more permeable membranes higher in the sinuses. If the snuff is blown into the respective nostrils by a second person using a long tube, the substance is received quite forcefully, and some particles may even reach the lungs, which is not desirable (Holmstedt & Lindgren 1967; Wassén & Holmstedt 1963). Some pure chemical substances may be snuffed less painfully by dissolving in a suitable solution and administering with a nose-spray bottle, which has the added advantage of the snuffer being able to calibrate the dose fairly accurately. Side-effects of snuffing appear almost instantaneously, and may include runny nose, burning sensation in the nasal cavity, headache and irritation. Long-term snuffing damages the nasal mucosa.

Jonathan Ott has recently published a dense overview of psychoactive snuffs (Ott 2001c), which the interested reader will no doubt wish to consult.

Optically

Drugs in relatively pure form, usually diluted in fluids, are sometimes administered as eyedrops (see Samorini 1996c) or simply smeared on the eyes [eg. see **Elaeophorbia**]; effects via this route are often very quickly felt, but some substances applied this way may cause painful irritation or optical damage. I have observed a friend administer LSD [in paper 'tab' form] to herself by placing it under her eyelid, removing it when she began to feel the effects. Personally I don't care to go poking around my eyes in such a fashion, but this provides some further evidence of optical administration as an effective route.

Rectally

Here the drug is administered in either a suppository or a liquid enema form, for absorption into the blood from the rectal- and intestinal-lining. It is usually used for those who are unconscious, or unable to swallow or keep things down, and the absorption from rectal administration is usually irregular and incomplete. However, in some cases rectal administration has proven fatal [eg. with coffee enemas (Eisele & Reay 1980) – see **Coffea**], and many drugs also irritate the rectal membranes.

Injection

This is not recommended unless if undertaken with medical supervision, due to the very real possibility of infection and air embolism associated with injecting substances directly into the bloodstream. Crude plant extracts should never be injected – if you really must use this approach to ingestion, use pure compounds only and clean, sterile equipment.

Pure substances may be injected intravenously [i.v.], directly into a vein; intramuscularly [i.m.], directly into skeletal muscle; subcutaneously [s.c.], under the skin [in crude conditions this may include the application of a drug to burns or wounds made especially for this purpose – eg. see **Phyllomedusa**]; or intraperitoneally [i.p.], into the gut. Absorption with i.v. and i.p. methods is very rapid; i.m. and s.c. injections are absorbed more slowly. Injection is the most dangerous of all of these methods of ingestion. It is easy to overdose, as the substance involved is introduced directly into the blood without any biological hindrance from the gastrointestinal-tract to modify the effects to a safe level. Overdose is also more difficult to treat, as stomach-pumping or vomiting make little or no difference, since the substance never entered the digestive tract.

Cutaneously

Some substances, such as *nicotine* and *hyoscine*, may be absorbed directly through unbroken skin and into the bloodstream. Such topical administration is more delayed and prolonged in effect, particularly if the substance is kept in place on the skin. Some spots on the body absorb compounds more easily due to being more porous, such as the areas between the toes, in the armpits, on the temples and behind the ears. Substances may be topically administered by preparation of an ointment or salve, by bathing in a decoction or infusion of the herbs [see *Producing Plant Drugs*], or by direct application [such as wearing a head-band of bruised herbage, or inserting a chewed cud of tobacco (see **Nicotiana**) behind the ear].

Distribution and expulsion from the body

Once a drug enters the bloodstream, it disperses throughout the body via the circulatory system, with a small portion reaching the brain and other bodily organs after contending with lipid-barriers, enzymes and other biological modifiers. Those chemicals that enter the brain from the blood interact with neurotransmission or neuronal function [see *Neurochemistry*], after which they are usually enzymatically degraded, and removed from the brain to be transported by the bloodstream into organs of excretion. Some volatile substances, such as alcohol, can be partially excreted as fumes via the lungs. Alternately, for most other substances, the chemicals are filtered from the blood by the kidneys, and the liver enzymatically turns them into less lipid-soluble forms, which are later excreted in urine and faeces. Chemicals may also be eliminated via the bile, saliva, sweat and breast-milk, or in drastic situations, vomit.

Combinations

Often plants are consumed in combinations designed to increase or modify the desired effects. This may take the form of a synergy, where the different components complement each other to increase effectiveness beyond the sum of the parts. It may be done to add different aspects to the whole experience, or to counteract unwanted or hazardous side-effects. Other types of combination are intended to render active plants which would not normally be effective alone [such as in the Amazonian 'ayahuasca']. To illustrate the possibilities of combinations, we will look at a number of important examples of plant-combining in both historical and modern-day practice. Please bear in mind that some combinations may be much more toxic and potentially dangerous than the individual substances. In some cases these combinations are known of and are warned against, but the gaps in our knowledge of drug interactions are vast, and any new combinations should be treated with utmost caution until their properties have been evaluated. Both with herbs and pure chemicals, experimenting with new combinations has become a popular pastime amongst drug enthusiasts - sadly this has occasionally resulted in deaths. Be smart and don't become a statistic!

Wines, Beers, and Meads

Although wines are primarily prepared from the fermentation of grapes [fruit of Vitis vinifera], usually producing 8-14% alcohol, it is lesser-known that the ancient Egyptians and Greeks quite often fortified their wines with intoxicating herbs. Thus, the potent Greek wines of legend [which had to be diluted with water for safe use] do not merely owe their effects to alcohol content. It should be noted, however, that some older texts do not always clearly distinguish between wines, beers and meads, yet all are alcohol-containing products of fermentation. This method of fortification with herbs works well, as the alcohol provides a solvent and preservative for the additive plants. However, alcohol can synergise with some other herbs to produce a dangerous degree of depression [ie. of the respiratory system; eg. see **Papaver**], so care should be taken with choice of additives.

The Egyptians are known to have fortified their wines with plants such as **Datura**, **Hyoscyamus** and **Mandragora**; as well as possibly **Catha** edulis, **Papaver** somniferum and **Nymphaea** caerulea. The Greeks were known to have used **Atropa**, 'hellebore' [Helleborus spp. (Ranunculaceae), or **Veratrum** spp.], **Hyoscyamus**, **Mandragora**, **Papaver**, **Crocus** sativus, Oleander spp. [Apocynaceae; highly toxic!], Cyclamen spp. [Primulaceae] and a variety of incenses as additives.

Beer is produced from the fermentation of malted grain with brewer's yeast [Saccharomyces uvarum (S. carlbergensis); S. cerevisiae is used for ales] in water, along with herbal additives, today usually hops [see **Humulus**]. Belgian lambic beers instead use over 30 different types of wild yeast. The alcohol content of beer is generally 2-5[-10%]. However, in our earlier history, many beers were made using additives more intoxicating than hops. The same can be said for meads [mead being a more ancient preparation than beer or wine], which basically consist of fermentations of water and honey [generally 2-4% alcohol]. Such additives [in Europe] included 'ash' leaves [Fraxinus excelsior (Oleaceae)], **Cannabis**, **Datura**, **Atropa**, 'hellebore', **Hyoscyamus**, **Ledum**, **Lupinus**, **Mandragora**, 'myrtle' [Myrtus communis (Myrtaceae)], 'bog myrtle' [Myrica gale (Myricaceae); see *Endnotes*], oak bark [Quercus spp. (Fagaceae)] and **Papaver**. Celtic druids were associated with the use of magical beers or similar ritual or healing beverages; **Hyoscyamus** and **Amanita** muscaria have been hypothesised as likely ingredients for these Druidic beverages. The narcotic Erica spp. ['heather' (Ericaceae); see *Endnotes*] were a popular ingredient of meads and beers for centuries across Europe, Scandinavia and the British Isles (Buhner 1998; Rätsch 1992, 1998, 1999b; Simpson et al. 1996).

African groups have been hypothesised to have once made mead using *psilocybin*-containing fungi [see **Panaeolus**, **Psilocybe**]. A west African 'millet' [Sorghum vulgare (Gramineae) – see *Endnotes*] beer called 'dolo' has used additives including **Acacia** camplyacantha, 'balanos' [Balanites aegytica (Zygophyllaceae)], **Datura** seeds, **Grewia** flavescens and Hibiscus esculentus [Malvaceae; see *Endnotes*] (Rätsch 1992). Millet beer made in Tanzania, known as 'pombe', has been found to contain c.4-5% alcohol. The related 'sorghum' or 'guinea corn' [S. bicolor] is also widely used in Africa as a source grain for fermented beers (De Smet 1998).

A South African beer/mead called 'khadi', which is prohibited in some areas, has many regional variations, but is generally based on water, sugar or honey, a fungus that grows inside termite mounds, and roots [sometimes fruits] of various tuberous plants. The latter ingredient may consist of Coccinia spp. [Cucurbitaceae], **Delosperma** spp. [Aizoaceae], Eriospermum spp. [Liliaceae], Euphorbia spp. [Euphorbiaceae; see *Endnotes*], Glia spp. [Umbelliferae], **Grewia** spp. [Tiliaceae], Kedrostis spp. [Cucurbitaceae], Khadia spp. [Aizoaceae], **Nananthus** spp. [Aizoaceae], Rhaphionacme spp. [Periplocaceae], Stapelia spp. [Asclepiadaceae][S. gigantea is a Zulu remedy for hysteria (Watt 1967)], Trochomeria spp. [Cucurbitaceae] and/or Tylosema spp. [Leguminosae] (Hargreaves 1999).

Apparently in Australia, Physalis peruviana [Solanaceae] has been used to make a psychoactive beer (Rätsch 1998); tropane alkaloids are found in the genus [see *Endnotes*].

Traditional beers are usually not strained, thus retaining some of the yeast and its accompanying noteworthy nutritional virtues (Buhner 1998). Forms of wine have also been made from the fermentation of plants other than Vitis, such as the palm wines popular in tropical areas, produced from immature coconuts [Cocos nucifera; Palmaceae], which may reach an alcohol content of over 7%. Gabonese palm wine may sometimes be strengthened with Chasmanthera welwitschii root [Menispermaceae], bark from Garcinia klaineana, G. mannii and/or G. ngouyensis [Guttiferae; see *Endnotes*], Morinda confusa leaves [Rubiaceae; see *Endnotes*], Turraea vogelii leaves [Meliaceae; see *Endnotes*], Xylopia aethiopica leaves [Annonaceae], **Dioscorea** latifolia var. sylvestris tuber and Gardenia ternifolia [Rubiaceae; part used not reported, though the root has been used as a homicidal poison]. The date palm Phoenix dactylifera (Arecaceae) was tapped for its sap by the Mesopotamians, who fermented it to make wine. Palm and date wines have a reputation for aphrodisiac properties, but the same could probably be said of alcoholic beverages in general; however, sometimes it has been fortified with **Datura** seeds for this purpose. Bananas [see **Musa**] have likewise been used in parts of Africa to prepare fermented beverages. 'Manioc' or 'cassava' root [Manihot esculenta (Euphorbiaceae)] is also widely used to prepare alcoholic beverages, both in Africa and S. America [see 'chicha' below, and *Endnotes*]. In South Africa Hyphaene crinata sap is sometimes used, and in Malawi the fruit of **Ziziphus** abyssinica is used. The main requirement for a plant part to ferment is a reasonable content of sugars and/or starches; the potential range of choice for starting materials is therefore enormous (De Smet 1998)!

Balché

This Mesoamerican brew is further discussed under its own entry [see **Lonchocarpus**]. It is also a mead-like drink, based on honey, and the bark from **Lonchocarpus** violaceus [probably psychoactive on its own]. It is sometimes further fortified with inebriating plant and animal substances, such as the following [with some Mayan names]:

Acacia cornigera – 'akunte''
Agave spp. [see 'pulqué' below] – 'kih'
Bufo marinus – 'bab'; **Bufo** spp. – 'wo''
Capsicum spp. – 'ik'
Datura inoxia – 'xtohk'uh'
Nicotiana spp. – 'k'uts'
Nymphaea ampla
Plumeria alba, P. rubra [Apocynaceae] – 'nicte' [see *Endnotes*]
Polianthes tuberosa, P. spp. [Amaryllidaceae] – 'bac nicte'
Tagetes erecta, T. lucida – 'macuil xuchit'
Theobroma bicolor – 'ninichh cacao'
Theobroma cacao – 'hach kakaw'
and Vanilla planifolia ['vanilla bean'; Orchidaceae; see *Endnotes*] – 'bukluch'

The following additives are suspected of having been incorporated into balché:

Dendrobates spp. [see **Phyllomedusa**] – 'xut''
Lophophora williamsii – 'wi''
Panaeolus subbalteatus – 'kuxum lu'um'
Passiflora spp. – 'poch', 'pochil-ak'
Psilocybe spp. – 'lol lu'um'
Solandra spp. – 'bak nikte''
and **Turbina** corymbosa – 'xtabentum' (Rätsch 1992, 1998)

Chicha

'Chicha' is a generic term referring to mildly alcoholic beverages popular throughout Central and South America. The fermentation is usually based on germinated and masticated corn [Zea mays (Gramineae)], though other plants have been used as the basis including **Acacia** aroma fruits, Berberis congestiflora, B. darwinii, B. linearifolia [Berberidaceae], Chenopodium quinoa [Chenopodiaceae], **Gaultheria** phyllireaefolia, Manihot esculenta [Euphorbiaceae; 'manioc'], Mauritia spp. [Palmaceae], **Pernettya** spp., **Prosopis** alba, P. chilensis, P. tamarugo fruits, Schinus spp. [Anacardiaceae] and Ugni spp. [Myrtaceae]. The drink is often fortified with other psychoactive additives, or thus used as a delivery agent for the additives. Plants used as additives have included **Anadenanthera** colubrina, **Ariocarpus** fissuratus, **Brugmansia** spp., Chytroma gigantea and C. turbinata [Lecythidaceae] dried and powdered flowers, **Coryphantha** spp., **Datura** inoxia, **Lolium** temulentum, **Lophophora** williamsii, **Mammillaria** spp., **Nicotiana** glauca, **Pachycereus** pecten-aboriginum, **Passiflora** rubra fruit, **Paullinia** yoco and **Tabernaemontana** muricata (Cobo 1990; Cutler & Cardenas 1947; Festi & Samorini 1999a; Rätsch 1992, 1998; Schultes & Raffauf 1990).

Pulqué

'Pulqué' is a Mexican alcoholic beverage, produced from succulents of the genus Agave [Amaryllidaceae/Agavaceae; also known as 'maguey' or 'century plants']. It was popular with the Aztecs and other related cultures, who usually held it to be sacred, and its consumption was generally restricted to either ritual or medicinal purposes. The drink is made by first severing the top of the middle stem as it elongates and prepares to flower. The wound resulting from this is left to heal over for several months, and is later pierced repeatedly, hollowed out to form a cavity, and left for sap to collect and age. The sap is collected periodically, with fresh wounds to the plant cavity being covered over each time. Once collected, the sap is further fermented for 1-2 weeks. The drink was once frequently fortified with other ingredients, some of which have been identified or tentatively identified, including **Acacia** albicans, A. angustissima, **Bursera** bipinnata [Burseraceae; see *Endnotes*], **Calliandra** anomala, **Datura** spp., **Lophophora** williamsii, **Mimosa** spp., Phaseolus spp. [Leguminosae], **Prosopis** juliflora, **Psilocybe** spp., **Rhus** schinoides, **Sophora** secundiflora, Triticum aestivum [Gramineae] and **Turbina** corymbosa (De Barrios 1997; Rätsch 1992, 1998). A variety of Agave spp. are used in Mexico to make 'mezcal', a liquor distilled from the plants [and also a name for the plants themselves]. Mezcal quality varies considerably, due to the species used and the methods and materials used to prepare it - much mezcal is 'bootleg' liquor made in rural areas. 'Tequila' is a kind of high quality mezcal which is made only in the region of Tequila, and only from A. tequilana (Bahre & Bradbury 1980; De Barrios 1997; Rätsch 1998). For discussion of the 'Agave worm' or 'mezcal worm' see *Endnotes*.

Although Agave spp. have sometimes been used in Mexico to stun fish, it is unclear whether they have psychoactivity of their own without fermentation, although pulqué has been observed to have a 'clearer' mental effect than many similar low-alcohol beverages, which does suggest some pharmacology of interest. They generally contain saponins, steroid saponins, papain, sugars, hecogenin glycosides, polysaccharides, minerals and vitamin C. A. americana has yielded 0.4-3% hecogenin, oxalic acid, saponins and an essential oil (Rätsch 1998). *GABA* has been found in Agave americana var. marginata (Durand et al. 1962).

Chhang

'Chhang', a word with many variations in spelling, is the name of a fermented beverage with even more variations of recipe from region to region. It is prepared and used in various parts of Asia, especially Nepal, n. India, and Tibet. Based on rice, barley, and/or millet, the beverage is distinguished, despite its variations, due to the use of specially prepared yeast cakes [also made with many local variations], which are added to initiate fermentation. The major ingredients of these cakes are usually rice or barley flour, as well as crushed ginger root; ginger is used because it often carries **Aspergillus** spores, which develop when the ingredients are crushed together and fermented in a moist cloth. This mould [as well as members of several other genera sometimes found, such as **Rhizopus**, Hansenula and Mucor] converts the starches present into sugar, which are fed upon by wild yeasts (Buhner 1998). Psychoactive plants, such as **Tribulus**, are sometimes added to chhang to fortify the beverage (Navchoo & Buth 1990).

Absinthe

'Absinthe' is an alcoholic liquor produced using primarily **Artemisia** absinthium, as well as other herbs, some of which are also psychoactive. There are many different recipes, but here is one:

- **Artemisia** absinthium 30g
- **Acorus** calamus 1.8g
- **Coriandrum** sativum seed 3.2g
- Hyssopus officinalis 8.5g [Labiatae; 'hyssop']
- **Foeniculum** vulgare seed 25g
- **Illicium** verum fruit 10g
- Melissa officinalis 6g [Labiatae; 'lemon balm' – see *Endnotes*, *Producing Plant Drugs*]
- and **Pimpinella** anisum seed 30g

Place the dry herbs in a jar, moisten with a little water, and add 800ml 85-95% alcohol; steep for 1 week, shaking every day; add 600ml water, and leave for 1 more day. Strain out the liquid finely, squeezing out the herb pulp; wet the herbs with some more alcohol, and squeeze out again. This must be distilled, changing the receiver when distillate turns yellow. To the distillate, add another 3g A. absinthium, 1.1g M. officinalis, 4.2g Mentha spp. [Labiatae; 'mint' – see *Endnotes*], 1g **Citrus** spp. peel and 4.2g **Glycyrrhiza** spp. root. Macerate for 3 days, before straining finely, and add a small amount of sugar syrup. Makes 1 litre.

Absinthe has a special procedure for serving. A small amount is poured into the glass; a slotted spoon is placed over the glass, holding a sugar cube; and water is poured over the sugar cube into the glass, changing the colour of the absinthe from green to yellow (Conrad 1988; Pendell 1995).

Taoist elixirs of immortality

Taoist alchemists in ancient China, and likely still today internationally, long strived in secret to ritually prepare combinations of plant, animal and mineral substances in order to obtain a legendary 'elixir of immortal-

ity' or of 'enlightenment'. The ingredients of such combinations are mostly shrouded in obscurity, and could be expected to have differed from one practitioner to the next. However, some are known, and include substances with actions ranging from tonic and adaptogenic, to psychedelic. As qualities may overlap, I will not attempt to categorise them, but such constituents have reportedly included **Amanita** muscaria, **Camellia** sinensis, **Centella** asiatica [ancient useage in dispute – see the **Centella** entry], **Ganoderma** spp., **Nelumbo** nucifera, **Nymphaea** spp. and **Panax** ginseng (Cooper 1984; Hajicek-Dobberstein 1995; Rätsch 1992).

Mushrooms containing *psilocybin* might have been used (Sanford 1972), such as possibly species from **Gymnopilus**, **Psilocybe**, or **Panaeolus**. Other representatives of the wide array of tonics used in Traditional Chinese Medicine [TCM], such as Polygonatum cirrhifolium [Liliaceae; 'huang jing'], might also have been used for these pursuits. This latter herb is considered a "food of the immortals" – it is a tonic that aids in building bone and sinew, promotes semen production, and retards ageing processes (Hsu et al. 1986; Reid 1995). Some other Chinese tonic herbs will be discussed in the main text and the *Endnotes*.

Witch's brews and flying ointments

It is now known that there was [and still is] a pharmacological basis for the 'witchcraft' exercised in Europe and North America. Most real-life witches were experienced herbalists, and prepared decoctions [to be drunk] and ointments [to be applied, sometimes through the vaginal membranes from application to a broomstick, for example] which produced the state of mind conducive to reports of flying through the night, having intercourse with the devil, etc.

Some documented ingredients, with some brief comments, are listed below.

Aconitum spp. [Ranunculaceae; 'monkshood', 'wolfsbane' – see *Endnotes*]
Acorus calamus [Araceae]
Allium sativum [Liliaceae; 'garlic'] – in India, A. cepa bulb is considered aphrodisiac and stimulant; in Norway, A. schoenoprasum ssp. sibiricum [Siberian chives] has been reported as an ingredient of a witch potion used to cause harm, and is reputed to protect against sea serpents
Amanita muscaria [Agaricaceae]
Apium graveolens [Umbelliferae; 'celery' – see *Endnotes*] – probably seeds used
Artemisia spp. [Compositae]
Atropa belladonna [Solanaceae]
Ballota nigra [Labiatae; 'black horehound'] – bitter medicinal
Boswellia sacra resin [Burseraceae]
Cannabis sativa [Cannabaceae]
Claviceps purpurea [Clavicipitaceae]
Conium maculatum [Umbelliferae]
Crocus sativus [Iridaceae]
Datura spp. [Solanaceae]
Euphorbia spp. [Euphorbiaceae; see *Endnotes*]
Ferula asafoetida [Umbelliferae]
Foeniculum spp. [Umbelliferae]
Helleborus spp. [Ranunculaceae; 'hellebore'] – narcotic, toxic
Hyoscyamus spp. [Solanaceae]
Iris spp. [Iridaceae] – aphrodisiac?
Lactuca spp. [Compositae]
Lolium temulentum [Gramineae]
Mandragora officinalis [Solanaceae]
Myristica fragrans [Myristicaceae]
Nasturtium spp. [Cruciferae; 'watercress']
Nicotiana tabacum [Solanaceae]
Nymphaea spp. [Nymphaeaceae]
Papaver spp. [Papaveraceae]
Pastinaca sativa [Umbelliferae; 'wild parsnip' – see *Endnotes*]
Petroselinum crispum [Umbelliferae]
Piper nigrum [Piperaceae]
Populus balsamifera, P. nigra [Salicaceae; 'poplar'] – stimulant and analgesic
Potentilla spp. [Rosaceae; 'cinquefoil' – see *Endnotes*]
Scopolia spp. [Solanaceae]
Solanum nigrum, **Solanum** spp. [Solanaceae]
Taxus baccata [Taxaceae]
Veratrum album [Liliaceae]
and **Verbena** officinalis [Verbenaceae].
Unspecified orchids [eg. see **Vanda**, **Cypripedium**, **Oncidium**, **Stelis**, many species in *Endnotes*] were also used (Alm 2003; Bremness 1994; Chiej 1984; De Vries 1991; Nadkarni 1976; Ott 1993; Rätsch 1992, 1998; Rudgley 1993, 1995, 1998; Schultes & Hofmann 1980, 1992).

The following is a recipe for an alleged "traditional English flying ointment", with the ingredients as follows [for actual ointment preparation, see the previous chapter]:

- 3g 'annamthol' [an old name for Aconitum spp. – see *Endnotes*]
- 30g **Areca** catechu nut
- 50g 'opium' [see **Papaver**]
- 15g 'cinquefoil' [Potentilla spp. – see above]
- 15g **Hyoscyamus** nigrum
- 15g **Atropa** belladonna
- 15g **Conium** maculatum
- 5g 'cantharidin' ['Spanish fly', Lytta vesicatoria – a ground beetle with highly toxic excitatory and genital-inflammatory effects]
- and 250g **Cannabis** indica (Robinson 1996)

It is of interest to note that Aztec priests also used magical ointments, said to have contained ingredients such as spiders, scorpions, salamanders, caterpillars, vipers [all burnt to ashes][see *Endnotes*], tobacco [see **Nicotiana**] and **Turbina** corymbosa (De Acosta 1604; Robicsek 1978). Inca priests were also known to have used magical ointments of uncertain composition (Cobo 1990).

Betel packages

See the **Areca** entry for more on this topic. The stimulating betel nut [**Areca** catechu] is chewed widely in India, where it is known as 'paan' or 'tambula', and is also a commonly-used drug over much of south-east Asia. At its most basic level, the crushed nut is wrapped in a 'betel leaf' [**Piper** betle – see **Piper 1**] with a dash of lime for mastication. However, a wide array of other plants may be added to this package to alter the effect or palatability. Some combinations or blends are available commercially, with the betel nut and lime already mixed in. Ingredients that have been added to betel packages, with some brief comments, include:

Acacia catechu [Leguminosae] gum
Amomum subulatum [Zingiberaceae; 'greater cardamom'] fruits – digestive
Anethum graveolens [Umbelliferae; 'dill'] fruits
Aquilaria agallocha [Thymeleaceae; 'eaglewood'] resin – see *Endnotes*
Beta vulgaris [Chenopodiaceae; 'beetroot'] – sugar produced from the root is used
Carum bulbocastanum, C. carvi [Umbelliferae; 'caraway'] fruits – digestive
Cinnamomum cassia, C. zeylanicum [Lauraceae; 'cinnamon'] bark
Cinnamomum camphora ['camphor laurel'] crude *camphor*
Cocos nucifera [Palmaceae; 'coconut palm'] dried kernel – mature liquid endosperm contains *GABA* (Durand et al. 1962)
Coriandrum sativum [Umbelliferae; 'coriander'] fruits
Crocus sativus [Iridaceae; 'saffron'] stigmas
Cucumis melo [Cucurbitaceae; 'melon'] seeds – see *Endnotes*
Cuminum sativus [Umbelliferae; 'cumin'] seeds – tonic, stimulant, digestive
Dryobalanops aromatica [Dipterocarpaceae; 'Borneo camphor'] crude *camphor* – see *Endnotes*
Elettaria cardamomum [Zingiberaceae; 'cardamom'] fruits – digestive, antispasmodic, stimulant, aphrodisiac; essential oil is 'stimulating and invigorating'
Erythroxylum coca [Erythroxylaceae] – *cocaine* added
Foeniculum vulgare [Umbelliferae; 'fennel'] fruits
Myristica fragrans [Myristicaceae; 'nutmeg'] kernel
Nicotiana tabacum [Solanaceae; 'tobacco']
Nigella sativa [Ranunculaceae; 'nigella'] seeds – digestive, treats nerve defects [in Germany, N. damascena has been known as 'hexenkraut' ('witch herb') and 'hexli', and N. sativa as 'hexenanis' ('witch anise') (De Vries 1991); N. arvensis is used to ward off the evil eye in parts of Turkey (Ertug 2000)]
Pimpinella anisum [Umbelliferae; 'aniseed'] fruits
Saccharum officinarum [Gramineae; 'sugar cane'] – sugar produced from the stems is used
Smilax calophylla [Liliaceae; 'sarsaparilla'] rhizome – male tonic [see *Endnotes*]
Syzygium aromaticum [Myrtaceae; 'clove tree'] dried immature flower buds
Tamarindus indica [Leguminosae; 'tamarind'] young leaves – antipyretic, astringent
and **Uncaria** gambir [Rubiaceae; 'pale catechu'] gum (Bavappa et al. 1982; Bremness 1994; Chopra et al. 1958; Gowda 1951; Nadkarni 1976; Rätsch 1990).

Ayahuasca

'Ayahuasca' is discussed more fully under the entries for **Banisteriopsis**, **Diplopterys** and **Psychotria**. However, here we will look at some of the wide array of plants that have also been used in its preparation. Most of the major known pychoactive additives, and some of the medicinal ones, are covered under their own entries, and in the *Endnotes* [under 'Latin American Obscurities'], so this will be a selection of plants not discussed elsewhere, with their native names. Their individual properties, if known, will also be briefly covered.

Anthodiscus pilosus [Caryocaraceae] – 'tahuari' (McKenna et al. 1995).
Bauhinia guianensis [Leguminosae] – 'motelo huasca'. 'Two pieces' of the ground vine are added (Luna & Amaringo 1991).

Cabomba aquatica [Nymphaeaceae] – 'murere', 'mureru' (McKenna et al. 1995).

Calathea veitchiana [Marantaceae] – 'pulma'. Added to "see visions" (Schultes 1972); contains *tryptophan* (McKenna et al. 1995).

Calycophyllum spruceanum [Rubiaceae] – 'capirona negro'. Treats diabetes; the **Banisteriopsis** caapi vine also grows up this tree (Luna & Amaringo 1991); bark added to ayahuasca (Trout ed. 1998).

Campsiandra laurifolia [Leguminosae] – 'huacapurana'. Bark added (Trout ed. 1998).

Canavillesia hylogeiton, C. umbellata [Bombaceae] – 'puca lupuna', 'lupuna colorada'. Strict diet required, otherwise can cause death. Also taken alone under 1 month diet. The bark is stripped and rasped before being decocted in water. Consuming the brew initially causes fever and tinnitis, followed by a lucid visionary state in which one can learn icaros and other knowledge from the tree's spirit. The spirit of the tree is a female who usually provides knowledge to sorcerers (Bear & Vasquez 2000; Luna & Amaringo 1991).

Capirona decorticans [Rubiaceae] – 'capirona negra'. May be taken alone under diet as a plant teacher (Luna 1984); said to be dangerous if the strict diet and sexual abstinence are broken (McKenna et al. 1995).

Ceiba pentandra [Bombaceae] – 'lupuna blanco'. Sometimes used in sorcery (Luna & Amaringo 1991); tentatively identified as an additive (Luna 1984). Considered a strong 'doctore' which may kill if the required diet is broken (McKenna et al. 1995). Ceiba spp. trees are sacred to the Maya (Rätsch 1999a). In African traditional medicine, C. pentandra has been used to treat a variety of disorders, including "mental troubles", dizziness, headache and fever. The stem bark has yielded the isoflavones pentandrin and pentandrin 5'-O-β-D-glucoside (Ngounou et al. 2000).

Chorisia insignis, C. speciosa [Bombaceae] – 'lupuna'. See **Capirona** decorticans; bark is added (Trout ed. 1998). The Aguaruna say that lupuna [either referring to **Ceiba** spp. or **Chorisia** spp.] can be used to become a sorcerer, by drinking tobacco-water at the base of the tree to become intoxicated, then entering the city that is said to reside inside it, to receive magical darts from the spirit of the tree (Luna & Amaringo 1991).

Clusia sp. [Guttiferae] – 'miya', 'tara', 'appane'. One or two leaves chewed, or boiled with the drink (Rivier & Lindgren 1972).

Cornutia odorata [Verbenaceae] – 'shinguarana'. Leaves tested negative for alkaloids (McKenna et al. 1984a).

Couroupita guianensis [Lecythidaceae] – 'ayahuma'. See Capirona decorticans; considered a powerful plant teacher, even alone. When used alone [shamans who use primarily this plant are known as 'paleros'], the flower is soaked in a bowl of water for three days, before it is removed and the infusion drunk. A diet lasting three years must be kept before acquiring this plant as an ally [some say it only requires a 30-day diet]; its spirits are said to be a tiger [odd in this part of the world], and a headless dead man, who "teaches evil things". When added to ayahuasca, the bark is used. The fruit has been used to treat alcoholics, and the plant is also given to dogs to increase their strength and hunting abilities. It is reputed to 'cure strong sicknesses' and 'fortify the body' (Luna 1984; Luna & Amaringo 1991; McKenna et al. 1995). Contains indole alkaloids (McKenna et al. 1995).

Coussapoa tessmannii [Moraceae] – 'renaco' (McKenna et al. 1995).

Dieffenbachia alba [Araceae] – 'patiquina'. Occasionally a small piece of the stem is added; the plant is also used to kill sorcerers. Toxic compounds are found in the genus (Luna 1984; Luna & Amaringo 1991), which is common in horticulture ['dumb cane'] (pers. obs.). See also D. sequine below.

Fittonia sp. [Acanthaceae] – 'mamperikipini'. The Machiguenga used large amounts of it in ayahuasca before they discovered **Psychotria**; it is said to produce 'visions of eyeballs'. The Kofan and Siona-Secoya use the plant to treat headaches. An extract was apparently active on 5-HT1a and 5-HT2a receptors (Russo undated). Fittonia spp. are common in horticulture (pers. obs.).

Geogenanthus sp. [Commelinaceae] – no longer used; produces patterned visions (Russo undated).

Gnetum leyboldii, G. nodiflorum [Gnetaceae] – possibly 'kúri kaxpi dá'. May perhaps represent an obscure source of 'yajé' [see **Banisteriopsis**], but this is doubtful (Trout ed. 1998).

Guettarda ferox [Rubiaceae] – 'garabata'. Contains cathenine, hetero-*yohimbine* alkaloids (McKenna et al. 1995); the related G. viburnoides is known as 'angico', a name which is also applied to **Anadenanthera** spp. in Brazil (Trout ed. 1998).

Heliconia sp. [Heliconiaceae] – 'winchu'. This unidentified species, possibly identical to H. stricta, is added to ayahuasca by the Shuar (Bennett 1992).

Herrania sp. [Sterculiaceae] – 'kushiniap'. The Shuar add fruit husks, bark and/or leaves to ayahuasca (Bennett 1992).

Himantanthus succuba [Apocynaceae] – 'bellaco caspi'. Requires special diet (Luna 1984); contains fulvoplumieron and flavonoids (McKenna et al. 1995).

Lomariopsis japurensis [Dryopteridaceae/Polypoidaceae] – 'shoka', 'dsuii teitseperi'. 3-4 branches added to the brew by the Sharanahua (Rivier & Lindgren 1972).

Malouetia tamaquarina [Apocynaceae] – 'guay-ee-ga-mo-yoo-ke-ree', 'cuchara caspi'. Leaves sometimes added for difficult diagnosis. Its fruits are eaten by the 'pajuil' bird [Nothocrax urumutum], rendering its bones toxic to dogs and others. Contains steroidal alkaloids (Ott 1993; Pinkley 1969; Schultes 1957, 1967, 1987; Schultes & Raffauf 1990).

Mandevilla scabra [Apocynaceae] – 'clavohuasca'. Considered a plant teacher (Luna 1984).

Mansoa alliacea [Bignoniaceae] – 'ajo sacha', 'sacha ajos'. May be used for good luck. Used alone under diet as a 'very strong' plant teacher to 'learn medicine' (Luna 1984; McKenna et al. 1995), as well as being disinfectant and used to repel evil spirits; the leaves are burned in the evening for this purpose (Luna & Amaringo 1991). Also antirheumatic (McKenna et al. 1995).

Montrichardia arborescens [Araceae] – 'raya balsa'. Juice of shoots is also taken alone [under special 6 month diet] to learn to travel to 'underwater realms' to gain healing knowledge (Luna 1984).

'Mukuyasku' [Malpighiaceae] – an unidentified vine cultivated by the Shuar; leaves are added to ayahuasca (Bennett 1992).

Phrygilanthus eugenoides, P. eugenoides var. robustus [Loranthaceae] – 'miya', 'ko-ho-bo'. A similar quantity of leaves to 'chacruna' [see **Psychotria**] is added, or the juice drunk with ayahuasca (Pinkley 1969; Rivier & Lindgren 1972; Schultes & Raffauf 1990).

Phtirusa pyrifolia [Loranthaceae] – 'suelda con suelda'. May also be taken alone under diet as a plant teacher (Luna 1984).

Pontederia cordata [Pontederiaceae] – 'amaron borrachero' ['intoxicant of the boa']. Suspected of being added to ayahuasca. Used to relieve facial paralysis; contains sterols and triterpenes (Schultes 1972; Schultes & Raffauf 1990).

Rinorea viridiflora [Violaceae] – 'ayahuasca'. A bioassay of a Shuar ayahuasca brew, containing this plant as the admixture to **Banisteriopsis** caapi, was active in a manner suggestive of the presence of *DMT*; the plant itself still needs chemical analysis (Trout ed. 1998). The Shuar add an unidentified plant which they call 'paraprа' to ayahuasca; it is thought to possibly be a Rinorea sp. (Bennett 1992).

Sabicea amazonensis [Rubiaceae] – 'koti-kana-ma'. Added to sweeten the taste (Trout ed. 1998). See *Endnotes* for more.

Sclerobium setiferum [Leguminosae] – 'palosanto' (McKenna et al. 1995).

Scoparia dulcis [Scrophulariaceae] – 'nuc-nuc pichana'. May be taken alone under diet as a plant teacher (Luna 1984); contains triterpenes, 6-MeO-benzoxazolilinone (McKenna et al. 1995). See *Endnotes*.

Stygmaphyllon fulgens [Malpighiaceae] – 'kai ria'. Leaves sometimes added in the Mitú region to make the drink stronger; contains saponins (Schultes & Raffauf 1990).

Tournefortia angustifolia [Boraginaceae] – 'hetu bisi'. Not actually added to the brew, but amongst the Siona sections of vine are split and infused overnight, the infusion being drunk the morning before an ayahuasca session as a purgative. Leaves of T. cuspidata are made into a tea to relieve trembling in the elderly. Some members of the genus contain pyrrolizidine alkaloids (Schultes & Raffauf 1990).

Tovomita sp. [Guttiferae] – 'chullachaqui caspi'. The jungle spirits known as chullachaqui [an encounter with which may make one ill or insane] are said to live where these trees are abundant (Luna & Amaringo 1991). Taken alone under diet, 2 handfuls of the rasped bark are infused in water overnight (Bear & Vasquez 2000). The diet last 30 days, and the plant reputedly strengthens the body. Taken with ayahuasca, 4 pieces of bark are added to the brew (McKenna et al. 1995).

Triplaris surinamensis, T. surinamensis var. chamissoana [Polygonaceae] – 'tangarana'. Shoots are added in place of **Psychotria**, when leaves of the latter are unavailable. May also be taken alone under diet as a plant teacher (Luna 1984; Trout ed. 1998).

Tynnanthus panurensis [Bignoniaceae] – 'clavohuasca'. Tentatively identified as an additive; considered a plant teacher (Luna 1984).

Vismia guineensis [Guttiferae] – used in ayahuasca made for dancing amongst the Hupda-Maku (Leite da Luz undated); bark and roots have been used both internally and externally to treat skin disorders. Roots have yielded β-sitosterol, anthraquinones and xanthones; the essential oil contains mostly α-*pinene* (Bilia et al. 2000a). In Liberia, the Mano have been reported to "rub the bud [...] between the hands and inhale the fumes for the relief of vertigo" (Watt 1967). Back in the Amazon, the related V. tomentosa is given as a tonic for elderly people who are physically degenerated and have "difficulty in understanding instructions" (Schultes 1993).

Vitex triflora [Verbenaceae] – 'tahuari', 'taruma' (Ott 1995c; Trout ed. 1998). Other Vitex spp. such as V. agnus-castus are used medicinally to treat rheumatism, pneumonia, headaches, respiratory troubles, menstrual problems and bacterial dysentery (Bremness 1994; Chevallier 1996). V. agnus-castus is sometimes used as 'jurema branca' [see **Mimosa**] in Brazil (Ott pers. comm.; Ott 1997/1998). See *Endnotes* for more.

Vouacapoua americana [Leguminosae] – 'huacapu'. Requires special 30-day diet, may be taken alone as a plant teacher (Luna 1984; McKenna et al. 1995); used in magic by the Tiriós (Trout ed. 1998).

The combination of plant chemistry that leads to what is now often referred to as the classic 'ayahuasca-effect' consists of appropriate amounts of harmala-type alkaloids [eg. *harmine*, *harmaline*, *leptaflorine*] with MAOI-activity, and *tryptamine*-alkaloids, particularly *DMT* – both of the broader indole alkaloid group. The harmala-alkaloid source is generally **Banisteriopsis** caapi, and though the harmala-alkaloids inhibit MAO at lower concentrations than their psychoactive levels, the vine is frequently used in larger amounts than necessary, and so the psychotropic and 'experience-modifying' effects of the vine and its alkaloids often also shine through [though also adding to nausea and vomiting]. *Harmine* inhibits MAO efficiently from about 1.5mg/kg; *harmaline* does so from about 1.2-1.32mg/kg [expect personal variations]. The *DMT* source is often **Psychotria** viridis or **Diplopterys** cabrerana. *DMT* needs to be present in the brew at about 1.5-2 times the amount used for smoking purposes – many people find perhaps 40-60mg to be quite sufficient, though some people seem to require much higher quantities [ie. greater than 100mg]. Based on a method tested and suggested by Jonathan Ott (Ott 1994), many people in the west prepare their ayahuasca [or 'ayahuasca analogues'] with a gentle 3-stage decoction [as described in the previous chapter], using a 30% lemon juice/70% water solution [just over enough to cover the plant matter]. The harmala-component and the *DMT*-component are also often prepared separately in non-indigenous preparations – it is recommended that the harmala-component undergoes a longer simmering time than the *DMT*-component [15-20 min. for the former, if done in one go]. The harmala-alkaloid brew should preferably be drunk first, and the *DMT*-brew drunk up to 10-15 minutes later, after giving time for MAO to be inhibited. Results will also be achieved if the extracts are prepared and consumed together, as is traditional, but some believe this may not be as efficient (Callaway et al. 1999; Ott 1994; Trout ed. 1998; pers. comms.). If using **Peganum** harmala seeds as an MAOI substitute for **Banisteriopsis**, efficient filtering of the brew is strongly advised, as small pieces of seed have a tendency to linger in the throat and nasal passages, if vomited back up [which is quite likely!]. These fragments have a particularly nasty taste, which adds an unpleasant dimension to the experience, that can be avoided (pers. obs.).

Although ayahuasca or ayahuasca analogues rich only in *DMT* and harmala alkaloids are generally very safe to consume, special caution is advised when any *5-MeO-DMT* is present. Some people have found this alkaloid, taken orally and combined with MAOI, to be unpredictable and to sometimes result in highly distressing experiences and loss of consciousness (pers. comms.). More disturbingly, there is one known case of a person found dead the morning after having consumed a herbal ayahuasca analogue that contained [based on post mortem blood analysis] harmala alkaloids typical of **Banisteriopsis**, as well as *DMT* and relatively very high levels of *5-MeO-DMT*. However, the actual cause of death was not determinable from the post mortem (Skleroy et al. 2005).

It should be noted that in Amazonia the ayahuasca beverage often uses only **Banisteriopsis**, and that the most common admixture plant is tobacco [see **Nicotiana**] rather than any *DMT*-containing plant. For this reason the so-called 'ayahuasca effect' discussed above is somewhat inappropriately named, and refers to a simplification of the brew most prevalent in non-traditional use.

Zombi potions

In rural Haiti, the zombi phenomenon has long been a part of life, and has only relatively recently been explored from an ethnopharmacological and ethnobotanical/zoological viewpoint. Evidence suggests that people may be made into zombis by members of Vodoun-related 'secret societies' if they have committed severe breaches of social protocol and subsequently deemed by the society as deserving of such a fate [which is believed to be one worse than death]. Zombis are 'created' due to the administration of plant/animal compounds in several phases, accompanied by magical ritual. Powerful sorcerers can reputedly create a zombi with the use of magic alone. The first phase consists of use of the 'poison' or 'trap', which is a powder prepared in various forms. The most widely noted method of applying the poison is to place it in the form of a cross on a doorway or other spot where the intended victim is to walk; however, this could not be expected to allow passage of the poison through the calloused sole of the foot [though the mere sight of it may cause the victim to fall into shock, now being aware of their approaching fate], and if magic alone is not effective then a more direct application may follow, such as blowing the powder into the face or rubbing it into the skin or freshly-made flesh wounds [some common ingredients are abrasive and/or irritating – see below]. Some such powders are intended to kill outright [these may be placed in food to be eaten by the victim]; others cause various kinds of illness; some are used to capture the soul of the victim. Indeed, the process of zombification [as seen by Haitians] essentially consists of capturing the soul of the victim, which is stored in a special jar by the sorcerer responsible, and is itself a kind of zombi – one which is considered to be of more value than a 'mere zombi of the flesh'.

The zombi powders which demand our interest are those which initially cause the victim to appear intoxicated or seriously sick, and later appear to be dead. Sometimes, if the poison was too strong, true death may result – or if not strong enough, the desired effect may not eventuate. Evidence suggests that in this mock-death the victim is still conscious, yet totally paralysed and can not respond to stimuli. Metabolism is lowered to the point where vital signs appear to be absent on cursory analysis. Shortly after a quick burial, the victim is dug up at night by the perpetrators and revived with magical rites and an 'antidote'. At this point, various methods are used to prevent the soul of the victim re-entering the body, and the soul is captured in the previously mentioned jar. Sometimes the revival does not work and the body is found to be truly dead upon exhumation. Different people have their own preferred recipes for the poison and antidote. Although there is no firm documentation on how the zombis are 'created' after this revival, anecdotal evidence suggests that victims are force-fed a paste containing **Datura** stramonium, teasingly known in Haiti as 'concombre zombi' or zombi cucumber. This may also be the actual 'antidote' referred to above, as the potions usually termed antidotes to the zombi poison are apparently only used as a protectant to coat exposed flesh during preparation of the poison. The delirium and amnesia resulting from **Datura** ingestion, coupled with the domineering magic of the sorcerer, the horrifying experience already undergone and cultural-religious conditioning, are believed to help create the final zombified state. However, it must be stated that in Haiti it is believed that powders and other drugs alone can not create a zombi – it is the magic involved which is the most important, and sometimes sole, element. New zombis are given new names and taken to remote localities; sometimes they may be used for slave labour. They must be re-fed the **Datura** paste at regular intervals. Folklore claims that exposure to even tiny amounts of salt may rouse a zombi from its state of amnesiac enslavement. Unfortunately, former-zombis are not accepted in Haitian society and are still regarded as dead and unwanted, even if they are seen in a seemingly recovered state and recognised years after burial.

Plants and creatures used in the powders vary from one practitioner to the next, or depending on the intended result. Ingredients reported to have been included are as follows:

Albizzia lebbeck [Leguminosae] – 'tcha-tcha' fruits. Contains toxic saponins that weaken vital functions; other Albizzia spp. treat epilepsy and nervous complaints [see *Endnotes* for more].
Ameiva chrysolaema [a lizard] – this is burned before being added.
Anacardium occidentale [Anacardiaceae] – 'pomme cajou' leaves. In parts of S. Africa, an intoxicating drink is made from the fruit; contains compounds that can cause severe contact inflammation and irritation. A. occidentale is the well-known 'cashew tree'.
Anolis coelestinus, A. cybotes ['anole lizards'] – see Ameiva chrysolaema.
Bufo marinus [Bufonidae] – 'buga' toad.
Comocladia glabra [Anacardiaceae] – 'bresillet'. A dangerous plant, the resin of which causes severe contact inflammation and dermatitis; it is considered to be evil and malicious.
Dalechampia scandens [Urticaceae] – 'mashasha'. Bears stinging hairs containing *acetylcholine*, *serotonin* and *histamine*.
Dieffenbachia sequine [Araceae] – 'calmador'. Its tissues contain calcium oxalate needles that cause irritation and swelling upon ingestion, causing throat and mouth constriction if absorbed orally. See also D. alba above.
Diodon holocanthus, D. hystrix ['porcupine fish'] – 'poisson fufu', 'bilan'. Contain tetrodotoxin, which is extremely toxic and causes neuromuscular paralysis, and even death [see *Endnotes*].
Epicrates striatus [a lizard] – see Ameiva chrysolaema.
Homo sapiens [human] – burnt grave remains are usually added to the powdered poison [for some discussion of human chemistry see *Neurochemistry*, *Influencing Endogenous Chemistry*].
Leiocephalus schreibersi [a lizard] – see Ameiva chrysolaema.
Mucuna pruriens [Leguminosae] – 'pois gratter' fruits.
Osteopilus dominicensis [a tree frog] – two varieties, 'crapaud brun' and 'crapaud blanc'. The skin is used in small amounts and has irritating glandular secretions [see also **Phyllomedusa** and *Endnotes* for other frogs].
Sphoeroides spengleri, S. testudineus ['sea toad', 'puffer' or 'blowfish'] – 'crapaud du mer'. See Diodon spp. above.
Trichilia hirta [Meliaceae] – 'consigne'. The leaves treat anaemia, asthma, bronchitis and pneumonia; may induce vomiting and sweating.
Urera baccifera [Urticaceae] – 'maman guepes'. See Dalechampia scandens.
Zanthoxylum martinicense [Rutaceae] – 'bwa pine'.

Some of the powders also contain small amounts of various tarantulas and centipedes [see *Endnotes*]. As well as the plants listed above which can irritate and/or blister the skin, ground glass is often added to help break the skin surface so the poison may be readily absorbed. The most important and consistent ingredients amongst the varied recipes noted are

the human remains, and the numerous species of tetrodotoxin-producing fish, which are considered most potent in summer. Tetrodotoxin [discussed further in *Endnotes*] is believed to be responsible for inducing the death-like state observed from administration of active samples of the poison; other ingredients are often not included in quantities that would be expected to be pharmacologically active, but let's not forget the possibility of synergy. In any case, the naturally varying toxicity of such fish is reflected in the varying potencies of zombi powders.

Ingredients reported for the various 'antidotes' include the following:

Aloe vera [Liliaceae] – a laxative and purgative; relieves itching and inflammation. See also Aloe spp. in *Endnotes*.

Amyris maritima [Rutaceae] – 'bois chandelle'.

Capparis cynophyllophora, C. spp. [Capparidaceae] – 'bois ca-ca' ['shit tree'], 'cadavre gate' ['spoiled corpse']. Foul-smelling plants that treat oedema and are believed to have magical properties; they are used to make magical charms. See also Capparis spp. in *Endnotes*.

Cedrela odorata [Meliaceae] – 'cedre'. A tonic that 'realigns various components of the soul', and treats rheumatism and malarial fever; contains c.3% essential oil.

Citrus limon [Rutaceae] – lemons, 'magically prepared'.

Guaiacum officinale [Zygophyllaceae] – 'gaiac franc'. An analgesic and laxative; contains saponins, and an aromatic resin. See *Endnotes*.

Ocimum basilicum [Labiatae] – 'basilic'.

Petiveria alliacea [Phytolaccaceae] – 'ave'. See *Endnotes*.

Prosopis juliflora [Leguminosae] – 'bayahond'.

As stated above, such 'antidotes' [which frequently also contain alcoholic spirits, perfumes and ammonia] are seemingly not used to revive zombis from their mock-death, but predominantly to coat exposed flesh as a protectant during preparation and application of the poison. These antidotes are believed to counteract the effects of the poison, yet due to the recorded ingredients Davis (1988a) stated that they must be pharmacologically inactive for this purpose. He did not, however, report having submitted samples of the antidotes to testing for antagonism of the poison samples collected. The **Datura** paste fed to the victim after removal from the grave may be the actual antidote which helps terminate the first phase and initiate the final phase of zombi creation (Davis 1988a, 1988b).

Sehoere

The Basuto of southern Africa have been reported to employ cast-off horns from their cattle as containers for a composite drug, 'sehoere', which is ritually consumed in conjunction with 'intoxicating feasts' [see **Acacia**, *Endnotes*]. The composition of the sehoere is said to differ, but one informant claimed that the following ingredients have been used:

Cyperus fastigiatus [Cyperaceae] – 'mothoto'

Ipomoea oblongata [Convolvulaceae] – 'mothokho'

Pentanisia variabilis [Rubiaceae] – 'setima mollo'

Phragmites australis root [Gramineae] – 'qoboi'

Phygelius capensis [Scrophulariaceae] – 'mafifi matso'

Polygonum sp. [Polygonaceae; see *Endnotes*] – 'morara o moholo'

Sagittarius serpentarius flesh [Sagitariidae] – 'leshokhoa', 'secretary bird'

Typha latifolia [Typhaceae; see *Endnotes*] – 'motsitla'

Xysmalobium undulatum [Asclepiadaceae] – 'leshokhoa'

Human flesh, derived from 'slain enemies', is also sometimes added. The ingredients are charred and mixed with fat before use. It was also reported that "One of these plants is slightly toxic, and sometimes the Basuto women take advantage of this property for making their beer [see above] more intoxicating. The beer is then called joala ba hiki" (Laydevant 1932). Unfortunately, it was not mentioned which plant was being referred to.

Utopian Bliss Balls

This is a contemporary preparation, which has been a popular psychedelic snack food for several decades.

- **Argyreia** nervosa – 5 seeds
- bee pollen – 1tsp
- **Turnera** diffusa powdered herb – 1 pinch
- dates [Phoenix dactylifera fruit] – 1 fruit
- **Panax** ginseng powdered root – 1 pinch
- **Centella** asiatica powdered herb – 1 pinch

The **Argyreia** seeds are crushed, and ground together with the herbs and bee pollen; this mixture is stuffed into the pitted date, and consumed by one person with tea [see **Camellia**] (Rätsch 1990).

Herbal 'ecstasy', smart drinks and energy drinks

At least a decade ago, a recipe was being freely circulated by word of mouth for a "herbal ecstasy" [referring, of course, to the synthetic MDMA (3,4-methylenedioxy-N-methyl-*amphetamine*), popularly called 'ecstasy']. It is very simple to prepare, as long as you can obtain a good source of *safrole*. All that is required [per person] is ½ a ripe avocado [fruit of Persea americana (Lauraceae) – see *Endnotes*], 2 tablespoons freshly ground nutmeg [see **Myristica**], and about 4 drops of **Sassafras** oil [now difficult to obtain]. The ingredients are mixed together into a paste, which is left to sit for about 10-30 minutes [during which it turns a greyish colour], and consumed – eg. spread on bread and eaten. Of course, nutmeg in quantity tastes foul on its own, and this concoction is only a little bit easier to get down – but once it's down, it stays down. Myself and three friends consumed a dose each one afternoon many years ago, and we all had different responses. One of us noticed effects about 1.5-2 hours after consumption, and was very intoxicated for the next 4-5 hours. Another did not notice anything until about 3 hours later, when he was driving at night, and it came on unexpectedly – his intoxication continued to subside and re-emerge for a few more hours, before rapidly returning to his original state. I had a mild but persistent effect [noticeable after about 2-3 hours] which was potentiated by smoking **Cannabis**. The experience was characterised by a moderate and pleasant CNS stimulation accompanied by positive mood enhancement, enhanced thought-processes and colour perception, and a general feeling of peace, goodwill and confidence. Despite my experiences with nutmeg on its own, none of us experienced any negative side-effects that night, or the next day. It is for this reason that I presume the avocado is present as a lipid-soluble buffer for the digestive system, as many essential oils [as present in this recipe] display liver toxicity and severe gastric upset after internal ingestion.

Many preparations have been available over the past few years claiming to be herbal substitutes for MDMA; some have virtue, others not, though it appears that some people are better able to appreciate the effects of some of these products than others. Common ingredients are **Ephedra** and **Paullinia** cupana; other ingredients which have been used include **Panax** ginseng, **Ginkgo**, **Centella** asiatica, **Cola** nuts, **Corynanthe** yohimbe, **Polygala** tenuifolia, **Glycyrrhiza**, green tea [see **Camellia**], **Maytenus** ebenifolia [mis-spelled as 'ehrifolia'], nutmeg [usually as 'rou gui', a "rare Chinese nutmeg"; see **Myristica**], **Ptychopetalum** spp. ['muira puama'], **Turbina** corymbosa seeds, **Ziziphus** jujuba, **Salvia** miltiorrhiza, **Sida** spp., **Syzygium** aromaticum, **Tribulus** terrestris, Angelica dahurica [Umbelliferae; see *Endnotes*], Carthamus tinctorius [Compositae], Epimedium grandiflorum [Berberideae; see *Endnotes*], Inula japonica [Compositae], Lepidium meyenii [Brassicaceae; see *Endnotes*], Paeonia veitchii [Ranunculaceae; see *Endnotes*], '**Citrus** extract' [actually synephrine] and 'geranium oil extract' [actually a synthetic chemical which is found naturally in small amounts in this oil; see Pelargonium in *Endnotes*] as well as vitamins and amino acids (pers. obs.; Rätsch 1998). Some of these ingredients, and others, are often found in the abundant varieties of 'smart drinks' and 'energy drinks' currently available. Listed ingredients have included **Paullinia** cupana, **Cola** nuts, **Centella** asiatica, **Ginkgo**, **Corynanthe** yohimbe, **Glycyrrhiza**, Tabebuia lapacho [Bignoniaceae; see *Endnotes*], ginger [see *Endnotes*], green tea [see **Camellia**], **Panax** ginseng, **Pueraria** lobata, **Ilex** paraguariensis, kava [see **Piper 2**], **Humulus**, **Theobroma** cacao, **Capsicum**, '**Citrus** extract' [see above], *caffeine*, *phenylalanine*, tyrosine, *taurine*, leucine, *methionine*, inosine, carnitine, proline, *pyroglutamic acid*, *glutamine*, *aspartic acid*, glucuronolactone, glucose, sucrose, fructose, folic acid, calcium, vitamin C [ascorbic acid] and B vitamins (pers. obs.).

I have in my possession a recipe for "Exstacy cake" [sic.], retrieved over a decade ago from an issue of Revelation magazine [based in Western Australia; unfortunately I only had access to the single page it was printed on, and can not give a proper reference for it]. Also, unfortunately, many of the measures/quantities for the ingredients were not given, presumably leaving it up to the intuition of the cook. I have never made one, but according to the creator it "looks like a tropical garden, tastes better than Amadeus' table and gives you pupils like black flying saucers"! The ingredients and method are as follows [with my additional comments]

- Flesh of 1 coconut [Cocos nucifera (Palmaceae)], grated
- juice of 2 limes, and grated skin of 1 [very fresh] [**Citrus**]
- 6-7 ripe peeled bananas [**Musa** spp.]
- 1 well-ground nutmeg [**Myristica** fragrans]
- 1 stick cinnamon [**Cinnamomum** zeylanicum]
- 'little-finger sized' turmeric root, grated [Curcuma longa (Zingiberaceae)] – contains antioxidants
- 20 red and pink Hibiscus spp. blooms [flowers must be fresh, all greenery removed] [see *Endnotes*]
- polenta [from Zea mays; see *Endnotes*]
- sultanas [from Vitis vinifera (Vitaceae)]
- ghee [clarified butter]
- poppy seeds [**Papaver** somniferum]
- cold chamomile tea [**Anthemis**/**Matricaria** sp.]
- rosewater [from Rosa spp. (Rosaceae)] – preferably Lebanese Red [Cortas 'Maward' brand]
- brown rice flour [Oryza sativa (Gramineae)]
- sugar or honey to taste
- 1 cup lecithin [pre-soaked in water]
- 4 drops bitter almond oil [**Prunus** spp.]
- coconut cream [from Cocos nucifera] and/or cold wattleseed coffee [**Acacia** spp.] and/or Japanese tea [**Camellia** sinensis]

Squeeze the lime juice over the bananas, add the nutmeg, turmeric, grated lime skin, grated coconut flesh, and ½ the cinnamon. Squeeze the mass together, and then mix in the hibiscus blooms. Bake this [in a glass

baking dish] in a moderately hot oven for 20 minutes.

To prepare the next layer of the cake, slowly boil up a small pot of polenta with the coconut cream and/or cold wattleseed coffee [and/or substitutes], plus the rest of the cinnamon, a few sultanas, and an extra touch of nutmeg. While the polenta cooks, melt some ghee, pour it into a bowl containing the poppy seeds, cold chamomile tea and rosewater. Mix together, and add enough brown rice flour to make a smooth mixture. When the polenta is cooked, add a bit of sugar or honey and the lecithin; the polenta will become slimy. Add a few more hibiscus petals, followed by the ghee mixture. Stir, and remove base mixture from oven.

Add 4 drops only of the bitter almond oil to the polenta/ghee mix. Spread over the base, slice some banana on top and squeeze over a little lime juice. Cover the baking dish with its lid [or a wet banana leaf, shiny side up, weighted down with empty coconut shells] and bake 15-20 minutes at c.200°C. Remove from oven and add 5 pale hibiscus flowers chopped finely and sprinkled over the top. Add rosewater, cut into small pieces, and serve hot.

A mixture I found effective on several nights as a euphoric inebriant [though not similar to MDMA] was produced by bringing the following ingredients slowly to a boil, simmering for several minutes on lowest heat, and cooling before drinking [with honey added]. Weights are approximate.

- **Alpinia** galanga dried root, 10g
- **Areca** catechu dried nut, 10g
- **Cinnamomum** zeylanicum dried bark, 5g
- **Foeniculum** vulgare dried seed, 4g
- **Glycyrrhiza** glabra dried rhizome, 4g
- **Illicium** verum dried fruit and seed, 4g
- Lycium chinense [Solanaceae; 'Chinese wolfberry'] dried fruit, 5g [see *Endnotes*]
- **Myristica** fragrans dried nut, 2g [1 whole nutmeg]
- **Papaver** somniferum dried leaves, 4g
- **Pimenta** dioica dried fruit, 2g
- Silybum marianum [Compositae; 'milk thistle'] extract equivalent to 7g dry fruit – protects liver from toxicity [see *Endnotes*]
- **Syzygium** aromaticum, a pinch
- and lecithin.

The effects manifested within about 1 hour following consumption [it didn't taste nice], and consisted of CNS stimulation, euphoria and mild sensory distortions, accompanied by mental introspection, lasting about 6 hours.

IF POISONING SHOULD OCCUR

This book can not, unfortunately, provide a thorough guide to the treatment of poisoning, due to the great variety of compounds featured, and their wildly varied natural combinations. I can not over-state the importance of looking before you leap! Ingesting unknown substances can be a highly risky business, as there are many quite toxic and even deadly chemical compounds distributed amongst the natural world. Many of the plants discussed in this book are perfectly safe if used properly. However, others are more toxic, and are accompanied by warnings in the text regarding the potential for death and other, less final, physiological effects. Take note of these warnings, and take care to learn to recognise common plants that can be dangerous. Some of these can closely resemble a less toxic but psychoactive plant to the unwitting plant collector.

It is definitely encouraged to go to your local university library and do your own research. Find out all you can about updates of plant chemistry, explore the toxicity of compounds contained in the plant, and most importantly, find out all you can about the treatment of poisoning. Required action may differ in small but significant ways, depending on which chemical or combination of them has been consumed; while it may be recommended to induce vomiting in one case, such an approach may provoke further disaster in another.

If you think you have been seriously poisoned, take any appropriate immediate action to relieve the poisoning [having done your research beforehand] and have someone get you medical help as soon as possible. This is one reason why it's always good to have someone around when you experiment. It is also a good idea to have, near your telephone, a number to call for poisoning advice. In the case of the classic natural psychedelics, such as **Lophophora**, **Psilocybe**, **Cannabis** etc., if it is all getting too much and you are so paranoid or uncomfortable that you think you have been poisoned, a visit to the emergency ward is exactly what you don't need. Doctors in such places often pump the stomachs of people having 'bad trips' [even though they know such a method will not be effective] just to "teach them a lesson" [in malice?]. Those of the medical profession, generally, do not understand anything about the psychedelic experience, and they will not give you a sympathetic come-down. These natural psychedelic agents just mentioned are relatively non-toxic, and the practical chance of overdose to the point of physical concern with them is so remote as to be almost non-existent.

Still...

Be careful, and good travelling!

PART TWO

The Plants, Fungi and Animals – Entries by Genus

ACACIA

(Leguminosae/Mimosaceae)

Acacia abyssinica *Hochst. ex Benth.* – ol giloriti, ol kiloriti

Acacia acuminata *Benth.* **ssp. acuminata (A. acuminata var. ciliata** *C.F.W. Meissn.***)** - jam wattle, raspberry jam wattle

Acacia acuminata ssp. burkittii *(F. Muell. ex Benth.) Kodela et Tindale* **(A. burkittii** *F. Muell. ex Benth.***; A. randelliana** *W. Fitzg.***)** - fine leaf jam wattle, Burkitt's wattle, sandhill wattle, pin bush, gunderbluey

Acacia albida *Delile.* **(A. gyrocarpa** *Hochst.***; A. saccharata** *Benth.***; Prosopis kirkii** *Oliv.***)** – apple ring acacia, white acacia, white thorn, winter thorn, anaboom

Acacia angustissima *(Mill.) O. Kuntze* **(A. angustifolia** *(Mill.) Kuntze***; A. filiciana** *Willd.***)** – eastern prairie acacia, fern acacia, palo de pulqué, ocpatl

Acacia auriculiformis *A. Cunn. ex Benth.* **(Racosperma auriculiforme** *(A. Cunn. ex Benth.) Pedley***)** – northern black wattle, Darwin black wattle, pale-barked wattle, ear pod wattle, ear-leaf acacia, marra

Acacia bahiensis *Benth.* **(A. tavaresorum** *Rizz.***)** – jurema branca, calumbi difuso, coraco de mulata, espinheiro, pau de ferro, unha de gato [see also **Uncaria** tomentosa]

Acacia baileyana *F. Muell.* **(Racospermum baileyanum** *(F. Muell.) Pedley***)** – Cootamundra wattle, golden mimosa

Acacia berlandieri *Benth.* **(A. tephroloba** *A. Gray***)** – huajillo, guajillo, matorral, membre

Acacia caesia *(L.) Willd.* **(A. intsia** *Willd.***; A. torta** *(Roxb.) Craib.***)** – aila, chilar, karanta, kandam janam

Acacia complanata *Cunn. ex Benth.* **(A. anceps** *Hook., non DC.***; Racosperma complanatum** *(Cunn. ex Benth.) Pedley***)** – long-pod wattle, flat-stemmed wattle

Acacia concinna *(Willd.) DC.* **(A. sinuata** *(Lour.) Merr.***)**

Acacia confusa *Merr.* **(A. richei** *A. Gray***)** – hai hung tou ['red bean from the sea'], hai yuk ['sea medicine'], 'thoughtful tree'

Acacia cornigera *(L.) Willd.* **(A. spadicigera** *Cham. et Schlechtend***)**

Acacia courtii *Tindale et Herscovitch*

Acacia cultriformis *A. Cunn. ex G. Don* **(A. glaucifolia** *A. et N. Baumann ex Meisn.***; A. glaucophylla** *F. Cels***; A. papuliformis** *G. Don***; A. scapuliformis** *A. Cunn. ex G. Don***; Racosperma cultriforme** *(Cunn. ex G. Don) Pedley***)** – knife-leaf wattle, dog-tooth wattle, half moon wattle, golden glow wattle

Acacia difformis *R.T. Baker* – drooping wattle, wyalong wattle, mystery wattle

Acacia farnesiana *(L.) Willd.* **(A. lenticellata** *F. Muell.***; Mimosa farnesiana** *L.***; Popanax farnesiana** *(L.) Raf.***; Vachellia farnesiana** *(L.) Wight et Arn.***)** – jurema branca, sweet acacia, mimosa bush, huisache, stinking bean, cassie, alwek, irlakwe, putunarri, yintiringirningi

Acacia floribunda *(Vent.) Willd.* **(A. floribunda var. latifolia** *Benth.***; A. intermedia** *A. Cunn. ex Hook.***; A. longifolia f. floribunda** *(Vent.) Siebert et Voss***; A. longifolia var. floribunda** *(Vent.) Benth.***; A. retinodes var. floribunda** *(Vent.) H. Vilm.***; Mimosa floribunda** *Vent.***; Racosperma floribundum** *(Vent.) Pedley***)** - gossamer wattle, white sallow wattle, sally wattle

Acacia leucophloea *(Roxb.) Willd.* – hivar, rijua, arjiya, reon, babula-bhed

Acacia longifolia *(Andrews) Willd.* **ssp. longifolia (A. longifolia var. latifolia** *Sweet***; Mimosa longifolia** *Andrews***)** – sallow wattle, Sydney golden wattle, long-leafed acacia

Acacia longifolia ssp. sophorae *(Labill.) Court* **(A. longifolia var. sophorae** *(Labill.) Benth.***; A. longifolia fo. sophorae** *(Labill.) Siebert et Voss***; A. sophorae** *(Labill.) R. Br.***; Mimosa sophorae** *Labill.***; Racosperma sophorae** *(Labill.) Martius***)** – coast wattle

Acacia longissima *Hort. ex H.L. Wendl.* **(A. linearis** *Sims, non. Desv. ex Ham.***; A. linearis var. longissima** *(Hort. ex H.L. Wendl.) DC.***; Racosperma longissimum** *(Hort. ex H.L. Wendl.) Pedley***)** – narrow-leaf wattle

Acacia maidenii *F. Muell.* **(Racosperma maidenii** *(F. Muell.) Pedley***)** – Maiden's wattle

Acacia mellifera *(Vahl) Benth.*

Acacia mucronata *Willd. ex H.L. Wendl.* **(A. longifolia var. mucronata** *(Willd. ex H.L. Wendl.) Benth.***)** – narrow-leaf wattle, variable sallow wattle

Acacia neurophylla *W. Fitzg.*

Acacia nilotica *(L.) Willd. ex Delile* **(A. adansonii** *Guill. et Perr.***; A. arabica** *(Lam.) Willd.***; A. scorpioides** *Wight***; A. vera** *Willd.***)** – scorpion mimosa, Egyptian thorn, sunt, kaarad, gaudi, babul, Indian gum-arabic tree, ol giloriti, ol kiloriti

Acacia nilotica ssp. subalata *(Vatke) Brenan* – ol giloriti, ol kiloriti

Acacia nubica *Benth.* **(A. orfota** *Schweinf.***; A. pterygocarpa** *Hochst. ex Benth.***)** – pelil, wanga, oldepe, gomur

Acacia obtusifolia *A. Cunn.* **(A. intertexta** *Sieber ex DC.***; A. longifolia fo. elongata** *Benth.***; A. longifolia fo. latifolia** *Benth.***; A. longifolia var. obtusifolia** *(A. Cunn.) Benth. ex Seem.***; Racosperma obtusifolium** *(A. Cunn.) Pedley***)** – stiff-leaf wattle, blunt-leaf wattle

Acacia orites *Pedley* **(Racosperma orites** *(Pedley) Pedley***)** – mountain wattle

Acacia phlebophylla *H.B. Will.* **(A. longifolia var. phlebophylla** *F. Muell. ex Benth.***; A. sophorae var. montana** *F. Muell.***)** – Buffalo sallow wattle

Acacia piauhiensis *Benth.* – jurema branca, calumbi branco

Acacia polyacantha *Willd.* **ssp. camplyacantha** *(Hochst. ex A. Rich.) Bren.* **(A. caffra** *(Thunb.)* **var. camplyacantha** *(Hochst ex A. Rich.) Aubrev***; A. camplyacantha** *Hochst ex A. Rich.***; A. catechu** *Oliv. non Willd.***)** – fárcèn karnata ['falcon's claw'], kamboorin shááhòò ['hawk's claw']

Acacia pycnantha *Benth.* **(A. falcinella** *Meisn., non I.F. Tausch***; A. petiolaris** *Lehm.***; A. westonii** *Maiden***)** – golden wattle, broad-leaved wattle

Acacia retinodes *Schltdl.* – swamp wattle, silver wattle, ever-blooming wattle, wirilda

Acacia rigidula *Benth.* – blackbrush

Acacia senegal *(L.) Willd.* **(A. dudgeoni** *Craib ex Holl.***; A. verek** *Guill. et Perr.***; Mimosa senegal** *L.***)** – Egyptian thorn, gum arabic tree, Sudan gum arabic, Somali gum, arabic cape gum, baval, goradia, kher, kumta, mgwara, ol gitende, ol kerdidi, ol derkesi, ol terikesi

Acacia seyal *Del.* – white-galled Acacia, white whistling thorn, buffalo thorn, thirsty thorn, suakim gum arabic, ol jorai, ol jerai, sadra bed, bulbi, ndom, erehi

Acacia seyal *Del.* **var. fistula** *(Schweinf.) Oliv.* – ol jorai, ol jerai

Acacia simplicifolia *(L. f.) Druce et MacBride* **(A. simplex** *(Sparrman) Pedley***)** – tatagia

Acacia victoriae *Benth.* **(A. coronalis** *J.M. Black***; A. decora var. spinescens** *Benth.***; A. hanniana** *Domin.***; A. sentis** *F. Muell.***; Racosperma victoriae** *(Benth.) Pedley***)** – elegant acacia, elegant wattle, bramble acacia, bramble wattle, prickly wattle, arlep, tuperle, urlepe, pulkuru, narran, ngatunpa, aliti, kanaparlku, yalupu, yarlirti, gundabluie

Acacia spp. – wattles [many of the African Acacia spp. have a huge array of colloquial names, and only a small selection is listed here]

Note: although the 'leaves' of non-bipinnate Acacia spp. are technically referred to as phyllodes, for overall simplicity they will be called leaves below, as they look like leaves and serve the same functions. The species with phyllodes, rather than pinnules [Acacia subgenus Phyllodineae], have been reclassified into a separate ge-

nus, Racosperma. Some of these (from Butcher et al. 2001 and Pedley 1987) are listed above. However, the proposal doesn't seem to have taken hold with the majority of wattle-lovers and other botanists, who continue to refer to them all as Acacia.

The wattles are a large group of trees and shrubs found mostly in Australia and Africa, where they flourish due to their tolerance of dry conditions and ability to restore fertility to the soil. Many African wattles, with their high, flat canopies are a familiar sight on the savannahs, and are much loved by elephants and giraffes as food.

The wattle with the most extensive cultural history is A. senegal – its wood was used in building the Jewish tabernacle [possibly A. seyal instead] (Duke 1983), and its branch in flower was used to symbolise the sacred word of the Hebrews. A sprig placed in the turban is said to ward off evil, and the wood is burned in sacred fires in India. The tree has been associated with several deities – Ishtar [goddess of love and war], Diana [or Artemis – goddess of fertility, nature and the moon], Ra [sun god and guide of the worlds], and Osiris [god of fertility and resurrection] (Cunningham 1994; Jordan 1992). In Nigeria and Senegal, a mistletoe [see *Endnotes*] growing parasitically on A. senegal is infused and taken as a body-wash or in other ways, to give "quick, clear vision" as a magical hunting aid (Burkill 1985-1997). It is well known that mistletoes often absorb the phytochemicals of the host plant [see also **Duboisia**]. The resin from the tree, known as 'Gum Arabic' [a.k.a. 'white sennar gum', 'kordofan gum'], is used in sweets, inks, fabric printing, to add shine to silk, and as a thickener for artist's paints. It has been used to treat burns, inflammations, dysentery, gonorrhea and other complaints, also acting as a demulcent and emulsifier. It was once also extracted from A. nilotica [as A. arabica], and similar gums have been extracted from A. laeta and A. seyal ['suakim gum arabic']. A. catechu is the source of 'catechu' or 'cutch' [see also **Uncaria**], a disinfectant and antiinflammatory gum sometimes chewed with betel nuts [see **Areca**, *Methods of Ingestion*] (Bremness 1994; Gowda 1951; Morton 1977), and used medicinally for its astringent properties. It is extracted from the inner bark by water decoction, which is then concentrated, and poured into moulds to dry (Felter & Lloyd 1898).

A. tortilis was said by the Bedouins to be the original 'tree of knowledge' (Shulgin & Shulgin 1997). A. polyacantha ssp. camplyacantha is regarded as an aphrodisiac in the Belgian Congo. In Senegal the root bark is macerated in water for a day and drunk to combat fatigue, lumbago and rib-pains. Also in Senegal, the powdered root of A. seyal is taken with the dried ventral portion of a fat hedgehog as an aphrodisiac; the gum and bark are also believed to be aphrodisiac (Burkill 1985-1997; Duke 1983; Watt & Breyer-Brandwijk 1962).

In Africa, A. ataxacantha root is macerated in water with **Securidaca** longepedunculata and Capparis tomentosa, and taken to treat hernia, sores and wounds. The leaf is analgesic, and contains an alkaloid. A. nilotica has been used in Sudan for many medical ailments, such as colds, bronchitis, diarrhoea, haemorrhage, dysentery and syphilitic lesions. The fruit has antibacterial actions. Also, the Masai take a decoction of the stem bark and root to acquire courage – it acts as a nerve stimulant, aphrodisiac and 'intoxicant'. The Masai make such use of a variety of plants [see also *Endnotes*] to make them aggressive and strong, characters for which Masai warriors are renowned. These same plants may also be used as stimulants for dancing. The plants may be taken in a number of ways, but one method regularly observed has been the consumption of a water infusion of barks and roots, along with meat that had been cooked with an extract of the same or similar plants. Milk is not to be consumed on the same day, as dysentery may apparently result. Depending on the need [a more demanding battle or raid requiring greater preparation], such stimulant-feasts may continue for up to a month or more. Acacia spp. included have been A. abyssinica [roots], A. nilotica, A. nilotica ssp. subalata, A. senegal, A. seyal [bark], and A. seyal var. fistula. One researcher [S.L. Hinde] reported in 1901 that "when the warriors are preparing to go on the war-path, or even in their war-dances, many of them chew the bark of the mimosa tree [probably an Acacia sp. – Ed.], the properties of which are supposed to endow the partaker with strength and courage. Some of the men become raving mad from the effects of the bark, and others fall into a comatose condition". Used under similar circumstances these Acacia spp. have also been said [by D. Storrs-Fox] to "produce a fierce and unbalanced state of mind" (Burkill 1985-1997; El Nabi et al. 1992; Lehmann & Mihalyi 1982). Bark decoctions of A. nilotica ssp. subalata have been reported to have intoxicating and aphrodisiac effects, and the root is used to treat impotence. In Tanganyika, A. mellifera has also been reportedly cooked with meat and eaten as a stimulant. A. mellifera var. detinens is believed to affect the weather, by the Tlhaping, who say that it attracts lightning, and that cutting one of the trees down after the first rains have fallen will result in bad weather. The hooked thorns of the stems are believed to "have the power of enticing and detaining the 'weather spirit'" (Watt & Breyer-Brandwijk 1962).

Some Australian aboriginal tribes use selected Acacia spp. [such as A. aneura, A. beauverdiana, A. calcicola, A. coriacea, A. estrophiliata, A. hakeoides, A. homalophylla, A. kempeana, A. ligulata, A. pruinocarpa, A. salicina and A. saligna] to produce a fine, alkaline ash for chewing with tobacco [see **Nicotiana**] or pituri/pitcheri [see **Duboisia**], to aid in alkaloid release. The part used is usually either the leaf, bark or twigs, varying from species to species. In the Lake Eyre district, A. salicina used for ash production is often itself called 'pitcheri'. Here, the young branch tips [up to 23cm long] were cleaned of damaged and diseased growth. To make the ash, the tips "were tied in bundles, ignited over the fire and then allowed to burn out while held over a wooden bowl" (Aiston 1937; Bindon 1996; Johnston & Cleland 1933; Latz 1995; Low 1990; Peterson 1979).

A. aneura wood is sometimes made into spear-heads; it is said to contain toxic compounds, and thus causes dangerous wounds. The roasted, ground seeds are an important and nutritious food. Mature seeds of A. murrayana were roasted and used as a coffee substitute [see **Coffea**] by early European settlers. Bark of A. falcata, as well as bark and leaves of A. penninervis, have been used to stun fish, as have the bark and twigs of A. melanoxylon [in the Lismore region of NSW]. The latter species has been suspected of poisoning stock, and the wood is thought to cause dermatitis. In the Fitzroy River region of Queensland, A. salicina bark is used as a fish poison. Branches of A. holosericea have also been so used. A. pulchella and A. verniciflua have also been used as fish poisons, but the parts used were not reported (Hurst 1942; Latz 1995; Low 1990).

The boiled young leaves, shoots and seeds of many wattles are edible [wattle seed is often made into a nutritious bread], and the roots can be tapped for water; they are also used to treat a variety of ailments (Bindon 1996; Latz 1995; Maslin et al. 1998). Root shavings of A. georginae have been used as a tea substitute [see **Camellia**] (Latz 1995). In n. Australia, the Ngarinyman heat leaves and branches of A. lysiphloia on hot coals, and apply them to sore muscles or joints as an analgesic (Smith et al. 1993). An infusion of the leaves and pods of A. auriculiformis is used as an analgesic wash, to relieve body pains (Low 1990). In Groote Eylandt, a species which is probably A. pellita is used for the same purpose. Its heated leaves are also applied to the forehead for headaches. Excited and uncontrollable children are sometimes held head-down in smoke from the burning young leaves, to quieten them (Bindon 1996; Levitt 1981).

Aboriginal use of wattles in sacred contexts is common in many parts of Australia. A. peuce is often featured in mythology from central Australian indigenous groups. A. dorotoxylon [A. ammobia] is an important plant in the mythology of the Pitjantjatjara, who use its seed as food. The leaves of A. aneura, another food-provider, have been used as a mat on which sacred objects are placed. In central Australia, secret male rituals are conducted to ensure the proliferation of A. murrayana seed, which is an important food. A. ligulata is of ritual and spiritual importance to Warlpiri women, and the leaves are used in smoking ceremonies to treat a wide variety of illnesses. In northern Australia, crushed leaves of A. estrophiliata are smouldered in smoking ceremonies, to drive away evil spirits. A. dictyophleba, A. pruinocarpa and A. lysiphloia leaves are used as 'smoking medicines' in northern Australia, for newborn babies and their mothers. A. ligulata is also used for 'smoking medicine' (Aboriginal Communities 1988; Bindon 1996; Hurst 1942; Latz 1995; Low 1990).

A. cornigera is sometimes used in the preparation of 'balché' [see **Lonchocarpus**, *Methods of Ingestion*] by traditional Mayans, and the Maya of San Antonio, Belize, drink a tea of the root as an aphrodisiac. A. angustissima and A. albicans roots were probably once added to Aztec 'pulqué' brews [alcoholic beverages prepared from Agave spp. – see *Methods of Ingestion*], presumably to enhance the effects. In Brazil, A. bahiensis, A. farnesiana and A. piauhiensis are known as 'jurema branca' [see **Mimosa**, **Pithecellobium**], though it is unknown whether they are actually used ritually as the name would suggest (Ott 1995b, 1997/1998, pers. comm.; Queiroz 2000; Rätsch 1998).

In India, the gum of A. nilotica is fried in ghee [clarified butter] and taken as an aphrodisiac (Nadkarni 1976). The seeds have also been fermented with dates to make a beverage (Usher 1974). The tree is considered sacred and holy in India, and is thought to be the home of the spirit of a Mohammedan saint. No one is allowed to cut them down, and offerings are made to them for good luck (Trout ed. 1997b, citing Majupuria 1988. Religious and Useful Plants of Nepal and India. Publ. M. Gupta, India). Also in India, A. farnesiana is used to treat insanity, delirium, epilepsy, convulsions, cholera, carbuncles and rabies; in Algeria it is used as an aphrodisiac and insecticide. A flower infusion is known to be stimulant, aphrodisiac and antispasmodic; essential oil from the pods is sedative, aphrodisiac, muscle-relaxant and cardiac-sedative. The essential oil from the flowers, 'cassie oil', is a popular scent, particularly in France (Nadkarni 1976; Trout ed. 1997b; West & Brown 1920). In Fiji, a bark decoction of A. simplicifolia is used as a purgative, and a cold leaf drink treats stomach ache (Cambie & Ash 1994).

Wattles are becoming better known now for their alkaloid contents. Traditionally used for their tannin content in tanning leather [from species such as A. pycnantha] in Australia, many species have been shown to yield alkaloids of the *tryptamine*, *phenethylamine*, imidazole and pyrrolidine classes. However, perhaps due to the finding of *DMT* in some species, alkaloid analyses of Australian Acacia spp. have not been published in any recent years. Despite this, independent researchers have since succeeded in discovering new visionary species that have not undergone formal analysis for alkaloids. These discoveries have in some cases result-

ed from misidentification, and in some cases from intuitive exploration. Some species also contain cyanogenic glycosides and have poisoned stock animals, so much care should be taken with chemically unknown species. Australian species known to be cyanogenic include A. bineura, A. cheelii, A. deanei, A. dorotoxylon, A. farnesiana, A. glaucescens, A. longifolia and A. oswaldii; others include A. giraffae, A. lasiopetala, A. robusta, A. stolonifera and A. tortilis ssp. heteracantha. Flowers, but not leaves, of A. borrowi produced hydrocyanic acid [HCN]. A. roemeriana and A. berlandieri have been reported to be cyanogenic from a field test, though subsequent work was not able to find any HCN. The cyanogenic glycoside usually present in S. African Acacia spp. is acacipetalin; in Australian species, it is usually sambunigrin. Many Acacia spp. are also regarded as toxic due to their content of tannins, acids such as fluoroacetic acid, and neurotoxic amino acids such as djenkolic acid [in seeds] (Conn 1973; Conn et al. 1989; Culvenor 1970; Hungerford 1990; Watt & Breyer-Brandwijk 1962). Acacia spp. also contain a variety of flavonoids in their heartwoods, which have proven useful indicators in chemotaxonomy (Clarke-Lewis & Dainis 1964; Clarke-Lewis & Porter 1972; Tindale & Roux 1969, 1974), as have the free amino acids present in the seeds (Evans et al. 1977).

Australian Acacia spp. known to have edible seeds [ie. those that have been used as such by native peoples] include A. acuminata, A. aneura, A. ayersiana, A. baileyana, A. beauverdiana, A. burkittii, A. brachystachya, A. confluens, A. coriacea ssp. sericophylla, A. craspedocarpa, A. cuthbertsonii, A. dictyophleba, A. dorotoxylon, A. estrophiolata, A. farnesiana, A. holosericea, A. inaequilatera, A. jennerae, A. kempeana, A. ligulata, A. linophylla, A. macdonnelliensis, A. maitlandii, A. microbotrya, A. murrayana, A. notabilis, A. olgana, A. omalophylla, A. oswaldii, A. pachyacra, A. palustris, A. pruinocarpa, A. pycnantha, A. ramulosa, A. retinodes, A. rivalis, A. salicina, A. saligna, A. sclerosperma, A. stenophylla, A. tetragonophylla, A. tysonii, A. victoriae and A. xiphophylla. Seeds from some species are simply eaten raw, whilst others are cooked before consumption. Sometimes the unripe pods are steamed and eaten whole. Although seeds of A. cowleana are sometimes eaten raw [after grinding to a paste with water], damper made from them has the reputation of causing headache (Bindon 1996; Maslin et al. 1998).

When identifying Acacia spp., it is worth noting that closely related species have been known to interbreed, which may complicate both matters of chemistry and positive identification. Also, apparently many Australian Acacia spp. have yet to be identified (New 1984). Results of analyses below reported by White (1944a, 1944c, 1951, 1954, 1957) were all performed on plants growing in New Zealand. White (1944a) noted that high concentrations of *phenethylamine* tended to be found only in species with uninerved leaves, and flowers in racemes [an exception to this is A. acinacea]. Species rich in this alkaloid also tended to contain it in moderate quantity in the ripe seed pods (White 1951).

A. acinacea stems and leaves yielded 0.04-0.07% alkaloids in Feb., 0.79-0.82% in Dec.; ripe seed pods yielded 0.08% alkaloids; seeds contained 0-traces of alkaloids. The alkaloid mixture consisted largely of *phenethylamine* (White 1951).

A. acuminata ssp. acuminata yielded 0.72% alkaloids from stems and leaves, and ssp. burkittii yielded 1.5% [both harv. Oct.]; this appeared to consist mostly of *tryptamine*, as well as smaller amounts of an unidentified *phenethylamine*-like base, and another unidentifed non-volatile base (White 1957). In an alkaloid screening, leaves of a plant from a nursery in Geelong, Vic. [Australia] gave strong positive results (CSIRO 1990). Recent TLC/GCMS analysis found ssp. acuminata leaves to contain 0.6-0.8% *DMT*, and up to 1.6% in bark; young leaves contained almost entirely *tryptamine*. On the other hand, ssp. burkittii was very variable in content, with bark of wild plants yielding 0.2-1.2% *DMT*, and leaves yielding under 0.1% alkaloids, mostly *NMT* (Jeremy 2007).

A. adunca [A. accola] stems, leaves, and flowers [harv. Aug.] yielded 3.2% alkaloids, which appeared to consist of c.70% N-methyl-*phenethylamine*, with smaller amounts of *phenethylamine* (White 1957); leaves from Qld. [Australia] yielded 2.4% N-methyl-*phenethylamine* (Fitzgerald 1964a).

A. albida leaf has been stated to yield *DMT* (Shulgin & Shulgin 1997), but this is in error. Traces of *5-methoxy-DMT* [*5-MeO-DMT*] were tentatively identified in twigs [harv. Oct.], as well as possibly *N-methyltryptamine* [*NMT*] (Trout ed. 1997d). Seeds contain large amounts of albizziine, with lesser amounts of α-amino-β-acetylaminopropionic acid, α-amino-β-oxalylaminopropionic acid, αβ-diaminopropionic acid, djenkolic acid, pipecolic acid [homoproline; 2-piperidinecarboxylic acid] and 4-OH-pipecolic acid (Evans et al. 1977).

A. angustissima leaves have yielded 0.028% N-methyl-*phenethylamine* (Camp & Norvell 1966); roots tested tentatively positive for *DMT* and *5-MeO-DMT* [harv. Mar.], though a second test was negative. Traces of *5-MeO-DMT* were also tentatively detected in seeds. There exists one report of the use of roots [presumably in an ayahuasca analogue] giving some psychoactivity; others consuming the same material did not report any effects (Trout ed. 1997d). The whole shrub also yielded 7,3',4'-trihydroxyflavonol (Clarke-Lewis & Dainis 1967).

A. argentea [A. leptostachya] leaves have yielded 0.03-0.6% N-cinnamoyl-*histamine* (Fitzgerald 1964b).

A. auriculiformis leaves have tested positive for alkaloids (Aboriginal Communities 1988); others have tentatively identified *5-MeO-DMT* in stem bark [harv. Apr.] (Trout ed. 1997b). Bark also contains a mixture of polyphenols which are mostly polymeric leuco-cyanidins and leuco-delphinidins, which turn red on exposure to light. Heartwood yielded 10% (-)-teracacidin, and lesser amounts of other flavonoids (Drewes & Roux 1966). Aerial parts have yielded α-spinasterol and 0.01% auriculoside [a flavan glycoside with mild CNS-depressant activity] (Sahai et al. 1980); funicles have yielded triterpenoid saponins called acaciasides A & B, with antifilarial activity (Ghosh et al. 1993). Fruit pericarps have yielded triterpenoid saponins with spermicidal activity, including acaciaside, proacaciaside-I, proacaciaside-II and acaciamine (Garai & Mahato 1997). Seeds contain large amounts of albizziine, with lesser amounts of S-carboxyethylcysteine, S-carboxyethylcysteine sulphoxide and α-amino-β-acetylaminopropionic acid (Evans et al. 1977).

A. baileyana [from Australia], growing in California [foothills of Santa Cruz Mts, Woodside], yielded [from the leaves] 0.02% alkaloids in late March [80% *tetrahydroharman*, 20% *tryptamine*], and 0.028% in early Oct. [*tryptamine* only]; July collections yielded no alkaloids (Repke et al. 1973). Stems, leaves, flowers and seeds from plants growing in New Zealand [harv. Mar., Aug.] were shown to contain small amounts of alkaloids (White 1944a). Bark and heartwood contain flavonoids (Tindale & Roux 1969). Seeds contain large amounts of albizziine and S-carboxyethylcysteine, with lesser amounts of S-carboxyethylcysteine sulphoxide, S-carboxyisopropylcysteine, 4-OH-pipecolic acid, 5-OH-pipecolic acid, pipecolic acid, djenkolic acid, djenkolic acid sulphoxide and α-amino-β-acetylaminopropionic acid (Evans et al. 1977); others have found in the seeds what was tentatively identified as *DMT* and 2 other indoles in small amounts (Trout ed. 1997b). Ripe and unripe pods have yielded c.0.02% unidentified alkaloids, with ripe and unripe seeds showing only traces (White 1951).

A. berlandieri has been responsible for stock intoxications, called 'guajillo wobbles' or 'limberleg', in Texas, which has been said to be due to the main alkaloid, N-methyl-*phenethylamine* (Camp & Norvell 1966; Keeler 1975; Kingsbury 1964). In one study, leaves yielded 0.28-0.66% of this alkaloid, with highest levels in May, and lowest in September (Camp & Moore 1960). Others found *tyramine*, N-methyl-*tyramine*, and *hordenine* to also be major alkaloids in the leaves (Adams & Camp 1966). In a more recent analysis, fresh leaves, petioles and tender stems were shown to have highest alkaloid concentrations [including a greater number of methylated analogues] in late autumn. Material yielded a large number of alkaloids, including some never before found in plants [ie. *amphetamine*s]. Constituents identified were [% given as early spring; late autumn] – N-methyl-*phenethylamine* [0.17; 0.374], N,N-dimethyl-*phenethylamine* [0.0099; 0.06], *phenethylamine* [0.099; 0.139], 3,4-dimethoxy-5-OH-*phenethylamine* [0.001; 0.0041], β-MeO-3,4-dihydroxy-5-MeO-*phenethylamine* [-; 0.003], *amphetamine* [0.0003; 0.001], *methamphetamine* [0.002; 0.001], N,N-dimethyl-*amphetamine* [0.0046; 0.023], p-OH-*amphetamine* [0.0008; 0.0007], p-MeO-*amphetamine* [4-MA – see *anethole*] [-; 0.0036], 3,4-dimethoxy-5-OH-*amphetamine* [0.0002; 0.0047], *tyramine* [0.037; 0.13], N-methyl-*tyramine* [0.0188; 0.0746], 3-MeO-*tyramine* [0.0003; 0.0015], 3,5-dimethoxy-*tyramine* [0.0003; 0.0034], *hordenine* [0.0009; 0.033], candicine [-; c.0.0035], *dopamine* [0.0004; 0.0025], N-methyl-*dopamine* [0.0002; 0.0011], *mescaline* [0.0005; 0.0036], trichocereine [-; 0.0028], anhalamine [0.0005; 0.004], anhalidine [0.0003; 0.0041], peyophorine [0.0003; 0.0047], *nicotine* [0.004; 0.011], *nornicotine* [0.002; 0.0072], mimosine methyl ester [0.0011; 0.0024], nortryptiline [0.002; 0.0071], 3-α-cumyl-1,3,4-oxadiazolidine-2,5-dione [0.031; 0.042] and musk ambrette [0.0027; 0.0027] (Clement et al. 1997). However, the validity of this research data is currently under question. Some of the compounds claimed to have been identified with comparison to reference standards had never been reported as having been synthesised before and have never before been found in nature, and the authors have made themselves unavailable for comment. These doubts also apply to the results published by the same authors regarding A. rigidula, discussed below (Shulgin pers. comm.; Trout pers. comm.).

A. buxifolia stems and leaves [harv. Dec.], from a variety slightly different than the norm, yielded 0.65% alkaloids; seeds yielded 0.09% alkaloids; pods yielded 0.58% alkaloids. The alkaloid mixture appeared to consist largely of *phenethylamine* (White 1951).

A. caesia bark has yielded *tryptamine* and *DMT*-N-oxide (Ghosal 1972; Ghosal et al. 1970b). An ethanol-extract of the aerial parts was hypothermic, and had unspecified actions on the CNS, and respiratory and cardiovascular systems (Trout ed. 1997b, citing Bhakuni et al. 1973. Indian J. Experimental Biol. 11:43-54).

A. cardiophylla stems, leaves, and flowers [harv. Oct.] yielded 0.03% alkaloids; stems and leaves yielded 0.02-0.06% alkaloids [highest in Mar.]. The alkaloid mixture appeared to contain *tryptamine* and *phenethylamine* (White 1957). In an alkaloid screening, leaves and stems from Mitcham, Vic. [Australia] gave negative results (CSIRO 1990).

A. catechu bark extract may contain c.60% tannins, including catechutannic acid, catechuic acid, and catechin; the gum contains sugars such as d-galactose, d-rhamnose, l-arabinose, and l-glycuronic acid (Nadkarni

1976; Watt & Breyer-Brandwijk 1962). The plant has also yielded taxifolin, a flavonoid with antiinflammatory, antioxidant, antihepatotoxic, antibacterial, antiviral, antifungal (Harborne & Baxter ed. 1993), analgesic and anti-oedema properties (Cechinel-Filho et al. 2000). The gum has been claimed to contain *mitraphylline*, roxburghine D, and gambirine (Huang 1993). However, I could not locate a primary reference for these alkaloids occurring in Acacia, and this was most likely in confusion with 'pale catechu' [derived from **Uncaria** gambir or U. rhynchophylla].

A. complanata dried leaves and stems from s. Queensland [Australia] yielded 0.3% N-methyl-*tetrahydroharman*, and traces of *tetrahydroharman* (Johns et al. 1966b). Alkaloid screening detected 0.22% alkaloids in leaf and stem (CSIRO 1990).

A. concinna leaf has yielded 2.1% *nicotine* [w/w] and 1.2% calycotomine [d/w] (Gupta & Nigam 1971).

A. confusa is said to be poisonous, but is widely used in Chinese medicine. It is an introduced species in Hong Kong, where it is used as a muscle relaxant, and to treat blood disorders. Dried stems yielded 0.074% alkaloids, c.20% being *DMT*, with 80% *NMT*; 0.017% β-sitosterol was also obtained (Arthur et al. 1967); trunk bark yielded *NMT*, as well as an unidentified *tryptamine* alkaloid that did not appear to be *DMT* (Lou et al. 1965). Root bark yielded 2.85% alkaloids [44.75% *DMT*, 55.25% *NMT*] (Liu et al. 1977). Unspecified parts [probably mixed aerial parts] yielded 0.005% *DMT*, 0.009% *DMT* N-oxide, 0.006% *NMT* and 0.007% N-chloromethyl-*DMT*, a new alkaloid which is probably an artefact of extraction (Buchanan et al. 2007). Dried leaves yielded 0.014% taraxerol, 0.027% lupeol (Arthur et al. 1967), and the flavonoids myricetin 3-O-(2"-O-galloyl)-α-rhamnopyranoside, myricetin 3-O-(3"-O-galloyl)-α-rhamnopyranoside 7-methyl ether, and myricetin 3-O-(2",3"-di-O-galloyl)-α-rhamnopyranoside (Lee, T.-H. et al. 2000). Bark and heartwood extracts have shown antioxidant free radical-scavenging activity, probably due to phenolic compounds (Chang et al. 2001). Seeds have been shown to contain large amounts of albizziine, with lesser amounts of S-carboxyethylcysteine, S-carboxyisopropylcysteine, α-amino-β-acetylaminopropionic acid, α-amino-β-oxalylaminopropionic acid, djenkolic acid, 4-OH-pipecolic acid, and 2,4-cis-4,5-trans-dihydroxypipecolic acid (Evans et al. 1977).

A. constricta leaves yielded 0.02% alkaloids, including what was tentatively identified as N-methyl-*phenethylamine* (Camp & Norvell 1966).

A. courtii, closely related to A. orites [see below], has been found by TLC/GCMS to contain up to 2% alkaloids in the bark, mostly or entirely *DMT*, and up to 1.2% in leaves, again mostly or entirely *DMT*. As this species is relatively rare with a restricted range, efforts at cultivation should be made rather than harvesting from wild plants (Jeremy 2007).

A. cultriformis leaf and stem yielded 0.07% alkaloids in Feb., 0.06% in Apr.; an August assay found 0.02% alkaloids in stems, 0.02% in leaves and 0.04% in seeds. The alkaloids appeared to include *phenethylamine* (White 1944a). Stems and leaves from two separate plants [harv. Dec.] yielded traces and 0.02% alkaloids, respectively, and unripe seed pods yielded 0.04% alkaloids; this appeared to consist mainly of *tryptamine* (White 1951). Stems and leaves [harv. Jul.] yielded 0.02% alkaloids, consisting partly of *tryptamine*, and a *phenethylamine*-like base (White 1957). Independent TLC analysis showed tentative presence of *5-MeO-DMT* in leaves, twigs and flowers (Trout ed. 1997b, pers. comm.).

A. cunninghamii [A. trinervata] gave positive tests for HCN (Hurst 1942). Leaf harvested in June [from Miles, Qld] tested positive for alkaloids, as did bark harvested in November [Warwick, Qld]. Other assays produced inconclusive results (Webb 1949). The plant has been the subject of some interesting bioassays. "The extract of one unripe pod of A. cunninghamii injected hypodermically into the arm of a person caused great pain, swelling and redness of the injected spot, as well as nausea and shivering; the extract of two pods caused headache, skin irritation, paralysis of the accomodation of the eye and mydriasis. It is beyond doubt that the juice of six wattle pods, hypodermically injected, will kill a man. Injected into the leg of a frog it caused total loss of sensibility and paralysis of muscles." The unripe pods have yielded 3% of a saponin which causes irritation and local anaesthesia, and acts as a "strong poison for the muscles and nerves". The saponin was found in smaller amounts in other green plant parts (Hurst 1942). The oral toxicity of the saponin is not known, though saponins are, in general, known to have irritant and/or caustic properties.

A. delibrata [from Australia] also contains a saponin in its pods, with similar properties to that from A. cunninghamii (Hurst 1942).

A. difformis leaves tested tentatively positive for presence of traces of *DMT*, and roots for *5-MeO-DMT* [2 year old plants]; roots from the next year did not contain any detectable *5-MeO-DMT*, though stems did [tentatively identified] (Trout pers. comm.).

A. farnesiana stem bark has yielded *tryptamine* (Ghosal 1972); others have found no alkaloids in leaf, stem bark, root bark, seed or flower (CSIRO 1990; Fong et al. 1972; Trout ed. 1997b). The green fruit has tentatively been shown to contain small amounts of *5-MeO-DMT* and an unidentified β-carboline (Trout ed. 1997b). The flower essence has yielded up to 30.9% methylsalicylic ester, as well as many other compounds, including *eugenol* [some found none], *methyleugenol*, butyric acid, geraniol, benzyl alcohol, benzaldehyde, anisaldehyde, p-cresol and OH-*acetophenone* (Schimmel & Co. 1904; Trout ed. 1997b, citing Duke 1981. Handbook of Legumes of World Economic Importance. Plenum Press, NY).

A. floribunda tops [harv. Apr.] yielded 0.18% alkaloids, consisting mostly of *tryptamine*, with traces of *phenethylamine*; flowers [harv. Sep.] yielded 1.18% alkaloids [0.82% from an undated harvest], consisting of +- equal quantities of *tryptamine* and *phenethylamine* (White 1944c); flowers [harv. Oct.] yielded 0.15-0.98% alkaloids; leaves yielded 0.07-0.08% alkaloids; stems yielded 0.04-0.19% alkaloids; stems and leaves combined yielded 0.06-0.16% alkaloids (White 1944a); bark has yielded traces of an alkaloid that was not identified (White 1951). It may be that the techniques used by White were not good for identifying *DMT*, as this commonly cultivated species has recently been found to be a good source of that alkaloid. Using TLC/GCMS, leaves were found to contain mostly *DMT* [usually less than 0.1%]; bark yielded up to c.1% alkaloids, with 0.3-0.5% *DMT*, slightly less *NMT*, and small amounts of *tryptamine*, *harman* and *norharman* (Jeremy 2007).

A. greggii leaves yielded 0.016% alkaloids, including what was tentatively identified as N-methyl-*phenethylamine* and *tyramine* (Camp & Norvell 1966).

A. hakeoides was reported to contain *phenethylamine* (White 1944a), but the plants analysed were later determined to have been A. praetervisa [see below, as A. prominens] (White 1951).

A. harpophylla leaves from Queensland [Australia] yielded 0.1-0.6% alkaloids [*phenethylamine* and *hordenine* in a 2:3 ratio], with 0.3% alkaloids in bark (CSIRO 1990; Fitzgerald 1964a). Bark from branchlets [harv. Jun.] tested strongly positive for alkaloids, though bark of the stems tested negative (Webb 1949).

A. holosericea bark [harv. near Mackay, Qld] has yielded 1.2% *hordenine* (Fitzgerald 1964a); plants from Lotus Creek, Qld yielded 1.22% alkaloids from the bark, and leaves and stems gave weak positive reactions for presence of alkaloids (CSIRO 1990). In another screening, leaves, bark and root of A. holosericea tested negative for alkaloids (Aboriginal Communities 1988).

A. implexa roots were tentatively reported to contain *5-MeO-DMT* (Trout ed. 1997b), but this was in error (Trout pers. comm.). Leaf material harvested in November [from Mt. Lindsay and Warwick, Qld] tested moderately to strongly positive for alkaloids, whilst bark tested negative. Immature fruits were also alkaloid-positive. December-harvested leaf [from Mt. Glorious, Qld] gave mostly negative results (Webb 1949). In a later screening, leaves gave only weak-positive reactions (Rovelli 1967). The unripe seed pods have been implicated in stock deaths and illness (Hurst 1942).

A. kettlewelliae leaves and stems yielded 1.3% alkaloids in Apr. and 1.88% in Oct., which appeared to consist of more than 92% *phenethylamine*, with no *tryptamine* (White 1957); leaves from Creswick, Vic. [Australia] yielded 0.9% N-methyl-*phenethylamine* (Fitzgerald 1964a).

A. laeta has been stated to contain *DMT* in the leaves (Shulgin & Shulgin 1997), but this is in error (Trout ed. 1997d).

A. leucophloea root bark has yielded *tryptamine* (Ghosal 1972), as well as the diterpenoids leocoxol, leucophleol and leucophleoxol (Rojas et al. 2001). The bark is aphrodisiac and demulcent; an alcohol-extract of aerial parts was CNS-depressant and hypotensive. The plant is known to be cyanogenic (Trout ed. 1997b, citing Indian J. Exp. Biol. 9:91 [1971], Indian Vet. J. 54:748 [1977] and J. Res. Indian Med. 8:67 [1973]).

A. linifolia stems and leaves were reported to contain *phenethylamine* (White 1944a), but the plants analysed were later found to have been A. prominens. Stems, leaves, and flowers [harv. Apr., Sydney (Australia)] yielded 0.03% of an alkaloid that was not identified (White 1951). Stems and leaves from Sydney plants contained "insignificant concentrations of alkaloid" in Oct. (White 1957).

A. longifolia ssp. longifolia growing naturalised in California has yielded the *histamine*-amides N-(2-imidazol-4-yl-ethyl)-trans-cinnamamide and N-(2-imidazol-4-yl-ethyl)-deca-trans-2,cis-4-dienamide. Respectively, leaves [harv. late Jan.] yielded 0.0038-0.004%/0.0225-0.024%, leaves [harvested Mar.] yielded 0.0067%/0.027%, bark [harv. late Jan.] yielded 0.015%/0.0175%, and pods [harv. at maturity in Jul.] yielded 0.09-0.17%/0.06-0.112%. Seeds [harv. Jul.] and flower spikes [harv. in Mar., fresh] contained traces of these two compounds (Repke 1975). Tops from plants growing in New Zealand [harv. Nov.] yielded 0.12% alkaloids [c.1% was obtained from tops (I suspect this assay may have actually been on flowers) with an unspecified harvest time]; flowers [harv. Sep.] yielded 0.186% alkaloids. In both, *phenethylamine* was identified as a minor constituent, and though *tryptamine*-like bases seemed to be present, *tryptamine* itself was not detected (White 1944c), except in some samples of flower spikes (White 1951). Tops and flowers combined have yielded up to 0.01% *phenethylamine*; in one sample, it only comprised 9.2% of the total alkaloids. Stems and leaves collected at various times in New Zealand yielded 0.02-0.29% alkaloids; there was no clear correlation between yield and month of harvest. From an Oct. harvest, stems yielded 0.15% alkaloids, leaves 0.06%, and flowers 0.14-0.29% (White 1944a). Bark [harv. Apr.] yielded 0.03% alkaloids; seeds yielded 0.01%

alkaloids (White 1951). Material from Victoria [Australia] was reported to contain N-methyl-*tyramine*, *hordenine*, *NMT*, N-formyl-*NMT*, N-methyl-*tetrahydroharman*, 2-methyl-THβC, N-cinnamoyl-*histamine*, 3-OH-dec-2-enoyl-*histamine*, and other *histamine*-amides (Nichols 1983). However, this data was referenced to Rovelli (1967), which only reported finding *histamine*-derivatives in the leaves [from 0.2% total crude alkaloids] of Australian-grown plants [location not specified]; no indoles were reported from this species (Rovelli 1967). This species has been reported to yield *DMT* (Harborne et al. ed. 1971), possibly confused with A. phlebophylla [as A. longifolia var. phlebophylla]. However, independent psychonauts have verified that at least some examples of this species can be useful as an entheogen. Up to 0.2% *DMT* [as well as what may be *tryptamine*] has reportedly been obtained from unspecified parts, with highest yields in winter (E 1996; E pers. comm.). Also, in 1995, a friend succeeded in obtaining what seemed to be *DMT* from the bark of A. longifolia ssp. longifolia from Eltham, Vic. [Australia]. This was successfully smoked by six people (pers. comm.). A. longifolia ssp. longifolia bark has also yielded up to 18.9% tannin, the leaf yielding smaller amounts. Leaves have also yielded hydrocyanic acid (Hurst 1942; Watt & Breyer-Brandwijk 1962); naringenin [5,7,4'-trihydroxyflavonol] has also been found in flowers [0.12%] and leaves (Clarke-Lewis & Dainis 1967; White 1957). Seeds contain large amounts of albizziine, with lesser amounts of S-carboxyethylcysteine, S-carboxyisopropylcysteine, S-carboxyethylcysteine sulphoxide, djenkolic acid, djenkolic acid sulphoxide, γ-glutamyldjenkolic acid, pipecolic acid, 4-OH-pipecolic acid, 5-OH-pipecolic acid, and α-amino-β-acetylaminopropionic acid (Evans et al. 1977). Found in SA, NSW, and Victoria [Australia].

A. longifolia ssp. sophorae growing in California has been claimed to have yielded *DMT*, *5-MeO-DMT*, *bufotenine*, *gramine* and cinnamoylhistamine [as well as other *histamine*-derivatives] at levels of 0.6% in bark, and 0.15% in leaves, in an elusive unpublished analysis (E 1996; E pers. comm.); *DMT* was apparently a minor alkaloid in both bark and leaf in these assays (Trout pers. comm. quoting D. Siebert). A. longifolia ssp. sophorae from Victoria [Australia] was reported to contain N-methyl-*phenethylamine*, *tyramine*, N-methyl-*tyramine*, *NMT*, *DMT*, *tetrahydroharman*, N-methyl-*tetrahydroharman*, 2-methyl-THβC, N-cinnamoyl-*histamine*, N-decadienoyl-*histamine*, 3-OH-dec-2-enoyl-*histamine*, other *histamine*-amides, and *nicotine* (Nichols 1983). However this was referenced to Rovelli (1967), who only reported finding *histamine*-derivatives in leaves from plants growing at Mentone, Vic. [0.1% crude bases in May, 0.03% in Jan.] (Rovelli 1967). A form of A. longifolia close to ssp. sophorae yielded 0.15% crude alkaloids from unripe pods, 0.07% from stems and leaves [harv. May], and none from seeds (White 1944a). Alkaloid screening in Australia revealed strong presence of alkaloids in the leaf (CSIRO 1990). Found in eastern Australia [SA, NSW, Vic. and Tas.].

A. longissima has yielded useful tryptamine alkaloids in some assays (E pers. comm.). Plants from Springbrook, Queensland, yielded 0.25% alkaloids from leaves, and 0.02% from bark; the identity of the alkaloid/s was not reported (CSIRO 1990). Less than 0.01% alkaloids were detected in stems and leaves [harv. Jul., Oct.], and seeds (White 1944a).

A. maidenii is a variable species, which has sometimes been confused with A. obtusifolia in the wild (E pers. comm.; Mulga pers. comm.). Bark yielded 0.36% *DMT*, and 0.24% *NMT* (Fitzgerald & Sioumis 1965), though a later screening found a slightly higher yield of 0.71% total alkaloids. Bark extracted for pharmacological testing yielded 0.13% alkaloids, consisting of *DMT* and *NMT*. Given orally to rats, the extract was active from 100mg/kg; 250mg/kg produced convulsions. In mice, presence of convulsions was not noted even at 500mg/kg [oral]. In cats, 10mg/kg [oral or i.p.] caused "acute bewilderment and a marked fear complex when approached." In anaesthetised cats, 0.5mg/kg [route of administration not noted] showed respiratory depressant and cardiotoxic activity; in anaesthetised dogs, 0.1-0.5mg/kg [i.v.] was cardiotoxic (CSIRO 1990). Younger trees are said to give best yields (E 1996). Others have had little success with obtaining *DMT* from this plant, due to quite variable yields. The common form with broader, more falcate phyllodes appears to be +-deficient in alkaloids. The leaves of useful varieties are said to sometimes contain greater levels of alkaloids (pers. comms.; Mulga undated); in an early alkaloid screening, the phyllodes gave a strong-positive reaction (Rovelli 1967). Leaf and bark harvested from Tamborine, Qld [Australia] in June tested strongly positive for alkaloids (Webb 1949). Roots have tested strongly positive for *NMT* [major constituent] and *DMT*; wood tested weakly positive for *5-MeO-DMT*; and twigs tested positive for *5-MeO-DMT* [all tentative identifications] (Trout ed. 1997b). Heartwood yielded the flavonoids teracacidin and 7,8,4'-trihydroxyflavonol, as well as (+)-pinitol, L-pipecolic acid, trans-4-OH-L-pipecolic acid, L-proline and 4-OH-L-proline (Clarke-Lewis & Dainis 1967). It is found in Qld, NSW and isolated areas of Vic., Australia.

A. mellifera leaves have been stated to contain *DMT* (Shulgin & Shulgin 1997), but this is in error (Trout ed. 1997d).

A. mucronata var. longifolia leaf appears to contain *DMT* and probably other alkaloids (E pers. comm.); in a formal alkaloid screening, alkaloids were detected in the leaf of A. mucronata var. dissitiflora, and also of an unspecified variety of the species [which gave a slightly stronger reaction] (CSIRO 1990; Rovelli 1967).

A. myrtifolia leaf and stem yielded 0.76% crude bases, including (-)-acacine [a new spermidine alkaloid], and traces of unidentified alkaloids (Nichols 1983). Alkaloid yield did not vary seasonally, in plants from the Dandenong Ranges [Vic., Australia] (Rovelli 1967). Stems and leaves from Sydney, Australia [harv. Apr.] did not yield any alkaloids (White 1951).

A. neurophylla hybridises with A. acuminata, and is represented by two subspecies - ssp. neurophylla and ssp. erugata. The former is very variable, and some specimens may represent new species or subspecies. Plants from the A. neurophylla complex were found [by TLC/GCMS] to contain mostly *DMT* in the bark, with leaves containing mostly *harman* and *norharman*, with traces or no *DMT* (Jeremy 2007).

A. nilotica has been said to contain *DMT* in the leaves (Ott 1993; Shulgin & Shulgin 1997), though this may have been in error as Ott (1994) later retracted the statement. Leaves, stem bark, roots and seeds have all tested negative for alkaloids (Odebiyi & Sofowora 1978). Others have stated that the leaf has yielded *tryptamine* and *leptaflorine* (Oliver-Bever 1986), yet this is suspect. Stems, roots, and leaves have tentatively tested positive for the presence of traces of *5-MeO-DMT*. Seeds have tentatively tested positive for the presence of *DMT*, *NMT* and *5-MeO-DMT*, though later tests did not confirm this (Heffter 1996; Trout ed. 1997b, pers. comm.). Immature fruits of plants growing in Queensland [as A. arabica; harv. Dec.] tested positive for alkaloids (Webb 1949). The seeds contain large amounts of N-acetyldjenkolic acid, with lesser amounts of djenkolic acid, djenkolic acid sulphoxide, N-acetyldjenkolic acid sulphoxide, pipecolic acid and 4-OH-pipecolic acid (Evans et al. 1977). An aqueous extract of the seeds showed spasmogenic, vasoconstrictive, and hypertensive effects in animal studies (Amos et al. 1999); a methanol extract of the pods showed antispasmodic and antihypertensive effects in animals (Gilania et al. 1999), and a water extract was antimicrobial (El Nabi et al. 1992). A. nilotica is found in Sudan, Egypt, India and Australia [NT, SA and Qld]; A. nilotica ssp. indica is also found in Australia (International... 1994; Parsons & Cuthbertson 1992).

A. nubica dried leaves [harv. in Sudan, late Nov.] yielded 0.0016% *DMT* (Khalil & Elkheir 1975).

A. obtusifolia is a variable Australian species which has sometimes been confused with A. maidenii, A. longifolia ssp. longifolia and A. orites in the field (pers. comms.). Bark has yielded 0.15% alkaloids, though their identities were not reported (CSIRO 1990); in n.e. NSW, 0.15-0.2% has typically been isolated (E pers. comm.), though others have achieved higher yields of 0.4-0.5%. Fresh young leaves yielded c.0.07% alkaloids (Mulga undated); dried leaves from different locations have yielded 0.15-0.3% alkaloids. Bark has been used in ayahuasca analogues, and extracted for freebase alkaloids. Preliminary TLC analysis of one bark extract revealed the presence of at least 5 alkaloids, including what was very tentatively identified as *DMT*, *5-MeO-DMT*, and *bufotenine*. At some times of year, plants from the same patch yielded an extract seemingly comprised of *DMT* and a larger quantity of *NMT*. A great deal of variation in alkaloid composition has been observed [based on subjective experiences and limited TLC analysis], seemingly influenced by a complex range of factors including time of harvest, rainfall, soil composition, and possible hybridisation. Definite correlations betwen alkaloidal composition and these factors have not yet been determined (E pers. comm.). In one array of extracts, a summer extract was orange in colour, whereas a winter extract was dark brown, although there was further variation between colour and season that suggests it's not that simple. Initial analysis found the orange summer extract to contain traces of *bufotenine* and the dark winter extract to contain more, though a second analysis found none (Trout 2005). A recent, more accurate analysis of stem bark extract by HPLC/MS found *DMT* as the major alkaloid by far, with traces of *tryptamine*, possibly *NMT*, and unidentified β-carbolines; no *5-MeO-DMT* or *bufotenine* was observed (Mulga 2005). Another analysis [TLC/GCMS] using plants from various sources also found no *5-MeO-DMT* or *bufotenine*. In general, bark contained up to 1.4% alkaloids - mostly *DMT*, with lesser amounts of *NMT*, *tryptamine*, *harman* and *norharman*; leaves contained mostly *NMT*, with lesser amounts of *DMT* (Jeremy 2007). Heartwood has yielded the flavonoids melacacidin, isomelacacidin, teracacidin, isoteracacidin, and 7,8,4'-trihydroxyflavonol, as well as (+)-pinitol and an unidentified leuco-anthocyanidin (Clarke-Lewis & Dainis 1967).

A. orites has on occasion been confused with A. obtusifolia and A. longissima [see above], and is suspected of being useful for shamanic purposes (pers. comms.; pers. obs.). Some underground researchers have reported obtaining alkaloids that might be β-carbolines (E pers. comm.).

A. phlebophylla leaves [harv. May] gave a strongly positive result in alkaloid screening; "leaves and tops" harvested later, in August, yielded 0.3% *DMT* as apparently the sole alkaloid [or at least the major alkaloid by far] (Rovelli 1967; Rovelli & Vaughan 1967). A recent TLC/GCMS analysis found leaves to contain up to 0.6% *DMT*, though youngest growth was much less potent; bark contained up to 1% *DMT*, though bark harvesting of this species is not sustainable (Jeremy 2007). Others have reported yields of 0.1-1% *DMT* from leaves (Julian pers. comm.). Most of the natural population has been heavily and adversely affected by

galling caused primarily by a rust fungus, Uromycladium sp. (Heinze et al. 1998), though a recent extensive bushfire at Mt. Buffalo appears to have destroyed the infected material, and the species is currently regenerating well. This Victorian species is also rare and may be considered threatened, and successful cultivation is often difficult. Wild specimens should preferably be left unmolested, particularly given the poor health of most of the current population of mature trees. Careless wandering throughout its natural range might also possibly aid in spreading the galling fungus to areas previously unaffected. In the past, however [at least in my case, when I was not aware of these factors apart from that of the limited range of the species], myself and others have successfully used this plant in ayahuasca analogues, with c.20g dried leaves and stems [harv. late Jan.] being a moderate [but still very strong] dose, accompanied with c.3g **Peganum** harmala seeds (pers. obs.; see also Ott 1994). Interestingly, the closely related A. alpina, which looks somewhat like a dwarf A. phlebophylla and grows in the same area but at higher altitude, gave a negative result in alkaloid screening of the leaves (Rovelli 1967).

A. podalyriaefolia bark from Ipswich, Qld [Australia] yielded 0.12% alkaloids; stems and leaves yielded 0.28% alkaloids (CSIRO 1990); stems and leaves [harv. Feb.] yielded 0.11% alkaloids, which appeared to contain *phenethylamine* (White 1944a); stems and leaves [harv. Nov.] yielded 0.29% alkaloids, which appeared to consist mainly of *tryptamine*, with smaller amounts of *phenethylamine* (White 1957); stems and leaves collected after flowering yielded 0.11% alkaloids, consisting mostly of *tryptamine*, with no *phenethylamine* (White 1951); seeds and pods yielded 0.11% alkaloids, also consisting mainly of *tryptamine*, with smaller amounts of *phenethylamine* (White 1957).

A. polyacantha ssp. camplyacantha dried leaves [harv. in Sudan, late Nov.] yielded 0.004% *DMT* (Khalil & Elkheir 1975). Leaves also contain the flavonoids rutin and vicenin 2 (International... 1994).

A. polystachya bark yielded 0.35% N-cinnamoyl-*histamine* (Fitzgerald 1964b).

A. pravissima stems [harv. Aug.] yielded 0.13% alkaloids; leaves [harv. Aug.] yielded 0.31% alkaloids; stems and leaves combined [harv. Mar.] yielded 0.44% alkaloids. This appeared to consist largely of *phenethylamine* (White 1944a). Tops [harv. Jan.] yielded 0.69% crude alkaloids, consisting mostly of *phenethylamine* (White 1954).

A. prominens [A. praetervisa] stems and leaves yielded 0.2-0.65% alkaloids [highest found in Aug. and Dec.]; stems and leaves separately [harv. Aug.] yielded 0.17% alkaloids each; seeds yielded 0.04% alkaloids. *Phenethylamine* appeared to be the major alkaloid (White 1944a, 1951). Stems and leaves from both a small and a large tree yielded 0.23% and 0.25% alkaloids, respectively [harv. Aug.]; this consisted of c.50% *phenethylamine* and c.20% N-methyl-*phenethylamine* (White 1957). Flowering tops of a horticultural variety yielded 1.8% alkaloids, consisting mostly of what was tentatively identified as *phenethylamine* and N-methyl-*phenethylamine*. Other samples of tops yielded 1.11-2.38% crude alkaloids. Both types varied in which alkaloid was predominant at different times, though no definite correlations could be determined (White 1954).

A. pruinosa tops have yielded 0.04% alkaloids, consisting mostly of *tryptamine*, with small amounts of *phenethylamine* (White 1944c); stems and leaves [harv. Feb.] yielded 0.03% alkaloids; stems and leaves [harv. May] yielded 0.09% alkaloids; stems and leaves [harv. Oct.] yielded 0.02% alkaloids (White 1944a); stems, leaves and flowers [harv. Aug.] yielded 0.02% alkaloids (White 1957); stems and leaves [harv. Dec.] yielded 0.02% alkaloids; no alkaloids were found in seeds or unripe pods (White 1951).

A. pycnantha is Australia's national floral emblem. A crude alkaloid extract was obtained in very small yield from the dried leaves. The extract smelled like *DMT*, and although the small quantity was not sufficient to determine its identity, it was psychoactive when smoked. The effect was similar to that of a sub-threshold dose of *DMT*. This has not yet been followed up with further extractions (pers. obs.). Less than 0.01% alkaloids were detected in leaves and stems [harv. Apr.], and stems, leaves and flowers [harv. Sep.] (White 1944a). An alkaloid screening did not reveal the presence of alkaloids in the leaf of the 'weeping variety'. A tannin, butein, has been found in the plant (Rovelli 1967).

A. retinodes has reportedly yielded *nicotine* (Nichols 1983 refers to Fikenscher 1960. Pharmaceutisch Weekblad 95:233-235, which I have been unable to locate; the Chemical Abstracts citation [see Bibliography] does not name the species analysed). Leaves of plants from Berwick, Melbourne [Vic., Australia] gave a small yield of a single major alkaloid which did not correspond with *nicotine*; also, leaves of plants from Cape Schanck, Mornington Peninsula [Vic., Australia] gave a very low yield of an alkaloid that could not be identified in comparison to the reference standards [which were *phenethylamine*, *hordenine*, *NMT*, *DMT*, *tetrahydroharman* and N-methyl-*tetrahydroharman*] (Rovelli 1967). Stems and leaves [harv. Apr.] and seeds were found to contain <0.01% alkaloids (White 1944a); in another assay, stems, leaves, bark, ripe and unripe seeds, and unripe pods contained no alkaloids (White 1951).

A. rigidula leaves in early tests yielded 0.025% alkaloids, consisting of a mixture of what was tentatively identified as N-methyl-*tyramine* and N-methyl-*phenethylamine* (Camp & Norvell 1966); more exhaustive study of fresh leaves, petioles, and tender stems revealed [% given as early spring; late autumn] *DMT* [0.032; 0.057], *NMT* [0.0005; 0.0055], *tryptamine* [0.00008; 0.0021], *phenethylamine* [0.087; 0.11], N-methyl-*phenethylamine* [0.23; 0.53], N,N-dimethyl-*phenethylamine* [0.012; 0.072], 3-OH-4-MeO-*phenethylamine* [0.0016; 0.016], N-methyl-3-OH-4-MeO-*phenethylamine* [0.0019; 0.018], *DMPEA* [0.0001; 0.0006], N-methyl-*DMPEA* [0.0008; 0.0028], 3,4,5-trihydroxy-*phenethylamine* [0.0002; 0.0013], N-methyl-3,4,5-trihydroxy-*phenethylamine* [0.00003; 0.0002], 3,4-dimethoxy-5-OH-*phenethylamine* [0.0016; 0.0057], β-MeO-3,4-dihydroxy-5-MeO-*phenethylamine* [0.0005; 0.0022], *tyramine* [0.046; 0.17], N-methyl-*tyramine* [0.024; 0.17], 3-MeO-*tyramine* [0.0002; 0.0013], N-methyl-3-MeO-*tyramine* [0.0003; 0.0028], *dopamine* [0.0009; 0.0036], N-methyl-*dopamine* [0.00005; 0.0008], N,N-dimethyl-*dopamine* [0.0011; 0.0045], *mescaline* [0.0003; 0.0027], N-methyl-*mescaline* [0.0002; 0.0035], trichocereine [0.00002; 0.0014], *hordenine* [0.0006; 0.053], *amphetamine* [0.0007; 0.0012], *methamphetamine* [-; 0.0012], N,N-dimethyl-*amphetamine* [0.0058; 0.039], p-OH-*amphetamine* [0.0002; 0.0007], p-MeO-*amphetamine* [4-MA – see *anethole*] [-; 0.0016], 3,4-dimethoxy-5-OH-*amphetamine* [0.0005; 0.006], anhalamine [0.001; 0.0049], anhalidine [0.0006; 0.005], *anhalonidine* [0.0002; 0.0016], peyophorine [0.0004; 0.004], *nicotine* [0.0046; 0.015], *nornicotine* [0.0023; 0.0084], pipecolamide [0.087; 0.098], p-OH-pipecolamide [0.024; 0.035], 1,4-benzenediamine [0.01; 0.013], 4-methyl-2-pyridinamine [0.034; 0.057], 2-cyclohexylethylamine [0.00008; 0.0035] and N-2-cyclohexylethyl-N-methylamine [0.0001; 0.0047] (Clement et al. 1998). See A. berlandieri above for comments on the doubtful validity of this data.

A. roemeriana leaves yielded 0.036% alkaloids, including what was tentatively identified as N-methyl-*phenethylamine*, *tyramine*, and N-methyl-*tyramine* (Camp & Norvell 1966).

A. schottii leaves contained an alkaloid tentatively identified as N-methyl-*phenethylamine* (Camp & Norvell 1966).

A. senegal leaves [harv. Sudan, late Nov.] yielded 0.003% *DMT* (Khalil & Elkheir 1975); an ethanol-extract of the stem bark showed spasmolytic and anti-inflammatory properties (Trout ed. 1997b, citing Indian J. Exp. Biol. 15:208 [1977]). Gum from the branches contains mainly salts of arabic acid [arabin], as well as an oxidising enzyme (Morton 1977).

A. seyal and A. sieberiana have been stated to contain *DMT* in their leaves (Shulgin & Shulgin 1997), though this is in error (Trout ed. 1997d); the latter species contains the cyanogenic glycosides heterodendrin, proacaciberin and proacacipetalin in leaves and pods, as well as 1-O-(2-methylbutyryl)vicianose, a 1-O-(2-methylbutyryl)disaccharide, and its isomer (Brimer et al. 1980).

A. simplicifolia stem bark and leaf yielded 3.6% alkaloids, consisting of 22.5% *DMT*, 40% *NMT*, 12.7% 2-methyl-THβC and small amounts of N-formyl-*NMT* (Poupat et al. 1976). It is found on some Pacific Islands, as well as in Argentina (International... 1994).

A. spectabilis leaves and stems yielded 0.21-0.35% alkaloids, consisting of 60-72% *phenethylamine*, with traces of a non-volatile base, and no *tryptamine*; leaves and bark [harv. Jun.] were rich in alkaloids (White 1957).

A. spirorbis [from New Caledonia] fresh root bark [harv. Mar.] yielded 0.15% alkaloids, including N-cinnamoyl-*histamine* [0.024%]; fresh trunk bark [harv. Mar.] yielded 0.06% alkaloids, including N-cinnamoyl-*histamine* [0.025%] and *hordenine* [0.007%]; leaves yielded 0.02% alkaloids, including N-cinnamoyl-*histamine* [0.019%]. A maceration of the trunk and/or root bark is used to treat rheumatism, and leaves are used to treat malaria (Poupat & Sévenet 1975).

A. suaveolens stems and leaves yielded 0.7-0.89% alkaloids; stems [harv. Sep.] yielded 0.07% alkaloids, leaves 0.69%, seeds 0.01%, and unripe seed pods 0.05-0.17%. Stems, leaves, and flowers [harv. Apr., Sydney (Australia)] yielded 0.97% alkaloids. The alkaloid mixture in all cases appeared to consist mainly of *phenethylamine* (White 1944a, 1951). Tops [harv. Nov.] yielded 1.1% crude alkaloids, consisting mostly of *phenethylamine* (White 1954).

A. texensis leaves yielded 0.008% alkaloids, including what was tentatively identified as N-methyl-*phenethylamine* and *tyramine* (Camp & Norvell 1966).

A. tortilis has been stated to contain *DMT* (Ott 1993), though this is in error (Trout ed. 1997b), and Ott (1994) later retracted the statement.

A. ulicifolia whole plant yielded 0.0166% ether-soluble tertiary alkaloids, which may be phenolic amines. In mice, 500mg/kg [oral] and 100mg/kg [i.p.] caused CNS-depression, with no observable effect at lower doses – double these doses were fatal (CSIRO 1990).

A. vestita stems and leaves gave different alkaloid yields at different times – 0.03-0.04% [Jan.], 0.28% [May], 0.08% [Jul.-Aug.], and 0.12% [Oct.]; this consisted of up to 83% *tryptamine*, with traces of a non-volatile base (White 1957).

A. victoriae has tentatively tested positive for *DMT* in aerial parts, and *5-MeO-DMT* in roots (Trout ed. 1997b). Alkaloid screening of leaf and stem was negative in spot tests (CSIRO 1990), though Rovelli (1967) obtained a weak-positive reaction with the leaves (Rovelli 1967). Aerial parts and seed pods contain triterpenoid saponins called avicins, which have

antioxidant and anticancer activities (Hanausek et al. 2001; Haridas et al. 2001).

In broad alkaloid screenings, a number of other Australian Acacia spp. were found to contain alkaloids which were not identified – A. amblygona [leaf and stem; only detected in some tests], A. aneura [0.009% in leaf], A. angusta [0.08% in leaf and stem], A. aulacocarpa [leaf harv. Jul., weak-positive; none in Jan. harvest], A. bakeri [leaf and stem], A. beauverdiana [leaf and stem], A. conferta [leaf harv. Jul., weak-positive], A. cowleana [leaf], A. dealbata [<0.01% in leaf and stem harv. Nov., seeds; weak-positive in leaf harv. Jun.], A. deanei [leaf and stem], A. decora [leaf harv. Jun.; traces in stem and leaf harv. Mar., Apr. & Oct.], A. decurrens [<0.01% in stem and leaf harv. May; 0.02% in stem and leaf harv. Feb.; none in stem and leaf harv. Dec.; weak-positive in leaf. harv. Jun.], A. doratoxylon [0.06% in leaf and stem], A. drumondii [<0.01% in leaf and stem harv. Feb., none in leaf and stem harv. Aug., or in flowers], A. elata [<0.01% in stem and leaf harv. Mar. & Nov., seeds; traces in unripe pods, none in bark or unripe seeds], A. estrophiliata [leaves], A. excelsa [leaf and stem], A. falcata [<0.01% in leaf and stem harv. May; traces in leaf and stem harv. Apr. & Dec., stem leaf and flower harv. Jul., and ripe seeds and pods; another assay of leaf in Jul. gave no alkaloids], A. fimbriata [leaf and bark, harv. Mar.], A. flexifolia [traces in stem, leaf, and flower harv. Jul.], A. gilbertii [leaf], A. gonophylla [leaf], A. howittii [reported incorrectly as A. vestita; <0.01% in stem and leaf harv. Feb.-May; no alkaloid in other assays of stem, leaf, ripe seeds, and pods], A. ixiophylla [leaf, harv. Jun.], A. juncifolia [0.008% in leaf], A. juniperina [leaf and stem harv. Nov., strong-positive], A. kybeanensis [leaf], A. latipes [leaf], A. leichhardtii [0.007% in leaf and stem], A. leiocalyx [leaf and stem], A. leiophylla [leaf], A. leprosa [<0.01% in stem and leaf harv. Feb., stem leaf and flower harv. Sep.], A. leptocarpa [0.09% in leaf; some tests negative], A. linearis [leaf], A. lunata [leaf harv. Jun., strong-positive], A. lysiphloia [leaf], A. maitlandii [leaf], A. mangium [leaf and bark], what may have been A. mearnsii [as A. decurrens var. mollis; <0.01% in seeds, 0.02% in stem, leaf and flower harv. Oct., none in galls], A. melanoxylon [young leaf; samples of mature leaf from other locations were negative; <0.01% in stem and leaf harv. Apr. & Aug.; 0.03% in ripe pods, none in bark or seeds], A. neriifolia [1.3% in leaf, 1.2% in bark], A. nervosa [leaf], A. oxycedrus [0.16% in leaf and stem], A. paradoxa [0.01% in tops; as A. armata, plants in New Zealand gave no alkaloid from stem and leaf harv. Mar., or stem, leaf and flowers harv. Oct., though ripe pods contained traces], A. pendula [leaf, not in bark in some tests], A. penninervis [leaf and bark harv. Jun., leaves gave stronger reaction], A. rhodoxylon [leaf and stem], A. rupicola [traces in stem, leaf and flower harv. Jul.], A. salicina [leaf harv. Jun., weak-positive; has also given negative results], A. saligna [<0.01% in stem and leaf harv. Feb.; traces in stem and leaf harv. Apr., as A. cyanophylla], A. semilunata [leaf], A. shirleyi [identity uncertain; leaf harv. Jun.], A. simsii [0.03% in leaf], A. stenoptera [leaf], A. stricta [<0.01% in stem and leaf harv. Feb. & Aug., also in seeds; another assay found none in stem, leaf, flowers, ripe seeds, or pods], A. terminalis [as A. discolor; 0.03% in stem, leaf and flower harv. Feb.; traces in stem and leaf harv. Apr.-May, traces in flower spikes], A. tetragonophylla [root bark; leaf was negative], A. torulosa [leaf, not in bark], A. triptera [leaf and branches harv. Jun.], A. umbellata [0.013% in leaf], A. urophylla [leaf], A. verniciflua [traces in stem and leaf harv. Feb.; another Feb. harv. gave no alkaloids], A. verticillata [<0.01% in flowers, leaf and stem harv. Sep.; none detected in bark], and A. viscidula [leaf and stem harv. Nov.] (Aboriginal Communities 1988; CSIRO 1990; Rovelli 1967; Webb 1949; White 1944a, 1951, 1957).

Acacia obtusifolia is an erect, glabrous shrub to small tree, 1-5m tall; branches rigid; branchlets +- angular, becoming terete, striate, reddish. Phyllodes dark green, rather thick and leathery, glabrous, 8-20cm x 7-25mm, narrow oblong-elliptic, flat and coriaceous, straight, margins uneven, often minutely glandular-resinous, reddish, apex obtuse, (1-)2(-3) prominent longitudinal nerves, secondary nerves finely branching [anastomosing] between, becoming raised when dry; pulvinus 2-3mm long; gland small, 5-10mm above the pulvinus; young phyllodes reddish. Inflorescence of pale to creamy yellow flowers scattered on 1-several spikes 3-7cm long in the axils; peduncles 5-7mm long, glabrous; flowers 4-merous; sepals partly united, lobes triangular and often ciliate; petals partly united, glabrous, apex keeled; ovary pubescent. Seed pod a legume, linear, 5-9(-15)cm x 4-7mm, thick-walled, subcylindrical, straight or slightly curved, not becoming twisted, attenuate at both ends. Seeds longitudinal in pod, funicle folded several times into a large aril. Fl. late Nov.-Feb.

Common in coastal forest and tablelands of NSW, extending to c.w. slopes and to n.e. Vic. and s.e. Qld.; in Eucalyptus spp. forests and woodlands, in higher rainfall areas of coastal mountains (Costermans 1992; Tame 1992).

Rarely fruits, self-propagates mainly from suckers (Entwistle et al. 1996); however, others dispute this and have observed this species to fruit readily (E pers. comm.). Germinate seeds by scarification, followed by soaking in water for a few hours; plant in well-drained, moist germination medium. Enjoys an open, sunny, well-drained position; fertilise with granite or rock dust. Hardy once established, cold-tolerant (Floyd pers. comm.).

A. longifolia ssp. longifolia and A. longifolia ssp. sophorae, once considered separate but closely related species, can sometimes be very difficult to tell apart, as they intergrade imperceptibly in some populations, and can also interbreed. They can usually [but not always] be distinguished from each other by a number of features. Proportions of leaf length to width on main stems are the easiest differences to observe in the field. In one examination, A. longifolia ssp. longifolia ranged from [5-]9.4-12[-20] x [0.5-]1.2-1.5[-1.9]cm; A. longifolia ssp. sophorae ranged from [5-]5.7-8.6[-12] x [1-]1.25-2.9[-3]cm. Leaves of A. longifolia ssp. longifolia are usually widest near or below the middle, narrowing gradually to the apex; leaves of A. longifolia ssp. sophorae are usually widest near or above the middle, narrowing abruptly towards the apex. Seed pods of A. longifolia ssp. sophorae are more contorted than those of A. longifolia ssp. longifolia [which are +- straight], and the seeds are larger and heavier [as well as being more numerous per-pod, on average]. Pods of A. longifolia ssp. sophorae are dark reddish-brown, whilst those of A. longifolia ssp. longifolia are brown. Chemically, A. longifolia ssp. sophorae leaf has a more complex flavonoid composition than A. longifolia ssp. longifolia (Butcher et al. 2001; Murray et al. 1978).

A. obtusifolia is readily distinguished from A. longifolia ssp. longifolia by the thicker, more rigid phyllodes, with resinous margins, of the former. A. maidenii and A. obtusifolia can also appear very similar in some instances, due to their wide variation and frequent co-habitation in the wild. Despite this, there are important differences which easily separate them. Leaves of A. maidenii are relatively light and flexible compared to those of A. obtusifolia, which are thick and leathery, and often have irregular, reddish margins, and reddish new growth. The nervation on A. maidenii is very fine and sparsely anastomosing, whilst A. obtusifolia nervation is more distanced and prominent. Flowers of A. obtusifolia are a light creamy yellow, whilst those of A. maidenii are golden yellow. Fruit of A. obtusifolia is straight, and fruit of A. maidenii is usually highly contorted (Entwistle et al. 1996; Mulga pers. comm.; pers. obs.). A. obtusifolia [as A. intertexta] was once confused with the similar A. orites (Clarke-Lewis & Dainis 1964), which has since been recognised as a separate species (Pedley 1964).

Exploitation for drug content has lead to much destructive harvesting of several Acacia spp. in Australia, causing noticeable damage in National Parks. This has particularly been a problem with A. phlebophylla [which has a very small population and is difficult to cultivate] and A. obtusifolia (E 1996; pers. comms.).

People outside of Australia may have difficulty in cultivating Australian Acacia spp., as the roots of the plants grow in symbiosis with soil-dwelling rhizobium bacteria. Rhizobium innoculants for various groups of Leguminous plants can be obtained from some horticultural suppliers. A. phlebophylla seed should be germinated as for A. obtusifolia, but may take up to a month to germinate; keep slightly moist in this time. In practice the seeds seem to have a low viability. Enjoys a sunny position, and a coarse, well-drained soil with elements of sand, gravel and granite; fertilise with granite or rock dust. Water only moderately; fungus-sensitive. Hardy, cold-tolerant (Floyd pers. comm.).

ACANTHURUS, KYPHOSUS, MUGIL, NEOMYXUS, MULLOIDICHTHYS, UPENEUS, ABUDEFDUF, EPINEPHELUS, SARPA and SIGANUS

(Acanthuridae)

Acanthurus triostegus *L.* **ssp. sandvicensis** *Streets* – convict surgeonfish, tang, convict tang, manini

(Kyphosidae)

Kyphosus bigibbus *Lacepède* **(K. fuscus** *Lacepède***)** – brown chub, grey seachub, grey drummer, insular rudderfish, isuzumi, nenue, karamami pakavai, minami-isuzumi, petit wiwa, umuleo, renigiiy

Kyphosus cinerascens *Forsskål* **(Pimelepterus cinerascens** *Forssk.***; Sciaena cinerascens** *Forssk.***)** – seachub, blue seachub, snubnose chub, highfin chub, chub, rudderfish, highfin rudderfish, bluefish, Ashen drummer, topsail drummer, isuzumi, tenjikuisaki, kibawo, kuwa, nenue, manaloa, achlat karang, beras-beras, renigiiy, sirisiriwai

Kyphosus vaigiensis *(Quoy et Gaimard)* **(K. bleekeri** *Fowler***; K. gibsoni** *Ogelby***; K. lembus** *(Cuvier)***; Pimelepterus vaigiensis** *Quoy et Gaimard***; Segutilum gibsoni** *Ogelby***)** – sea chub, lowfin chub, blue seachub, brassy chub, brass bream, drummer, Waigeu drummer, large-tailed drummer, low-finned drummer, lowfin rudderfish, isuzumi, nenue, saborre, renigiiy, lupak, yaaji

(Mugilidae)

Mugil cephalus *L.* **(M. strongylocephalus** *Richardson***)** – common grey mullet, flathead mullet, longarm mullet, black mullet, bright mullet, hardgut mullet, striped mullet, springer, ama ama, pua ama, haarder, kahaha, wu tau tze

Neomyxus chaptalii *(Eydoux et Souleyet)* **(Chaenomugil nauticus** *Bryan et Herre***; Mugil chaptalii** *Eydoux et Souleyet***)** – silvery mullet, Chaptall's mullet, eatar, uoauoa

(Mullidae)

Mulloidichthys flavolineatus *Lacepède* **(M. samoensis** *(Günther)***; Mulloides samoensis** *Günther***; Mullus flavolineatus** *Lacepède***)** – goatfish, gold-striped goatfish, golden goatfish, yellowstripe goatfish, Samoan goatfish, pallid goatfish, bait goatfish, surmullet, weke, weke'a'ā ['staring weke'], weke 'ula ['scarlet weke', 'ghost weke'], weke ke'oke'o ['white weke'], sand weke, baybayo, kawe, oama, tubac, tuyo, afolu i'a sina

Upeneus arge *Jordan et Evermann* – goatfish, gold-striped goatfish, band-tailed goatfish, surmullet, weke, weke pueo ['owl weke'], weke nono ['red weke'], weke pahulu ['nightmare weke'], jome, rouget, tebaweina, te maebo, tubac, tuyo, afolu i'a sina

(Pomacentridae)

Abudefduf septemfasciatus *(Cuvier)* **(A. multifasciatus** *Seale***; A. paee** *Curtiss***; Chaetodon rotundus** *L.***; Glyphisodon septemfasciatus** *Cuvier***)** – sergeant major, seven-banded sergeant major, banded sergeant, sevenbar damsel, damselfish, maomao, ulavapua, alala saga, mutu, bakej, tebukibuki, palata, shichisen-suzumedai

(Serranidae)

Epinephelus corallicola *(Valenciennes)* **(Seranus altivelioides** *Bleeker***; S. corallicola** *Valenciennes***)** – grouper, coral grouper, coral rock cod, gatala, rero, baraka, kugtung, vieille, hiregurohata, bulang, lapu-lapu, kusele, kerapu belosoh

(Siganidae)

Siganus argenteus *(Quoy et Gaimard)* **(S. rostratus** *(Valenciennes)***; Amphacanthus argenteus** *Quoy et Gaimard***; A. rostratus** *Valenciennes***; Teuthis argentea** *(Quoy et Gaimard)***; T. rostrata** *Valenciennes***)** – rabbitfish, silver rabbitfish, forktail rabbitfish, streamlined rabbitfoot, streaked spinefoot, rabbitface spinefoot, Roman-nose spinefoot, spinefoot, baliwis, malava, palit, cordonnier, hana-aigo, shimofuri aigo

Siganus canaliculatus *(Park)* **(S. oramin** *(Bloch et Schneider)***; Amphacanthus dorsalis** *Valenciennes***; Chaetodon canaliculatus** *Park***; Teuthis oramin** *(Bloch et Schneider)***)** – rabbitfish, seagrass rabbitfish, spiny rabbitfish, slimy rabbitfish, white-spotted rabbitfish, white-spotted spinefoot, pearly spinefoot, pearl-spotted spinefoot, gold-lined spinefoot, ellok, mole, lopauulu, baliwis, palit, shimofuri-aigo

Siganus corallinus *(Valenciennes)* **(Amphacanthus corralinus** *Valenciennes***; Teuthis corallina** *(Valenciennes)***)** – blue-spotted spinefoot, orange spinefoot, ocellated orange spinefoot, coral spinefoot, coral rabbitfish, spotted rabbitfish, cordonnier brisant, sango-aigo, sigano coral, kelang, lambai, belaris, igesheosheo

Siganus luridus *Rüppell* – dusky spinefoot, mouwasit

Siganus rivulatus *Forssk.* **(Amphacanthus rivulata** *(Forssk.)***; A. sigan** *Klunzinger***; Scarus rivulatus** *(Forssk.)***; Teuthis rivulatus** *(Forssk.)***)** – rabbitfish, rivulated rabbitfish, marbled spinefoot, baliwis, palit, cordonnier

Siganus spinus *L.* – little spinefoot, black spinefoot, scribbled spinefoot, bluntnosed spinefish, spiny rabbitfish, scribbled rabbitfish, black trevally, blue-spotted trevally, batwayi, safi, seeseege, epong

(Sparidae)

Sarpa salpa *(L.) Smith* **(Boops goreensis** *Valenciennes***; B. salpa** *L.***; Box goreensis** *Valenciennes***; Box salpa** *L.***; Eusalpa salpa** *L.***; Sparus salpa** *L.***)** – sea bream, goldline, salpa, saupe, salema, salema porgy, strepie

These fish, all colloquially referred to as 'weke' or 'dreamfish', have been implicated in a condition known to medics as 'ichthyoallyeinotoxism', or more simply, 'hallucinatory mullet poisoning'. This phenomenon has occasionally been noted from some areas of Hawaii and Norfolk Island [near Australia], as well as the Indian Ocean, and the Mediterranean for Sarpa spp. Around Hawaii [Kauai and Moloka'i] the fish are said to only be toxic from certain localities, and then only from June to August. Some locals say the toxic mullet and goatfish species often have red blotches on the surfaces of the lips and sides of the head. However, these features are not a fail-safe method of distinguishing between toxic and nontoxic specimens. The toxicity seems to be more or less random in populations of these fish. Different people also seem to display very different tolerances to the fish. Eating from the same catch, some people may become intoxicated, while others do not (Halstead 1988; Helfrich & Banner 1960). An unidentified fish found off the coast of Trujillo [Peru] is known as 'borracho', and its flesh is reported to be "highly hallucinogenic" (Kennedy 1982). In Mascareignes [Reunion Island], Siganus spinus is known as "the fish that inebriates". Sarpa salpa is said to have been used "for recreational purposes in the Mediterranean during the Roman Empire", and some Arabs know it as "the fish that makes dreams". Recently it has caused some 'hallucinogenic' poisonings that have been confused with ciguatera [see below]. It is sometimes sold in fish markets in the Mediterranean despite being known by local fishmongers to occasionally have these effects, though in Italy and Spain it is not regarded as edible (De Haro & Pommier 2006). Smith & Heemstra (1986) commented that "the flesh is tasty when quite fresh, but soon softens and is not much esteemed".

The Hawaiian term 'weke' translates roughly to 'opening a crack, or door'. Weke fish were once valued in sorcery, and much-used as offerings to the gods (Pukui & Elbert 1971), though their use today does not appear to have any ritual significance. Pukui & Elbert (1971) also mention a connection with the deity Pahulu ['nightmare'], who ruled over a horde of ghosts on his island home of Lana'i [adjacent to Moloka'i – see above]. Pahulu's soul influenced certain fish in the area so that they would bring about nightmares in anyone who consumed them. It is still believed locally that the resultant nightmares are worse from fish caught closest to Lana'i (Pukui & Elbert 1971).

The flesh of the whole fish may be eaten, but the head and brain are considered the most potent parts; not gutting the fish immediately after catching is also reputed to give more powerful effects. It reportedly makes no difference whether the fish is cooked or not. The symptoms of eating the 'toxic' fish consist of an itching or burning in the throat immediately after eating, in some people; some may experience muscular weakness and loss of coordination; some complain of a tight constriction of the chest. Gastric distress is sometimes reported. From 10 minutes to 2 hours after ingestion, CNS effects manifest, including hallucinations, mental depression, dizziness and loss of equilibrium. These effects last for 3-24(-36) hours, before complete recovery. If the consumer goes to sleep just before the effects begin, nightmares or unusual and vivid dreams may be experienced (De Haro & Pommier 2006; Halstead 1988; Helfrich & Banner 1960).

The existence of the dreamfish phenomenon was first revealed to the western public through an article in National Geographic (Roughley 1960), which included some interesting descriptions of the effects of the fish caught off Norfolk Island [Kyphosus fuscus – see below]. A local islander told Roughley "The small ones don't affect me, but once I had a big one for supper. I spent that night on an operating table, with the surgeon doing one operation after another – always cutting through a new and expensive suit I had just purchased." The photographer for the article, Joe Roberts ["who usually doesn't dream at all"], consumed a single broiled specimen, and reported the next morning, "It was pure science fiction. I saw a new kind of car, steered with a stick like a plane. And then I was taking pictures of a monument to mark man's first trip into space." Finally, Roughley ate a specimen himself for supper. In his own words – "I found it tasty, but strong flavoured, like mackerel. I told myself not to dream. But no. I dreamed I was at a party where everybody was nude and the band played 'Yes, we have no pajamas'" (Roughley 1960)!

The compounds responsible for causing the symptoms of hallucinatory mullet poisoning have not yet been identified, and there is still much room for speculation. It is interesting to note that some of these 'hallucinogenic' species are also important commercial fish, which are widely eaten without any resultant psychoactivity [most of the time!].

The dreamfish Kyphosus fuscus, sometimes eaten at Norfolk Island (Roughley 1960), has been claimed to contain *5-methoxy-DMT*, but there does not seem to be any chemical literature to support this (Ott 1993; Stafford 1992). K. fuscus is now considered a synonym for immature specimens of K. bigibbus (http://www.fishbase.org/). The presence of visionary tryptamines would not be entirely unlikely, however, due to their known presence in mammalian brains (eg. Corbett et al. 1978; Relkin 1983a), and the presence of tryptamines in other marine life (Shulgin & Shulgin 1997; see also *Endnotes*). Given that even common commercial fish - raw or cooked - contain β-carbolines [see *Influencing Endogenous Chemistry*], it is tempting to explain the chemical mechanism of hallucinatory fish poisoning as an ayahuasca effect [see *Methods of Ingestion*] or, in this case, 'fishuasca' (pers. obs.)!

There is a strong possibility that 'toxic' specimens of these fish accumulate psychoactive compounds, or precursors to psychoactive compounds, from their diet. Hawaiian fishermen sometimes attribute the toxicity to the blue-green alga Lyngyba majuscula, known as 'stinging lumu'. This has been refuted for a number of reasons. Firstly, the toxic fish are not known to feed on L. majuscula. Secondly, there is a lack of meaningful correlation between the occurrence of hallucinatory mullet poisoning and the distribution of L. majuscula (Helfrich & Banner 1960). L. majuscula has also been suggested as a source of 'ciguatera poisoning' [see below], which has different symptoms than the hallucinatory poisonings (Halstead 1988). However, this does not rule out algae altogether. Many

of these fish do feed on a variety of algae [some closely related to L. majuscula] and diatoms, and Siganus fuscescens, a close relative of some of the 'hallucinogenic' fish, does feed on L. majuscula. Seasonal and other variations in the toxicity might also relate to fluctuations in the ability of the fish to metabolise certain chemicals from their diet, leading either to their accumulation or their absence. Algae [and other marine organisms] can also be very variable in their chemical content, leading to further uncertainties (theobromus pers. comm. 2001).

Some blue-green algal blooms [cyanobacteria] produce powerful toxins – Anabaena flosaquae and Aphanizomenon flosaquae both produce anatoxin-a [up to c.1%], a potent *cocaine*-analogue [agonist of nicotinic *acetylcholine* receptors (3-50 times more potent than *nicotine* at neuronal receptors), stimulating catecholamine release, also with anticholinesterase properties; highly toxic, can cause death by respiratory paralysis]. Toxin production is increased with age, and at temperatures in the low 20's [°C]. Whilst these species also exist in non-toxic strains, there are also anatoxin-a producing strains of Cylindospermum spp. and Oscillatoria spp. (Buckingham et al. ed. 1994; Hunter 1992; Molloy et al. 1995; Rapala et al. 1993). Aphanizomenon flosaquae has been used in a controversial blue-green alga health product, which was claimed to boost energy levels; some users did report feelings of stimulation and increased energy, others did not (pers. comms. 1998).

Some of these fish, and their relatives, have also been implicated in 'ciguatera' poisoning. The polyether ciguatoxin [which is responsible for this poisoning] is thought to originate from the dinoflagellates Gambierdiscus toxicus [contains maitotoxin], Prorocentrum lima [contains okadaic acid] and other algae, which are eaten by some warm-water fish; G. toxicus often grows adhering to Turbinaria spp. fronds.These fish include Acanthurus triostegus, Mugil cephalus, Mulloidichthys flavolineatus, Upeneus arge, and Abudefduf septemfasciatus (Halstead 1988). In these cases, where the same species [or a sub-species, in the case of Acanthurus triostegus] is also implicated in hallucinatory mullet poisoning, there may be either confusion of symptoms by physicians, or a more complex variation in toxicity of these fish not yet understood (pers. obs.). Indeed, "ciguatera has become a general term used to describe fish poisoning caused by the consumption of tropical and subtropical finfish that can be differentiated from those related to *histamine* or tetrodotoxin" [see *Endnotes*] (Iwaoka et al. 1992), and by these criteria hallucinatory poisoning would be included under the broad umbrella of 'ciguatera' (pers. obs.). Symptoms may appear almost immediately, or up to 30 hours following consumption, and may vary between cases. Initial symptoms include abdominal pain, nausea, vomiting, watery diarrhoea, and sometimes tingling sensations and numbness of the mouth and throat. Other symptoms may include headache, blurred vision, photophobia, temporary blindness, mydriasis, malaise, anxiety, dizziness, motor incoordination, insomnia, exhaustion, weakness, pallor, ataxia, prostration, chills, fever, sweating, itching, cyanosis and rapid, weak pulse. Sometimes extensive skin disorders develop, and hair and/or nails may be lost. Severe poisonings may involve a continuing decline in motor coordination, diminished reflexes, difficulty in speaking, 'pins and needles', muscular paralysis, muscular twitches, tremors, convulsions, coma, and finally death from respiratory paralysis. Severe poisonings which are survived may take a long time to fully recover from, with some symptoms recurring many years later. Ciguatera poisoning involves a very large number of fish species, many of which are also considered good to eat under other circumstances (Halstead 1988).

Acanthurus triostegus from waters off the west coasts of Oahu and Hawaii was assayed for toxicity; ciguatoxin and/or related compounds were tentatively found in only 4% of fish analysed, although toxicity to mice extended randomly across much of the sample, indicating the presence of unrecognised toxins different to ciguatoxin. There was high variability in toxicity of different specimens caught from the same area and at the same time of day. The most lethal toxicity was found in methanol extracts, followed by hexane extracts; water extracts were largely survived with complete recovery from symptoms after 6hrs. Human skin contact with the water extract brought about a localised tingling sensation taking effect within 10min. and lasting 30min. (Iwaoka et al. 1992).

Kyphosus vaigiensis grows to 58cm; silvery-grey to bluish, darker to olive-brown above, with a close-set series of bright golden ribbons running head to tail; usually a patch of yellow-orange or silvery-white below the eye. Pectoral fin bright yellow, all others grey; 14-15 spines and rays in dorsal fin, soft dorsal rays very slightly shorter than dorsal spines; 12-13 spines and rays in anal fin. Jaws with single row of compressed incisors.

On rocky outcrops along northern coastline of Australia – shoals often seen in shallow waters of coral reef lagoons on the Great Barrier Reef, extending down into the Capricorn/Bunker Group area; Indo-Pacific.

Mugil cephalus grows to 76cm, weighing up to 8kg; olive-green above with silvery sides when in ocean, darker and browner from rivers and estuaries; small black spot at base of pectoral fin; body moderately elongate and compressed; head bluntly rounded and broad; eye almost obscured by a prominent adipose lid, a narrow slit over the pupil being uncovered; lower lip very thin with double symphysial knob. Jaws with row of setiform teeth on each, easily-shed. Anal fin with 8 rays, as with dorsal fin; pectoral rays 16-17. 1st and 2nd dorsal origins respectively opposite the 12th and 24th scales; anal origin slightly before the 2nd dorsal; pectoral reaches the 10th scale, with a distinct axillary scale.

Found in coastal and estuarine waters, entering fresh water; Indo-Pacific. Most important commercial fish in Queensland [Australia] (Grant 1982).

Acanthurus triostegus ssp. sandvicensis is found in Hawaiian waters; A. triostegus is more widely distributed.

Abudefduf septemfasciatus is found in the Indo-Pacific, in lagoons and outer reefs.

Siganus oramin is found in the Indo-Pacific, and near east Africa and Saudi Arabia (Halstead 1988). S. argenteus and S. corallinus have caused poisonings in Mauritius, S. luridus in Israel, S. rivulatus in Mauritius and possibly Israel, and S. spinus in Reunion (De Haro & Pommier 2006).

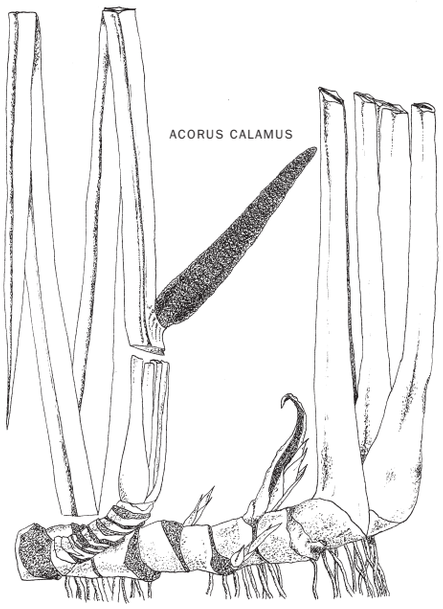
Sarpa salpa occurs in the Mediterranean, and e. Atlantic around S. Africa to s. Mozambique (Smith & Heemstra ed. 1986); it has caused poisonings in France, Tunisia and Israel (De Haro & Pommier 2006).

Other listed species are all found in the Indo-Pacific region (Halstead 1988).

Note – as some of the colour-related colloquial names of these fish seem to contradict each other, it should be mentioned that some fish change colour depending on maturity, what they are doing, and whether or not they are in the water.

ACORUS

(Araceae)



Acorus calamus *L.* **(A. aromaticus** *Gilib.***; A. odoratus** *Lam.***)** – sweet flag, sweet sedge, sweet calamus, ratroot, myrtle flag, rush, calamus, ugragandha, wasa, che ts'ang p'ou, pai ch'ang, chang pu

Acorus calamus var. americanus *(Raf.) Wulff* **(A. americanus** *(Raf.) Raf.***)** – makatek, makakerekerep, wee-kees

Acorus calamus var. angustifolius (A. angustifolius *Schott***; A. calamus var. angustatus** *Bess.***)** – shui chang pu

Acorus calamus var. calamus (A. asiaticus *Nakai***; A. calamus var. vulgaris** *L.***)**

Acorus gramineus *Aiton* **(A. pusillus** *Siebold***)** – shih chang pu, ch'ang p'u, akha

Used in medicine since the time of Hippocrates, sweet flag was an important ingredient in various preparations wherever it grew. The Sumerians used it in their sacred incenses, as did the ancient Egyptians, who also used the rhizome as an aphrodisiac. The Romans and Arabs also knew of its aphrodisiac properties. It has long been used in Ayurvedic medicine to treat diarrhoea and insanity, and the Chinese use it [A. calamus var. angustifolius and A. gramineus] to treat epilepsy, stroke, asthma, insomnia and arthritis. It is also said to 'replenish intelligence', and treat amnesia and 'excessive dreaming', and acts as a CNS-depressant sedative. In China it has been used in a potion consumed to 'see spirits', containing also Podophyllum pleianthum [see **Mandragora**] and **Cannabis** fruit [see **Cannabis** for further discussion of this potion]. In France, A. calamus has been added to beers, and in Holland, children chew the rhizome. Sometimes, the powdered rhizome is used to protect clothes from insect damage, and to kill fleas. The leaves may be scattered on the floor to deter pests and improve the odour of a room (Bremness 1994; Chopra et al. 1965; Hsu et al. 1986; Li 1978; Motley 1994; Nadkarni 1976; Rätsch

1992; Samorini & Festi 1995). Also, European witches may have used A. calamus var. calamus in some of their flying ointments (Ott 1993). Nowadays, the plants are used in perfumery, and in some countries the rhizome is sold as a crystallised sweet, like glazed ginger [see *Endnotes*].

The Cherokee use A. calamus var. americanus as a stimulant, antispasmodic and diuretic, and to treat digestive disorders, flatulence, intestinal worms, colds and headache. Many Native American tribal groups have similar uses for the herb, and chew, snuff, smoke or decoct it as a daily stimulant tonic and antifatigue agent. Many tribes also attribute mystical powers to the plant. Dakota warriors chewed it to a paste and rubbed it on their faces before battle, to make them calm and fearless. The Saulteau smoke it with tobacco [see **Nicotiana**] to relieve headache, as well as using it as a poultice for wounds and pains. The Cree, who know it as 'wee-kees' ['musk-rat root'], use it as a stimulant and aphrodisiac, chewing a small piece of the root [2.5-5cm length] while walking or hunting [or loving!]. The Cheyenne tie a piece of the rhizome to their children's night clothes to keep 'night spirits' away, and the Sioux also use it to keep away ghosts or evil spirits. The rhizome has also been used by the Omaha and Sioux, in the form of a snuff and an infusion, respectively, as a horse stimulant (Hamel & Chiltoskey 1975; Kindscher 1992; Morgan 1980, 1981; Motley 1994; Plowman 1969; Rätsch 1992).

In the Western Highlands of Papua New Guinea, the Raiapu Enga give A. calamus rhizome to their dogs as a hunting stimulant; it is prepared by chewing, and administered by spitting it into the noses of the dogs (Thomas 2001a). A. calamus is widely used for ritual magic in Papua New Guinea. It has been used "to make young men grow tall and strong, to promote success in hunting, to attract wealth and to prevent face paint from running during ceremonial dancing". It is also used in love magic (Paijmans ed. 1976).

Two westerners living with the Cree in the 1960's experimented on 5 occasions with large doses [c.25cm length] of the rhizome [reported as A. calamus – presumably it was A. calamus var. americanus], and reported 'LSD-like' experiences (Morgan 1980). Some modern-day experimenters have experienced no effect, or only sickness, from chewing the rhizome. Many others experience strong CNS-stimulation and mild sensory alterations from both American and Eurasian varieties, as well as with A. gramineus (pers. comms.). A self-experiment by Giorgio Samorini with 20g A. calamus rhizome produced a psychedelic state of moderate intensity, lasting 4-6 hours (Samorini & Festi 1995). I have experimented with an alcohol extract [inactive, possibly due to age] and chewed dry rhizome pieces [c.24g] of what was believed to have been A. calamus var. calamus. In the latter experiment, the rhizome pieces were swallowed when exhausted of flavour. The dose was chewed over the course of several hours, experiencing after this time a pleasant CNS-stimulation, not unlike the initial sensations of a *mescaline* experience. The effects developed no further, but the stimulation persisted for at least another 5-6 hours. On another occasion I ingested, in a similar fashion, rhizome slices of A. gramineus [estimated c.25cm length of rhizome c.1cm thick – this is really a wild guess]. The same CNS-stimulation was experienced, but after several hours mild delirium and nausea set in, followed quickly by sweating, stomach pain and severe vomiting, leaving a horrible after-taste throughout my nose, mouth and throat; I vomited twice more in the next 10 hours. Sweet flag rhizomes taste spicy, pungent and slightly sweet, with a bitter after-taste that gets nastier the longer the rhizome is chewed (pers. obs.).

There has been controversy about the true nature of sweet flag's psychoactive properties. This may be partially explained by the fact that the three varieties of A. calamus have been confused as one, and each has a different chemical and genetic profile. A. calamus var. americanus is found in N. America and Siberia; A. calamus var. angustifolius is found in India; and A. calamus var. calamus is found in Europe and n. India, and is sterile (Bruneton 1995; Darke ed. 1994). Populations of A. calamus var. calamus have also been found naturalised in Canada and the US (Packer & Ringius 1984). In animal experiments, Indian A. calamus [probably var. angustifolius] has generally shown sedative, tranquillising, analgesic, anticonvulsant, antiarrhythmic, antiadrenergic, and MAOI effects (Opdyke 1977). Rhizomes of most varieties yield 1.5-9% essential oil, and fresh aerial parts have yielded 0.12% (Bruneton 1995; Chopra et al. 1965; Nadkarni 1976).

Here the confusion spreads – β-*asarone*, frequently the major component of the essential oils [see below], acts as a sedative on its own, but the liver is potentially capable of aminating this chemical into the potent psychedelic TMA-2 (Shulgin 1976; Shulgin et al. 1967). Asian sweet flags, high in *asarones*, are often used as sedatives, with no greater level of psychotropic activity noted amongst these cultures [except for aphrodisiac effects] (eg. see Perry & Metzger 1980), doses possibly being too small [usually 1.5-7.5g]. A. calamus essential oil is generally said to have tranquillising properties. However, A. calamus var. americanus is used widely as a stimulant, and claimed to be psychedelic in higher doses, but contains little or no *asarone*. Could there be other active agents responsible, or is there even wider chemical variation than is now thought?

A. calamus var. americanus is devoid of β-*asarone*, which has been believed to be the 'active principle' in sweet flags. The rhizome essential oil [1.7% yield] is rich in sesquiterpene ketones, including shyobunone, isoshyobunone, 2,6-di-epi-shyobunone, acorenone, isoacorone and preisocalamendiol (Keller & Stahl 1983).

A. calamus var. angustifolius is dominant [up to 96% of the essential oil] in β-*asarone* (Motley 1994).

A. calamus var. calamus essential oil contains usually not more than 10% phenylpropanoids, mostly β-*asarone*, *methyleugenol* and *eugenol*, as well as sometimes calamol [an isomer of *asarone*]; also found are sesquiterpenoids such as acorenone [8%], β-gurjunene [6.7%], shyobunone [2.6%], isoshyobunone [6.2%], calamendiol [3.8%], α-selinine [3.8%], α-calacorene [3.5%], calamusenone [3.2%], camphene [3.2%], p-cymene [analgesic], γ-cadinene, linalol [sedative, fungistatic, antiseptic], α-terpineol, and α-cadinol (Battaglia 1995; Bruneton 1995; Chopra et al. 1965; Hall 1973; Harborne & Baxter ed. 1993).

A. gramineus has yielded 0.5-0.9% essential oil, mostly consisting of *asarone* (Hsu et al. 1986). In cultured rat neurons, a methanol extract of the rhizome showed a neuroprotective action against neurotoxicity mediated by *glycine* binding-sites of NMDA receptors (Choa et al. 2000).

Acorus calamus is a perennial wetland herb with a creeping and branching horizontal aromatic rhizome, tinted pink. Leaves equitant, basally sheathing, 1.7-3.8cm x 0.9-1.8m, rather rigid, bright green, acute, nerves parallel, midrib distinct; in emerging leaves, sporadic zones of lateral wrinkling and puckering. Spathe and peduncle barely distinguishable; peduncle narrower than leaves, strongly 2-3-ridged; spathe 15-75cm long; pedicel 3.2-3.8cm broad; spadix sessile, borne at or above midpoint of spathe/peduncle and held at 45°, cylindric, obtuse, slightly curved, yellow, becoming green, 5-10 x 1.2-3cm, densely crowded with bisexual flowers; sepals 5, orbicular, concave, incurved, as long as ovary, scarious; stamens 6, filaments linear-flat; anthers yellow, reniform. Ovary conical, 2-3-celled; stigma minute; ovules many, pendulous from the top of each cell. Fruit turbinate, prismatic, top pyramidal, few-seeded; seeds oblong, micropyle often fimbriate.

Throughout northern hemisphere, generally in marshes and at edges of waterways (Chopra et al. 1965; Darke ed. 1994); prefers rich, loamy soil in a sunny position, kept permanently moist. Propagate from very fresh seed, or by root division in spring and autumn (pers. comms.).

ACRAEA

(Nymphalidae, subfamily Heliconiinae/Acraeinae)

Acraea andromacha *Fab.* **(A. entoria** *Godart***; A. theodote** *Wallengren***; Papilio andromacha** *Fab.***)** – glasswing butterfly

This rather inconspicuous looking butterfly, the only Australian representative of the subfamily Acraeinae, is of interest because of a chemical curiosity. The eggs of the butterfly are laid on species of wild passionfruit [Adenia heterophylla, A. populifolia and **Passiflora** spp.], some of which produce β-carboline alkaloids and cyanogenic compounds. These chemicals are passed on to the larvae and the adult butterfly, as part of a chemical defence system against predators (Burns & Rotherham 1977; Fisher 1995; Watson & Whalley 1975). The **Passiflora** spp. utilised are P. alba, P. suberosa [both native to Australia], P. mollissima, P. edulis and P. ligularis, though the larvae do not thrive on these latter two species (Herbison-Evans & Crossley 2000).

Adult butterflies, which fed as larvae on β-carboline-containing plant material [species not noted], were shown to contain small amounts of *norharman* [β-carboline], *harman* [major alkaloid] and *harmine*. Along with **Heliconius** spp., butterfly samples also contained [as confirmed by TLC] 6-MeO-*harman* and *harmaline* (Cavin & Rodriguez 1988), though it is not made clear whether this applied to all species analysed.

Acraea andromacha eggs are pale yellow, slightly higher than wide, vertically ribbed, and laid in clusters on Adenia and **Passiflora** spp.; larvae yellow-brown to brownish-black, with numerous long black branched spines in longitudinal rows, arising from blue-black areas at the base, c.6 spines to each segment, upper part of head yellow, black below; pupa slender and elongate, creamy-yellow to brown, with irregular black lines on wing cases and orange spots edged with black on abdomen, attached by its tail to a pad of silk spun on a sheltered object near the food plant. Adult butterfly slow-flying, +- polymorphic, sexes similar in size and colouration, 50-60mm long, average wingspan 5.4-5.7cm, forewings almost transparent, underside almost the same as upperside, but hindwings with larger creamy spots in the blackish margins; beneath the tip of the abdomen, females have a shiny plate or pouch on which a brown mass called a sphragis is deposited by the male after copulation to prevent another fertilisation.

New Caledonia, New Georgia, Indonesia, Sulawesi [Celebes], New Guinea, Samoa, Fiji, Australia [n. WA, NT and Qld to Sydney (NSW) all year – occasionally s. to Vic. and Adelaide (SA) in late summer and autumn, when unusually humid] (Burns & Rotherham 1977; Watson & Whalley 1975).

ACTINIDIA

(Actinidiaceae)

Actinidia arguta *(Siebold et Zucc.) Planch. ex Miq.* **(Trochostigma arguta** *Siebold et Zucc.***)**
Actinidia kolomikta *(Maxim. et Rupr.) Maxim.* **(A. gagnepainii** *Nakai***; A. kolomikta var. gagnepainii** *(Nakai) H.L. Li***; Prunus kolomikta** *Maxim. et Rupr.***)** – miyama-matatabi
Actinidia polygama *(Siebold et Zucc.) Maxim.* **(A. lecomtei** *Nakai***; A. polygama** *Miq.***; A. polygama var. lecomtei** *(Nakai) H.L. Li***; A. repanda** *Honda***; A. volubilis** *Franch. et Sav.***; Trochostigma polygama** *Siebold et Zucc.***)** – silver vine, Chinese cat powder, ch'ang-chu, mu tian liao, matatabi

In China, plants of the genus Actinidia are called 'yang-tao', and have been cultivated there since at least 770AD. A. deliciosa [A. chinensis] is the common 'kiwi fruit', or 'Chinese gooseberry'. A. arguta sap is used by the Ainu of Siberia as an expectorant. A. polygama is used in TCM in rice wine, as a sedative to depress the limbic system. A decoction of the stem is used as a sedative in Russia and Ukraine. The plant is also sometimes used in zoos to tranquillise and inebriate large cats. A. kolomikta is also useful in this regard. When smoked, A. polygama has a similar effect to 'catnip' [see **Nepeta**] (Emboden 1979a; Ott 1993).

The chemicals responsible for the cat-attracting/inebriating effects of these plants are primarily *actinidine* [a monoterpenoid pyridine alkaloid], matatabilactone [a mixture of iridomyrmecin and isoiridomyrmecin], and other similar lactones, such as are found in **Nepeta** (Sakan et al. 1959a, 1959b, 1965; Tucker & Tucker 1988). See *Endnotes* for the occurrence of these compounds in insects.

A. arguta has yielded *actinidine* (Gross et al. 1972).

A. chinensis fruit contains actinidin, an acidic protein which is not the same as *actinidine* (Harborne & Baxter ed. 1993).

A. polygama leaves and galls have yielded *actinidine*, matatabilactone (Sakan et al. 1959a), dihydro-*nepetalactone*, isodihydro-*nepetalactone*, neo-*nepetalactone* (Sakan et al. 1965), actinidiolide, dihydroactinidiolide, and β-phenylethyl alcohol [induces salivation] (Tucker & Tucker 1988); the iridoid enol glucosides iridodialo-β-D-gentiobioside and dehydroiridodialo-β-D-gentiobioside have also been isolated from the plant (Murai & Tagawa 1979).

Actinidia polygama is a twining vine to 5m; branchlets glabrous, filled with white, solid pith. Leaves alternate, simple, dentate, 7-12 x 5-8cm, ovate or ovate-oblong, apex acuminate, base acute or rounded to subcordate, serrulate, glabrous above, usually bristly on veins, bronzed when young, silvery-white to creamy-yellow throughout or above only, in patches or flecks. Flowers in axillary cymes, solitary or in clusters of 2-3, to 3cm, white, fragrant, cup-shaped; sepals and petals usually 5, rounded; stamens numerous; anthers purple or yellow. Fruit a many-seeded berry to 2.5cm diam., ovoid-globose, apex somewhat beaked, yellow, translucent, sour. Fl. summer.

Temperate east Asia.

A. polygama var. lecomtei is different from the above in that its leaves are glabrous beneath, and the anthers are brown. Found in w. China.

Plant in deep and well-drained loamy soil, rich in organic matter with neutral pH; grows well in part shade; will withstand temperatures as low as -17°C; shelter from wind, which will easily snap and bruise young growth (Burras ed. 1994).

ACTINOPYGA, AFROCUCUMIS, CUCUMARIA, EUAPTA, HOLOTHURIA, PENTACTA and STICHOPUS

(Echinodermataceae/Holothuroideae)

Actinopyga agassizi *Selenka*
Actinopyga lecanora *Jaeger* **(Holothuria lecanora)** – stone fish
Afrocucumis africana *Semper* **(Pseudocucumis africana)**
Cucumaria echinata *Von Marenzeller*
Euapta lappa *Müller*
Holothuria argus *Jaeger* **(Bohadschia argus** *Jaeger***)** – Polynesian sea cucumber, spotted sea cucumber, ocellated sea cucumber, sand-sifting sea cucumber, sand-eating cuke, leopard fish sea cucumber, tiger fish
Pentacta australis *Ludwig*
Stichopus chloronotus *Brandt* – green fish
Stichopus variegatus *Semper* – Australian sea cucumber, curry fish, gamat

Collectively also known as – sea cucumber, sea slug, trepang, holothurie, beche de mer, fieuse de coton, hai shen ['sea ginseng'], warripa

For centuries, Macassans from Celebes harvested sea cucumbers from waters off the coast of Arnhem Land [n. Australia], bringing them to China, to be sold as 'sea ginseng' to the wealthy [see **Panax**]. They had a repuation as a nervous stimulant and aphrodisiac. Some of the aphrodisiac reputation may come from the phallic shape of the creature's bodies, as well as the fact that they eject liquid when excited or irritated. As 'trepang', sea cucumbers are a popular food in the Indo-Pacific region, where they are boiled, dried, and sometimes smoked to leach out toxins, in order to render them safe to eat [deaths have been reported from sea cucumber ingestion]. Trepang is often added to soups and stews, to help bring out the flavour of the foods it is cooked with (De Monfreid 1935; Halstead 1988). Today, trepang is harvested from all over the world to supply the demand for it as food.

Due to the extended cooking required for safe consumption, indigenous Australians of the northern coasts did not make much use of sea cucumbers as food. The Warramirri, however, know of other properties – they say that the sea cucumber has a special sexual energy which it can impart on the consumer, and it is associated with their 'trickster deity' Marryalyan. Other indigenous elders from northern Australia have stated that eating them uncooked causes vomiting and diarrhoea, followed by a period in which the mind is affected strangely, and one feels "un-real and delirious" (Cawte 1996). The juice of sea cucumbers such as H. argus and H. atra has been used in Guam to catch fish, by poisoning coral reef pools with it (Nigrelli & Jakowska 1960).

Sea cucumbers have been shown to contain steroidal glycosides called holothurins [most concentrated in the 'organs of Cuvier' (see below) and the body wall], which have anticholinergic, haemolytic, antimetabolic and some antitumour properties. They also direct muscle-contraction, and may be 'irreversible' neurotoxins. The neurotoxic potency of holothurin A is similar to that of *cocaine*. Fortunately, holothurins are much less toxic to mammals orally than i.p., and they are largely hydrolysed by gastric acids into nontoxic products. Other compounds found include aglycones [such as griseogenin, koellikerigenin and holotoxinogenin], saponins [such as cucumarioside and stichoposide] and quaternary ammonium bases [homarine]. Contact with sea cucumber toxins may result in burning pain, redness and violent inflammation, and even blindness, if brought into contact with the eyes (Baslow 1977; Corbett 1971; Elyakov et al. 1973; Halstead 1988; Hashimoto 1979; Nigrelli & Jakowska 1960).

Sea cucumbers have an elongated body, with a series of tentacles around the mouth (at the bottom of the body); some also have tube-feet attached to the body. Skeleton a series of irregular plates embedded in the skin. Organs of Cuvier are a series of tubules attached to the stem of the respiratory tree; may be emitted from the anus (whereupon they swell and stretch on contact with the water, becoming sticky) to entangle predators. Habit is vertical on the sea floor, in a wide range of habitats and depths, sometimes camouflaged with debris; they attach themselves using their tube-feet, and move with rhythmic body contractions; they feed on fine bottom materials and organisms, shovelled into the mouth with the tentacles (Halstead 1988).

AESCULUS

(Hippocastanaceae)

Aesculus californica *(Spach.) Nutt.* – California buckeye
Aesculus glabra *Willd.* – Ohio buckeye, smooth buckeye, foetid buckeye
Aesculus hippocastanum *L.* **(Hippocastanum vulgare** *Gaertn.***)** – buckeye, horsechestnut, conker tree, monkey chestnut, suo huo zi
Aesculus pavia *L.* – red buckeye
Aesculus spp. – buckeyes

Aesculus spp. are of interest due to their obscure narcotic properties. Seeds of A. pavia and other Aesculus spp. have been used by natives of southern and eastern US to stun fish. A. glabra and other Aesculus spp. were used in N. America in the 19th century as an opium substitute [see **Papaver**]. A Dr McDowell from this time claimed that 0.65g of the powdered seed-coat was equal in potency to 0.2g of opium. In 1877, Prof. E.M. Hale wrote that A. glabra causes "confusion of the mind, vertigo, stupefaction and coma", as well as gastro-intestinal complaints. Buckeye seeds have also been described as "an irritant of the cerebro-spinal system". Medicinally, they have also been used to relieve some forms of asthma. In overdose, coma and death may result. A. hippocastanum is regarded as having weaker effects than other species such as A. glabra (Emboden 1979a; Felter & Lloyd 1898; Pammel 1911). Most buckeyes are toxic to stock animals, the young growth and mature fruits being considered the most toxic parts. A. pavia has been recorded as causing incoordination, sluggishness, excitability and twitching in cattle and horses. The flowers of A. californica are toxic to bees, and honey made by them has also caused poisoning in humans who have ingested it (Kingsbury 1964).

The Cherokee use A. octandra seeds as a poultice for swellings, sprains, infections and tumors; an infusion is taken to prevent fainting, and small pieces of the seed may be chewed and swallowed for colic. A bark infusion is used to aid childbirth, and stop post-partum bleeding (Hamel & Chiltoskey 1975).

During food-shortages, the treated mashed fruit of A. hippocastanum

has been used as animal-fodder; the protein-rich seeds have been ground and made into flour or a coffee substitute [see **Coffea**], after washing and boiling to remove toxins. The plant has been implicated in the deaths of children who ate the nuts. They have been reported to cause inflammation of mucous membranes, burning sensations in the stomach, nausea, and vomiting (Bremness 1994; Pammel 1911). In medicine, compounds from the seed are used as an astringent, antiinflammatory, and to tone and strengthen vein walls (Bruneton 1995; Chevallier 1996; Mabey et al. ed. 1990). The hardened nuts have long been popular with European schoolchildren in the game of 'conkers'.

A. hippocastanum seed contains up to 10% saponins, collectively called aescin [inhibits chemically-induced tumours], which is made up of derivatives of protoaescigenin and barringtogenol; proanthocyanidins [epicatechol-derivatives], flavonol glycosides, 6-8% lipids [including phytosterol, linoleic acid, palmitic acid, stearic acid], tannins, pectin, 40-50% starch, calcium and phosphorous. Bark also contains aescin, tannins and 2-3% coumarins, including aesculoside (Bruneton 1995; Chiej 1984; Harborne & Baxter ed. 1993), aesculetin, aesculin, scopolin, *scopoletin*, fraxin and fraxetin. Aesculin and aesculetin were the major coumarins, and maximum yields were obtained from bark of young branches [1.06% coumarins], compared to wood and leaves (Reppel 1956). The plant has also yielded butyrospermol, dicaffeoylspermidine, N,N-dicoumarylspermidine, isoescigenin, fungitetraose, and plastoquinones 4 & 8 (Buckingham et al. ed. 1994).

Aescin is also found in other Aesculus spp. In subtoxic doses, it acts as a respiratory stimulant, cardiac stimulant and hypotensive; it is also antiinflammatory, and increases corticosterol and *adrenocorticotropin* levels (Huang 1993; Rastogi & Mehrotra ed. 1990-1993).

Aesculus glabra is a tree to 10m tall; bark grey, much furrowed and broken into scaly plates. Leaves deciduous, compound; leaflets usually 5(-7), elliptic to obovate, +- abruptly acuminate, narrowed at base, 7.5-13cm long, finely toothed, pinnately straight-veined; petioles 10-15cm long. Flowers in branched clusters 10-15cm long, showy, to c.3cm long, pale greenish-yellow; pedicels jointed; calyx campanulate to tubular, irregularly 5-lobed, c.6mm long, often oblique or gibbous at base; petals (4-)5, nearly equal in length, villous-ciliolate, clawed, nearly hypogynous; stamens (5-)7(-8), exserted to almost twice corolla length; filaments long, slender, often unequal in length; anthers elliptical, glandular-apiculate, 2-celled, opening longitudinally. Ovary 3-celled; style 1; pistils mostly imperfect and sterile. Fruit a capsule to 5cm diam., prickly, with 1-2 seeds; seeds to 35mm wide, with thick coat and a large round pale scar. Fl. Mar.-May.

In woodlands and bottomlands in n.e. Texas, primarily in the Ohio and Mississippi Valleys (Correll & Johnston 1970).

'Texas buckeye' or 'Mexican buckeye', Ungnadia speciosa, is an unrelated plant from the Sapindaceae [see **Sophora**].

AGROCYBE

(Agaricaceae/Bolbitiaceae)

Agrocybe farinacea *Hongo*

Agrocybe semiorbicularis *(Bull. ex St. Amans) Fayod* **(A. arenaria** *(Peck) Singer***; A. arenicola** *(Berk.) Singer***; A. pediades** *(Rf.) Fayod***; A. semiorbicularis** *(Bull. ex Fr.) Fayod***; A. subpediades** *(Murr.) Watling***; Agaricus semiorbicularis** *Bull.***; Naucoria semiorbicularis** *(Bull.) Quél.***; N. vervacti** *(Fr.) Kumm.***)**

Agrocybe sp.

In studies of Oaxacan 'narcotic puffballs' [see **Lycoperdon**, **Scleroderma**], A. semiorbicularis was identified by an indigenous informant as causing similar effects. Its supposed similarity in appearance to **Psilocybe** mexicana was thought to have possibly caused confusion (Ott 1993), though I assume the native people would know their fungi sufficiently well not to make such an error in identification. Curiously, though the researchers ingested the puffballs identified by their informant, they did not bioassay the Agrocybe sp.

A. farinacea, a beautiful species from Japan, has yielded 0.2-0.4% *psilocybin*. None could be detected in Japanese A. semiorbicularis (Koike et al. 1981).

An unidentified Agrocybe sp. from Finland has also yielded 0.003% *psilocybin* (Ohenoja et al. 1987).

Agrocybe semiorbicularis is a small mushroom; cap 1-3cm diam., yellow or whitish-greasy, ochraceous, drying to almost white, hemispherical or slightly expanded, smooth, greasy, flesh white, firm and thin; stem pallid yellow or whitish, smooth, +- equal, ring absent, flesh whitish, becoming tinged brown in stem-base, fibrous and full; gills cream at first, turning coffee-brown at maturity, adnate or slightly decurrent, crowded; spores rust-brown, smooth, ellipsoid, germ pore indistinct, 10-14 x 8-11µm; basidia 4-spored; gill-edge cystidia flask-shaped; gill-face cystidia rarely seen; odour not distinctive; taste not distinctive. Fr. summer-autumn.

Solitary, scattered, or in loose trooping groups, on soil or in grass; common in UK (Jordan 1995), widely distributed in N. America (Phillips 1991), and also reported from Australia (May & Wood 1997).

ALCHORNEA

(Euphorbiaceae)

Alchornea castaneifolia *(Humb. et Bonpl. ex Willd.) A. Juss.* **(A. castaneifolia** *Baill.***; A. castaneifolia** *Benth.***; Hermesia castaneifolia** *Humb. et Bonpl. ex Willd.***)** – hiporuru

Alchornea cordifolia *(Schum. et Thonn.) Müll.-Arg.* **(A. cordata** *(A. Juss.) Müll.-Arg.***; Schousboea cordifolia** *Schum. et Thonn.***)** – Christmas bush, tekei, agyama, mbom, diangba [many other names]

Alchornea floribunda *Müll.-Arg.* – alan, elando, eando, niando, delande, dilandu, mulolongu, kai, sumara fida

Alchornea hirtella *Benth.* – bwujanka, be tira, tibi, tukingi, tolokenge, kuliwuri, tola-tamis ['spider's web kola']

Alchornea laxiflora *(Benth.) Pax et K. Hoffm.* **(Lepidoturus laxiflorus** *Benth.***)** – uwenuwen, ububo, ijan, ijan funfun, ijandu, pepe, longoso, urievwu

Alchornea rugosa *(Lour.) Müll.-Arg.* **(A. hainanensis** *Pax et K. Hoffm.***; A. javensis** *Müll.-Arg.***; Cladodes rugosa** *Lour.***)**

People of the Byeri cult of the Fang of Gabon [an older precursor to today's Bwiti – see **Tabernanthe**] used to consume large amounts of 'alan' root [A. floribunda, though one author identified alan as Hylodendron gabonense (Leguminosae)] as an initiatory entheogen. They say the effects are weaker and shorter-acting compared to 'iboga' [**Tabernanthe**]. During the initiation proceedings, with the initiate strongly affected by the alan root, s/he was shown the skulls of their ancestors in order to be able to communicate with spirits of the dead. It is still sometimes used today as an occasional iboga-additive, or as an aphrodisiac, for which purpose the root cortex is macerated in palm-wine [see *Methods of Ingestion*] for several days. It is said to produce an intense excitement, and 'indescribable bliss' with later depression, vertigo and collapse, during which the spirit is believed to journey to the land of the ancestors. Occasionally the intoxication leads to overdose and death. The sun-dried root bark may also sometimes be taken powdered, mixed with salt and food, and consumed previous to battle or tribal ritual for strength (De Smet 1996, 1998; Emboden 1979a; Pope 1969; Rätsch 1990, 1992; Samorini 1993, 1995a, 1997a). The leaves are sometimes eaten in the Congo as an antidote to poison, and leaf or root sap may be applied to skin afflictions or wounds (Burkill 1985-1997).

In Ivory Coast, the purgative leaves of A. cordifolia are taken in decoction and as a bath, as a sedative antispasmodic. The plant has a great variety of medicinal and practical uses, and twigs are used as chewsticks. A. hirtella root or leaf sap is taken as a sedative analgesic in w. Africa; the root is taken by decoction, and the sap is applied topically or to scarifications. A. laxiflora is used by the Yoruba of Nigeria in incantations to deflect malevolent sorcery back to the sender (Burkill 1985-1997). A. castaneifolia has been used in Peru as an ayahuasca-additive [see **Banisteriopsis**], and is widely employed as a rheumatism treatment (Luna 1984; McKenna et al. 1995; Ott 1994).

A. castaneifolia has yielded alchorneine, imidazole and corynantheine type indole alkaloids [see also **Corynanthe**] (McKenna et al. 1995).

A. cordifolia roots and stems have yielded 0.04-0.26% alkaloids, including possibly *yohimbine* (Paris & Coutarel 1958). Leaves and bark contain saponins and tannins, as well as a bitter principle, alchorin (Burkill 1985-1997).

A. floribunda roots and stems yielded 0.56-1.21% alkaloids, of which *yohimbine* was tentatively identified from the root extract (Paris & Coutarel 1958). The presence of *yohimbine* here and in other Alchornea spp. is thought to be in error, possibly in confusion with the alchorneine-type indole alkaloids, which were then poorly known (Burkill 1985-1997; De Smet 1996; Samorini 1993; pers. obs.). In a later analysis, trunk bark yielded 0.013% alkaloids, c.66% of which was alchorneine; root bark yielded 0.186% alkaloids, mostly alchorneine with smaller amounts of isoalchorneine; leaves yielded 0.483% alkaloids, including isoalchorneine and alchorneinone (Khuong-Huu et al. 1972). Given to anaesthetised dogs, a decoction of the powdered root was found to increase the sensitivity of the sympathetic nervous system to *epinephrine* (De Smet 1996).

A. hirtella yielded 0.06-0.74% alkaloids from bark and roots, believed to include *yohimbine* [see above] (Paris & Coutarel 1958); the trunk bark later yielded 0.016% alkaloids, including alchorneine (Khuong-Huu et al. 1972).

A. latifolia has yielded *GABA* (Durand et al. 1962).

A. rugosa leaves yielded 0.386% alkaloids, consisting of alchorneine, alchornidine, and isopentenylguanidine alkaloids, including N1,N1-diisopentenylguanidine (CSIRO 1990).

Alchornea floribunda is a leaning shrub or small tree, sometimes subscandent, to 10m tall, mostly without milky sap; branchlets, petioles and undersides of leaves minutely puberulous. Leaves alternate, simple, elongate-obovate-oblanceolate, long-attenuate at base, shortly acuminate

at apex, repand-denticulate margin, 14-31 x 6-12cm, lateral nerves in 12-19 pairs with sessile glands at base; bracts up to 1mm long, inconspicuous; petioles 0.5-3cm long. Flowers dioecious, much reduced, pale green. Male flowers in panicles of 10-25cm long spikes, terminal, axillary, and on old wood; calyx closed in bud, enveloping the stamens, calyx lobes valvate; petals absent; stamens 7-8, 1-2-seriate, the outer alternate with sepals, or all +- central; interstaminal glands absent; filaments unbranched, usually free; anthers 2-celled, opening lengthwise, anther cells pendulous, not long-cylindrical; rudimentary ovary sometimes present. Female flowers terminal, simple or branched, up to 11-40cm long; interstaminal glands absent; ovary 3-celled, ovary cells 1-ovuled; ovules pendulous; styles 3, simple, 5-15mm long, free or united at base; indumentum not stellate. Fruit a 3-celled capsule or drupe, c.8-11mm broad, smooth, pubescent; seeds often with conspicuous caruncle, endosperm copious, fleshy, embryo straight.

In forest undergrowth; Mali, Liberia, s. Nigeria, Cameroun, Guinea, Gabon, Zaïre, Uganda, Sudan (Hutchinson & Dalziel 1955-1972).

ALSTONIA

(Apocynaceae)

Alstonia constricta *F. Muell.* **(A. mollis** *Benth.***)** – bitterbark, quinine bark, fever bark, Australian fever bark, Peruvian bark, whitewood, lacambie

Alstonia scholaris *(L.) R. Br.* **(A. cuneata** *Wall.***; Echites scholaris** *L.***; Pala scholaris** *(L.) Roberty***)** – dita, dita bark, bitterbark, devil tree, milky pine, white cheesewood, white pine, whitewood, pale mara, chhatim, birrba, koorool, zopang, katung

Alstonia venenata *R. Br.* **(A. venenatus** *Brown***)** – dita, addasarpa, rajaadana, pazhamunnipala

These trees, notable for their array of indole alkaloids, have varied medicinal uses. Bark of A. scholaris rolls off in layers, and has long been used to make parchments. It is used in treating a number of ailments in India – such as menstrual cramps, stomach ache, chronic ulcers, dysentery, diarrhoea, teeth caries, catarrh, leprosy, asthma, heart diseases, blood diseases, tumours and general pain. Mixed with oil and milk, it is used for earache. The bark may also be taken as a general tonic after sickness (Kirtikar & Basu 1980; Nadkarni 1976). It is used by some indigenous peoples of n. Queensland, Australia for fever, dysentery and abdominal pain, and the latex used to treat neuralgia and toothache. The tender leaves may also be roasted and powdered to use as a poultice for skin ulcers (Forster & Williams 1996; Lassak & McCarthy 1990). In TCM, the dried leaves ['deng tai ye'] are used as an expectorant and antiphlogistic (Huang 1993). The seeds have been taken as an aphrodisiac by practitioners of tantric yoga, to prolong and intensify erection, and stimulate the sensory nerves. They are prepared by crushing and soaking in water over night, straining and drinking the water the next day; for stronger effects, the seeds may be boiled. A starting dose for experimentation is 2g (Miller 1985; Rätsch 1990, 1992).

In India, ripe fruit of A. venenata is used to treat insanity, epilepsy and syphilis; the bark has also been shown to act in a similar fashion (Bhattacharya et al. 1975; Kirtikar & Basu 1980; Nadkarni 1976). In some parts of the west Pacific, A. acuminata root bark is added to palm wine to give a bitter flavour (Usher 1974), most likely due to alkaloid content. During the early periods of Australia's colonisation, A. constricta bark was used as a 'bitters'. The decocted bark was also once used by beer brewers in England as a bitter hops substitute [see **Humulus**] (Cribb & Cribb 1981). In eastern Australia, A. constricta stem bark is used as a tonic and febrifuge; it is also reported to act as a cerebrospinal stimulant and antiperiodic. The latex has also been applied to sores. Bees have been observed to become intoxicated from the flower nectar – "they would drop to the ground in a comatose state and stay there for quite a long time. Then...they would waddle up to the plant and climb laboriously up and get stuck into these flowers again...and down they would come...absolute drunkards they became" (Lassak & McCarthy 1990). The plant is considered toxic to livestock (Forster & Williams 1996).

A. actinophylla [A. verticillosa] leaf and bark from Chillagoe, Queensland [Australia], harvested in June, gave positive tests for alkaloids, the bark more strongly so (Webb 1949).

A. brassii yielded 0.65% bases from bark; in mice, 500mg/kg [oral] of the bases produced sedation, ledge unsteadiness, dilated pupils, increased sensitivity to touch and sound, rapid breathing and intermittent clonic seizures (CSIRO 1990).

A. constricta stem bark has yielded alstonine ['chlorogenine', see below; inhibits cancer cell replication (Beljanski & Beljanski 1982), has antipsychotic-like effects in animals (Costa-Campos et al. 1998)], alstonidine, alstonilidine, vincamedine, porphyrosine, quebrachidine, O-3,4,5-trimethoxybenzoylquebrachidine, 14-ketoalstonidine and 1-carbomethoxy-β-carboline (Allam et al. 1987); root bark has yielded *reserpine*, alstonidine, alstonilidine, vincamajine and O-3,4,5-trimethoxycinnamoylamajine (Lassak & McCarthy 1990). Leaf of A. constricta var. mollis from Miles, Queensland [harv. Jun.] tested strongly positive for alkaloids (Webb 1949).

A. macrophylla bark has yielded alstophylline, villalstonine, macralstonine, macralstonidine, macrophylline and 'alkaloid M' (Kishi et al. 1965).

A. quaternata bark has yielded 0.2% alkaloids, including [as % of total alkaloids] 10% quaternatine, 0.3% cathafoline, 0.2% quaternine, 0.2% *yohimbine*, 0.2% pseudoyohimbine, and 0.2% tubotaiwine; leaves and twigs yielded 0.055% alkaloids, including 25% *yohimbine*, 10% pseudoyohimbine, 1.5% quaternine, 1.3% tubotaiwine, 1.2% cathafoline, 1.2% vincamajine, 0.5% quaternoxine, 0.3% quaternidine, and <0.1% quaternoline (Mamatas-Kalamaras et al. 1975).

A. scholaris bark has yielded ditamine, echitamine [ditaine], echitamidine, echitenine, echitine, echiteine, echicerine, echiretine, alstonine, venoterpine glucoside, β-amyrin acetate and lupeol acetate; root bark has yielded 0.21% echitamine, 0.001% echitamidine, 0.002% N-demethylechitamine, 0.0004% pseudoakuammigine, 0.0004% akuammicine N-oxide, 0.00035% akuammicine N-methiodide, <0.0001% akuammicine, 19,20-OH-dihydroakuammicine, 0.00045% tubotaiwine, stigmasterol and α-sitosterol; leaves have yielded 0.2% alkaloids consisting of strictamine [MAOI and antidepressant], picrinine, picralinal, pseudoakuammigine, 12-MeO-echitamidine [scholarine], and lochneridine, as well as betulin, ursolic acid and β-sitosterol (Boonchuay & Court 1976; Hartley et al. 1973; Kirtikar & Basu 1980; Lassak & McCarthy 1990; Rastogi & Mehrotra ed. 1990-1993). Bark from plants growing in Innisfail, Queensland [harv. May] tested strongly positive for alkaloids (Webb 1949). Flowers have yielded 0.01% picrinine [CNS-depressant], 0.004% strictamine, 0.0003% tetrahydroalstonine, and an unidentified indole alkaloid [0.00008%] (Dutta et al. 1976).

Seeds have been reported to contain alstovenine, 'chlorogenine', *reserpine*, and venenatine (Rätsch 1992), though I have been unable to locate any primary reference to support this. Chlorogenine was, at one point, considered synonymous with alstonine (Henry 1939), though chlorogenine is no longer recognised as an alkaloid name, due to confusion in early literature about the correct identity of the substance when extracted from plant material (Buckingham et al. ed. 1994). The chlorogenine first isolated by Hesse is synonymous with alstonine; the chlorogenine first isolated by Schunck is synonymous with the glucoside rubichloric acid, isolated by Rochleder. Miller (1985) claimed that "the seed contains a powerful alkaloid, chlorogenine, now considered the principal agent that acts as an aphrodisiac", though he appears to equate chlorogenine with *chlorogenic acid*, which is a different substance entirely. It should be noted that another unrelated substance is now known as 'chlorogenin' [(3β,5α,6α,25R)-spirostane-3,6-diol], which might cause further confusion.

A. spectabilis bark has yielded alstonamine, echitamine, echitenine, ditamine, quebrachidine, pleiocarpamine, villalstonine and macralstonidine (CSIRO 1990).

A. venenata stem bark has yielded alstovenine [MAOI], venenatine [*reserpine*-like action], echitovenidine [MAOI], echitovenine, 3-dehydroalstovenine, venalstonine, venalstonidine, anhydroalstonatine and trimethylgallamide; root bark has yielded alstovenine, venenatine, *reserpine* and 3-dehydro-*yohimbine* [3-dehydroalstovenine]; leaves have yielded echitovenaldine; and fruits have yielded echitoserpidine, echitoserpine, venoterpine, ursolic acid, β-amyrin and β-amyrin acetate; the plant has also yielded minovincinine and kopsinine (Bhattacharya et al. 1975; Farnsworth & Cordell 1976; Ganzinger & Hesse 1976; Rastogi & Mehrotra ed. 1990-1993).

A. villosa bark from plants growing in Cairns, Queensland [harv. Sep.] tested strongly positive for alkaloids (Webb 1949).

Alstonia venenata is a shrub usually 1.8-2.4(-6)m tall, glabrous. Leaves in whorls of 3-6, membranous, 10-20 x 2-4.5cm, oblong-lanceolate, very finely acuminate, base much-tapered, main nerves numerous, very close, parallel, slender, uniting in an intramarginal nerve, midrib strong; petiole 1.3-2cm long. Flowers white, inodorous, in terminal subumbellate pedunculate cymes, flowers often racemose on branches; calyx 5-lobed, without glands inside, 2.5mm long, lobes 1.6mm long, triangular-ovate, acute, ciliate; corolla hypocrateriform, tube slender, cylindric, swollen at tip over stamens, 13-22mm long, throat naked or +- enclosed by a ring of reflexed hairs, throat hairy at and below the insertion of stamens, lobes 8mm long, oblong, subacute, glabrous, overlapping; stamens near the top of the tube, included; anthers free, subacute; disc of 2 ligulate glands alternating with the carpels, annular or sometimes obscure, sometimes truncate or lobed. Carpels 2, distinct; ovules numerous in each carpel, many-seriate; style filiform; stigma minute. Follicles 2, 7.5-12.5 x 0.8cm, stalked, falcately curved, tapering at both ends, beaked, glabrous, striate; seeds 10-13mm long, flattened, linear-oblong, with a tuft of hairs at each end, the hairs shorter than the seed.

India (Kirtikar & Basu 1980).

To differentiate between the barks of A. constricta and A. scholaris – the former is very bitter, and inner bark turns almost blood-red with strong nitric acid, and brown in alcoholic iodine solution; the latter is less bitter, and inner bark turns red with strong sulphuric acid, yellowish-green with strong nitric acid, and almost black with alcohol-iodine solu-

tion (Lassak & McCarthy 1990).

ALTERNANTHERA

(Amaranthaceae)

Alternanthera lehmannii *Hieron.* **(A. fasciculata** *Suess.***; A. lanceolata** *(Benth.) Schinz***; A. mexicana** *Schltdl.***; A. microcephala** *(Moq.) Schinz***; A. panamensis** *(Standl.) Standl.***; A. stenophylla** *(Standl.) Standl.***; Achyranthes lehmannii** *(Hieron.) Standl.***; Ach. panamensis** *(Standl.) Standl.***; Ach. stenophylla** *Standl.***; Brandesia lanceolata** *Benth.***; B. mexicana** *Schltdl.***; Mogiphanes soratensis** *Rusby***; Telanthera lanceolata** *(Benth.) Moq.***; T. mexicana** *Moq.***; T. microcephala** *Moq.***)** – borrachera, chicha

This herb is used by the Kofan and Ingano of the Colombian Putumayo, and by the Siona of Ecuador, as an additive to their ayahuasca [see **Banisteriopsis**]; it is cultivated in home gardens in the Peruvian Amazon. It may also be added to the fermented drink 'chicha' [see *Methods of Ingestion*], after which it is named. Its addition is said to induce "a very strong intoxication which affects the voice" (Pinkley 1969; Schultes 1957, 1966, 1967a; Schultes & Hofmann 1980; Schultes & Raffauf 1990; Uscategui 1959). When smoked, the leaves were reported to produce a strange intoxication reminiscent of the tropane alkaloids. However, it was later revealed that this had been done shortly after the peak of a smoked **Salvia** divinorum experience (friendly pers. comm.). Later bioassays by numerous psychonauts have found no activity from smoking the plant, or from smoking concentrated extracts. It is thought that the true activity of this plant, if any, may lie in an ability to synergise with some other psychoactive substances (friendly pers. comm.; pers. comms.).

In Mocoa, the plant is decocted and taken as a purgative. The related A. sessilis ['racaba'] is cooked and eaten as food in Malaya, Indonesia and Congo (Usher 1974). In Queensland, Australia, A. nana and A. repens have been suspected of causing the death of sheep and pigs, respectively (Webb 1948).

The chemistry of A. lehmannii remains obscure, but the related A. repens has yielded triterpene saponins (Sanoko et al. 1999). A. sessilis tested positive for HCN in the seed and whole plant (Watt & Breyer-Brandwijk 1962). An unidentified Alternanthera sp. from Warwick, Queensland tested positive for alkaloids in the leaf, and more strongly in the root (Webb 1949).

Alternanthera lehmannii is a herbaceous plant, stem barely thickened at articulations, erect, branched, angled, upper parts mainly subvillous-pilose, lower parts glabrescent. Leaves petiolate, membranaceous, slender, lanceolate-oblong, up to 8.5 x 3.5cm, both ends attenuate, acuminate, mucronulate, margin entire or subundulate, long-ciliate, both sides sparsely pilose, upper side yellowish-green, under side pale, pinnatinerved, nerves slightly raised on both sides, lateral nerves c.10-11, curved, parallel; petiole 5-10mm long, moderately villous. Inflorescence terminal, solitary subglobose heads 4-5mm long, erect; peduncle to 6cm long, slender, villous; flowers shortly pedicellate; pedicels shortly villous, bracteate; bracts c.4, c.1mm long, glabrous, whitish, ovate, acuminate to elongate awns, awns 0.5-1mm long; perianth laciniate, trinerved, scarious, glabrous, oblong, acute, unequal, 2.5-3mm long, c.1mm wide, whitish-yellow; staminodes c.1.5mm long; filament long, apex deeply 4-dentate-laciniate, margin entire; anthers oblong, c.0.5mm long.

Growing near shady locations, 1700-1800m; Popayan [Colombia] (Heironymus 1895).

AMANITA

(Agaricaceae)

Amanita citrina *Schaeff. ex S.F. Gray* **(A. mappa** *(Batsch. ex Fr.) Quél.***)** – false death cap

Amanita cothurnata *Atkinson*

Amanita gemmata *(Fr.) Gillet* **(A. gemmata** *(Fr.) Bertil.***; A. junquillea** *Quél.***)** – jonquil Amanita, gemmed Amanita, crenulate Amanita

Amanita muscaria *(L. ex Fr.) Pers. ex Gray* – fly agaric, 'soma', toadstool, fairy mushroom, amanite tue-mouche ['fly-killer Amanita'], fliegenschwamm, fliegenpilz ['fly mushroom'], panx, tshashm baskon ['eye opener'], yuyo de rayo, yuy chauk ['herb of the thunderbolt'], kaqulja, kakulja, ruk'awach q'uatzu:y, itzel ocox, rocox aj tza ['devil's mushroom'], moscario, hongo mosquero, hongo matamoscas, benitengutake, miskwedo, mukhomor, flugsvamp, aka-haetori ['red fly catcher'], raven's bread

Amanita pantherina *(DC. ex Fr.) Secr.* – panther cap, the panther, panther agaric, pantera, pantherschwamm, krôtenschwamm, tignosa, pixaca, tengutake, hongo malo, hongo loco, false blusher

Amanita porphyria *(A. et S. ex Fr.) Secr.*

Amanita regalis *Fr.* **(A. muscaria var. regalis** *(Fr.) Maire***)**

Amanita rubescens *(Fr. ex Pers.) S.F. Gray* – blusher

Amanita strobiliformis *(Paul.) Quél.* – ibotengutake ['warted tengu-mushroom'], haetorimodashi ['fly killer']

Amanita tomentella *Kromb.*

A. muscaria is well known to many people, even if they do not know its identity. It is often seen as the prototypical mushroom, and has long adorned the artwork of children's story books. Its best known common name, 'fly agaric', stems from the use of the mushroom in stunning flies so that they may be easily dispatched. For this purpose, a cap was often placed in a shallow dish with some water and honey, and left on a window-sill to attract its victims. The fungus does not actually kill flies, despite much mythology to the contrary. Given the Scandinavian mythological association of flies with evil, this once-common use for A. muscaria might have existed in a context of magical protection against negative influences (Nichols 2001).

The shamanic use of A. muscaria is best known in Lapland and Siberia [by the Koryak, Khanty, Mansi, Forest Nenets, Selkup, Nganasan, Ket, Chukchi, Itelmen, Yukagir, Even, Eskimos and Russians living along the Kolyma River]. Many tribes allowed its use by anyone, but some reserved it for shamans – though shamans who could practice effectively without A. muscaria were considered 'stronger'. It is consumed as an oracle, to treat diseases, interpret dreams, communicate with spirits and other worlds, or to name a new-born – it is always 'told' in a loud voice the reason for its use. The mushroom is said to influence one via the A. muscaria 'manikins', little spirits who tell the consumer what they need to know, in the form of song, story, or taking one on journeys to other places and worlds. If the manikins do not appear, no revelations are received, or one is simply led to other realms but 'shown' nothing significant. The mushroom is also said to increase one's strength and endurance, and may be taken for performing arduous tasks. Potential users are first given a small amount, to test for violent tendencies – such people are not allowed to consume it. It is also never taken simultaneously with liquor, as this combination is believed to be very dangerous, even deadly. Others are left to do and behave as they wish while under the mushroom's influence (Heim 1963b; Saar 1991; Schultes & Hofmann 1980, 1992; Tyler 1966; Wasson 1968). Though once suppressed by Communism, shamanic use of this mushroom persisted more or less secretly in Siberia, and still exists there on a limited basis (Salzman et al. 1996).

Ancient Scandinavian use of A. muscaria has also been suggested, though such use is not known to exist there today, as it is widely [and falsely] believed to be a deadly mushroom (Nichols 2001). Use of this mushroom has been suggested to have contributed to the actions of the infamous Scandinavian 'berserkers'; in Norway, going berserk was outlawed in 1015AD [see also **Ledum**] (Fabing 1956; Tyler 1966). A. muscaria has also been used as a shamanic sacrament by native North Americans [Great Lakes region of Canada and the US], and was still used up until recently by some Ojibway shamans (Wasson 1979). The Quiche Maya regard A. muscaria as 'evil or diabolical', and Kekchi-speaking people of Guatemala call it the 'devil's mushroom'. These names may relate from poisonings after ingesting fresh specimens; it seems likely that its proper preparation and use was once better known to some of the Guatemalan Maya, as it is directly associated with Kakulja [god of thunder and lightning], one of the powerful Mayan deities mentioned in their holy book, the Popol Vuh (Lowy 1974, 1977).

A. muscaria has been proposed in a detailed set of arguments by R. Gordon Wasson to have been the original sacred 'soma' of the Hindus [see *Introduction*]. Many people accept this identification, though many also disagree, and several alternatives have been considered over the decades [see **Ephedra**, **Mandragora**, **Nelumbo**, **Psilocybe** and **Peganum**]. Some consider the effects of fly agaric intoxication to be not 'entheogenic' enough to have been soma, but differing chemical composition of material may be responsible for much of the discrepancies (Festi & Bianchi 1990; Flattery & Schwartz 1989; Heinrich 1992; McKenna 1991; Ott 1993, 1998b; Wasson 1968). Soma as a drug may have referred to a number of different psychoactive herbs [and/or combinations thereof] which induced the appropriate state, rather than being one mystery plant. In my subjective opinion, based solely on nature of effects, plant substances chemically analogous to *psilocin* or ayahuasca [see **Banisteriopsis**] would be most likely to have been the preferred sacraments of the ancient Vedists. However, I am certainly not a scholar in that field and my opinion should be taken with at least one grain of salt!

A. muscaria might also have been the mushroom involved in the Lesser Mysteries of Eleusis [see **Claviceps**, **Panaeolus**] (Samorini 2001; Webster et al. 2001). It has also been suggested that A. muscaria was used in the quest for enlightenment by early Buddhists; and that it may have been the cause of Buddha's enlightenment under the Bodhi tree. The latter may have been a birch [Betula spp.], the 'world tree' of many cultures, with which these fungi grow symbiotically (Hajicek-Dobberstein 1995).

Oddly enough, A. muscaria was even tested and proposed as a wine substitute in Italy, 1880, when a parasite threatened local vineyards. In rural Europe, the mushroom has a small reputed history of use as an inebriant (Samorini 1996a). In Catalonia [Catalunya], an autonomic territory in Spain, use of A. muscaria for psychotropic effects is known, and may

have been more prevalent in the past (Fericgla 1992). Use of A. muscaria has also been uncovered in the Shutul Valley of Afghanistan, which appears to be a remnant of older traditional use. The chief purpose for its use is as a stimulant, though it is also sometimes used for "treatment of psychotic conditions", or applied externally to frostbite. The mushrooms are gathered in late spring [often already dried from the sun], powdered, and boiled with Impatiens noli-tangere ssp. montana ['mountain snapweed'] and soured goat-cheese brine. Though its main use is reported to be as a stimulant, extracts of accounts from local informants described stronger inebriations. For example – "a feeling of weariness and a need for sleep overcomes me. I hear voices, although I am alone in my room"; "First, I am very sleepy, then I feel good. I forget sentences... Once I thought that I was a tree"; "I ran around in the woods and didn't know who or where I was." Further north in the valley, the extract is fortified with "calyx-tips of seed-bearing flowers" of **Hyoscyamus** niger, and applied externally by massage (Mochtar & Geerken 1979).

A. pantherina is also claimed to have been used as an inebriant in Japan. In 1927, Cape Province [S. Africa], there was a recorded incident of accidental ingestion by 7 people; 3 of them died, and this seemed to be due to muscarine poisoning [see below] (Watt & Breyer-Brandwijk 1932). The fungi were probably eaten fresh or in excess. A. gemmata has been reported as causing "intoxication" and "malaise" in a group of people who ingested it, presuming it to be edible (Heim 1963b); human intoxications from A. regalis have also been reported (Stijve 2000).

Today, A. muscaria and A. pantherina are sometimes used experimentally and sacramentally by western psychonauts, virtually wherever they grow. Their non-traditional use is particularly prevalent, though still infrequent, in the Pacific northwest US and adjacent Canada, southern Australia, and Europe (Weil 1977b; pers. obs.). In Germany, A. muscaria is available in pharmacies as a homoeopathic tincture [called 'Agaricus muscarius'; 100ml derived from c.35g fresh mushroom], used to treat depression, 'mental weakness', epilepsy, Parkinson's disease, menopausal flushes, tics, and paresis of the bladder, amongst other uses. The effect of the tincture may be increased by heating it twice for 3 minutes until boiling, in order to decarboxylate most of the *ibotenic acid* to *muscimol* [see below] (Waldschmidt 1992). Some people have taken to simply consuming a small piece of the mushroom everyday as a neurotropic (pers. comms.). With special preparation, it has even been eaten as food - in Mexico after peeling off the cuticle and throwing it away along with the water used to cook the mushroom, and in Italy boiled with the water then discarded and the mushroom pickled in brine (Michelot & Melendez-Howell 2003).

A. muscaria and A. pantherina have been prepared and consumed in a variety of ways, but to avoid toxic symptoms, they are usually thoroughly dried or toasted prior to consumption [to facilitate decarboxylation of *ibotenic acid* to *muscimol* – see below]. It is known that fresh specimens are much more toxic than dried, and that smaller amounts can be fatal [this is not a concern with sensible doses of properly dried mushrooms]. Often only the cap is used, though the whole mushroom may be taken – the inside skin of the cap seems to be richest in active compounds. Some Siberians believe the younger, partially open mushrooms are stronger in 'narcotic power', and are used to facilitate physical exertions, and mature mushrooms are used for visionary purposes – though this information seems to contradict itself. It is said that the cap "must not be bigger than the hollow of the hand with crooked fingers" [10-15cm across]. Dosages vary with individual tolerance and with batch potency – to test the water, beginners may start with one dried, moderate-sized mushroom [perhaps cap 10cm across fresh], or ¼-½ a cup of dried, finely chopped mushroom [which may be 2-4 specimens of mixed size – up to 21 or more have been used in Siberia, where odd-numbered doses are the rule]. It is said that "if you feel after eating two fungi that it is time to finish, you should still eat one more". They may simply be chewed and eaten, or chewed and the saliva swallowed, as is often the case in traditional practices. Alternately, they are extracted by water decoction or infusion, or macerated, and have been infused in fruit juice or with the juice of Epilobium angustifolium ['fire-weed', 'rose-bay willowherb' – see *Endnotes*] or of **Vaccinium** uliginosum, which is said to make the drink stronger (Emboden 1979a; Saar 1991; Stafford 1992; Wasson 1968; pers. exp.).

Some people prefer to smoke the dried skin of the cap (Rätsch 1990; pers. comms.), for a much weaker effect of shorter duration. However, the material does not burn well, and must be re-lit for each inhalation. Some people have noted no effects worth remarking on; often, large amounts must be smoked for a noticeable effect. In any case, it is actually the flesh just under the skin [cuticle] of the cap that is most potent, not the skin itself, which often causes some confusion (pers. comms.; pers. obs.).

The effect of A. muscaria is also claimed to be increased by drinking large quantities of cold water after ingestion. Drinking the urine of someone intoxicated by A. muscaria is also known to be effective, as is eating the flesh of a reindeer who had eaten it [only if killed when it is still inebriated]. This occurs because *muscimol* [see below] is passed through the body relatively unmetabolised.

Shortly after consumption, many feel the urge to lie down and rest or sleep [this is sometimes to minimise the transient nausea that may occur]. Physical effects are often felt before this, and manifest as nausea, trembling, sweating, and a mild sense of detachment – though in some batches, these adverse effects do not occur. Some of these side-effects might perhaps be due to small amounts of muscarine, a cholinergic toxin affecting muscarinic *acetylcholine* receptors [see *Neurochemistry*], or perhaps to vanadium or amavadin [a vanadium chelate] when present in large amounts. The sleep stage is light, and the subject may often still be partly aware of surrounding sounds, and in this phase the CNS effects of the mushrooms usually first become apparent, with strange lucid dreams occurring. After 1-2 hours, the subject arises and feels to have awoken to a different world – usually, things appear the same, yet undeniably different in an inexplicable way. A positive, even euphoric, playful mental state is experienced, yet physical co-ordination and basic motor skills may be greatly impaired, and twitching may occur. Pleasant auditory and visual effects may be experienced, as well as peculiar somatic hallucinations. Objects or the self sometimes appear either greatly magnified or shrunken. Sometimes, one's awareness of the outside world may be virtually non-existent for several hours. Adverse experiences are known, however – some have found themselves trapped in self-repeating time-loops, where they experienced the same short time-period over and over again until the effects wore off, and this usually produced a dysphoric reaction towards the episode. The main body of effects may last from 4-8 hours or so, with no notable after-effects (Festi & Bianchi 1990; Hatfield & Brady 1975; Ott 1993; Saar 1991; Stafford 1992; Weil & Rosen 1983; pers. exp.; pers. comms.).

The chemicals mainly responsible for the characteristic symptoms of A. muscaria and A. pantherina are the isoxazoles *ibotenic acid* and *muscimol*. *Muscimol* apparently does not occur in the fresh mushroom, but is formed during extraction or preparation, by simultaneous decarboxylation and dehydration of *ibotenic acid*. Pharmacologically, *muscimol* is 5-10 times as potent as *ibotenic acid*. Muscazone, which is closely related chemically to *ibotenic acid*, has not been adequately investigated pharmacologically. In animals it has shown 'sedative' activity similar to, but weaker, than that produced by *ibotenic acid* and *muscimol* under the same testing conditions (Bresinsky & Besl 1989; Waser 1967). The cholinergic toxin muscarine was once thought to be the psychoactive chemical present in A. muscaria, but it is now known to be present in quantities generally too small to be significant, and in any case, shows only weak oral activity (Eugster 1967; Waser 1967). The non-protein amino acids stizolobic acid and stizolobinic acid may also be contributors to the activity of species in which they are present. They are still little-studied, but have shown neuronal depolarising activity in rat spinal cord. Stizolobic acid, the most potent of the two, was more potent than *glutamic acid* in these tests. In rat cerebral cortex, stizolobic acid caused excitation in most neurons affected by *glutamic acid*, and potentiated other excitatory amino acids (Ishida & Shinozaki 1988). Amavadin is also found in some of these species [see below], and when present, is usually most concentrated in the stems (Koch et al. 1987). If amavadin is shown to have toxic effects, then there may be a chemical basis for some people's preference for the caps of psychoactive species [as some use only the caps and discard the stems] (theobromus pers. comm.).

Treatment for intoxication from A. muscaria and chemically similar relatives consists of inducing vomiting and taking activated charcoal (Michelot & Melendez-Howell 2003). However, this might only be useful if the ingestion was very recent - once the effects have taken hold it seems unlikely that much unabsorbed drug would remain in the stomach. Unless a very high and possibly dangerous dose has been consumed, the best course is probably to just deal with it in a safe place [not in hospital] until the effects inevitably wear off, as normal doses have no real risk except the possibility of inadvertent self-harm due to loss of motor coordination (pers. obs.). Cholinesterase inhibitors such as physostigmine, once considered an antidote to A. muscaria intoxication, are still suggested by some physicians (Michelot & Melendez-Howell 2003) yet in reality are useless in this context, deriving from the outdated belief that the mushroom is active due to its [low] muscarine content.

Some **Amanita** spp. contain highly toxic chemicals and are commonly responsible for deaths of careless mushroom hunters [usually seeking edible mushrooms, rather than the psychoactive species discussed here; for further discussion see the end of this entry]. Some **Amanita** spp. are also prized edible mushrooms, such as A. caesarea, A. rubescens [see below] and A. lanei [A. calyptroderma].

A. citrina has yielded 0.04-1.693% *bufotenine*, *bufotenine* N-oxide [Stijve (1979) reported that "all samples contained 300-600mg", though did not note whether this referred to individual specimens, and if so, their weights], 0-0.025% *tryptophan*, 0-0.593% *5-hydroxytryptophan*, traces of *serotonin* [Stijve reported "all samples contained 100-200mg"; see above], 0-0.039% N-methyl-*serotonin*, 0-0.06% *tryptamine* (Beutler & Der Marderosian 1981; Beutler & Vergeer 1980; Stijve 1979; Wurst et al. 1992), and traces of *DMT* and *5-methoxy-DMT*. Cultured mycelium of German A. citrina was shown to contain c.0.03% *bufotenine* and traces of other compounds (Tyler & Gröger 1964a). In European samples [pooled from Germany, Netherlands and Switzerland], *bufotenine* content was low [c.0.8%] in caps [reported as 'bulbs' – presumably immature specimens were analysed?], with higher yields obtained from stems [c.1.5%]. The 'bulbs' were richer in *5-hydroxytryptophan* content (Stijve 1979). An ex-

tract was shown to inhibit *glutamic acid* neurotransmission in rat hippocampus, due to activation of 5-HT receptors (Moldavan et al. 2002). A. citrina is easily confused with deadly species such as A. phalloides.

A. cothurnata from Virginia has yielded large amounts of *ibotenic acid* and *muscimol* (Chilton & Ott 1976).

A. gemmata has yielded *muscimol* (Beutler & Der Marderosian 1981) and *ibotenic acid* in small amounts, as well as traces of stizolobic acid and stizolobinic acid (Bresinsky & Besl 1989; Chilton & Ott 1976). Though others have found no isoxazoles in typical N. American samples, specimens that were intermediate with A. pantherina contained isoxazoles (Benedict et al. 1966).

A. muscaria fresh samples from Italy yielded 0.038% *muscimol* and 0.099% *ibotenic acid* from caps, and 0.008% *muscimol* and 0.023% *ibotenic acid* from stems (Gennaro et al. 1997). Japanese specimens [many lacking stems] were found to contain <0.001-0.28% *ibotenic acid* and 0.0046-0.1% *muscimol* in caps; neither were detected in stems of one sample. Cap cuticle contained <0.001-0.019% *ibotenic acid* and <0.0025-0.03% *muscimol*; cap flesh contained <0.001-0.14% *ibotenic acid* and 0.012-0.077% *muscimol* (Tsujikawa et al. 2006). Brazilian specimens yielded 0.08-0.13% *muscimol* (Stijve & de Meijer 1993). Samples from many locations have yielded large amounts of *ibotenic acid* and *muscimol* [up to 0.18% combined, though some yielded none], with traces of muscazone [Eugster et al. (1965) only found it in summer-fruiting Swiss specimens], 1-methyl-1,2,3,4-tetrahydro-β-carboline 3-carboxylic acid, R-4-OH-pyrrolidone, β-N-butyl-D-glucopyranoside, stizolobic acid, stizolobinic acid [A. muscaria var. formosa also yielded larger quantities of these latter two compounds] (Benedict et al. 1966; Chilton & Ott 1976; Eugster 1967; Eugster et al. 1965; Festi & Bianchi 1990; Hatfield & Brady 1975; Takemoto et al. 1964b), traces of muscarine [0.0002% or more, w/w] (Eugster 1967), muscaridine [0.00003%, as the chloroaurate; not stated whether w/w or d/w], *acetylcholine* (Kögl et al. 1960), *choline*, *atropine*, *hyoscine*, *hyoscyamine* and *bufotenine*. The presence of these last 4 alkaloids is now strongly doubted, and others have failed to detect them in this species. In any case, the quantities purported to have been found would be pharmacologically insignificant (Eugster 1967, 1968; Festi & Bianchi 1990; Stijve 1979; Tyler 1961; Waser 1967). Vanadium and amavadin [mostly in stems] have also been found (Gillard & Lancashire 1984; Koch et al. 1987). The pigmentation of the cap is due to muscaflavin, muscaurins I-VII, muscapurpurin (Hatfield & Brady 1975; Musso 1979), muscarubin and muscarufin. Dioleine 1,3 is thought to be the fly-attracting component. A glucan-derivative, AM-ASN, shows some antitumor activity. Worryingly, some researchers suspect this species of containing small amounts of amatoxins and/or phallotoxins, with one study apparently detecting traces of amatoxins, but this needs further study and confirmation. The haemolysin phallolysin, found in A. phalloides, has also been detected. The species may accumulate high levels of heavy metals from the environment, which is also a cause for concern (Michelot & Melendez-Howell 2003). An extract of A. muscaria was shown to excite glutamic-NMDA receptors and muscarinic *acetylcholine* receptors in rat hippocampus (Moldavan et al. 2002).

Extracts available in the Japanese drug underground, purporting to contain A. muscaria, contained only small amounts of *ibotenic acid* and/or *muscimol*, and also contained adulterants such as *caffeine*, *hyoscine*, *atropine*, *harmine*, *harmaline*, *5-MeO-DMT* and the synthetic 5-MeO-DIPT [5-methoxy-diisopropyltryptamine] (Tsujikawa et al. 2006).

A. pantherina from many locations yields large amounts of *ibotenic acid* and *muscimol* [up to c.0.46% combined, though some yielded none], with varying smaller amounts of stizolobic acid and stizolobinic acid (Benedict et al. 1966; Chilton & Ott 1976; Repke et al. 1978; Takemoto et al. 1964b); muscazone has also been found in some samples (Ott 1993), as well as (2R),(1R)- and (2R),(1S)-2-amino-3-(1,2-dicarboxyethylthio) propanoic acid [NMDA receptor antagonists] (Michelot & Melendez-Howell 2003). Small amounts of muscarine have been found, of which 53% was present as epi-muscarine (Stadelmann et al. 1976), which is apparently inactive (Bresinsky & Besl 1989). Japanese specimens were found to contain 0.019-0.027% *ibotenic acid* and 0.15-0.19% *muscimol* in caps, and <0.001% *ibotenic acid* and 0.064% *muscimol* in stems; cap cuticle contained 0.049-0.051% *ibotenic acid* and 0.093-0.13% *muscimol*, whereas cap flesh contained 0.038-0.098% *ibotenic acid* and 0.12-0.35% *muscimol* (Tsujikawa et al. 2006). It is said to have yielded *bufotenine*, but others have failed to replicate this (Stijve 1979; Tyler 1961). An extract was shown to excite glutamic-NMDA receptors and muscarinic *acetylcholine* receptors in rat hippocampus (Moldavan et al. 2002). A. pantherina may be easily confused with the similar A. spissa [A. excelsa], which is considered edible. They can mainly be differentiated by the fact that the 'bulb' of A. spissa runs gradually into the stipe, whereas that of A. pantherina is abruptly emarginate (Bresinsky & Besl 1989).

A. porphyria has yielded 0.01-0.617% *bufotenine*, 0-0.51% *5-hydroxytryptophan*, traces of *serotonin*, 0-0.072% N-methyl-*serotonin* (Beutler & Der Marderosian 1981; Wurst et al. 1992), *bufotenine* N-oxide and traces of *5-methoxy-DMT* (Tyler & Gröger 1964a). Another test found only 0.22-0.51% *5-hydroxytryptophan* and small amounts of *serotonin* (Beutler & Vergeer 1980).

A. regalis, considered by some to simply be a variant of A. muscaria [to which it is very similar], has yielded *ibotenic acid* and *muscimol* [0.1-0.62% combined in Swiss specimens] (Bresinsky & Besl 1989; Stijve 2000), as well as 0.0032-0.0192% vanadium (Meisch et al. 1979), and amavadin, the latter mostly in the stems (Koch et al. 1987).

A. rubescens collected in former Czechoslovakia was found by Wurst et al. (1992) to contain 0.018-0.02% *bufotenine*, although in the same research paper the authors also state that "A. rubescens contains no *bufotenine*" (Wurst et al. 1992). This species is considered edible only after cooking in water and discarding the water (Phillips 1981). It is rather similar in appearance to A. pantherina (pers. obs.).

A. solitaria has been found to contain 2 unidentified isoxazole-like compounds, solitaric acid and solitarine, which resembled *ibotenic acid* and *muscimol*, respectively, in chromatography and colour reactions (Benedict et al. 1966).

A. strobiliformis from Japan [but not those from North America or Europe] yielded *ibotenic acid*, as well as *aspartic acid*, *glutamic acid*, *glycine*, alanine, leucine, isoleucine, proline, threonine, serine, valine, *phenylalanine* and tyrosine (Chilton & Ott 1976; Takemoto et al. 1964a). It is now thought that the Japanese specimens may not have been A. strobiliformis, but possibly A. pantherina or another similar species (Benedict 1972; Benedict et al. 1966).

A. tomentella has also yielded *bufotenine* (Beutler & Der Marderosian 1981; Tyler 1961).

A. velatipes, considered a variety of A. pantherina, yielded 0.0397% vanadium from the cap (Meisch et al. 1979); amavadin was also found, mostly in the stems (Koch et al. 1987).

Amanita muscaria has a pileus 8-20cm across, globose or hemispherical at first then flattening, bright scarlet covered with distinctive white pyramidal warts which may be washed off by rain, leaving the cap almost smooth and the colour faded; stipe 80-180 x 10-20mm, white, often covered in shaggy volval remnants as is the bulbous base, the white membranous ring attached to the stem apex sometimes flushed yellow from the pigment washed off from the cap; flesh white, tinged red or yellow below the cap cuticle; taste pleasant to unpleasant, smell faint, becoming stronger on drying; gills free, white; spore print white; spores broadly ovate, nonamyloid, 9.5-10.5 x 7-8µ. Late summer to late autumn.

Grows in a mycorrhizal relationship with birch trees [Betula spp.] and other European trees [eg. oak (Quercus spp.) and pine (Pinus spp.)]; common (Phillips 1981); Europe, Great Britain, temperate Asia, N. America, Australia, New Zealand.

Care should be taken when collecting Amanita spp., as some species [A. bisporigera, A. dunensis, A. ochreata, A. phalloides ('destroying angel'), A. subalbiacea, A. tenuifolia, A. verna ('white death cap') and A. virosa ('destroying angel')] can be deadly. Violent gastric disturbance usually occurs 6-24hrs after ingestion, followed by an apparent remission of symptoms. Some 2-4 days later, effects related to serious liver and kidney damage emerge, and death may result. These species contain peptides that are toxic to the liver, such as the amatoxins, phallotoxins and virotoxins (Bresinsky & Besl 1989; Hatfield & Brady 1975; Low 1985); muscarine has also been found in A. phalloides, accompanied by epi-muscarine (Stadelmann et al. 1976). These fungi, however, bear little resemblance to A. muscaria, being mostly white. Still check a good guidebook, though…better safe than sorry [dead]! NEVER consume an unknown Amanita sp. or one that you feel at all uncertain about. The same can be said for all plants and fungi.

A simple field test has been devised to evaluate the presence of some amatoxins in fresh or dried mushrooms (Beutler & Vergeer 1980), which may be invaluable to the curious ethnomycologist [see *Producing Plant Drugs*].

AMARANTHUS

(Amaranthaceae)

Amaranthus spinosus *L.* **(A. caracasanus** *Kunth***)** – thorny amaranth, spiny pigweed, caruru de espinho, espina de la playa, quiltonil de burro, quiltonil de pajaro, achpar-ba, Janum leper-ara, auia kiaka, le xian cai

This weedy herb has interesting usage by the Lodha of west Bengal. The powdered dry roots are smoked to induce 'hallucinations', and it is said that eating the root paste can cause temporary insanity. In other areas, the leaves or root paste are applied externally to wounds and bubos (Pal & Jain 1989). The Cherokee use the leaf as an astringent, to relieve heavy menstruation (Hamel & Chiltoskey 1975); they also use the plant in 'ceremonial medicine' (Ott 1993). In Basutoland, the plant is used as an ash added to snuffing tobacco [see **Nicotiana**]; it is also used in snuffs in Transvaal, though the form of preparation was not mentioned. A. caudatus is also more commonly added to snuffs in south-eastern Africa (Watt & Breyer-Brandwijk 1962). In Mt Lamington, n. Papua New Guinea, the Orakaiva use an unidentified Amaranthus sp. ['tumeni'] with another unidentified cockscomb ['siroru'; Celosia sp.?], "to produce a ceremonial shaking fit" (Thomas 2001a).

In Australia, A. macrocarpus, A. paniculatus, A. spinosus and A. viridis have been suspected of causing poisoning in livestock (Webb 1948). In Brazil, A. spinosus is known to cause cattle intoxications, with symptoms including prostration, difficulty in walking, oedema in the neck, and dark, foetid diarrhoea (Pott & Alfonso 2000). Amaranthus spp. have been used as food in many countries, for the edible leaves and seed of many species (Genders 1988; Low 1991b).

A. blitum and A. graecizans, which are considered poisonous in Russia, contained 0.63-0.7% alkaloids in leaves, and 0.4-0.45% in stems (Abdulla-Zade & Agamirova 1965).

A. spinosus leaves and stems have yielded hentriacontane and α-spinasterol; roots have yielded α-spinasterol, α-spinasterol octacosanoate, oleanolic acid, D-glucose, D-glucuronic acid, and β-D-glucopyranosyl(1→4)-β-D-glucopyranosyl(1→4)-β-D-glucopyranosyl(1→3)-oleanolic acid; the plant has also yielded, from unspecified parts, quercetin, rutin, stigmasterol, campesterol, cholesterol, stearic acid, oleic acid and linoleic acid (Rastogi & Mehrotra ed. 1990-1993). Leaf, stem and root from Brisbane, Queensland [Australia], harvested in April, gave negative tests for alkaloids (Webb 1949). As well as A. angustifolia, it tested positive for HCN [whole plant] (Watt & Breyer-Brandwijk 1962).

Amaranthus spinosus is an erect, branched glabrous herb to 1m tall, varying in colour from green to red or purple, with 2-5 straight, divergent spines 5-10mm long at most axil nodes; stems terete. Leaves alternate, ovate-lanceolate or oblong, 3-10 x 1.9-5.1cm, narrowed to an obtuse mucronate apex, base broadly cuneate to petiole; petiole slender, equalling the blade or shorter. Flower spikes numerous, dense, 5-15cm long, 6-10mm thick, bisexual, flowers unisexual, c.1mm long, terminal parts mostly male, basal parts and axillary clusters mostly female; bracts setaceous, equalling or exceeding sepals; sepals of female flowers 5, oblong, obtuse, 1-1.5mm long, apiculate; sepals of male acuminate; stamens 5, free; anthers 2-celled; staminodes 0. Ovary compressed; style short or absent; stigmas 2, filiform or subulate; ovule 1, erect. Utricle rugose, nearly equalling sepals. Achene rugose, thin and loose, 1.5-2mm long, tip entire or 2-3-toothed, bursting irregularly, terminal portion spongy and rough; seed nearly circular, orbicular, compressed, 0.7-1mm wide, testa crustaceous, black, shining.

An abundant weed in warm zones of both hemispheres, in wasteland, crops and stock yards; of doubtful origin (Gleason 1952; Hooker 1954-1961). Found in Australia along the central and north coast of NSW, and the Queensland coast (Auld & Medd 1992).

AMSONIA

(Apocynaceae)

Amsonia tabernaemontana *Walter*

This North American herb has no ethnobotanical uses to my knowledge – however, it has yielded some interesting alkaloids.

As well as the green parts and roots yielding the β-carbolines *harmine* [0.0036% from whole plant, in one test], *harmalol* and *tetrahydroharman* (Lutomski & Nowicka 1969; Lutomski et al. 1968c), the leaves have yielded the indole alkaloids (-)-tetrahydroalstonine, (+)-*akuammidine*, (-)-dihydro-18,19-corynantheol, (+)-dihydro-19,20-condylocarpine, (+)-aspidospermidine, (+)-Δ1-aspidospermidine, (-)-N-formyl-aspidospermidine, (+)-1,2-dihydro-aspidospermidine, (-)-quebrachamine, and (+)-vincadifformine (Panas et al. 1972; Zsadon & Kaposi 1972), and roots have yielded the indole alkaloids (+)-Δ1-aspidospermidine, (-)-eburnamine, (+)-eburnamonine, (-)-nor-C-fluorocurarine, (-)-quebrachamine, and 2 unidentified alkaloids (Panas et al. 1973). Other indole alkaloids have been found in the plant – eburenine, (-)-tabersonine [hypotensive; see **Voacanga**], vincadine, 14,15-dehydrovincadine, epivincadine, dehydroepivincadine, 14,15-dehydroepivincadine, 16-α-carbomethoxy-quebrachamine, 16-β-carbomethoxy-(-)-quebrachamine, lochnericine, (-)-tetrahydropresecamine, tetrahydrosecamine, and decarbomethoxy-tetrahydrosecamine. Members of the genus have also reportedly yielded (+)-*yohimbine* and β-*yohimbine* (Buckingham et al. ed. 1994; Ganzinger & Hesse 1976).

The related A. elliptica [from Japan] has yielded 0.36% tabersonine hydrochloride, tabersonine N-oxide, 0.061% 3-oxo-tabersonine, 0.026% tetrahydroalstonine, 0.0008% Δ14-*vincamine*, 0.007% 16-epi-Δ14-*vincamine*, 0.051% 14,15-epoxy-3-oxo-vincadifformine, and 0.0028% 16-carbomethoxy-16-OH-14,15-epoxy-3-oxo-1,2-dehydro-aspidospermidine from the seeds (Aimi et al. 1978).

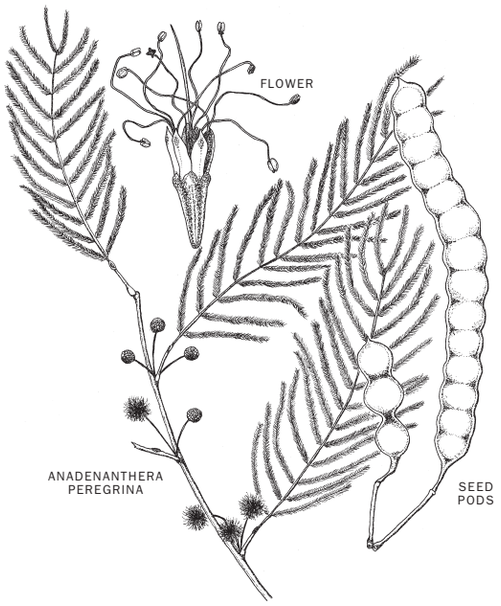
Amsonia tabernaemontana is an erect, perennial herb, with erect stems 40-100cm tall. Leaves alternate or irregularly scattered, thin,

opaquely green, narrowly lanceolate to ovate or broadly elliptic, 8-15cm long, acuminate, obtuse or acute at base, glabrous or finely pubescent beneath. Blue flowers in terminal cymes, cymes flat to pyramidal, many-flowered; calyx deeply 5-parted; corolla salverform, villous in the throat, its 5 lobes lanceolate, corolla tube 6-10mm long, corolla limb c.1cm wide; anthers separate. Ovaries 2, many-ovuled, without nectaries. Follicles cylindric, erect, 8-12cm long; seeds naked. Fl. May-Jun.

In moist or wet woods on the coastal plain, New Jersey to Vancouver, more widely distributed in the southern states west to Oklahoma and Texas, north in the interior to s. Indiana, c. Illinois, Montana and Kansas (Gleason 1952).

ANADENANTHERA [including PIPTADENIA]

(Leguminosae/Mimosaceae)



Anadenanthera colubrina var. colubrina *(Vellozo) Brenan* **(Acacia colubrina** *(Vell.) Mart.***; Mimosa colubrina** *Vell.***; Piptadenia colubrina** *(Vell. Conc.) Benth.***)**

Anadenanthera colubrina *(Vell.) Bren.* **var. cebil** *(Grisebach) Altschul* **(A. macrocarpa** *(Benth.) Brenan***; Piptadenia macrocarpa** *Benth.***; P. microphylla** *Benth.***)** – vilca, villca, huillca, wilka, cebil, hatáj, hatáj ilé, kurupa, curupáy-curú

Anadenanthera excelsa *Grisebach* **(Piptadenia excelsa** *(Gris.) Lillo***)**

Anadenanthera peregrina var. peregrina *(L.) Spegazzini* **(Acacia microphylla** *Willd.***; A. niopo** *(Humb., Bonpl., et Willd.) Humb.***; Piptadenia peregrina** *(L.) Benth.***)** – yopo, yupa, cohoba, niopo, ñopo, curupa, curupáy, hisiomi, huillca, mori, paricà, ai'ku:duwha, angico, acuja

Anadenanthera peregrina *(L.) Speg.* **var. falcata** *(Benth.) Alt.* **(A. falcata** *(Benth.) Speg.***; Piptadenia falcata** *Benth.***)**

Piptadenia communis *Benth.*

Piptadenia contorta *(DC.) Benth.* **(Acacia contorta** *DC.***; Newtonia contorta** *(DC.) Burkart***; Pseudopiptadenia contorta** *(DC.) G.P. Lewis et M.P. Lima***)** – angico, angico-branco, saia-de-comadre

Piptadenia gonoacantha *(Mart.) Macbr.* **(Acacia gonoacantha** *Mart.***; Pityrocarpa gonoacantha** *(Mart.) Brenan***)**

Piptadenia leptostachya *Benth.* **(Monoschisma leptostachyum** *(Benth.) Brenan***; Pseudopiptadenia leptostachya** *(Benth.) Rausch.***)**

Piptadenia moniliformis *Benth.* **(P. obliqua** *(Pers.) J.F. Macbr.***)** – jurema preta, angico de bezerro, estralador, feijaozinho braco, kip, quip

Piptadenia novoguineensis *Warb.* **(Prosopis insularum ssp. novoguineensis** *(Warb.) Bret.***; Schleinitzia novoguineensis** *(Warb.) Guinet***; S. novoguineensis** *(Warb.) Verdc.***)**

Piptadenia paniculata *Benth.* **(Pityrocarpa paniculata** *(Benth.) Brenan***)**

Piptadenia rigida *Benth.* **(Anadenanthera rigida** *(Benth.) Altschul***)** – curupáy rá, vilcarán

Piptadenia stipulacea *(Benth.) Ducke* **(P. communis var. stipulacea** *Benth.***; Pityrocarpa stipulacea** *(Benth.) Brenan***)** – jurema branca

The seeds, and occasionally the bark, of A. colubrina var. cebil and A. peregrina var. peregrina form the basis of an entheogenic snuff which was formerly consumed over a large portion of S. America. Based on archaeological findings, the seeds of A. colubrina var. cebil are known to have been snuffed in central Peru since at least c.1200BC, and in n. Chile since at least c.780AD. They have been smoked in pipes even earlier, in n.w. Argentina since c.2130BC. Smoking pipes have been uncovered in central Chile, dating to c.500AD, though so far there is no evidence to determine what was smoked in them. Ancient use has also been reported from Paraguay, the West Indies [A. peregrina var. peregrina], and the s. Brazilian highlands [probably A. colubrina var. cebil] (Falabella et al. 2001; Schultes 1967b; Torres 1993, 1995; Torres et al. 1991). 'Vilca' or 'villca', as this snuff has been known, seems to have a variety of meanings. In one Quechua myth, a slain warrior captain known as 'Villca Quire' transferred the quality of vilca to the fruits of the tree he was buried under. In the Aymara language, 'villca' was the old word for the sun, also referring to shrines dedicated to the sun or other deities, and to the purgative medicinal visionary herb which is now understood to be A. colubrina var. cebil (Torres 2001). The Taínos of the Greater Antilles were the first culture observed by foreign explorers to consume 'cohoba', a snuff now known to have been made from seeds of A. peregrina var. peregrina. The purpose of consuming this snuff was to come into contact with the 'zemís', spirits which took a variety of forms [eg. specific deities, 'nature spirits', and intermediaries between worlds] and were often represented in carved statuettes (Torres 1998).

Up to the 16th century, A. colubrina var. cebil seeds were used as a snuff by Inca shamans, who were also sometimes known to consume them as an enema, or in 'chicha' beer [see *Methods of Ingestion*]. The leaves might also have been used in the preparation of snuffs and enemas. A. colubrina var. cebil seed snuff is still prepared and used in parts of Argentina, Paraguay, Peru and Bolivia. Mataco shamans of n. Argentina sometimes also smoke a cigarette made from 8-10 crumbled seeds with tobacco [see **Nicotiana**] and sometimes other herbs ['aromo' leaves - **Amaranthus** spp., **Acacia** caven, A. farnesiana] for the same effect, though often the whole cigarette is not needed for one session. Sometimes they may snuff and smoke the seeds in the same session. A. peregrina var. peregrina is still used in the Orinoco Basin [including Colombia, Ecuador, Venezuela, Brazil and Peru], notably by the Yanomamo, who prefer it over **Virola** [which they also snuff] because of its greater strength. Some tribes have reportedly taken the seeds orally [besides the use in chicha mentioned above], eating them boiled and mixed with honey, or drinking them after boiling 2-3 seeds in water with Polypodium spp. root [see *Endnotes*]. In Paraguay, both A. colubrina var. cebil and A. peregrina var. peregrina, as well as Piptadenia rigida, are reportedly used as 'inebriants'. The Guahibo of the Orinoco have also been observed to snuff A. peregrina var. peregrina whilst chewing **Banisteriopsis** liana, which should noticeably intensify the effects. Some tribes seem to take the snuff as a daily stimulant, whilst others reserve its use for shamans only, or it is used communally for special circumstances. Some, such as the Yanomamo, use the snuff almost casually, at any time of day. Generally it may be used to invoke the 'hekula spirits', in order to divine the cause of illness or the success of an upcoming hunting expedition. Sometimes it is inhaled in order to engage a sorcerer in shamanic combat. Some use it to sharpen the senses and intuition before hunting, and some [such as the Catauxi] may even administer it to their dogs for such purposes. The usual snuffing dose may start at 1-2 tsp, and more is taken as needed to reach the desired state (Brewer-Carias & Steyermark 1976; Chagnon 1992; Chagnon et al. 1971; Cobo 1990; Davis 1996; Fish & Horning 1956; Lizot 1985; Ott 1993; Rätsch 1998; Schleiffer 1973; Schultes 1955a, 1967b; Schultes & Hofmann 1980; Torres 1993, 1995, 1996; Torres & Repke 1996; Torres et al. 1991; Uscategui 1959; Wassen 1967).

On a related note, a Piptadenia sp. known as 'angico' [a name applied to some other Leguminous plants, including **Anadenanthera** spp. (Trout ed. 1998)] is considered a protective tree by the 'jurema' drinking Kariri-Shoko of n.e. Brazil (Da Mota 1997). In Brazil, P. stipulacea is known as 'jurema branca', and P. moniliformis as 'jurema preta' (Queiroz 2000), though it is not known whether these trees are used as the names would suggest [see **Mimosa**, **Acacia**, **Pithecellobium**].

Methods for the preparation of these snuffs vary from group to group, but there are several basic variations. In the 19th century, the Matpure of the Orinoco were observed to break open and moisten the seed-pods, allowing them to ferment until they turned black. The softened seeds were then ground into a cake together with flour and lime from snail shells. Richard Spruce observed a Gauhibo man roast the seeds before grinding them into a powder. The snuff may or may not be mixed with an alkaline substance such as lime, and does not seem to consist of any additive plants, unlike snuffs made from **Virola** (Schultes & Hofmann 1980).

It was once thought that the addition of lime or other alkali was necessary to facilitate absorption of the alkaloids. It now appears that lime is unnecessary for activity of the snuff, and only serves to make the snuff more painful when administered. The whole seeds may simply be lightly roasted [in a frying pan over low heat, with frequent stirring] until a peanut butter-like smell emerges and the seeds become brittle [but before visible fumes emerge]. They can then be ground finely and snuffed from a tray or flat surface through a short tube, or blown into the nose through a long tube by another person. They may also be smoked for a similar ef-

fect. It is not necessary to consume the full amount in a short time, as one would attempt with *DMT* and *5-methoxy-DMT* [see below]. The effects creep up over several minutes to peak after about 5-10 minutes, lasting an hour or less overall. The effects are best appreciated in low or dim light levels, lying down or reclining. Effects are usually felt as heavy tranquillisation and relaxation of the body and mind, with alterations in somatic sensation and slowing and abstracting of thoughts, and with mild visual alterations, which are more intense behind closed eyes. Side effects, when present, may include headache, nausea and/or feelings of intense pressure; one person described feeling very unpleasantly like a 'plucked chicken' over his entire body after smoking 1 A. colubrina var. cebil seed (pers. comms.; pers. obs.). Anecdotal evidence suggests that undesirable side effects may be avoided by discarding the seed husks and instead smoking the roasted, ground inner seed; and by spacing inhalations a few minutes apart (friendly pers. comm.).

It seems that certainty of the source species not does guarantee that the seeds will produce desirable effects; with some seed batches, unpleasant side effects predominate, with minimal psychoactivity. It is unclear at this time which elements of seed chemistry are responsible for these toxic symptoms, though this could be deduced from a simple comparitive analysis of seed batches with known effects. In the past people had assumed such effects were due to *bufotenine*; however, seed batches verified to contain predominantly *bufotenine* have a good record of positive experiences resulting from their ingestion. Perhaps the difference could lie also in individual variations in human neurochemistry and metabolic function (pers. comms.; pers. obs.).

Jonathan Ott described "sinuous, multihued, arabesque patterns, first viewed behind closed eyes, then on a stuccoed wall in a darkened hallway, and at length even on surfaces" from an experiment using snuff prepared from A. colubrina var. cebil seeds (Ott 2001a).

In one experiment I smoked 5 A. colubrina var. cebil seeds, crumbled to powder with a small quantity of tobacco [see **Nicotiana**], through a water-pipe, whilst under the influence of LSD. This was done during the latter part of the LSD experience, when closed-eye visuals were barely apparent. The seeds have a strong, characteristic smell when smoked, somewhat comparable to an imagined mix between peanut butter and *DMT*. Effects as described above were felt whilst still smoking the mixture, and grew in strength after lying down in the dark. I had a headache previously, which was intensified by smoking the seeds, but wore off with the effects of the seeds. Visual effects were perceived clearly behind closed eyes for several minutes. I was shown a complex framed lattice-like pattern in shades of brown and sandy-yellow, which gave the impression of containing much information, and demanded closer inspection. The feeling was of being in a panoramic gallery which contained only the one work of art (pers. obs.).

The seed pods of A. colubrina var. cebil have also been found to be pleasantly psychoactive when smoked. One segment of a pod, crumbled or ground and smoked through a water pipe, may be sufficient to produce effects. These take several minutes to creep up, developing into a pleasant 'stoned' state with slight enhancement of perception. Many people who have experimented with this particular batch of seed pods feel that the major alkaloid present is probably *5-methoxy-DMT* (friendly pers. comm. 2002; pers. obs.). However, this alkaloid has not yet been reported from verifiable samples of this species [see below].

One friend experimented with A. colubrina seeds as the *tryptamine*-alkaloid component of an 'ayahuasca analogue' [see *Methods of Ingestion*]. A dose of 9 seeds proved to be active with MAOI, taking effect within 30 minutes of consumption. Visual effects included the perception of people's faces appearing as masks, and were generally characteristic of *bufotenine* psychoactivity, although no negative side-effects were reported (E pers. comm.).

In another interesting experiment, two psychonauts each consumed 4 toasted, ground A. colubrina seeds, mixed into a glass of fresh grapefruit juice [see **Citrus**], and drunk quickly [no MAOI was consumed]. Whilst one psychonaut was feeling the first effects within 15min., the other did not notice anything until 45min. later. To quote the first subject – "The feeling started with the familiar closed eye images [which he had experienced previously from smoking the seeds – Ed.], and soon escalated into a beautiful feeling of electricity throughout my mind and body. Open eye visuals, mental and physical effects were much fuller and more vivid [compared to the smoking experience – Ed.]. My depth perception was increased quite a bit, and 'tracers' seemed to be more detailed and 'worked in' to the visual patterns than with [**Psilocybe**] mushrooms or **Salvia** divinorum. The effects lasted several hours [...] I slept well that night with no physical effects the next morning" (Jake pers. comm.).

Anandenanthera seed snuffs contain psychedelic *tryptamine* alkaloids which are responsible for the effects. Those responsible were long presumed to be *DMT* and *5-methoxy-DMT* [*5-MeO-DMT*], as *bufotenine* [*5-OH-DMT*] was believed to be toxic with no redeeming qualities. However it is now apparent that these alkaloids are usually only present in trace amounts compared to the predominant *5-OH-DMT* component, and are not consumed in quantities that could be effective (Torres & Repke 1996; Torres pers. comm. 1999). It seems that *5-OH-DMT* is indeed psychoactive after all, and many of its adherents would class it as a psychedelic or entheogen (see also McLeod & Sitaram 1985; Ott 2001a; *Chemical Index*).

A sample of 'paricà' snuff [of unknown plant origin], as used by the Piaroa, was found to contain *DMT*, *5-OH-DMT*, *5-MeO-DMT* and *harmine* (Holmstedt & Lindgren 1967). Though the *5-OH-DMT* component suggests that the snuff was derived from an Anandenanthera sp., the presence of *harmine* is unusual, and may have arisen from an admixture of **Banisteriopsis**.

A. colubrina var. colubrina seeds have yielded 2.1% *5-OH-DMT* (Pachter et al. 1959) and *DMT*; two other unidentified peaks were observed by chromatography (Yamasato et al. 1972).

A. colubrina var. cebil seeds yielded 3.51-12.4% *5-OH-DMT* [some samples contain only *5-OH-DMT*; the high value here is an exception to the norm, which may usually hover around 3%], *5-OH-DMT* N-oxide, 0.57% N-methyl-*serotonin*, 0.06% *DMT*, *DMT* N-oxide (Fish & Horning 1956; Fish et al. 1955; Iacobucci & Rúveda 1964; Torres & Repke 1996), djenkolic acid, N-acetyldjenkolic acid, pipecolic acid [2-piperidinecarboxylic acid], 5-OH-pipecolic acid, and 4-OH-pipecolic acid [as P. macrocarpa], or 4-OH-pipecolic acid alone [as A. macrocarpa] (Krauss & Reinbothe 1973). Seed pods have yielded *5-OH-DMT* and *DMT* [some contained only *DMT*]; the bark has yielded 0.1% 5-MeO-*N-methyltryptamine* (Fish et al. 1955; Iacobucci & Rúveda 1964), and traces of *5-OH-DMT* and *DMT* (Torres & Repke 1996). Snuff samples recovered from archaeological sites at San Pedro de Atacama [n. Chile], believed to have originated from A. colubrina or A. colubrina var. cebil, were found to contain *DMT*, *5-MeO-DMT* and *5-OH-DMT* (Torres et al. 1991).

A. excelsa seeds have yielded *5-OH-DMT* and *5-OH-DMT* N-oxide; seed pods have yielded *DMT*. Bark contained no alkaloids, though earlier research found an uncharacterised quaternary alkaloid in bark of this species (Iacobucci & Rúveda 1964). As P. excelsa, seeds were screened for amino acids and shown to contain primarily albizziine, N-acetyldjenkolic acid, and 5-OH-pipecolic acid, with smaller amounts of djenkolic acid and S-(β-carboxyethyl)-cysteine (Krauss & Reinbothe 1973).

A. peregrina var. peregrina seeds have yielded 0.009-2% alkaloids [though up to 7.4% *5-OH-DMT* alone has been found] – mostly [6-100%] *5-OH-DMT*, *5-OH-DMT* N-oxide, *DMT* [0-75%], *DMT* N-oxide, *5-MeO-DMT* [0-19%], *N-methyltryptamine* [*NMT*] and traces of 2-methyl-THβC, 2-methyl-6-MeO-THβC [2-methyl-*pinoline*] and 1,2-dimethyl-6-MeO-THβC [1,2-dimethyl-*pinoline*] (Agurell et al. 1968a; Chagnon et al. 1971; De Smet & Rivier 1987; Fellows & Bell 1971; Fish et al. 1955; Holmstedt & Lindgren 1967; Schultes et al. 1977b; Stromberg 1954; Yamasato et al. 1972). Experiments on the changes in chemical composition through aging showed that freshly collected seed contained mostly *5-OH-DMT* and *DMT*, with smaller amounts of *5-MeO-DMT* and 2-methyl-THβC; when stored [20°C, in darkness] for longer than a year, only *5-OH-DMT* was detected (De Smet & Rivier 1987; Rivier 1980). Bark yielded *DMT*, 0.4% 5-MeO-*NMT*, 0.64% *5-MeO-DMT*, 0.4% *NMT* and traces of 2-methyl-THβC, 2-methyl-*pinoline* [0.001%], 1,2-dimethyl-*pinoline* [0.001%] and *pinoline* (Holmstedt & Lindgren 1967; Legler & Tschesche 1963; Shulgin & Shulgin 1997; Torres & Repke 1996). Another study of the bark found only 0.042% alkaloids, consisting of 59% *5-MeO-DMT*, 36% 5-MeO-*NMT*, 1% *DMT*, 2% 2-methyl-*pinoline* and 2% 1,2-dimethyl-*pinoline*; yet another found 0.041% alkaloids, which was 95% *5-MeO-DMT* and 5% *DMT*. Leaves yielded 0.013-0.107% alkaloids, of which 12-49% was *DMT*, 48-88% *5-MeO-DMT*, along with traces of *NMT* (Agurell et al. 1969a; Schultes et al. 1977b); twigs have yielded 0.038% alkaloids, made up of 94% *5-MeO-DMT*, 5% *DMT* and 1% *5-OH-DMT*. Seedlings yielded in one collection 0.001% alkaloids, entirely *DMT*, and in another collection, 0.025% alkaloids, of the same type and proportion as in the twigs; seedlings in other tests [during 1st week of germination] yielded *5-OH-DMT* from the first day, with *serotonin* [*5-HT*], N-methyl-*5-HT* and *tryptamine* appearing in that order over the next week. Roots yielded 0.699% alkaloids, which was 97% *5-MeO-DMT*, 2% *DMT* and 1% *5-OH-DMT* (Fellows & Bell 1971; Schultes et al. 1977b; Torres & Repke 1996).

A. peregrina var. falcata has been poorly analysed, but *5-OH-DMT* was initially found in the seed (Der Marderosian 1967); later analysis found 4.9% alkaloids in seeds [95% *5-MeO-DMT*, 3% *DMT*, 1% *5-OH-DMT*], 0.28% in fruit [70% *5-MeO-DMT*, 25% *DMT*, 2% *5-OH-DMT*] and 1.6% in bark [60% *5-OH-DMT*, the remainder not identified] (Nunes et al. 1982a).

P. communis seeds have been found to contain *5-OH-DMT* and related compounds which were not identified (Altschul 1964).

P. contorta seeds have tested positive for the presence of *DMT*, *5-OH-DMT*, and one other unidentified compound.

P. gonoacantha seeds have yielded 1.2% alkaloids [40% *DMT*, 10% *5-MeO-DMT*]; fruit yielded 0.7% [10% *DMT*]; and bark yielded 0.2% [35% *DMT*, 1% *5-OH-DMT*] (Nunes et al. 1982a).

P. leptostachya seeds yielded 0.03% *theobromine*, as well as *5-OH-DMT* (Altschul 1964; Yamasato et al. 1972).

P. moniliformis seeds tested positive for *5-OH-DMT* (Yamasato et al. 1972).

P. novoguineensis from Papua New Guinea yielded 0.05% of a base which was not identified. In animal assays, it appeared to be orally inactive below 2g/kg [in mice], causing weak CNS depression at this dose; in cats, 5-10mg/kg [i.v.] caused hypotension, and augmented the response to *epinephrine* (CSIRO 1990).

P. paniculata seeds tested positive for alkaloids (Fish et al. 1955).

P. paraguayensis was found to contain no alkaloids in seeds or seed pods, though traces of what appeared to be a non-indole alkaloid were detected in the bark.

P. rigida seeds were not found to contain any alkaloids.

P. viridiflora seeds and pods were not found to contain any alkaloids (Iacobucci & Rúveda 1964).

Anadenanthera peregrina var. peregrina is a small shrub to tall tree 3-27m tall, unarmed, or lower trunk with conical thorns or wedge-shaped projections, becoming tubercular-verrucose, slightly corky, rugose; trunk 20-40cm diam. at chest height, usually leaning, twisted, sometimes divided at base into several shafts, irregular branches spreading out above to form an umbrella-like crown; bark grey to nearly black, with many small lenticels; young twigs and foliage puberulent, occ. glaucescent; mature foliage glabrous, or nearly so. Leaves alternate, bipinnately compound, 12-30cm long incl. petioles, main rachis +- channeled ventrally; petioles somewhat darkened at base, 5-15mm above base bearing a flattish, oval or oblong gland 0.5-5mm long; 1-4 similar, smaller glands one between or just below each of the ultimate pinna pairs; pinna pairs 10-30 or more, each pinna 2-5cm or more long, opposite or subopposite; leaflets sessile, not always borne to very tip of pinna, usually imbricate, 25-80 pairs, 2-8 x 0.5-1.5mm, linear, oblong or lanceolate, mostly straight, base oblique or truncate, apex acute to acuminate-apiculate, membranaceous and dull, sometimes differing in colour and texture dorsiventrally, venation obscure but for single, nearly straight, slightly excentric midvein, margins usually ciliate or ciliolate; stipules small, bristly, fugacious, broad basal bracts enclosing new shoots often persistent. Inflorescence globose-capitate heads 10-18mm diam. (incl. stamens), greenish-white to creamy yellow, in fascicles of 1-5, puberulous to glabrous in bud, head axillary and subterminal, rarely in racemose patterns in branch apices; peduncles 1.75-4cm long, puberulous, filiform or thicker, c.¾ up bearing a puberulous, bidentate, campanulate involucre becoming detached and sliding down to loosely encircle peduncle base; flowers c.35-50 per head, small, sessile, each subtended by a linear-spathulate or deltoid bracteole ½ the length of mature corolla; calyx campanulate, 0.5-2.6mm long, 5-dentate; corolla tubular-campanulate, 2-3.5mm long, 5-parted; stamens 10, 5-8mm long, glabrous, exserted; anthers bilocular, elliptical and longitudinally dehiscent, eglandular in bud. Ovary sessile to subsessile, many-ovuled, glabrous, narrowing into elongate style which enlarges apically into tubular stigma. Legume 5-35cm long (incl. stipe but not peduncle), 1-3cm wide, usually straight, oblong-elongate, regularly, irregularly, vaguely, or not at all constricted between seeds, +- flattened, margins slightly thickened, base attenuate to obtuse, apex mucronate to acuminate to cuspidate (rounded if tip broken off), surface scurfy to verrucose, dull, dried specimens dark brown with rufous scales, dehiscing along one suture only; seeds 8-16, very thin, flat, orbicular to suborbicular, dark chestnut brown to black, shiny, 10-20mm diam., with a rim or sharp margin, attached to a non-persistent, filiform funicle.

Primarily in open plains areas, scrub or wastelands, savannahs along watercourses, woody hillsides, and on open ridges, preferring clay or sandstone soils; n. Brazil, British Guiana, Colombia, Venezuela, West Indies, ranging from 15°S to 20°N.

A. peregrina var. falcata differs by being shorter (to 8m tall), trunk and branches more corky; pinna pairs less numerous but more leaflets, which are also longer, more falcate, coriaceous and nitid; heads white to creamy yellow; legume more falcate. Ranges from 25°S to 15°S; s. Brazil, Paraguay.

A. colubrina var. cebil has leaflets which are dilated in the middle, with prominent secondary venation; anthers glandular in bud; legume smooth to reticulate, nitid, relatively short and wide, often irregularly contracted

A. colubrina var. colubrina is found in e. Brazil and Argentina, and A. colubrina var. cebil is found in Argentina, Bolivia, Peru, Paraguay and s.e. Brazil (Altschul 1964).

ANETHUM

(Umbelliferae/Apiaceae)

Anethum graveolens *L.* **(Peucedanum anethum** *Baill.***; P. graveolens** *(L.) C.B. Clarke***)** – dill, garden dill, dill weed, dilly, European dill, aneto, aneton, aneldo, hexenkraut

Anethum sowa *Roxb. ex. Flem.* – Indian dill, sowa-dill, variyali sowa

'Dill' is, of course, a common culinary herb; its name comes from the Norse 'dylla' [to soothe]. The ancient Greeks were said to place the leaves over the eyes to induce sleep. It may be hung over a door or carried in sachets for protection against malicious influences, according to magical lore. A bath of dill water is said to make the bather 'irresistible', and the plant is said to be aphrodisiac when eaten or smelled (Chevallier 1996; Cunningham 1994). Germanic peoples have known A. graveolens as a witches herb ['hexenkraut'] (De Vries 1991). In Mexico, the seeds are cooked in oil, and used as an analgesic hypnotic (Heffern 1974). Dill seeds, eaten or chewed, aid digestion, and an infusion may treat hiccups, insomnia, stomach pain and flatulence. In the kitchen, fresh, immature green seed heads have the best flavour; they are used in dill-pickles, vinegars, salads, sour cream, and meat and fish dishes. The seeds are mineral-rich, and are good for a salt-deficient diet. The distilled essential oil of the plant has been used to flavour drinks, food, and childrens medicines (Bremness 1994; Chevallier 1996).

Dill herbage mixed with monosodium glutamate [MSG] was called 'ZNA' by some in the late 60's US drug culture, claimed to be smoked for psychoactivity (Krikorian 1968). It has been suggested that the essential oil of dill may be ingested for psychotropic effects (Gottlieb 1992), and this should probably refer to A. sowa rather than A. graveolens. Of course, caution is advised with all internal use of essential oils. The technique of massage followed by exercise, as applied with 'nutmeg' essential oil [see **Myristica**], may be a preferable route of ingestion.

A. graveolens fruits have yielded 2.5-4% essential oil, containing d-carvone [40-60%], dihydrocarvone, α-*pinene*, dipentene, phellandrene and d-limonene (Karow 1969); also found in the fruits are *chlorogenic acid*, ferulic acid, caffeic acid, aesculetin, umbelliferone, umbelliprenin, *scopoletin*, bergapten, and other unidentified coumarins (Dranik & Prokopenko 1970). No *dillapiole* was detected (Bandopadhyay et al. 1972); *myristicin* has been reported from the seed oil but this may have been in confusion with A. sowa (Harborne et al. 1969). Leaf yields an essential oil rich in d-α-phellandrene, β-phellandrene, p-cymene, *myristicin*, and 3,6-dimethyl-2,3,3α,4,5,7α-hexahydrobenzofuran [this powerfully-aromatic compound is largely responsible for the smell of dill-herbage], with smaller amounts of *dillapiole*, iso-*myristicin*, limonene, terpinene, α-*pinene* and carvone (Huopalahti 1986; Karow 1969); aerial parts have also yielded *scopoletin* (Aplin & Page 1968). Roots have yielded 0.03-0.05% essential oil, containing mainly carvone, *apiole*, and *myristicin*, as well as *camphor*, and well over 100 other compounds (Goeckeritz et al. 1980).

A. sowa fruits yield an essential oil rich in *dillapiole* [12-50% of essential oil], carvone [21-35%], dihydrocarvone [0.1-43%], and limonene [up to 34.4%], with traces [3-4%] of other constituents. Fruits gave negative tests for coumarins and flavonoids (Bandopadhyay et al. 1972; Betts 1969; Chakravarty & Bhattacharya 1954; Shah et al. 1971). Others detected *myristicin* and *apiole* in the seeds (Harborne et al. 1969).

Anethum graveolens is a slender annual herb arising from a taproot, to 40-170cm tall; stems branching, glabrous and glaucous. Leaves oblong to obovate, 13-35 x 10-12cm, pinnately decompound, ultimate divisions filiform, 4-20mm long, less than 0.5mm wide; petioles 5-6cm long, narrowly sheathing. Flowers in lax, compound umbels; peduncles terminal and lateral, 7-16cm long; rays 10-45, spreading ascending, 3-10cm long, subequal to unequal; pedicels 6-10mm long, subequal; calyx teeth absent; petals yellow, suborbicular, with a narrower inflexed apex. Styles short, stylopodium conical; carpophore 2-parted. Fruit ovate, flattened dorsally, glabrous, 5-ribbed, dorsal ones filiform, lateral ones thin-winged; seed face plane or slightly concave, c.4 x 2mm.

Native to Eurasia (Wagner et al. 1990).

A. sowa is often considered synonymous with A. graveolens, but some choose to differentiate A. sowa based on the presence of *dillapiole* in the seed oil, as well as slight morphological differences in the fruits (Betts 1969).

ANTHEMIS and MATRICARIA

(Compositae/Asteraceae)

Anthemis nobilis *L.* **(Chamaemelum nobile** *(L.) All.***)** – English chamomile, Roman chamomile, perennial chamomile, camphor plant, babunike-phul, babunaj

Anthemis tinctoria *L.* **(Cota tinctoria** *(L.) J. Gay ex Guss.***)** – dyer's chamomile, yellow chamomile

Matricaria chamomilla *L.* **(M. courrantiana** *DC.***; M. recutita** *L.***; Chamomilla recutita** *(L.) Raschert***)** – German chamomile, Persian chamomile, annual chamomile, babunphul, babuna

Chamomile, in its many guises, has long been a popular herb for its scent and sedative properties. The ancient Egyptians held A. nobilis sacred to Ra, and they used its oil to anoint the body and to treat fever. The Arabs also valued it, and the Saxons revered it as one of their nine sacred herbs. It was much used in Mediaeval Europe to lend its pleasant scent to clothes and homes, and was soon being grown as a lawn, so that it would release its scent when walked on (Lawless 1994). A. tinctoria is used to make dyes, and has antispasmodic and menstrual-stimulating actions. In India, the root or flowers of M. chamomilla are used as a stimulant tonic, while the flowers are used as an aphrodisiac, analgesic, sedative, brain tonic, diaphoretic and carminative. They are sometimes used to treat conditions of hysteria, and are also antispasmodic. Flowers of A. nobilis share

similar usage (Bremness 1994; Chevallier 1996; Kirtikar & Basu 1980; Nadkarni 1976; Viola et al. 1995).

In Africa, M. nigellaefolia is said to be responsible for an intoxication known as 'bovine staggers' or 'brain staggers', thought to only affect bovines, and resulting in behavioural depression, instability and clumsiness, followed by twitching and salivation. In extreme cases, coma, convulsions, and death occur (Watt & Breyer-Brandwijk 1932).

Chamomile is usually prepared as an infusion, though it can be decocted. When made sufficiently strong, it acts as a sedative analgesic, with slight hypnotic and soporific qualities (pers. comms.; pers. obs.). Chamomiles are also disinfectant, antiinflammatory and digestive, and can be applied topically as a wash for tired eyes and skin inflammation. Also, A. nobilis flowers have shown antitumour activity (Bremness 1994; Lawless 1994).

A. nobilis has yielded 0.4-1.5% essential oil, containing monoterpenes [such as limonene, sabinene, *pinene*], butyric acid, isobutyric acid, isobutanol, 3-methylbutan-1-ol, 2-methylbutan-1-ol butyrates, azulenes and many other compounds. Also found are c.0.6% sesquiterpene lactones of the germacranolide group [see **Calea**], including eucannabinolide, nobilin, 3-epi-nobilin and other derivatives; flavonoids, including kaempferol [MAOI, potential neuroprotectant (Sloley et al. 2000)], and glucosides of *apigenin* (see below) and luteolin; phenolic acids; and coumarins, including *scopoletin* (Bruneton 1995; Rastogi & Mehrotra ed. 1990-1993).

M. chamomilla has yielded flavonoids including *apigenin* (Viola et al. 1995), *apigenin* 7-glucoside and 6"-acetyl-*apigenin* 7-glucoside in levels of up to 8% in the dried flower heads; on drying, these glycosides partially hydrolyse so that concentrations of *apigenin* increase. Also found are flavonols, including isorhamnetin [MAOI (Sloley et al. 2000)], patulitrin and glucosides of luteolin and quercetin; coumarins, including herniarin and umbelliferone; phenolic acids; sesquiterpenoid lactones; and 0.3-1.5% essential oil, containing 1-15% chamazulene, (-)-α-bisabolol, various oxidated derivatives of bisabolol, and other compounds. Both (-)-α-bisabolol and a plant extract have been shown to inhibit ulcer formation and increase rate of healing. Mucilage from flower ovaries yielded 45% glucuronic acid, 21% xylose, 15% galactose, 10% arabinose, 7% glucose and 2% rhamnose (Bruneton 1995; Rastogi & Mehrotra ed. 1990-1993).

Matricaria chamomilla is a glabrous much-branched aromatic herb to c.30cm tall, spreading, annual. Leaves alternate, 2-3-pinnatisect, segments almost filiform. Flower heads terminal, long-peduncled, solitary, 1.3-2cm diam.; ray flowers female, fertile or sterile, ligule elongate, white, rarely short; disc flowers hermaphrodite, fertile, tube terete or 20-edged, limb 4-5-fid; involucre hemispheric; bracts oblong, in few series, appressed, margin white, outer shorter; receptacle naked, conic, elongating during fruiting; ligules white, much longer than the bracts, deflexed after flowering or 0; anther bases obtuse, entire; style arms of hermaphrodite with truncate and penicillate tips. Achenes oblong, often incurved, faces glandular or rugulose, truncate, dorsally convex, with slender white ribs on the ventral face; pappus none.

Much cultivated; found in Europe, w. Asia to India and Japan (Kirtikar & Basu 1980).

ANTHOCERCIS

(Solanaceae)

Anthocercis angustifolia *F. Muell.*
Anthocercis anisantha *Endl.*
Anthocercis fasciculata *F. Muell.*
Anthocercis genistoides *Miers* **(A. spinescens** *F. Muell.***)**
Anthocercis gracilis *Benth.* – slender tailflower
Anthocercis ilicifolia *Hook.*
Anthocercis intricata *F. Muell.*
Anthocercis littorea *Labill.* – yellow tailflower
Anthocercis viscosa *R. Br.* – sticky tailflower
Anthocercis spp. – ray flower, tailflower

This Australian genus has no recorded traditional uses, though its members yield hallucinogenic tropane alkaloids. They are rather variable in constituency.

A. angustifolia aerial parts [harv. Sep.] yielded 0.11% alkaloids, consisting mostly of *hyoscyamine*, and lesser amounts of *hyoscine*, their apo-derivatives and tigloyl esters.

A. anisantha aerial parts [harv. Aug.-Sep.] yielded 0.02% alkaloids of similar constituency to A. angustifolia, also with nor-*hyoscyamine* and nor-*hyoscine*, and littorine in some samples (Evans & Ramsey 1983).

A. fasciculata aerial parts [harv. Oct.] yielded 0.05% alkaloids, which was almost entirely *hyoscyamine* (Cannon et al. 1969).

A. genistoides aerial parts [harv. Aug.] yielded 0.07% alkaloids, consisting mostly of meteloidine, as well as *hyoscyamine*, *hyoscine*, nor-*hyoscyamine*, 6-OH-*hyoscyamine* and tropine (El Imam & Evans 1984). In other samples [harv. Aug.-Sep.], aerial parts yielded 0.01-0.08% alkaloids, mostly *hyoscyamine* or *hyoscine*, as well as their nor-derivatives, tigloyl esters, tropine and possibly 6-OH-*hyoscyamine*; roots yielded 0.15% alkaloids.

A. gracilis aerial parts [harv. Oct.] yielded 0.03% alkaloids, mostly *hyoscine*, as well as *hyoscyamine* and their apo-derivatives (Evans & Ramsey 1983).

A. ilicifolia aerial parts [harv. Aug.] yielded 0.25% alkaloids, mostly *hyoscine*, as well as nor-*hyoscyamine*, apo-*hyoscine*, apo-*atropine*, 6-OH-*hyoscyamine*, littorine, meteloidine and tropine; roots yielded 0.23% alkaloids of similar constituency, with the omission of meteloidine, and addition of tigloidine and valeroidine (El Imam & Evans 1984).

A. intricata aerial parts [harv. Sep.] yielded 0.08% alkaloids, mostly *hyoscyamine*, as well as *hyoscine*, their nor-derivatives, tigloyl esters, littorine and 6-β-acetoxy-3-α-tigloyloxytropane (Evans & Ramsey 1983).

A. littorea aerial parts yielded 0.12-0.16% crude bases – apo-*atropine*, nor-*atropine*, *hyoscine*, nor-*hyoscine*, tropine, ψ-tropine, 6β-tigloyloxytropan-3α-ol, 3α-tigloyloxytropane, 0.02% meteloidine, 0.015% littorine, 0.001% *hyoscyamine*, and 0.006% of a mixture of littorine and *hyoscyamine*; roots yielded 0.1% alkaloids, consisting of the above compounds [without 6β-tigloyloxytropan-3α-ol], as well as tigloidine, cuscohygrine and 3α,6β-ditigloyloxytropan-7β-ol; flowers yielded 0.15% alkaloids, consisting of *hyoscyamine*/*atropine*, nor-*atropine*/nor-*hyoscyamine*, *hyoscine*, littorine and meteloidine (Cannon et al. 1969; Evans & Treagust 1973b).

A. viscosa ssp. viscosa aerial parts and roots [harv. Sep.] yielded 0.02% alkaloids, mostly *hyoscyamine*; aerial parts with lesser amounts of *hyoscine*, their apo-derivatives, tigloyl esters, and two unidentified bases; roots with apo-*hyoscyamine* and tigloyl esters (Evans & Ramsey 1983). Another sample [harv. Oct.] yielded 0.08% crude bases from aerial parts, consisting mostly of *hyoscyamine*, as well as 2% rutin and 0.5% ursolic acid (Cannon et al. 1969); yet another analysis, using samples of unstated harvest time, found 0.11% alkaloids in aerial parts, and 0.12% in roots (Evans & Treagust 1973b).

A. viscosa ssp. caudata aerial parts [harv. Oct.] yielded 0.04% alkaloids, mostly *hyoscyamine*, as well as *hyoscine*, their apo- and nor-derivatives, tigloyl esters and tropine; root bark yielded 0.02% alkaloids, with +- equal amounts of *hyoscyamine*, apo-*hyoscyamine* and tigloyl esters (Evans & Ramsey 1983).

Anthocercis ilicifolia is an erect shrub to 2.7m with 1-2 stems, often tinged with purple, branches and leaves glabrous, rarely with scattered glandular hairs; seedlings with prickles on stems. Leaves obovate to narrowly obovate-elliptic, occasionally spathulate or elliptic, sessile or almost so, 15-80 x 7-35mm, thick and fleshy, entire, or the juvenile leaves dentate. Inflorescence panicle-like, leafless except at base; pedicels 3-8mm long; flowers bisexual, slightly zygomorphic, subtended by a pair of opposite bracts; calyx 4-8mm long, campanulate to cupular, 5-lobed; corolla 12-27mm long, narrowly tubular with spreading 5-lobed limb, the lobes volutive in bud, bright yellow, the striations purple to maroon, tube often tinged with purple outside, lobes linear, 6-18 x 3-6mm; stamens 4, inserted at base of corolla-tube, 4-10mm long; staminode sometimes present; anthers bilocular, not cohering, dorsifixed, dehiscing by longitudinal slits. Ovary bilocular; stigma capitate, very shortly bilobed. Capsule narrowly ovoid-ellipsoid, acute to apiculate, 11-21mm long, opening from apex by 2 bifid valves, the lower part enclosed by persistent calyx, fruit often malformed due to galling; seeds 1.4-1.9mm long.

In calcareous sand; a colonising species after fire or disturbance. Endemic to s.w. coast of Western Australia from Kalbarri to Perth (Haegi et al. 1982).

ANTHOTROCHE

(Solanaceae)

Anthotroche myoporoides *C. Gardner* – wheelflower
Anthotroche pannosa *Endl.* **(A. blackii** *F. Muell.***; A. healiana** *F. Muell.***)** – wheelflower
Anthotroche walcottii *F. Muell.* – wheelflower

This Australian genus of three species has no traditional usage recorded, yet is known to be host to small quantities of hallucinogenic tropane alkaloids.

A. myoporoides aerial parts yielded 0.04% alkaloids, most of which was nor-*hyoscyamine*, as well as *hyoscyamine*, *hyoscine* and apo-nor-*atropine*; roots yielded 0.02% alkaloids, mostly tropine, as well as *hyoscyamine*, nor-*hyoscyamine* and 3-α-acetoxytropane.

A. pannosa aerial parts yielded 0.01% alkaloids, mostly *hyoscyamine* with lesser amounts of *hyoscine*, nor- and apo-derivatives of *hyoscine*, and tropine; roots yielded 0.02% alkaloids, mostly *hyoscyamine*, as well as nor-*hyoscyamine* and tropine.

A. walcottii aerial parts yielded 0.02% alkaloids, mostly *hyoscyamine*, as well as *hyoscine*, nor- and apo-derivatives of *hyoscine*, and apo-nor-*atropine*; roots yielded 0.04% alkaloids, mostly nor-*hyoscyamine* with lesser amounts of *hyoscyamine* (Evans & Ramsey 1983).

All plant parts tested were from mature specimens, harvested in September.

Anthotroche myoporoides is an erect, rounded, often intricately

branched shrub to 3m, closely and densely tomentose throughout with non-glandular, dendritic hairs and smaller glandular hairs, greyish, the new growth bronze-green. Leaves alternate, obovate to narrowly obovate-elliptic, mostly 20-35 x 5-15mm, juvenile leaves larger; petiole to 10mm long, sometimes very short. Flowers axillary or terminal, in loose 4-6-flowered clusters; pedicels absent or to 5mm long; calyx campanulate to cupular, 4.5-9mm long, 5-lobed, lobes 2-4mm long; corolla 5.5-8.5mm long, tube narrowly funnel-shaped or dilated, pale greenish with deep violet (rarely drab grey-green) striations; limb of (4-)5(-6) short broad lobes, volutive in bud, 2.5-4mm long, violet, rarely drab white, margins sometimes white; stamens 5, included; anthers unilocular, not cohering, dehiscing by a semicircular slit. Ovary bilocular; stigma capitate, very shortly bilobed. Fruit a smooth capsule, +- globose, 3-4mm diam., opening from apex by 4 valves, +- enclosed by calyx; seeds c.3mm long, subreniform.

In small populations on sand plains in shrubland or mallee; endemic in the n. Irwin district of s.w. Western Australia (Haegi et al. 1982).

ANTIRHEA

(Rubiaceae)

Antirhea lucida *(Sw.) Benth. et Hook.* **(Guettarda nitida** *Maza***; Laugeria lucida** *Sw.***; Malanea citrifolia** *A. Rich.***; M. lucida** *(Sw.) A. Rich.***; M. nitida** *Desr.***; Stenostomum lucidum** *(Sw.) Gaertn.***; Sturmia lucida** *(Sw.) Gaertn.***)**

The roots of this West Indian tree recently yielded 0.37% indole alkaloids – including 0.00125% *DMT*, 0.00112% 2-methyl-*pinoline*, 0.0035% N,N-methyl-3'-indolylmethyl-5-*MeO-tryptamine* [a new alkaloid], and 0.002% *gramine*. The test samples were about 3 years old, however [harv. Jun. 1992, Dominican Republic] (Weniger et al. 1995), and fresh material might perhaps yield greater quantities of *DMT*, due to its relative instability.

A. putaminosa from Rockhampton, Queensland [Australia], harvested in December, tested positive for alkaloids in the bark, leaf, mature fruits and [most strongly] root bark (Webb 1949). Bark has yielded 0.02% alkaloids; roots yielded 0.05%; leaves yielded antirhine as the major alkaloid, with unidentified trace constituents. Antirhine in mice had no observable effect at 100mg/kg [p.o.]; 300mg/kg "produced decreased motor activity, low posture, dyspnea, convulsions and death". The bark alkaloids, given p.o., caused "slight mydriasis, CNS depression and lacrimation" at 250mg/kg; given i.p., 20mg/kg "produced decreased activity, bradypnea and somnolence". Root alkaloids given p.o. caused miosis at 250mg/kg; "depression, ataxia, convulsions and hypothermia" at 500mg/kg; death resulted at 1g/kg (CSIRO 1990).

Other Antirhea spp. have yielded *yohimbine*- and corynantheine-type alkaloids (Weniger et al. 1995).

Antirhea lucida is a tree 6-13m tall; trunk to 45cm thick, with smooth bark; branchlets greyish or yellowish, slender, terete or subangulate, glabrous, usually densely leafy. Leaves opposite or whorled, oblong-ovate to elliptical, obtuse or acutish at apex, acute to rounded and short-decurrent at base, 6-12 x 3.5-6cm, glabrous, thin, firm-chartaceous, with very faint venation, costa subimpressed above, prominent beneath, lateral nerves inconspicuous, 7-13 on each side, irregularly spaced; stipules inter- or intra-petiolar, ovate-deltoid, acuminate, 5-8mm long, minutely sericeous outside, caducous; petioles stout, 3-8mm long, glabrous. Inflorescence axillary, once-forked, with numerous sessile or subsessile flowers along upper side of branches, inflorescence branches slender and 3-8cm long; peduncles slender, 2-3cm long; flowers mostly bisexual and actinomorphic, distant, alternate, sessile or subsessile, ebracteolate; perianth biseriate; calyx 2-3mm long, glabrous or minutely puberulent, limb persistent, 5-lobed, lobes semiorbicular, often unequal, ciliolate; corolla 5-7mm long, gamopetalous, white, campanulate, glabrous or minutely puberulous, tube 3.5-5mm long, lobes imbricate, half as long as tube, oval-oblong, obtuse; stamens inserted at or near corolla throat, epipetalous, as many as corolla-lobes and alternating with them; anthers included or partially exserted, mostly dorsifixed 2-locular, dehiscing lengthwise. Ovary inferior, crowned by disc, 2- or more locular, with as many ovules; ovules pendulous from top of loculi, solitary in each loculus; style usually slender, 2-lobed. Fruit a red or black drupe with hard endocarp, oval or oblong, 5-7(-10)mm long, 3-4.5mm thick; seeds 2, brown; endosperm absent or scanty. Fl. Jul.-Nov.

On limestone rocks in woodland, or in thickets, below c.2,450m; Jamaica [St. Thomas], Bahamas, British Honduras, Greater Antilles, St. Croix, St. Lucia, Trinidad, Virgin Islands (Adams 1972; Standley 1934), Dominican Republic (Weniger et al. 1995).

ARCHONTOPHOENIX

(Palmaceae/Arecaceae)

Archontophoenix sp. – king's date palm

The generic name of these large, attractive palms derives from the Greek 'archon', meaning king, or ruler, and 'phoenix', meaning palm or date palm. In New Britain, Papua New Guinea, the nuts of an Archontophoenix sp. are reported to be chewed as an inebriant with the leaves of **Pueraria** phaseoloides, seemingly in a manner analogous to the use of 'betel nut' [see **Areca**] (Paijmans ed. 1976). According to Dowe & Hodel (1994), this genus is endemic to Australia, with close relatives existing in the Pacific region. If this is the case, perhaps the species used in New Britain is introduced, or was confused with a closely related genus.

Archontophoenix spp. are moderately tall, solitary, erect, emergent, pleonanthic, monoecious palms; trunks slender, often with swollen base; leaf scars sometimes prominent. Leaves paripinnate, reduplicate, cleanly deciduous; sheaths tubular, forming an elongate crownshaft eventually splitting opposite the petiole, coloured green, brown, or purple; ligule absent; petiole absent to moderately long; rachis long; pinnae linear-acute, inserted in a single plane along rachis, subopposite, erect to semi-pendulous, rigid or lax, midrib prominent, secondary ribs frequently present abaxially, abaxial surface green or with silver-grey scales, sometimes very dense to give silvery-grey colour; ramenta lacking, or present on midrib abaxially, medi-fixed. Inflorescence intrafoliar at maturity, branched to 3-4 orders, erect to pendulous paniculate, branches divaricate, protandrous; bracts enclosing inflorescence 2, the prophyll attached at peduncle base fully enclosing peduncular bract; peduncular bract inserted slightly above attachment of prophyll, tubular, bracts deciduous immediately prior to floral anthesis, small to moderate rameal bracts often present; peduncle short, stout; rachis much longer than peduncle; rachillae erect or pendulous, elongate, zig-zagged throughout or only toward apex; flowers unisexual, sessile, lilac-purple or white-cream-light green, in well-spaced triads of a single pistillate flower subtended by a pair of staminate flowers one either side, borne spirally throughout rachillae, or only on proximal portion, and then with flowers distally, in pairs or solitary. Staminate flowers asymmetric in bud; sepals 3, imbricate; petals 3, valvate, much longer than sepals; stamens 9-35; anthers dorsifixed, near middle, basally bifid, apically pointed, latrorse; filaments curved or deflexed. Pistillate flowers smaller than staminate, symmetric; pistillode cylindric, about as long as stamens, tapered, apically lobed; sepals 3, imbricate; petals 3, imbricate, briefly valvate at apex; staminodes 3, tooth-like; gynoecium unilocular, uniovulate; style short; stigmas 3, recurved. Fruit conic-ovoid, ellipsoid, globose to subglobose, coral pink, red or dark brick-red at maturity; stigmatic remains apical or subapical; epicarp thin, smooth or lightly pebbled; mesocarp thin, crustaceous or brittle, non-operculate; seed 1, ovoid, globose to subglobose, hilum lateral, raphe fibres elongate, anastomosing, adherent to seed.

Six species endemic to eastern Australia, generally not further inland than Great Dividing Range; in coastal and near-coastal lowlands and ranges, to 1,200m altitude (Dowe & Hodel 1994). The genus includes such commonly cultivated palms as A. alexandrae and A. cunninghamiana.

ARCTOSTAPHYLOS

(Ericaceae)

Arctostaphylos alpina *(L.) Spreng.* **(Arbutus alpina** *L.***)** – alpine bearberry

Arctostaphylos patula *Greene* – manzanita, big dinas, dinas coh

Arctostaphylos pungens *Kunth* **(Daphnidostaphylis pungens** *(Kunth) Klotzsch***; Uva-ursi pungens** *(Kunth) Abrams***)** – manzanita, big dinas, dinas coh

Arctostaphylos uva-ursi *(L.) Sprenger* **(Arbutus uva-ursi** *L.***)** – uva ursa, uva ursi, kinnikinnick, sagackhomi, bear's grape, bearberry, mealberry, mountain box, mountain cranberry, sandberry

Arctostaphylos spp. [from the Greek, 'arcto' (bear) and 'staphylos' (grape-bunch); 'uva-ursi' also means 'bear-grape' in Latin] are widely used by native North Americans for both medicinal and ceremonial purposes. The Nitinaht called A. uva-ursi 'kinnikinnick' [roughly translated as 'that which is mixed', or 'he who mixes'], as it is one of the principal smoking mixtures amongst indigenous peoples of the northwest. Some would reportedly become so intoxicated by smoking bearberry leaves that they would fall into the fire and remain immobile! This use spread into Canada, and the plant became a major herb of exchange with other tribes, as well as with settlers, who mixed it with their tobacco [see **Nicotiana**] to make a mix called 'sagackhomi', also called 'larb' by some Western hunters. Peoples of the Pacific north-west sometimes smoked it with yew [see **Taxus**], and it was said to make a person dizzy; the Kwakiutl also smoked A. uva-ursi as a narcotic, and the Ojibway smoked leaves of both A. uva-ursi and A. alpina. The Navajo also smoke A. patula and A. pungens for rain prayers and good luck. The Menomini and Thompson smoke A. uva-ursi leaves, as well as making an astringent infusion from them to strengthen the bladder and kidneys. The Cherokee use it for dropsy and urinary diseases, as well as eating the berries as food. The Lower Chinook and Quinalt use the berries to allay appetite; the berries may make a bland sur-

vival food which is more edible after cooking. Dried berries may also be made into necklaces or rattles. Stems and berries have also been used to treat headache and scurvy. A. pungens has been used by the Tarahumara of Mexico, who made a wine from it (Bremness 1994; Emboden 1979a; Hamel & Chiltoskey 1975; Ott 1993; Siegel et al. 1977; Winter 1998). Today in herbal medicine, the leaves are used as an astringent, antiinflammatory and diuretic, and to expel stones (Chiej 1984).

A. alpina leaves have yielded 4.9% arbutin [see below] (Fromard 1985).

A. uva-ursi leaves have yielded 0.011% arbutin [diuretic, antitussive, urinary disinfectant, inhibits insulin degradation], 0.005% methylarbutin, 2-O-galloylarbutin, 4'-O-galloylarbutin, 6-O-galloylarbutin, monotropein [see **Monotropa**; content highest during exponential growth], hydroquinone [see **Vaccinium** for toxicity], [possibly] asperuloside, piceoside, ericoline, hyperin, uvaol, quercetin and myricetin derivatives, cyanidin, delphinidin, (+)-catechol, gallic acid [antibacterial, antiviral, antifungal, astringent, antiinflammatory, antitumour, antimutagenic, choleretic, bronchodilator, promotes smooth muscle contraction, inhibits insulin degradation], citric acid, ursolic acid, and quercetin [antiinflammatory, antibacterial, antiviral, inhibits smooth muscle contraction, inhibitor of many enzymes] (Buckingham et al. ed. 1994; Chiej 1984; Fromard 1985; Harborne & Baxter ed. 1993; Karikas et al. 1987; Kawaguti et al. 1939; Rastogi & Mehrotra ed. 1990-1993; Swiatek & Komorowski 1973; Waehner et al. 1975; Walewska 1966; Zechner 1931). One study reported obtaining arbutin yields of up to 18.6% (Fromard 1985), but I am uncertain whether this was a typographical error.

Arctostaphylos uva-ursi is a semi-trailing, mat-forming shrub with glabrous stems; throws out numerous rooting branches, usually 50-100cm long; branchlets glabrate or variously pubescent. Leaves alternate, persistent, coriaceous, oblong-obovate to spatulate or oblanceolate, 1-3cm long, obtuse or rounded at apex, tapered to base, entire, dark green and glossy on upper surface, paler beneath, leathery; petioles very short. Flowers pink, drooping, in groups of 3-10 in terminal racemate clusters in axils of fleshy, firm bracts; calyx saucer-shaped, deeply 5-lobed, sepals broadly ovate, c.1.5mm long, imbricate, distinct to base; corolla white to pinkish, globose, ovoid, bell-shaped, 4-6mm long, with 5 short lobes, spreading or recurved; stamens 10, filaments pubescent, much dilated in basal 1/3, much shorter than corolla; anthers subglobose, 2-awned, opening by pores. Ovary 5-celled, conic-ovoid, subtended by a 10-lobed disc; 1 ovule in each cell; style columnar, 5-lobed; stigma capitate. Fruit a smooth, dull red loculicidal drupe with a navel-like depression, sharply flavoured (or mealy and flavourless, depending on who you believe!), 6-10mm diam.; containing 5 bony nutlets, partly or wholly concrescent. Fl. late spring to early summer.

Native to n. US, Canada, and n. Eurasia, common in Scottish highlands, grows naturally through most of Europe in moist conditions among undergrowth or in grassy places where little light penetrates; sometimes on sandy or rocky soil in America, usually in moist to dry woods, and sandy roadsides (Bremness 1994; Chiej 1984; Emboden 1979a; Gleason 1952; Moss 1983).

ARECA

(Palmaceae/Arecaceae)

Areca caliso *Becc.*

Areca catechu *L.* **(A. catechu** *Willd.* **A. hortensis** *Lour.***)** – betel nut palm, areca palm, catechu palm, supari, piri, pinang, ping lang, bing lang, guvaka, guvka, popo

Areca macrocalyx *Zipp. ex Blume* – samaguk

'Betel nut', the fruit of [usually] A. catechu, is one of the world's most popular stimulants, being chewed by an estimated 10% of the world's population [largely in India and s.e. Asia, as well as in Australasian and Pacific countries]. A. macrocalyx is also chewed in Papua New Guinea, and A. caliso in the Philippines. Betel nut was mentioned in early Sanskrit texts [as 'guvka' or 'pinang'], and was also used by ancient Persians and Arabs. Moroccans burn the nuts on charcoal grills to ward off evil spirits, and wear them as amulets. Betel nuts are also chewed by the Swahili of Zanzibar and Tanzania, the Shambala of Kenya, the Ngazija of the Comoros, and Indians and s.e. Asians in South Africa. Betel is widely chewed by Mohammedans during Ramadan fasts. In India, betel use is a respected facet of society, due to the ritualised aspects of its preparation and use, encouraging social and spiritual exchange. In Ayurvedic medicine, betel nut is used as a digestive, anthelmintic, diuretic, astringent and cardiotonic. The nuts are used in TCM as an anthelmintic, and to treat dysentery and diarrhoea, slow heart rate, lower blood pressure and increase intestinal secretions. In Cambodia, the leaves are brewed and taken internally to treat bronchitis, and externally for lumbago. The root is used to treat liver disease, and the fruit is given with opium [see **Papaver**] to treat diarrhoea. Malay women sometimes use young shoots to procure abortion in early stages of pregnancy. The sweet inner shoots and young flower stems may be eaten raw, boiled or fermented as food. Unripe betel nuts are considered to be intoxicating, and cause dizziness (Bavappa et al. 1982; Chopra et al. 1965; De Smet 1998; Gowda 1951; Huang 1993; Kirtikar & Basu 1980; Marshall 1987; Nadkarni 1976; Ott 1995a; Paijmans ed. 1976; Rätsch 1992; Schmid 1991; Von Bibra 1855; Usher 1974); Nepalese shamans chew the fresh nuts with lime, salt and 'betel leaf' [see below] for shamanic travel (Müller-Ebeling et al. 2002). In parts of West Java, the roots are crushed and decocted with Imperata cylindrica roots and **Piper** nigrum seeds, and "drunk as an invigorating tonic to make men strong" (Wightmann et al. 1994).

Betel nuts may be prepared in several ways. The most popular preparation is that of whole, dried ripe nuts ['chali' or 'kottapak'], which are sundried for 35-40 days and then dehusked. When the nuts are cut in half and sundried for 10 days, before being dehusked and further dried, they are known as 'parcha'. Today, mechanical drying and dehusking methods are more common. Unripe nuts at 6-7 months of maturity may be made into 'kalipak' – the nuts are dehusked, cut into pieces, boiled in water [or a diluted extract of previous boilings], coated with 'kali' [a concentrate of previous water extracts] and dried, either in the sun or over a fire. 'Iylon' is made from unripe nuts which are simply sliced and dried; 'nayampak' is similar, but is made from nuts that are more immature. 'Scented suparis' are pre-made blends of betel nut pieces, spices and essential oils – recipes differ from region to region and from one manufacturer to the next (Bavappa et al. 1982).

Betel nut is often chewed [or rather, sucked in the corner of the mouth] as a quid ['paan' or 'sirih'] – a powdered, grated or crushed nut is mixed with a small pinch of burnt lime [to liberate the alkaloids as their bases; this also hydrolyses most of the *arecoline* to form arecaidine – see below], as well as a variety of spices and herbs [see *Methods of Ingestion*]. Tobacco [**Nicotiana**] is one of the most common additives today. These are wrapped in a [preferably] fresh 'betel leaf' [**Piper** betle – see **Piper 1**], and the morsel is ready for use. The copious red juice generated is either swallowed or spat out periodically. Initial use causes unpleasant symptoms such as nausea, dizziness, cold sweat, sore tongue, constricted throat and loose bowels. After regular use, these symptoms subside, except with large doses [up to 28g – normal dose of powder in Indian medicine is 0.6-2g]. The stimulatory effect is generally mild. Regular betel chewers have red to black stained teeth and gums, which they are usually quite proud of. This is largely due to catechin [see below], which turns bright red under strongly alkaline conditions. Although said to be good for the gums, regular and excessive use [it is usually chewed every day, and often after meals] is detrimental to oral health, irritating the gums and loosening the teeth. While it is excellent for reducing teeth caries and maintaining a healthy digestive tract in disease-ridden areas, the betel nut is now considered to be carcinogenic. This proposition has been questioned as relying on circumstantial evidence, and due to the ubiquitous use of tobacco additives (Bavappa et al. 1982; Gowda 1951; Kirtikar & Basu 1980; Lehane 1977; Marshall 1987; Nadkarni 1976; Ott 1993; Von Bibra 1855), though current research seems to support the notion, due to discovery of the formation of carcinocenic nitrosamines in the saliva, such as N-nitrosoguvacine, N-nitrosoguvacoline, MNPN [3-(methylnitrosamino)-propionitrile] and MNPA [3-(methylnitrosamino)propionaldehyde], when chewing betel nut with lime. Addition of tobacco brings formation of yet more nitrosamines (Prokopczyk et al. 1987; many more recent publications on this topic), and the addition of slaked lime has been shown to play a role in the oral carcinogenesis. Lime is known to cause a rapid turnover of cells, killing them, and increases the likelihood of cell mutation (Thomas & MacLennan 1992). It has been proposed that the co-use of betel leaf [see above] reduces formation of nitrosamines due to antioxidative activities deriving from the leaf (Jeng et al. 2002; theobromus pers. comm.). It is not known at this point whether oral usage of betel nut extracts without lime pose a similar health risk.

It has recently been shown that the non-alkaloidal dichloromethane fraction of the nut extract inhibits MAO-A in rat brain (Dar & Khatoon 2000). Betel nut has also shown adverse reactions when combined with certain pharmaceutical drugs, such as fluphenazine [resulting in tremors, stiffness and akithesia], flupenthixol and procyclidine [jaw tremors, rigidity, bradykinesia], prednisone and salbutamol [bronchoconstriction counteracts the positive effects of these drugs in treating respiratory disorders] (Fugh-Berman 2000). Although some asthmatics may have no problems, asthmatics in general should probably avoid betel nut, due to the bronchoconstriction that the nut, and the major alkaloidal constituent, *arecoline*, are known to cause (Kiyingi 1992; Taylor et al. 1992).

A. catechu nut has yielded 0.2-0.7% alkaloids, mainly *arecoline* [0.1-0.67%], as well as arecaidine [arecaine; *GABA*-uptake inhibitor], arecolidine, homoarecoline, guvacine [*GABA*-uptake inhibitor], guvacoline, isoguvacine, *coniine* and *choline*; as well as 15% condensed tannins [polyphenols, including leucocyanidin, catechin and epicatechin – catechin may inhibit MAO-B (Mazzio et al. 1998)], 15% lipids and 50-60% sugars. Green, unripe nuts yielded 0.1-0.15% alkaloids, of which 69.8% was *arecoline*, 24.4% ethyl-N-methyl-1,2,5,6-tetrahydropyridine-3-carboxylate, 1.8% methylnicotinate, 0.7% guvacoline, 0.49% ethylnicotinate, 0.21% ethyl-N-methylpiperidine-3-carboxylate, 0.2% methyl-N-methylpiperidine-3-carboxylate and 0.02% *nicotine*; as well as 17.2-43.85% polyphe-

nols, 8.1-12% fat, 8.2-9.8% fibre, 17.3-23% polysaccharides and 6.7-9.4% protein. Ripe nuts contain lower levels of polyphenols [11.1-17.8%] and protein [6.2-7.5%], and higher levels of extractable *arecoline* [0.12-0.24%], fat [9.5-15.1%], fibre [11.4-15.4%] and polysaccharides [17.8-25.7%]. Another study, probably using ripe nuts, found arecaidine to be the major alkaloid [1%], followed by *arecoline* [0.07%]. *Arecoline* is largely hydrolysed to form arecaidine when chewed with lime; like *arecoline*, arecaidine also has cholinergic and anthelmintic effects, though it is less toxic and has fewer parasympathomimetic side effects than *arecoline*. The body also produces nicotinic acid as a by-product of betel chewing (Bavappa et al. 1982; Bruneton 1995; Buckingham et al. ed. 1994; Holdsworth et al. 1998; Huang 1993; Johnston et al. 1975; Marion 1950; Marshall 1987; Nadkarni 1976; Rastogi & Mehrotra ed. 1990-1993; Schermerhorn et al. ed. 1957-1974).

Areca catechu has a solitary trunk, quite straight, 12-30m tall, usually c.50cm circumference, uniformly thick; stems erect, smooth, green in upper portion, annulate. Leaves pinnate, 1.2-1.8m, leaflets numerous, 30-60cm, upper confluent, glabrous, thin, with several midribs, attached to the rachis in a vertical line; base of petiole expanding into a smooth, green, amplexicaul sheath. Spathe double, compressed, glabrous; spadix much-branched, bearing male and female flowers in numerous close-set spikes; rachis stout, compressed; branches with filiform tips; male flowers minute, very numerous, sessile, bractless, occupying the upper portion of the spikes; calyx 1-leaved, small, 3-cornered, 3-parted; petals much longer than the small sepals, 3, oblong, rigid, striated; stamens 6, filaments short; anthers sagittate; female flowers much larger, few at base of spikes, sessile, bractless; sepals 3, orbicular, imbricate, cordate, rigid, fleshy, permanent; petals 3, orbicular, imbricate, with acute valvate tips; staminodes 6, connate; style scarcely any; stigmas 3, short, triangular. Fruit 3.8-5cm long, ovoid or oblong, supported by the persistent perianth, mesocarp fibrous; seed (nut) inside smooth, orange or scarlet, surface with attractive reticulate patterning, with a truncate base (Kirtikar & Basu 1980).

Tropics; India and s.e. Asia, to Pacific Islands.

Grow young plants in a mix of leaf-mold/loam or peat/loam; older plants prefer ½ sand and ½ loam. May require a greenhouse in colder climates. Water at least every 2 days. A tree may produce c.250 nuts a year. When the fruits are ripe, the nuts are removed from the mesocarp, washed free of pulp, and sun-dried. Sometimes the nuts are boiled before being sliced and sun-dried (Bremness 1994; Grubber 1973).

In the US, betel nut 5x extract powder is illegal (friendly pers. comm.); in England, betel nut is illegal to import, but the law there regarding this is not widely enforced (theobromus pers. comm.).

ARGEMONE

(Papaveraceae)

Argemone glauca *(Nutt. ex Prain.) Pope* – Hawaiian poppy, puakala

Argemone mexicana *L.* **(A. leiocarpa** *Greene***; A. mucronata** *Dum.-Cours. ex Steud.***; A. ochroleuca** *Sweet***; A. spinosa** *Moench***; A. versicolor** *Salisb.***; A. vulgaris** *Spach***; Echtrus mexicanus** *Nieuwl.***; E. trivialis** *Lour.***; Papaver spinosum** *Bauhin***)** – prickly poppy, Mexican poppy, chicalote, cardo santo, devil's fig, amapola del campo, pivla dhatura, satyanashi, kanre phul, palanti kanta, sungure kanda, thakal

Argemone munita *Durand et Hilg.* – flatbud prickly poppy, chicalote

Argemone polyanthemos *(Fedde) G.B. Ownbey* **(A. intermedia var. polyanthemos** *Fedde***)** – North American prickly poppy

Argemone spp. – prickly poppies

The Aztecs held A. mexicana to be sacred to Tlaloc, god of rain and thunder; they believed it to be eaten by all inhabitants of the underworld. Both Aztec and Mayan healers used it to treat headache, earache, asthma, flu, chest problems, constipation, fever, dizziness, halitosis and snakebite. The Mapuche also regard it as a sacred plant. Chinese immigrants in 19th century Mexico [Sonora, Sinaloa and Baja California] recognised its properties, and derived a type of opium [see **Papaver**] from it called 'chicalote tamales'. It was said to produce "blissful self-forgetfulness and complete absence of wants". An ointment of the latex is also said to be effective against sunburn, and an infusion of it treats nervousness and cramps. Seeds of the plant are also used in parts of Mexico for similar purposes, and the dried leaves are smoked for their 'aphrodisiac' properties. The roots of an Argemone sp. have been used by the Guarani of Paraguay, who brew them with 'yerba maté' [see **Ilex**] to make a medicinal stimulant. The North American A. polyanthemos is known as a strong irritant and narcotic, being feared as a poison. A. glauca from Hawaii is also said to be narcotic and psychotropic (Emboden 1979a; Heffern 1974; Pendell 1995; Rätsch 1992; Tyler 1966; Watt & Breyer-Brandwijk 1932). A. mexicana is used in Nepal to treat pain, itching and insomnia (Müller-Ebeling et al. 2002). In southern N. America, ash from the burnt leaves of A. intermedia is used by indigenous people for tattooing (Usher 1974). Other Argemone spp. share similar chemistry and pharmacology. Care should be taken with all species, as cases of poisoning have been recorded.

The seeds of Argemone spp. have been said to have '**Cannabis**-like' effects (Watt 1967), though they have apparently been eaten in cakes and other foodstuffs without consequence (Usher 1974). Such food use may have been in small amounts, or it may be that the heat and length of cooking destroys the alkaloids originally present. However, in India, A. mexicana seeds and their oil are sometimes encountered as an adulterant of Indian mustard seeds [see **Brassica**], and their consumption results in what has been called 'epidemic dropsy'. Symptoms include nausea, vomiting, diarrhoea, breathlessness, swelling of the limbs, and glaucoma; sometimes death results from cardiac arrest. The toxicity, attributed to the alkaloids sanguinarine and dihydrosanguinarine, primarily affects the liver, heart, kidneys and lungs, and results in extensive oxidative damage to cell membranes (Das & Khanna 1997; Thatte & Dahanukar 1999).

Usually the seeds, or the golden sap from the unripe seed capsules, are the portions ingested. The capsule can be pierced in the same way as with **Papaver** [though be careful of the prickles], and the sap similarly collected and dried, for use again in a similar fashion to true opium (Gottlieb 1992; pers. comms.). This may not be recommended with species rich in sanguinarine, due to the toxicity mentioned above. Recently, smokeable extracts of A. mexicana foliage have become popular on a small scale, and like many things, synergise well with **Cannabis**. However, the smoke is harsh and most likely not very healthy, even through a water-pipe, and it would seem best to vapourise the dried sap instead. Some people have reported dream-enhancement when smoking A. mexicana 5x extract before going to bed (pers. comms.; pers. obs.). Roughly 500mg [or ¼tsp] dried, powdered leaf of A. mexicana, A. glauca or A. munita ssp. rotunda [A. rotunda], taken orally with fruit juice, has been observed to provide pleasant mood-enhancement, with 2g more 'contemplative' in effect. A. grandiflora, A. polyanthemos and A. pleiacantha were found to be much weaker using the same methods. The same people noted that the leaf was preferable to the latex, as the latter "seems to be missing" something compared to the effects of the former (Lazar 2002).

These materials contain isoquinoline alkaloids related to those found in **Papaver**, some of which have anticholinergic and antihistamine properties (Capasso et al. 1997) as well as being narcotic sedatives (Preininger 1975). The alkaloids berberine and chelerythrine give the latex its yellow colour; on air contact, the latex turns orange, a colouration thought to be caused by sanguinarine [pseudochelerythrine] (Bandoni et al. 1975). Besides the toxicology of sanguinarine as mentioned above, this alkaloid has been shown to inhibit the activity of MAO (Lee et al. 2001) and *glutamic acid* decarboxylase enzymes (Netopilova et al. 1996), as well as having anticholinesterase, adrenolytic, sympatholytic, local anaesthetic, and bactericidal activities (Preininger 1975). See **Papaver** for further commentary on some of these alkaloids. Many of them [such as berberine, chelerythrine, coptisine and sanguinarine] inhibit AChE (Ulrichová et al. 1983).

A. alba [A. albiflora] has yielded allocryptopine, berberine, chelerythrine, coptisine, *protopine* and sanguinarine (Preininger 1986).

A. albiflora ssp. texana has yielded 0.02% alkaloids [33% sanguinarine, 28% allocryptopine, 23% *protopine*, 9% berberine, 6% coptisine] (Stermitz et al. 1973b).

A. aurantiaca aerial parts [still mostly in rosette stage, beginning to bud] from Texas yielded 0.1% alkaloids [60% *protopine*, 40% coptisine] (Stermitz et al. 1969).

A. brevicornuta has yielded 0.03% alkaloids [85% (-)-norargemonine, 15% berberine] (Stermitz et al. 1973b).

A. chisosensis flowering and fruiting aerial parts [harv. Texas] yielded 0.04% alkaloids [88% berberine, 11% allocryptopine, traces of *protopine*].

A. corymbosa ssp. arenicola flowering and fruiting aerial parts [harv. Arizona] yielded 0.09% alkaloids [92% berberine, 4% allocryptopine, 3% cryptopine, traces of sanguinarine] (Stermitz et al. 1969).

A. echinata has yielded 0.13% alkaloids [40% cryptopine, 30% berberine].

A. fruticosa has yielded 0.89% alkaloids [60% allocryptopine, 20% hunnemanine] (Stermitz et al. 1973a).

A. glauca var. glauca has yielded 0.47% alkaloids [40% *protopine*, 20% allocryptopine, 20% sanguinarine, 10% berberine, 10% chelerythrine] (Stermitz et al. 1971).

A. gracilenta aerial parts [harv. Jun., Arizona] have yielded 0.33% alkaloids [>90% argemonine, traces of argemonine N-oxide, argemonine methohydroxide, isonorargemonine, *protopine*, laudanine, muramine, munitagine, platycerine, reticuline] (Stermitz & McMurtrey 1969).

A. hispida aerial parts [harv. Jul., Wyoming] yielded 0.61% alkaloids [c.45% argemonine, 44% norargemonine, 5% bisnorargemonine, 6% reticuline] (Stermitz & Seiber 1966).

A. mexicana has yielded 5.5% alkaloidal residue, containing allocryptopine, berberine, (-)-cheilanthifoline, chelerythrine, norchlerythrine, coptisine, cryptopine, dihydrosanguinarine, norsanguinarine, sanguinarine, oxyhydrastinine, *protopine*, (-)-α-canadine methohydroxide, (-)-β-scoulerine methohydroxide, (-)-α- and (-)-β-stylopine methohydroxide, (-)-α-tetrahydropalmatine methohydroxide and 6-acetonyldihydrosanguinarine. Another investigation found 0.125% alkaloids,

1.75% resin and 1.1% tannins from roots and stems; alkaloids consisted of 0.084% *protopine* and 0.041% berberine. Vietnamese plants yielded 0.28% alkaloids from green aerial parts, and 0.425% from roots, consisting mostly of allocryptopine [37% of total alkaloids in green parts; 36% in roots] and *protopine* [21% in green parts, 16% in roots], as well as sanguinarine, heletrine, and 2 unidentified alkaloids. Seeds have yielded 22-36% of a toxic oil called 'argemone oil', consisting largely of sanguinarine and dihydrosanguinarine. The total alkaloids from this extraction antagonised *serotonin*, *acetylcholine* and *histamine* in animal experiments (Bose et al. 1963; Bui & Mura'eva 1973; Das & Khanna 1997; Onda & Takahashi 1988; Preininger 1986; Santos & Adkilen 1932). Its alkaloids have also been reported to reduce *morphine* withdrawal symptoms in animals (Capasso et al. 1997). Leaf and stem of Australian material growing in Rockhampton, Queensland [harv. Dec.] tested moderately strongly positive for alkaloids (Webb 1949).

A. munita ssp. argentea flowering and fruiting aerial parts [harv. Mar., California] yielded 0.28% alkaloids [c.60% allocryptopine, 20% isonorargemonine, 5% argemonine, 5% *protopine*, and 10% mixture of unidentified alkaloids]. The latex of this subspecies is nearly white (Stermitz et al. 1974).

A. munita ssp. rotundata aerial parts [harv. Jul., Utah] yielded 0.22% alkaloids [65% bisnorargemonine, 27% munitagine, 4% muramine, 2% cryptopine, 2% reticuline, 0.06% 2,9-dimethoxy-3-OH-pavinane] (Coomes et al. 1973; Stermitz & Seiber 1966).

A. pleiacantha subspecies were found to have variable alkaloid composition; all samples studied were harvested in June. A. pleiacantha ssp. pleiacantha from Ashfork, Arizona contained mostly bis-norargemonine [45% of total alkaloids], as well as *protopine* [15%], berberine [10%], munitagine [10%], and traces of norargemonine and cryptopine; plants from Sho Low, Arizona contained mostly berberine [50%] and *protopine* [35%], as well as allocryptopine [15%]; plants from Hurley, New Mexico contained mostly berberine [60%], as well as *protopine* [15%] and allocryptopine [10%]. A. pleiacantha ssp. ambigua from Peeples Valley, Arizona contained mostly berberine [30%], cryptopine [25%], bisnorargemonine [20%] and munitagine [10%]; plants from Prescott, Arizona contained mostly berberine [60%], as well as 10% each of *protopine*, cryptopine, and allocryptopine, and 3% each of munitagine and bisnorargemonine; plants from Seneca, Arizona contained mostly berberine [45%], allocryptopine [30%], and *protopine* [20%], as well as bisnorargemonine [3%] and munitagine [1%]; plants from Ashfork, Arizona contained mostly berberine [30%], *protopine* [25%], and cryptopine [25%], as well as traces of munitagine and bisnorargemonine; plants from Miami, Arizona contained mostly *protopine* [55%], as well as bisnorargemonine [20%], munitagine [10%], and traces of berberine. The less widespread A. pleiacantha ssp. pinnatisecta from High Rolls, New Mexico contained mostly munitagine [75%], as well as bisnorargemonine [15%] (Stermitz & Coomes 1969).

A. polyanthemos [harv. Argentina] aerial parts yielded 0.8% alkaloids [50% allocryptopine, <30% N-norchelerythrine, 15% chelerythrine, 12% berberine, and traces of *protopine* and sanguinarine]; roots also yielded 0.8% alkaloids, of similar composition. Aerial parts [flowering and fruiting] of plants from Wyoming and New Mexico yielded 0.07-0.12% alkaloids [82-86% berberine, 13-17% allocryptopine, traces of *protopine* and sanguinarine]; traces of chelerythrine and N-norchelerythrine have also been found in US specimens (Bandoni et al. 1975; Stermitz et al. 1969). Coptisine and (-)-scoulerine have also been found in the plant (Preininger 1986).

A. sanguinea flowering aerial parts [harv. Texas] yielded 0.05-0.07% alkaloids – alkaloids from the purple-flowered variety [which gave the slightly higher yield in this analysis] contained almost entirely berberine [94%], as well as muramine [6%]; alkaloids from the white-flowered variety contained 68% berberine, 22% allocryptopine, 6% argemonine, and 4% muramine (Stermitz et al. 1969).

A. squarrosa has yielded c.1% α-allocryptopine (Brochmann-Hanssen & Nielsen 1966).

A. subfusiformis ssp. subfusiformis [yellow-petal variety] aerial parts yielded 0.4% alkaloids [41% *protopine*, 28% allocryptopine, 9% berberine, 5% sanguinarine, 4% chelerythrine]; roots yielded 1.4% alkaloids [47% sanguinarine, 26% *protopine*, 18% allocryptopine, 7% berberine, 1% chelerythrine]. Aerial parts of the white-petalled variety yielded 0.8% alkaloids [55% *protopine*, 34% allocryptopine, 8% berberine, 3% sanguinarine]; roots yielded 0.4% alkaloids [28% *protopine*, 19% berberine, 17% allocryptopine, 3% sanguinarine, 3% chelerythrine]. The large quantities of sanguinarine in the roots are thought to form rapidly from dihydrosanguinarine, on exposure to air; previous studies suggest that only minor quantities of sanguinarine occur in this species. Incidentally, the petals of the white-petalled variety turn yellow a few days after picking, and at this stage were shown to contain berberine and sanguinarine; similarly aged petals of the yellow-petalled variety only contained berberine (Bandoni et al. 1975).

A. subfusiformis ssp. subinermis aerial parts yielded 0.6% alkaloids [46% *protopine*, 31% allocryptopine, 16% berberine, 4% sanguinarine]; roots yielded 0.9% alkaloids [42% sanguinarine, 20% *protopine*, 17% allocryptopine, 12% berberine, 2% chelerythrine] (Bandoni et al. 1975).

A. subintegrifolia flowering and early fruiting aerial parts [harv. Mar., s. of Mexicali, Baja California] yielded 0.14% alkaloids [c.70% allocryptopine, 20% *protopine*, 5% berberine, 5% mixture of unidentified alkaloids] (Stermitz et al. 1974).

A. turnerae has yielded 0.11% alkaloids [60% (-)-armepavine, 40% (-)-tetrahydropalmatine (see *Endnotes*)] (Stermitz et al. 1973b).

Argemone mexicana is a glaucous, erect, prickly annual herb, with bright yellow latex; stems mostly 1, often branched near base, bluish-green, pithy, smooth or slightly pubescent, 25-100cm tall, with scattered stiff yellow perpendicular or slightly reflexed prickles. Leaves glaucous, alternate, bluish-green, with conspicuous light blue markings over veins on upper side, smooth or with distant spines on main veins; basal leaves slightly stalked and crowded into a rosette, oblanceolate, lobes oblong, incised to ½ or more the distance to the midrib, sinuses comparitively narrow; upper leaves sessile and clasping the stem, 6-20 x 3-8cm, deeply divided into 7-11 irregular lobes (though more shallow than in lower leaves), broadly elliptical to ovate, margins wavy, with acute marginal teeth each tipped with a slender spine. Flowers creamy white to yellow, shortly stalked or sesssile at apex, 3-6(-7)cm across, closely subtended by 1-2 foliar bracts; buds subspherical or barely oblong, 9-13mm thick, 10-15mm long, smooth or sparingly prickly; sepals 3, hood-like, terete, smooth or sparsely prickled and with a large spine below apex, 5-10mm long incl. spine, sepals shedding as flower opens; petals 4-6, 2.5-3 x 1.4-4cm, the outer obovate, the inner obovate to obcuneate; stamens 30-50, filaments pale lemon-yellow; anthers yellow. Style to c.1(-3)mm long in fruit; stigma dark red to purple, c.1-2mm long, 1.5-4mm wide, 3-6 lobed, the lobes pressed against each other and appressed to the style at anthesis. Fruit a smooth or prickly capsule 2.5-5 x 2cm, oblong to broadly elliptic, 25-45mm long x 12-20mm wide, excl. spines if present, crowned with persistent style, spines to 6-10mm long; 4-6-carpellate; ripe fruits opening from apex down, dehiscing away from the style ribs attached to stigma, leaving a structure resembling the ribs of an umbrella; seeds dark brown to black, 1.6-2 x 1.5mm, oily and finely veined. Seed is dormant when shed, up until a few months later.

In subhumid semi-arid scrubland on a wide range of soils, on roadsides, rabbit warrens, cultivated fields, streambeds and waste places; Mexico, West Indies, Central America. A weed of crops in Argentina, Puerto Rico, Australia, Philippines, India, Pakistan, Madagascar, Mauritius, Morocco, Nicaragua, Tanzania, S. Africa, and parts of the US (Ownbey 1958; Parsons & Cuthbertson 1992).

ARGYREIA [including Merremia]

(Convolvulaceae)

Argyreia acuta *Lour.* **(A. festiva** *Wall.***; Lettsomia chalmersii** *Hance***; L. festiva** *(Wall.) Benth. et Hook. f.***)**
Argyreia barnesii *(Merr.) Ooststroom*
Argyreia capitata *(Vahl) Choisy* **(Convolvulus capitatus** *Vahl***)** – thao bac dau
Argyreia cuneata *(Wild) Ker-Gawl*
'Argyreia hainanensis' (Erycibe hainanensis *Merrill?***; Merremia hainanensis** *H.S. Kiu?***)**
Argyreia luzonensis *(Hall. fil.) Ooststroom*
Argyreia mollis *(Burm. f.) Choisy* **(A. championii** *Benth.***; A. obtecta** *(Choisy) C.B. Clarke***; Convolvulus mollis** *Burm. f.***; C. sericeus** *L.***; Lettsomia championii** *(Benth.) Benth. et Hook. f.***; Rivea obtecta** *(Wall.) Choisy***)**
Argyreia nervosa *(Burm. f.) Bojer* **(A. speciosa** *(L. f.) Sweet***; Convolvulus nervosus** *Burm. f.***; C. speciosus** *L. f.***; Lettsomia nervosa** *(Burm. f.) Roxb.***; Rivea nervosa** *(Burm. f.) Hallier f.***)** – Hawaiian baby woodrose, elephant creeper, wooly morning glory, bhuanath haku, samundra phul, samudrashokha, samudrapalaka, samandarkapat
Argyreia obtusifolia *Loureiro*
Argyreia osyrensis *(Roth) Choisy* **(Ipomoea osyrensis** *Roth***)**
Argyreia phillipinensis *(Merrill) Ooststroom*
Argyreia pseudorubicunda *Ooststr.*
Argyreia ridleyi *(Prain) Prain ex Ooststr.*
Argyreia rubicunda *(Wall) Choisy*
Argyreia splendens *(Hornem.) Sweet* **(Convolvulus splendens** *Hornem.***; Ipomoea splendens** *(Hornem.) Sims***; Lettsomia splendens** *Roxb.***)**
Argyreia wallichii *Choisy*
Argyreia spp. – woodroses

Merremia tuberosa *(L.) Rendle* **(Convolvulus gossypiifolius** *Humb.***; C. macrocarpus** *Sprengel***; C. tuberosus** *(L.) Spreng.***; Ipomoea glaziovii** *Dammer***; I. mendesii** *Welw.***; I. nuda** *Peter***; I. tuberosa** *L.***; Operculina tuberosa** *(L.) Meisner***)** – large baby woodrose, pilikai, xixicamatic, paktha' pok' laak, quiebra machete, bejuco de golondrina, foco de luz, quinamacal, rosa de barranco

The seeds of A. nervosa are said to have been a popular inebriating aphrodisiac with poor Hawaiians in earlier years (Rätsch 1990). In India, A. nervosa root is used as an aphrodisiac nerve tonic, and the leaves are applied topically as a stimulant and rubifacient (Kirtikar & Basu 1980). Soaked for 7 days in the juice of Asparagus racemosus and taken in a dose of 2.9-5.8g with ghee for 1 month, the root "improves intellect, strengthens body and prevents effects of age" (Nadkarni 1976). Recently it was found that Kirati shamans in Nepal use the seeds to 'fly' shamanically, with one fruit capsule containing sufficient seeds for a dose. The flowers are used as an offering to the 'nagas' [see **Naja and Ophiophagus**] (Müller-Ebeling et al. 2002). The Akha and Mien of n. Thailand use the whole plant of A. wallichii as a tonic and analgesic (Anderson 1993).

Merremia tuberosa has been proposed to have been the Aztec 'xixicamatic', a type of 'ololiuqui' [see **Turbina**]. While generally not thought to be psychoactive [see below], M. tuberosa acts as a purgative and antipyretic. Modern Mayans use it to treat headaches (Austin 1998).

In the latter part of the last century, the practice of using A. nervosa seeds as a psychotrope began amongst elements of the drug subculture, particularly as an ingredient in 'Utopian bliss balls' [see *Methods of Ingestion*]. For use, the seeds [removed from their pods] are scraped clean of their fuzzy outer coating and adhering fine whitish hairs. This can be tedious and fiddly, but failure to completely remove these portions reputedly results in a greater level of unpleasant side effects. The tiny hairs, in particular, may be irritating to sensitive membranes. The seeds are usually either chewed [preferably when fresh, or after soaking to soften the seeds], ground and eaten [as in 'Utopian bliss balls'], or extracted into water before ingestion. A water extraction of the same kind used with **Ipomoea** is sufficient. Recently, psychonauts have been experimenting with a lime juice [see **Citrus**] extraction method. This involves soaking the cleaned, ground seeds in 1-2 tablespoons of lime juice for roughly 30 min., with periodic agitation of the mixture. After this time, orange juice is added and the mixture drunk. Some people prefer to let this settle before drinking, to avoid consuming the seed solids. The lime juice soak has been claimed to eliminate nausea [perhaps by neutralising some nauseating component of the seeds]. Although this has not been the case for everyone who has tried this method, it may be that nausea is indeed reduced in intensity. In the case of A. nervosa, 4-8 seeds may constitute a dose, although their effectiveness declines with age (Ott 1993; Rätsch 1998; Stafford 1992; pers. comms.; pers. obs.). A similar number of the larger seeds of M. tuberosa has been claimed to be psychoactive (Gottlieb 1992), and though the species has generally been regarded as inactive, I have received recent confirmation that at least some samples of M. tuberosa seeds are indeed active, but weaker in potency, compared with A. nervosa (pers. comms.).

Effects of psychoactive Argyreia spp. seeds are generally similar to those of psychoactive **Ipomoea** and **Turbina** species, due to similar chemistry [ie. indole ergoline alkaloids] (Der Marderosian 1967). However, like these other plants, the exact nature of effects should be expected to vary from one batch of seed to another [also varying with freshness]. Nausea and mild stomach cramps may be experienced within the first hour or two after consuming the seeds [or an extract thereof], wearing off shortly after. This nausea can be minimised by keeping still; if for any reason movement is necessary, it is best to move slowly and gently (pers. obs.). These seeds should not be taken by pregnant women due to their content of uterotonic alkaloids.

A. acuta seeds were found to contain *ergine*, *ergonovine* and *chanoclavine*-I.

A. aggregata seeds were found to contain unidentified ergoline alkaloids.

A. barnesii seeds were found to contain isoergine, ergometrinine, lysergic acid α-OH-ethylamide, *agroclavine*, *chanoclavine*-I & -II, *elymoclavine*, *festuclavine* and isolysergol.

A. capitata seeds were found to contain large amounts of ergolines including *ergine*, isoergine, *ergonovine* and *chanoclavine*, as well as an unidentified ergoline alkaloid (Chao & Der Marderosian 1973a). Roots and aerial parts yielded arcapitins A-C, dammarane-type triterpenes (Tofern et al. 1999b), but no ergolines (Tofern et al. 1999a).

A. cuneata seeds were found to contain isoergine, *ergonovine*, ergometrinine, lysergic acid α-OH-ethylamide, *agroclavine*, *chanoclavine*-I & -II, *elymoclavine*, *festuclavine*, *penniclavine*, lysergene, *lysergol* and isolysergol, as well as 7 unidentified ergolines.

A. hainanensis seeds were found to contain *ergine*, *ergonovine* and *chanoclavine*-I (Chao & Der Marderosian 1973a).

A. hookeri seeds were found to contain unidentified ergoline alkaloids; roots and aerial parts did not contain detectable ergolines (Tofern et al. 1999a).

A. luzonensis seeds were found to contain *ergine*, isoergine, *ergonovine*, ergometrinine, lysergic acid α-OH-ethylamide, isolysergic acid α-OH-ethylamide, *agroclavine*, *chanoclavine*-I & -II, *elymoclavine*, *festuclavine*, *penniclavine*, *lysergol*, isolysergol, ergosine and ergosinine, as well as 10 unidentified ergolines.

A. maingayi seeds were found to contain 5 unidentified ergoline alkaloids.

A. mollis seeds were found to contain *ergine*, isoergine, *ergonovine*, ergometrinine, lysergic acid α-OH-ethylamide, *agroclavine*, *chanoclavine*-I & -II, *elymoclavine*, *festuclavine*, *penniclavine*, isolysergol, ergosine and ergosinine, as well as 8 unidentified ergolines (Chao & Der Marderosian 1973a). The herbage was found to contain calystegines [see **Convolvulus**] (Schimming et al. 1998) as well as loline [see **Festuca**, **Lolium**], N-formylloline, N-methylloline, N-propionylnorloline [decorticasine], *nicotine*, pseudotropine, hygrine and cuscohygrine. Roots yielded loline, N-formylloline, N-methylloline, pseudotropine, hygrine, cuscohygrine, 2',4-N-methylpyrrolidinylhygrine and 2',3-N-methylpyrrolidinylhygrine. No ergolines were detected in aerial parts or roots (Tofern et al. 1999a).

A. nervosa seed has yielded 0.3-0.9% alkaloids. As % of dried seed, this may include 0.136% *ergine*, 0.188% isoergine, 0.049% *ergonovine*, 0.011% ergometrinine, 0.035% lysergic acid α-OH-ethylamide, 0.024% isolysergic acid α-OH-ethylamide, 0.006% *agroclavine*, 0.016% *chanoclavine*-I, 0.022% *elymoclavine*, and 0.113% other alkaloids, including *chanoclavine*-II, *festuclavine*, *penniclavine*, molliclavine, setoclavine, isosetoclavine, lysergene, *lysergol* and isolysergol, and up to 11 unidentified ergolines; pericarp yielded 0.0015% alkaloids (Chao & Der Marderosian 1973a, 1973b; Hylin & Watson 1965; McJunkins et al. 1969; Miller, M.D. 1970). No ergolines were detected in roots or aerial parts (Tofern et al. 1999a). As A. speciosa, leaves [from India] were found to be +- alkaloid-free, but yielded 1-triacontanol, epi-friedelinol, epi-friedelinol acetate and β-sitosterol (Sahu & Chakravarti 1971). However, identification is in question, as these researchers listed the plant as being synonymous with Stryptocardia tiliaefolia – which is presumably a spelling mistake, referring to **Stictocardia**.

A. obtusifolia seeds were found to contain *ergine*, isoergine, *ergonovine*, ergometrinine, lysergic acid α-OH-ethylamide, *agroclavine*, *chanoclavine*-I & -II, *elymoclavine*, *festuclavine*, *penniclavine*, ergosine, ergosinine and 5 unidentified ergolines.

A. osyrensis seeds were found to contain large amounts of ergoline alkaloids, including *ergine*, isoergine, *ergonovine* and *chanoclavine*, as well as unidentified ergolines.

A. phillipinensis seeds were found to contain *ergine*, isoergine, ergometrinine, lysergic acid α-OH-ethylamide, *chanoclavine*-I, *festuclavine*, *penniclavine*, *lysergol*, isolysergol and 2 unidentified ergolines.

A. pseudorubicunda seeds were found to contain large amounts of ergolines, including *ergine*, isoergine, *ergonovine* and *chanoclavine*, as well as unidentified ergoline alkaloids.

A. reticulata seeds were found to contain 2 unidentified ergoline alkaloids.

A. ridleyi seeds were found to contain ergosine, ergosinine and an unidentified ergoline alkaloid.

A. rubicunda seeds were found to contain *lysergol*.

A. splendens seeds were found to contain *ergine*, isoergine, *ergonovine*, ergometrinine, lysergic acid α-OH-ethylamide, *chanoclavine*-I & -II, *elymoclavine*, *festuclavine*, *lysergol*, ergosine, ergosinine and an unidentified ergoline.

A. wallichii seeds were found to contain *ergine*, isoergine, *ergonovine*, *chanoclavine*-I, *festuclavine* and isolysergol (Chao & Der Marderosian 1973a).

Merremia tuberosa seed has not formally yielded alkaloids, though one sample of dried sepals did test positive for small quantities of alkaloids, which were not identified (Hylin & Watson 1965). Roots and seeds have yielded saponin-like resins, and coumarins [*scopoletin* and umbelliferone]; roots also contain tropinone, hygrine, cuscohygrine, other hygrine derivatives, and calystegines (Austin 1998); leaves yielded quercetin, gentisic acid, vanillic acid, syringic acid, napthoquinones, and traces of saponins (Nair et al. 1986).

Argyreia nervosa is a woody climber to 10m, containing white latex. Leaves petiolate, entire, ovate-orbicular, apex obtuse, acute or with a short cusp, base cordate, 18-27cm long, densely white, grey or yellowish-hairy beneath. Inflorescence 1-many-flowered, axillary, subcapitate, on a long, stout, white-tomentose peduncle; sepals 5, often dorsally pubescent, herbaceous to subcoriaceous, often persistent in fruit; corolla 6-6.5cm, tubular to funnel-shaped, lavender, base of tube darker, mid-petaline bands and tube densely wooly outside; stamens included or exserted; stigma 2-lobed. Fruit berry-like, indehiscent, fleshy, leathery or mealy; seeds 1-4, usually glabrous, brown, rounded on back, with 2 angled sides.

Native to India, Bangladesh, introduced to Hawaii, pantropically cultivated and naturalised (Burras ed. 1994), such as the naturalised population/s in Queensland [Australia] (Hnatiuk 1990).

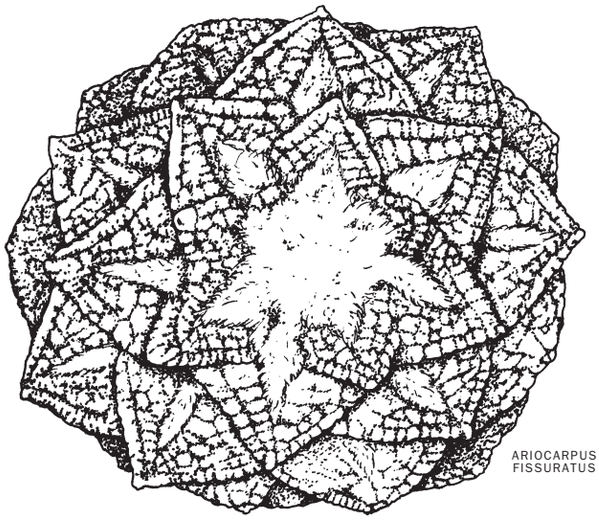
Propagate from scarified and soaked seed in spring, plant c.1-2cm deep; water sparingly after germination. Requires stout supports to climb, likes full sun and moderately fertile soil. Benefits from plenty of space for root development, from an early age. Will tolerate a winter low of 13°C; may require a greenhouse in colder climates (Burras ed. 1994; pers. comms.).

Some psychonauts have stated that A. nervosa exists in two virtually indistinguishable varieties – A. nervosa var. nervosa and A. nervosa var. speciosa. The former is most often sourced from Hawaii or n.e. Australia, the latter most often from India and Africa. A. nervosa var. speciosa seeds are reputedly lower in alkaloid content than the preferred A. nervosa var.

nervosa seeds, and are unfortunately much more prevalent in the commercial market (pers. comm.).

ARIOCARPUS

(Cactaceae)


ARIOCARPUS FISSURATUS

Ariocarpus agavoides *(Castañeda) Anderson* **(Neogomesia agavoides** *Cast.***)** – magueyitos ['little Agaves']

Ariocarpus fissuratus *(Engelmann) Schumann* **(A. lloydii** *Rose***; Anhalonium engelmannii** *Lemaire***; An. fissuratum** *Engelm.***; Mammillaria fissurata** *Engelm.***; Roseocactus fissuratus** *(Engelm.) Berg.***; R. intermedius** *Backeberg et Kilian***; R. lloydii** *(Rose) Berg.***)** – híkuli sunami, sunami, chaute, chautle, peyote cimarrón, peyote, dry whiskey, pezuña de venado

Ariocarpus kotschoubeyanus *(Lemaire) Schumann* **(A. sulcatus** *Schum.***; Anhalonium kotschoubeyanus** *Lem.***; An. sulcatum** *Salm-Dyck***; Roseocactus kotschoubeyanus** *(Lem.) Berger***)** – peyote, chaute, pata de venado ['deer's foot'], pezuña de venado ['cloved hoof of the deer']

Ariocarpus retusus *Scheidweiler* **(A. confusus** *Halda et Horacek***; A. elongatus** *(Salm-Dyck) M.H. Lee***; A. furfuraceus** *(Watson) H.C. Thompson***; A. retusus ssp. scapharostroides** *Halda et Horacek***; Anhalonium elongatum** *Salm-Dyck.***; An. furfuraceum** *Coult.***; An. prismaticum** *Lem.***; An. pulvilligerum** *Lem.***; Cactus prismaticus** *Kuntze***; Mammillaria furfuracea** *S. Wats.***; M. prismatica** *Hemsl.***)** – tsuwiri, peyote, chaute, chautle

Ariocarpus scaphirostris *Boedeker* **(A. scapharostrus** *Boedeker nom. illeg.***)**

Ariocarpus trigonus *(Web.) Schu.* **(A. retusus ssp. trigonus** *(Web.) Anderson et Fitz Maurice***; Anhalonium trigonum** *Weber***)** – chaute

Ariocarpus spp. – living rock, cactus edelweiss

These cacti are representatives of the group of 'false peyotes' known to some indigenous Mexican groups [see **Lophophora**], and their mucilage is sometimes used as a glue (Bravo 1937; Bruhn & Bruhn 1973; Schultes 1937a, 1937b). The Tarahumara consider A. fissuratus to be "even more powerful than wanamé" [**Lophophora** williamsii]. It is sometimes either eaten fresh or macerated in water and drunk, and is "strongly intoxicating". A "small, reddish cactus" referred to as 'peyote cimmarón', which may be an **Ariocarpus** sp., is said to be "considered ineffective by the Tarahumara, although one must not abuse it, or else one will die." A. retusus is regarded by the Huichol as a 'false peyote' that produces evil and undesirable effects. When on their annual peyote hunt, the Huichol believe that to any who had not properly purified themselves at the start of the pilgrimage by admitting all of their sexual encounters outside of marriage [see **Lophophora**], 'tsuwiri' [A. retusus] may appear to be a real peyote specimen. Eating it is reputed by the Huichol to send one into a deliriant-hallucinogenic state (Bye 1979b; Diaz 1979; Furst 1971; Schultes 1967a), which from the descriptions, seems similar to that experienced from anti-cholinergic tropane alkaloids in **Datura** and some other Solanaceous plants (pers. obs.). Amongst Huichol shamans who use A. retusus as an ally, 2 tubercles are eaten as one dose. The dried tubercle tips are reportedly smoked, presumably 'recreationally', by some Mexicans (Ben pers. comm. 2003; Sacred Succulents 2002). A. retusus is said to have been used medicinally, to treat malaria (Braga & McLaughlin 1969).

A. kotschoubeyanus is used as an external medicine for wounds, and its mucilage is used as a glue. A. agavoides is eaten in Tamaulipas as a food, for its sweet flesh; locals refer to the plants as 'magueyitos' (Smith 2000). When eaten in excessive amounts, it reputedly causes dizziness (Sacred Succulents 2002).

A. agavoides has yielded 0.001-0.01% alkaloids, over half of which was *hordenine*, with lesser amounts of N,N-dimethyl-3-MeO-*tyramine*, and traces of N-methyl-*DMPEA* and unidentified alkaloids (Bruhn & Bruhn 1973).

A. fissuratus has yielded *hordenine*, N-methyl-*tyramine* and 0.004% N-methyl-*DMPEA* (McLaughlin 1969; Norquist & McLaughlin 1970). Bioassays have confirmed the psychoactivity of this species, described only as "definitely psychoactive and possibly entheogenic" (Anon. 1998). Another experiment resulted in "non-hallucinogenic effects with strong narcotic pain killing qualities" (Smith 2000). One person, who referred to himself as a 'soft-head' [one who is easily affected by psychoactive drugs], experienced noticeable stimulation from a whole seedling [1g, including root], which was consumed after liquidising with vitamin C (theobromus pers. comm.).

A. kotschoubeyanus has yielded 0.089% *hordenine* and 0.019% N-methyl-*tyramine* (Neal et al. 1971). Bioassays have shown this species to be similarly psychoactive to A. fissuratus, though producing milder effects (Anon. 1998).

A. retusus has yielded 0.018% *hordenine*, 0.001% N-methyl-*tyramine* (Braga & McLaughlin 1969), 0.00045% N-methyl-4-MeO-*phenethylamine* and 0.00047% N-methyl-*DMPEA* (Neal & McLaughlin 1970), as well as the flavonoid retusin [0.041%] and 0.035% β-sitosterol (Dominguez et al. 1968).

A. scaphirostris [fresh] has yielded 0.012% alkaloids, consisting of *hordenine* [major alkaloid], N-methyl-*tyramine*, N-methyl-*DMPEA* and N,N-dimethyl-*DMPEA* (Bruhn 1975).

A. trigonus has yielded 0.013% *hordenine*, 0.0003% N-methyl-*tyramine* and 0.007% N-methyl-*DMPEA* (Speir et al. 1970).

These plants contain highest alkaloid levels when they are actively growing and healthy (Anderson 1960).

Ariocarpus fissuratus has a usually solitary stem, grey-green, inconspicuous, +- turnip shaped [including the root], only the flattened or slightly convex top protruding above ground; usually 4-5cm high, to 10cm diam.; tubercles flattened or somewhat angular on top, exposed portion deltoid, deeply fissured-tuberculate above, exposed portion usually 12-25mm long, 20-25mm across, densely wooly; spines none on mature plant. Flower on upper side of tubercle at end of groove, to 3.5(-4)cm diam. and long; sepaloids with magenta midribs and pale magenta to whitish margins, the larger oblanceolate, to 20-25mm long, 4.5(-6)mm wide, mucronulate, entire or slightly undulate; petals pale magenta, largest cuneate, to 30 x 15mm, apex rounded, margin entire or finely and irregularly toothed; filaments pale, c.6mm long; anthers yellow, 0.7mm long, plump; style pale, 15-19mm long, c.1mm greatest diam.; stigmas 5-10, mostly 3-4.5mm long, slender; ovary in anthesis 3-4.5mm long. Fruit white to greenish, at first fleshy but drying at maturity, becoming brown, +- smooth, globose to oblong, 6-15 x 3-6mm, remaining embedded in wool, finely disintegrating; seeds irregularly obovoid, 0.8 x 0.6 x 0.5mm.

Limestone soils often with rock fragments, in hills or ridges in desert at 500-1170m; s.w. Texas, Mexico [Chihuahua, Coahuila] (Benson 1982). Natural habitat has a pH of 7-8 (Anderson 1960). Prefers coarse, mineral-rich soil with a high proportion of gravel and rock. Slow-growing. Water sparingly. Enjoys partial sun, or full sun for part of the day (Trout & Friends 1999). Growth is greatly accelerated by grafting to a base stock of **Trichocereus** pachanoi or a similar fast-growing columnar cactus, though they can be difficult to graft successfully. One grower suggests only grafting "younger plants that are no more than 1½ to 2 inches in diameter." The root should also be left in the soil to regenerate (Anon. 1998).

ARMATOCEREUS

(Cactaceae)

Armatocereus laetus *(Kunth) Backeberg ex A.W. Hill* **(A. jungo** *Backeb.***; Cereus laetus** *(Kunth) DC.***; Lemaireocereus laetus** *(Kunth) Britton et Rose***)** – pishicol, pishicol blanco

In the valley of Huancabamba, high in the n. Peruvian Andes, this cactus is apparently considered to be equipotent with **Trichocereus** pachanoi, which it arguably resembles at a distance. It is said to be used in a similar manner by some of the locals who are aware of its powers (Davis 1983). A human bioassay of an unspecified quantity of A. arboreus resulted in no discernable activity (Stuart 2002).

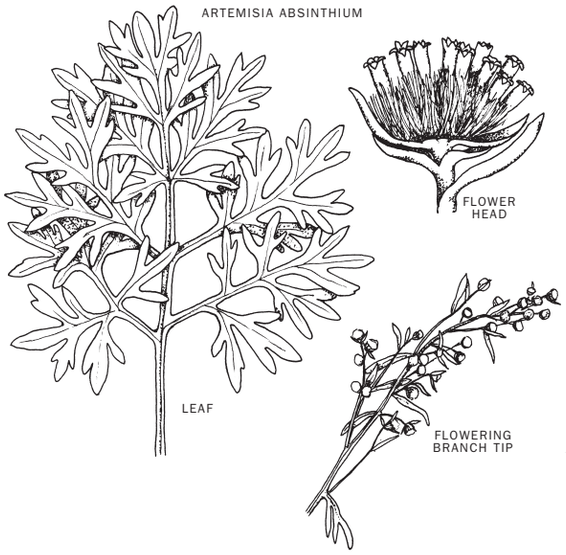
Chemistry of this obscure and rare cactus is unknown, but it would be expected to yield moderate quantities of *mescaline*, if the reports of Davis were accurate. One analysis of wild Peruvian material found a water content of 82.3%, but was unable to resolve any alkaloids or triterpenes; the method of analysis is questionable (Trout ed. 1999). Davis (1983) reported that results of an analysis for alkaloids would be published at a later date, but nothing has eventuated since the publication of his paper.

Armatocereus laetus is a large, tree-like cactus 4-6m high, much branched, columnar, bluish-grey to greyish-green, but not glaucous; 4-8 ribs, prominent; areoles 2-3cm apart; each bearing up to 12 spines, brown when young, becoming grey to nearly white with age, 1-3(-8)cm long, subulate. Flowers 6.5-8cm long, 5cm across, tubular-funnel shaped, nocturnal; perianth short, inner perianth segments white, 2cm long; pericarpel with small scales; receptacle tube short. Fruit green, with very spiny, wooly areoles; splitting down the side when ripe, white within; pulp edible. Seeds black, large, mostly flattened, ovoid or cap-shaped. Fl. summer.

N. Peru; Jaen, Sondorillo, Huancabamba and east of Abra Porculla. Also in s. Ecuador (Britton & Rose 1963; Davis 1983; Innes & Glass 1991). Requires good light; min. temp. 13ºC (Innes & Glass 1991). Should grow well with poor quality, well-drained soil, moderate sun and little water (Trout & Friends 1999).

ARTEMISIA

(Compositae/Asteraceae)



Artemisia abrotanum *L.* – southernwood, lad's love, hexenkraut
Artemisia absinthium *L.* – wormwood, absinthe, green ginger, wermuth, old woman, green muse, ajenjo, ajincuy, dhupma, shimali pati
Artemisia arborescens *L.* – shrub wormwood
Artemisia caerulescens *L.* **ssp. gallica** *(Willd.) Persoon*
Artemisia capillaris *Thunb.* – yin chen
Artemisia carruthii *A.W. Wood ex Carruth* **(A. vulgaris ssp. carruthii** *(Wood ex Carr.) F.C. Gates***)**
Artemisia cina *Bergius* – levant wormseed, hexenkraut
Artemisia copa *Phil.*
Artemisia dranunculus *L.* – tarragon, French tarragon, estragon, dragoncello
Artemisia frigida *Willd.* – chin-de-I-ze
Artemisia genipi *Weber* **(A. spicata** *Wulf. ex Jacq.***)** – black wormwood, genepi
Artemisia indica *Willd.*
Artemisia keiskeana *Miq.*
Artemisia ludoviciana *Nuttall* – sacred western mugwort, white mugwort, white sage, prairie sage, Mexican sagewort, xawiskarawirotapapanahi, lobed cudweed
Artemisia mexicana *Willd.* – itzauhyatl, estaphiate, ajenje
Artemisia nilagirica *(Clarke) Pamp.* – khel bijak, ote palandu
Artemisia scopulorum *A. Gray* – sage bush
Artemisia tilessii *Ledeb.*
Artemisia tridentata *Nutt.* – sagebrush, big sagebrush, sage among rocks, black coyote tobacco, rabbit candy, cetah c'ah, kah pilikhanik, mai lizin nat'oh
Artemisia vulgaris *L.* – mugwort, felon herb, sailor's tobacco, gypsy tobacco, English tobacco, old man, bollan bane ['white herb'], belfuss, armoise, cosi, moxa herb, muggar, muggons, ai-hao, hexenkraut, una, titepati, pati
Artemisia spp.

Artemisia is a large genus with many representatives bearing inebriating essential oils; they also find useage in medicine, often as tonics, anthelmintics and abortifacients. The genus is named after Artemis [identified with Diana], the 'mother of herbs', lady of the hunt and Greek goddess of wild places, wild beasts, the moon, and the sea. A. absinthium and A. vulgaris were sacred to her, and she was considered to be concentrated in those herbs, which were ingested during spring full-moon Artemis celebrations in the ancient Mediterranean, fertility rites which ended in group sexual bonding. In India, members of the genus are sacred to Shiva and Vishnu, and to Isis [the mother goddess] in Egypt (Albert-Puleo 1978; Jordan 1992; Pendell 1995; Rätsch 1992; theobromus pers. comm.).

The most famous of the Artemisia spp. is 'wormwood', A. absinthium. It has been believed to dispel evil spirits and cure poisoning, even though it is said to have grown along the route by which the serpent left the Garden of Eden. Burning it with sandalwood [see **Santalum**] is said to conjure spirits. It has been used to procure abortion, due to its uterine effects, and is known to repel insects and kill intestinal worms. A leaf infusion is tonic to the liver, blood, gall bladder and digestive system, reducing the toxicity of lead poisoning, as well as being antiinflammatory, antipyretic and antimalarial (Albert-Puleo 1978; Bremness 1994; Cunningham 1994; Simonetti 1990). In India, it is said to have "a remarkably tonic influence upon the brain, especially upon its higher faculties concerned with psychical function" (Nadkarni 1976).

Wormwood's real fame came with the invention in 1792 of 'absinthe', a potent alcoholic liqueur featuring A. absinthium as the principal herbal ingredient. The 'original' [a matter of debate] absinthe of Dr. Pierre Ordinaire ['La Fee Verte'] was 68% alcohol, and probably contained A. absinthium, aniseed [**Pimpinella**], sweet flag [**Acorus**], coriander [**Coriandrum**], chamomile [**Anthemis**, **Matricaria**], parsley [**Petroselinum**], hyssop, dittany, lemon balm [see *Endnotes*], veronica and spinach. It has been reported, though, that as early as 1559, independent London distilleries were making a crude absinthe by steeping dried leaves of A. absinthium in equal parts of malmsey wine and 'burning water thrice distilled'. Dioscorides mentioned that the inhabitants of Thrace and around the Sea of Marmara drank 'apsinthites oinon' ['wine with wormwood'] as a summer health tonic. Also, in Tudor-period England, an ale made with A. absinthium called 'purl', and a wine called 'purl royal', were being made and consumed, particularly as breakfast stimulants and appetite tonics (Conrad 1988; Gunther ed. 1934; Mabey 1997; Pendell 1995).

Since the wider introduction of true absinthe, its popularity and production spread, and many variations on the original recipes were marketed, but always with wormwood or its oil as the main additive. The best was generally considered to be 'Pernod Fils', which used wormwood, mugwort [A. vulgaris], hyssop, lemon balm, aniseed [see **Pimpinella**] and fennel seed [see **Foeniculum**]. In the 1840's, French soldiers in Algeria were issued absinthe as a fever-preventative. The drink was popular especially with artistic and creative personalities, having been consumed by such men as Vincent Van Gogh, Pablo Picasso, Oscar Wilde, Arthur Rimbaud, Charles Baudelaire and Ernest Hemingway. Pressure to ban absinthe soon came, largely after an alcoholic man claimed to have been under the influence of absinthe when he murdered his wife in 1905. Much of this pressure seemed to have originated from manufacturers of alcoholic beverages who were in competition with absinthe sales, and had heavy political influence. Claims of neurotoxicity were made [claims which extended to A. absinthium and *thujone*, one of its major constituents], which could in truth be related to the many counterfeit, poorly-manufactured absinthes on the market, many of which were not properly distilled and contained heavy metal additives to add the particular colour and turbidity that consumers would expect in their absinthe. The high alcohol content of these drinks would also account for more neurotoxicity than the herbal additives, wormwood being taken up as the culprit on dubious scientific grounds. Belgium banned it in 1905, and other countries soon followed suit. Bootleg absinthe is still made for local consumption in the Val-de-Travers region of Switzerland, and 'absenta', a Spanish version, was never outlawed. Otherwise, the closest drinks remaining are 'Pernod' [which contains no wormwood] and 'Vermouth' [which contains small amounts]. See *Methods of Ingestion* for more discussion (Albert-Puleo 1978; Conrad 1988; Mabey 1997; Ott 1993; Pendell 1995; Simonetti 1990; Usher 1974).

'Mugwort' [A. vulgaris] has long been used as a uterine stimulant, and is said to be an antidote to opium-poisoning [see **Papaver**]. It was once used in brewing beer, and is known in Germany as a witch's herb. It was the first of the 9 sacred herbs given to the world by Odin, and was known as 'una' by the Saxons in England. The Romans planted it alongside their roads, to be picked and placed in the sandals to relieve tired, aching feet. Placed under or in the pillow, it is said to produce wondrous dreams, an effect verified by some modern psychonauts. The Ainu use it to exorcise disease-causing spirits, by drinking an infusion of it before divination. In TCM, the herb is rolled into cones ['moxa'] to be placed on the body and burnt for heat-treatment ['moxibustion'], as well as being used to treat haemorrhage and diarrhoea. In India, it is used as an antispasmodic, larvicide, anthelmintic and stomachic. In parts of Asia, the leaves have also been smoked as an inebriant (Albert-Puleo 1978; Baill pers. comm.; Bremness 1994; Cunningham 1994; De Vries 1991; Mabey 1997; Mabey et al. ed. 1990; Misra & Singh 1986; Ott 1993; Simonetti 1990; Usher 1974). In Australia, some **Cannabis** smokers have used A. vulgaris foliage as an alternative when no **Cannabis** was available (pers. obs.). In

England, children would sometimes smoke mugwort in acorn-cup pipes, to become 'groggy', a state which they hid from their parents. On Tynwald Day [Jul. 5], the thousand year old parliament of the Isle of Man still meets outdoors at an ancient artificial mound at the centre of the island [Tynwald Hill]; nearly everyone present wears a sprig of mugwort ['bollan bane'] (Mabey 1997). The sprig is locally believed to guard against faeries (theobromus pers. comm.). It is said to be used as a 'sage' [see **Salvia**] in peyote ceremonies [see **Lophophora**] – it is rubbed over the body as a purifier, chewed before chewing peyote, or smouldered in the sweat-lodge (Schultes 1937a), though this might be a confusion with A. ludoviciana or another Artemisia sp. (pers. obs.). In Nepal, seeds and other aerial parts of A. vulgaris and other A. spp. are important shamanic herbs, required for all ceremonies [Chenopodium abrosioides is substituted if Artemisia can't be obtained - see *Endnotes*]; they are used for shamanic travel, ritual incense, as a protectant and medicine (Müller-Ebeling et al. 2002).

A. abrotanum is used in s. Europe to make a stimulating tonic drink; the herb is also put under the pillow to relieve insomnia. In Germany, it is considered a witch's herb ['hexenkraut']. In England, it was believed that a witch could not pass one of these plants without stopping to count every leaf. It has antiseptic, anthelmintic, and insect-repellant properties, as well as treating skin problems and acting as an emmenagogue. A. caerulescens ssp. gallica is used in Spain as an analgesic, antipyretic and antiinflammatory. A. arborescens has been used in European folk medicine as a contraceptive and abortifacient. A. cina is also a 'hexenkraut', effective against roundworm and threadworm, and said to be toxic in large amounts. A. afra is used as an ash with snuffing tobacco [see **Nicotiana**] in Basutoland, s.e. Africa. The Zuni of N. America inhale the smoke of A. carruthii as an analgesic. In Chile, an infusion of A. copa is consumed, said to be "probably hallucinogenic" (Bremness 1994; De Vries 1991; Ott 1993; Sacco et al. 1983; theobromus pers. comm.; Usher 1974; Watt & Breyer-Brandwijk 1962).

'Tarragon' [A. dranunculus] is a fiery herb with an unusual tang used as a cooking spice, and as a tonic, analgesic and appetite stimulant. The root acts as a soporific, and is used to treat toothache (Bremness 1994; Lawless 1995; Mabey et al. ed. 1990); the herb has also been used similarly to A. indica [see below]. The Apache inhale smoke from A. frigida to calm the nerves after a 'terrible fright'; the Potowatomi inhale its smoke as a stimulant. The Navajo drink a decoction of A. scopulorum to purify mind and soul. Crushed leaves of A. ludoviciana are snuffed by the Cheyenne to treat headaches, and the Winnebago use it as a smudge to 'revive consciousness'. To many Native American shamans, it is a very important and sacred herb, used to heal, purify, banish evil, and communicate with the Great Spirit. It is usually taken either by decoction, heated in a sweat-lodge, or smoked [as a smudge or incense]. A. mexicana was used by the Aztecs as an intoxicant – the inside of the stem was said to be used to lighten the mood, promote health and relieve cough, and flowers were used to treat 'lassitude'. The seeds of A. keiskeana are used in China to prepare 'elixirs of immortality'. In India, beds of A. indica are prepared for a person suffering from body pain; in Nepal, the leaves are heated and applied to treat dysentery (Heffern 1974; Kindscher 1992; Kindscher & Hurlburt 1998; Ott 1993; Rätsch 1992).

In Meghalaya, India, A. nilagirica leaf is used to treat 'brain diseases' and asthma, or decocted to apply to sores (Neogi et al. 1989). The Oraon of w. Bengal smoke A. nilagirica to produce 'hallucinations'; the burning herb also produces sedation and sleep, and the Santals of the same area use the leaf oil as a local anaesthetic. The plant has also been used as an asthma remedy (Pal & Jain 1989). A. capillaris is used in TCM for its dried young shoots, to treat jaundice; it has antipyretic, antibacterial, antiviral, antiasthmatic and hypotensive activities, though it can sometimes cause nausea, dizziness and distended abdomen (Huang 1993). The herb is pleasantly psychoactive when smoked, and is particularly effective smoked in combination with **Nymphaea** caerulea flowers (friendly pers. comm. 2002). A. genipi is used in Europe as a tonic, digestive expectorant, and in the manufacture of some liquors (Simonetti 1990). The Yupik of s.w. Alaska use A. tilesii to relieve joint pain and chest colds, and as a topical treatment for infections (Overfield et al. 1980).

A. tridentata, 'sagebrush', is used by Native Americans in 'smudging' [cleansing an area with smoke from a smouldering bundle of an aromatic herb] and sweat-lodges (Pendell 1995), for its purifying essence; it is also used as a digestive, anthelmintic, and disinfectant, as well as treating headache and colds (Winter 1998). It is said that apprentice shamans must learn to "tap the spirit of the sagebrush" in order to learn how to cure (Bremness 1994).

Many of these herbs contain *thujone*, which has narcotic and mildly 'psychedelic' effects; it may also be toxic in large amounts, and should be avoided by pregnant women. Many **Artemisia** spp. can be smoked to produce inebriation, which may differ qualitatively with different species bearing different chemical make-up, as *thujone* is not the only pharmacologically-active chemical in this genus, just the best-known. Richard Miller (1985) claimed that the sesquiterpene absinthin [which he called 'absinthine'], which is present in A. absinthium as the main bitter compound, "is listed as a narcotic analgesic in the same group as *codeine* and dextromethorphan hydrobromide". However, I have been unable to find any other sources which verify this seemingly unfounded statement.

A. absinthium essential oil is highest before blooming [0.2-1.7%], and may yield 2.76% α-*thujone*, 46-60% β-*thujone*, 2.7% sabinene, 3.2% trans-sabinol, 27.78% trans-sabinyl acetate, 1% myrcene, 1.4% geranyl-propionate, linalyl acetate, and thujols; the herb has also yielded absinthin, isoabsinthin, absintholide, anabsin, anabsinthin, artemisine, arabsin, arlatin, artabasin, artabsinolides A-C, artenolide, sesartemin, diasesartemin, episesartemin A, episyringaresinol, spinacetin, inuliobose, OH-pelenolide, ketopenelolides A & B, 7-ethyl-3,6-dihydro-1,4-dimethylazulene, 7-ethyl-5,6-dihydro-1,4-dimethylazulene, 5-(1-propenyl)-2-thiophenepropanoic acid (Bruneton 1995; Buckingham et al. ed. 1994; Lawless 1994; Ott 1993; Pendell 1995), and *choline*. An extract of the plant showed binding activity to nicotinic and muscarinic *acetylcholine* receptors in human brain, displacing *hyoscine* (MacKenzie 2000; Wakea et al. 2000).

A. annua aerial parts have yielded *scopoletin* and scopolin (Saitbaeva & Sidyakin 1971).

A. arborescens leaves and flowers from Italy yielded 1% essential oil, containing 45% β-*thujone*, 17.86% *camphor*, 11.32% chamazulene [antipyretic, antiinflammatory], traces of *methyleugenol*, α-*thujone*, humulene, *borneol*, and other compounds (Sacco et al. 1983).

A. caerulescens ssp. gallica contains *thujone* (Ott 1993).

A. capillaris shoots have yielded capillarin, capillene, capilline, capillone, scoparone, *chlorogenic acid*, caffeic acid, 4-OH-*acetophenone*, and an essential oil containing β-*pinene* (Huang 1993).

A. dranunculus might owe its hypnotic properties to its large content of *estragole* [68-80% of essential oil]; the oil also contains 6-12% cis- and trans-ocimene, 2-6% limonene, *thujone*, capilline, nerol, phellandrene, 9-OH-geraniol and cineol. The herb has also yielded methoxy-flavanones, naringenin [see **Citrus**], capillarin, capillone, scoparone, artemidiniol, artemidiol, 7-MeO-coumarin, 6,7-dimethoxycoumarin, inulobiose, L-pinitol, benzopyrans, 4-MeO-benzyl alcohol, 5-phenyl-1,3-pentadiyne, 4,6-heptadiyne-1,3-diol, iodine and vitamins A & C (Balza et al. 1985; Bremness 1994; Bruneton 1995; Buckingham et al. ed. 1994; Lawless 1995; Rastogi & Mehrotra ed. 1990-1993).

A. ludoviciana fresh flower heads yielded 0.01-0.1% anthemidin, a sesquiterpene lactone (Epstein & Jenkins 1979).

A. tilesii has yielded *thujone* and iso-*thujone* in a ratio of 4:1 [0.05% combined], with traces of *camphor*, cineole and artemisia ketone, as components of the essential oil (Overfield et al. 1980).

A. tridentata ssp. tridentata ['basin big sagebrush'] essential oil contains c.30% each of *thujone* and methacrolein [2-methyl-2-propenal], 11% 1,8-cineole and 3% *camphor*; ssp. vaseyana ['mountain big sagebrush'] essential oil contains no *thujone*, but is predominant in 1,8-cineole [57.8%], with smaller amounts of camphene [11.6%] and *camphor* [7.9%] (Weber et al. 1994). The herb has also yielded sesquiterpene lactones, including arbusculins A-C and desacetyl-matricarin (Shafizadeh et al. 1971); and artelin, artemisiole, artevasin, dehydroleucodin, dentatin A, dihydromagniolialide, 11-β-13-dihydro-santamarine, eupafolin, 1,2-epoxy-2,5-dimethyl-3-vinyl-4-hexene, 1-(3-OH-methyl-2,2-dimethylcyclopropyl)-2-methyl-1-propanone, p-mentan-9-ol, 2-methyl-2-propenal, 1-(3-OH-methyl-2,2-dimethylcyclopropyl)-2-methyl-2-propen-1-one, parishins B & C, santolinic acid, santolinolides A-C and tatridins A & B (Buckingham et al. ed. 1994).

A. vulgaris has yielded 0.1-0.2% essential oil, consisting of 0-82% α-*thujone*, 6-16% β-*thujone*, 3% *camphor*, 0.45-2.6% camphene, up to 15% camphone, 0.25-2% 1,8-cineole, 0.92% *eugenol*, the 3,5-dimethoxybenzene-isomer of *methyleugenol*, linalool, *pinene*, limonene, p-cymene, α-terpineol, geraniol, caryophyllene and cadinene; the plant has also yielded α-amyrin, ferneol, 12-tricosanol, vulgarin, vulgarole, epoxyartemisia-ketone, triyne-acids and 6-MeO-7,8-methylenedioxycoumarin (Bruneton 1995; Buckingham et al. ed. 1994; Lawless 1995; Misra & Singh 1986; Murray & Stefanovic 1986; Shulgin & Shulgin 1991).

Artemisia absinthium is a fragrant perennial herb c.40-100cm tall; stems finely sericeous or eventually glabrate. Leaves alternate, dissected, silvery-sericeous on both sides, or eventually subglabrate above, the lower long-petiolate and 2-3-pinnatifid, with mostly oblong-obtuse segments c.1.5-4mm wide, blade rounded-ovate outline, c.3-8cm long; upper leaves progressively less divided and shorter-petiolate, divisions often more acute. Inflorescence a panicle or raceme, leafy; heads discoid, flowers all fertile, the marginal pistillate; involucre c.2-3mm high, finely and densely sericeous; involucral bracts dry, imbricate; receptacle flat to convex or hemispherical, beset with numerous long white hairs between the flowers; anthers obtuse or subcordate at base; style-branches flattened, truncate, penicillate. Achenes nearly cylindric, narrowed to base and rounded at summit, glabrous. Fl. Jul.-Sep. (Gleason 1952).

Rocky hillsides and wasteland; native to Eurasia and n. Africa, established as a weed in Canada, US (Bremness 1994; Gleason 1952) and parts of Australia [Qld, WA]; cultivated as an ornamental and medicinal herb.

For absinthe manufacture, wormwood was planted in spring, and harvested the next year in July just before flowering. A plant may live for 6 years, with maximum leaf-production in the second year. The harvested leafy branches were stacked to dry for 1 month before being processed

(Conrad 1988) [see *Methods of Ingestion*].

ARUNDO

(Gramineae)

Arundo donax *L.* **(A. bifaria** *Retz.***; A. glauca** *Bubani***; A. latifolia** *Salisb.***; A. sativa** *Lam.***; Cynodon donax** *Raspail***; Donax arundinaceus** *P. Beauv.***; D. donax** *(L.) Asch. et Graebn.***; Scolochloa arundinacea** *(P. Beauv.) Mert. et Koch***; S. donax** *(L.) Gaudin***)** – giant reed, carrizo

A. donax has been asociated with Orpheus and the underworld; it is also considered sacred to Priapus and Silvanus, associated with sexuality and aphrodisia. Pan was said to have made the first 'pan-pipes' from the nymph Syrinx he was chasing, who had changed herself into a reed to avoid being raped. Since ancient times, A. donax has been used to make wind instruments such as 'shawms', which are often used in a magical context (Rätsch 1992; theobromus pers. comm.). It is still used today to make reeds for wind instruments, such as saxophones and clarinets. The Huichol of Mexico use its stems to make the arrows for their annual peyote pilgrimage [see **Lophophora**], as well as to make dance staffs to be held by the pilgrims (Ott 1993). Rhizomes of A. donax are decocted in Ayurvedic medicine as an emmolient, diuretic, anti-galactagogue and emmenagogue (Ghosal et al. 1969, 1971a).

There is vague anecdotal evidence that A. donax rhizome and **Peganum** harmala root are used together by some musical Sufi groups as a ritual entheogen; the practice is said to be very secretive (De Korne ed. 1996), if it exists at all. A. donax is reportedly used as an ayahuasca-additive in S. America (Rätsch 1998) [see **Banisteriopsis**], though supporting data is required. Due to their *tryptamine*-alkaloid content, A. donax rhizomes have been recently used experimentally in ayahuasca-analogues, though virtually no one has reported success. There is at least one seeming allergic reaction on record from ingestion of an A. donax rhizome extract with **Peganum** harmala seed extract. One person experienced blurred vision 1hr after ingestion, followed by the eyes becoming watery and swollen. Conjunctivitis and hives appeared the next day and persisted for 3 days (De Korne 1994; De Korne ed. 1996).

There is one report of psychoactivity from this plant, though the experience was qualitatively very different to *DMT*, and it is unclear how much of the effects were due simply to the strong dose of MAOI admixture [**Peganum** harmala]. Fresh rhizome [500g prior to washing, and removal of culm] was consumed with 15g **Peganum** harmala seed. The experience was described as 'rough' both mentally and physically, and 'projectile-vomiting' was experienced during the onset of effects. Early in the experience, there was contact with a strange-looking entity, who shared information with the psychonaut. Closed-eye imagery was described as "strikingly 3-dimensional and rotating like a carousel made entirely out of rising and falling waterfalls, and thin, almost fabric-like veils composed of pastel coloured lights". Open-eye imagery, in a slightly darkened room, was described by the psychonaut who was "in a place composed entirely of violet billowing fog with scattered glowing green dots (looking like a De La Warre 'electromagnetic node distribution' picture), where scattered curving 'cracks' in the clouds had bright orange light spilling out in radiating shafts, and drifting veils also composed of orange light". The psychonaut also found that he could observe anywhere in the world simply by thinking about the place or a person... "the entire world seemed quite transparent" (Trout pers. comm.).

A. donax whole plant [from India] has yielded 0.01% *DMT*, 0.064% *bufotenine*, 5-methoxy-*N*-*methyltryptamine*, 0.29% *gramine*, and *gramine*-N-oxide [c.14% of total alkaloids; actual yield not reported] (Dutta & Ghosal 1967). Rhizomes from Egypt have yielded 0.05% alkaloids [including *gramine*, *DMT*, *bufotenine* and 2 other alkaloids; in another test, *DMT*, *bufotenine*, dehydrobufotenine, bufotenidine (see below) and 5-MeO-*N*-*methyltryptamine* were found in rhizomes (no *gramine*), whilst aerial parts yielded *DMT*, *bufotenine*, 5-MeO-*N*-*methyltryptamine* and *gramine*], and in this case aerial parts yielded smaller quantities (Wassel 1982; Wassel & Ammar 1984). Rhizomes from India yielded 0.006% *DMT*, 0.002% 5-MeO-*N*-*methyltryptamine*, 0.026% *bufotenine*, 0.33% bufotenidine [neuromuscular blocker, anticholinergic, causes *histamine* release, uterine stimulant], 0.063% dehydrobufotenine [causes *histamine* release, has an anticholinergic effect on skeletal muscle, and is a uterine stimulant; see also **Bufo**], *tryptamine* and *gramine*-N-oxide. Flowers from India yielded 0.2% alkaloids, with 0.013% *DMT*, 5-MeO-*N*-*methyltryptamine*, 0.0016% *bufotenine*, 0.0009% *DMT* methohydroxide, *tryptamine*, 0.055% *gramine*, 0.096-0.104% *gramine* methohydroxide, 0.032% 3,3'-bisindolylmethyl dimethylammonium hydroxide, and 0.0005% *tetrahydroharman*. The *gramine* content remained constant for the first 2 weeks of flowering, then declined to almost nothing over the next week or so. Leaves and culms also contain alkaloids, as well as triterpenes and sterols. Leaf harvested in April from cultivated plants [Brisbane, Australia] tested strongly positive for alkaloids. A defatted ethanol extract of the rhizomes showed hypotensive and antispasmodic effects; total rhizome alkaloids have uterine-stimulant, anticholinergic and *histamine*-releasing effects (Bhattacharya & Sanyal 1972; Ghosal 1972; Ghosal et al. 1969, 1970b, 1971a, 1972b; Webb 1949). North American plants tested appear to be deficient in *DMT*, according to independent TLC analysis which found no *DMT*, except in new white roots <2mm diameter (Trout pers. comm.).

Arundo donax is a tall perennial reed, forming thickets, up to 7m tall, 2cm diam. at base, rising from a rough, knotty, branching rhizome. Leaves cauline, blades up to 100cm long, 5-7cm wide on main stem, blades numerous, broad, flat, glabrous, rounded and cordate at base; ligules short, membranous, with a minutely hairy margin. Inflorescence a dense, erect panicle, feathery, whitish to brown, up to 60cm long; spikelets several-flowered (2-7), 8-15mm long, laterally compressed, disarticulating above the glumes and between the florets; rachilla glabrous or shortly hairy; florets bisexual; glumes 2, unequal, membranaceous, 3-nerved, narrow, tapering into a slender joint, +- as long as spikelet; lemmas thin, 3-nerved, gradually narrowed at apex, with long silky hairs, the nerves ending in slender teeth, the middle one longer and ending in a straight awn.

Native to the 'Old World', frequently cultivated as an ornamental; common in gardens of the southern US, escaped along irrigation ditches from Texas to central California (Gleason 1952); escaped in Australia alongside roads and irrigation ditches along east coast, from Victoria to Queensland (Auld & Medd 1992).

ASARUM

(Aristolochiaceae)

Asarum arifolium *Michx.*
Asarum canadense *L.* – wild ginger, Indian ginger, Canada snakeroot, Vermont snakeroot, wamaxe
Asarum caudatum *Lindl.*
Asarum europaeum *L.* – hazelwort, asarabacca
Asarum forbesii *Maxim.* – batei-saishin
Asarum heterotropoides *F. Schmidt* **(Asiasarum heterotropoides** *(F. Schmidt) Maekawa***)** – oku-ezo-sai-shin, xi xin, saishin
Asarum sieboldii *Miq.* **(Asiasarum sieboldi** *F. Maekawa***)** – hsi-hsin, xi xin, saishin
Asarum sieboldii var. seoulensis *Nakai*

It is apt that the generic name of these herbs comes from the Greek 'asaron', meaning 'nausea'. They generally act as emetics, and are toxic to the kidneys and uterus in large amounts, but in smaller quantities they have medicinal applications, and have been used as snuffs to promote sneezing. A. europaeum is used as an immune stimulant and antiasthmatic; it has also been given as a snuff to cause sneezing. The herb is emetic, expectorant and diaphoretic. It has been used in alcoholic spirits, and was once used for dyeing wool due to the apple-green pigment that can be obtained from the plant (Bremness 1994; Chiej 1984).

A. canadense is used in N. America as a nerve tonic, stimulant, uterotonic, diaphoretic, carminative and diuretic (Hutchens 1973, 1992; Kindscher & Hurlburt 1998). A bioassay of A. canadense fresh roots [amount unspecified], which tasted similar to **Acorus** calamus rhizomes, revealed a sedative-hypnotic activity (pers. comm.).

The whole plant, or only the rhizome of A. heterotropoides and A. sieboldii, is used in TCM [0.9-3g] to treat colds, headache, toothache, vomiting, and inflammation of the mouth. The herbs also act as an analgesic, local anaesthetic, sedative, expectorant, emetic, purgative, diuretic, diaphoretic, respiratory stimulant, antispasmodic and antirheumatic. They can cause headache, sweating, irritation, dyspnoea, and even coma, although they are said to "be used to wake a person from unconsciousness" (Huang 1993; Huang et al. 1999). The essential oil caused, in animals, irritability, followed by paralysis and death (Perry & Metzger 1980); the doses used were probably very high.

A. arifolium rhizome essential oil contains mostly *safrole*, as well as *asarone*, *eugenol*, *methyleugenol*, *methylisoeugenol*, l-*pinene* (Miller 1902) and *eugenol* methyl ether (Power & Lees 1902).

A. canadense rhizome essential oil contains *eugenol*, *methyleugenol*, *borneol*, geraniol, *pinene*, linalool and terpineol (Lawless 1995; Power & Lees 1902); fresh leaves have yielded chalcone glycosides [0.006% chalcononaringenin 2',4'-di-O-glucoside and 0.012% chalcononaringenin 2'-O-glucoside-4'-O-gentiobioside] and flavonol glycosides [quercetin- and kaempferol-derivatives] (Iwashina & Kitajima 2000). A. canadense var. reflexum has yielded small quantities of aristolochic acid, which has anti-tumour properties (Doskotch & Vanevenhoven 1967).

A. caudatum rhizomes yielded 2-4% essential oil, consisting of 60-75% *methyleugenol*, 10% *asarone*, 10% azulene, and traces of *pinene* (Burlage & Lynn 1927).

A. europaeum rhizome essential oil has yielded 30-35% *asarone*, 15-20% *methyleugenol*, 2-3% asarylaldehyde, 12-15% bornyl acetate, 10-12% of a sesquiterpene, 1-2% of a terpene and 10-12% resins (Bruckner & Széki 1932); others also reportedly found sinapic acid [a phenylpropanoid], *methylisoeugenol* (Harborne & Baxter ed. 1993), trans-iso-*asarone* [bronchospasmolytic, secretolytic] (Farnsworth & Cordell 1976), *camphor* (Chiej 1984), *chlorogenic acid*, iso-*chlorogenic acid*, amino acids and sugars

in the rhizomes (Rastogi & Mehrotra ed. 1990-1993).

A. forbesii has yielded *elemicin*, trans-*asarone*, asarumins A-D and linoleic acid (Bian et al. 1990).

A. heterotropoides rhizome essential oil has been shown to contain 21-39% *methyleugenol* and 17-33% *safrole* (Wang et al. 1997), as well as *asaricin* (Harborne & Baxter ed. 1993); highest *methyleugenol* levels were found during sprouting, and after fruiting, while *safrole* was most abundant at these same times, as well as during flowering. The essential oil of aerial parts was shown to contain 1.4-9.6% *methyleugenol* and 0.36-2.1% *safrole*; both were most abundant during flowering, later decreasing in concentration (Wang et al. 1997). The plant has also yielded β-*pinene*, cineole, eucarvone, asarylketone, asarinin and dl-demethylcoclaurine (Huang et al. 1999). A. heterotropoides var. mandshuricum rhizomes have yielded pellitorine [(2E,4E)-N-isobutyl-2,4-decadienamide], (2E,4E,8Z,10E)-N-isobutyl-2,4,8,10-dodecatetranamide, and (2E,4E,8Z,10Z)-N-isobutyl-2,4,8,10-dodecatetraenamide (Yasuda et al. 1981).

A. sieboldii rhizome has yielded 3% essential oil, containing *methyleugenol*, *safrole*, *elemicin*, *pinene*, phenol, *asaricin*, eucarvone and palmitic acid (Chou & Chu 1936; Perry & Metzger 1980).

A. sieboldii var. seoulensis rhizomes yielded 2.21% essential oil, containing *safrole*, *methyleugenol*, l-*pinene* and palmitic acid (Kaku & Kondo 1931); glycosides are also found in the rhizomes (Hashimoto et al. 1992).

Some Asarum spp. are also reported to contain *1-allyl-2,3,4,5-tetramethoxybenzene* (Buckingham et al. ed. 1994).

Asarum heterotropoides is a perennial herb; rhizomes creeping, with short internodes. Leaves annual, membranous, thin, usually paired, long-petioled, cordate or reniform-cordate, entire, yellowish-green, usually obtuse, 4-6cm wide, scattered short-pilose on both sides, especially when young. Flowers radical, terminal, solitary, short-pedicelled, bisexual, glabrous, actinomorphic or scarcely zygomorphic; perianth-tube depressed-globose, 3(-4)-lobed, lobes fleshy, flat, obtuse, recurved above after anthesis, adnate at base to ovary then free above or gamosepalous; stamens 12 in 2 series; filaments longer than anthers. Ovary semi-inferior or superior, (3-)6-locular; ovules many, 2-seriate in each locule; styles 6, free or connate at base, very short. Fruit berry-like, the seeds exposed by the decaying lower portion, ellipsoidal, rounded on back, involute on margin, flat and with fleshy appendage on ventral face. Fl. May.-Jun.

Hohkaido [Japan]; Sakhalin, south Kuriles. Very similar to A. sieboldii (Ohwi 1965); A. heterotropoides var. mandshuricum is considered by some to be synonymous with A. sieboldii.

The plant is collected in its native range from May to June (Perry & Metzger 1980).

ASPERGILLUS

(Hyphomycetaceae/Aspergillaceae/Eurotiaceae)

Aspergillus flavus *Link.* – Aspergillus ear, kernel rot
Aspergillus fumigatus *Fres.*
Aspergillus niger *Van Tiegh.* – ear rot
Aspergillus spp.

It has been proposed that the mould A. fumigatus, rather than 'ergot' [see **Claviceps**] or mercury compounds, was the bread contaminant responsible for the case of mass poisoning in Pont-Saint-Esprit, France, in 1951. Those affected suffered from "bouts of violent hysteria" and were "overwhelmed by visual hallucinations and other sensorial illusions, as well as convulsions and cramps". Seven people died over the next four days, and psychic effects amongst those affected took up to two months to subside completely (Samorini 1997b).

Cattle feeding on hay infected with Aspergillus spp. have been known to experience irritability, 'anomalous behaviour', diarrhoea, and sometimes death (Samorini 1997b). Complex toxic syndromes resulting from consumption of Aspergillus-contaminated plant matter have been observed in a wide array of wild and domesticated animals (Pammel 1911). Worth mentioning is a case involving a large flock of Canada geese which became intoxicated from feeding on wet barley; they were described as "obviously stoned out of their tiny minds, judging by their erratic flight behaviour" (Smullen 1989). Although fermentation of the plant matter, producing alcohol, should be an obvious initial consideration, the possibility of infection by a psychotropic Aspergillus sp. or similar fungus should not be overlooked.

Another species, A. oryzae, known as 'koji', is used in the manufacture of many Japanese foods, such as 'shoyu' [soy sauce], 'tamari', 'miso', 'amazake' [a sweet fermented rice or millet porridge] and 'sake', presumably for its ability to produce maltose and diastase. A. oryzae is processed into a product known also as koji by innoculating steamed rice, which has been spread out to cool, with spores of the fungus. This is then placed in a cellar and stirred every 12 hours as the mould develops – four days later it is ready, and it is usually dried for storage. This koji is then used in the manufacture of sake and other products. A crude sake [c.14% alcohol] can be made in only 10-14 days, with just rice, koji, and yeast. A similar rice wine from Java ['raggi'] is also made using a mould fungus, but it is not known what species is used. Rabbits inoculated with the fungus showed convulsive symptoms (Bock & Voogelbreinder in press; Nadkarni 1976; Pammel 1911; theobromus pers. comm.). It is worth noting that the above-mentioned sake has some interesting history. In Japan, the beverage is associated with the god Susanoomikata, who is said to have created it to stupefy a serpent-monster so that it could be safely killed. The beverage has been used as an offering to tengu spirits and the gods in general, as well as being consumed in Shinto shamanic rites. In Korea, related rice wines of similar manufacture are still used as sacred inebriants by indigenous shamans (Rätsch 1999b). For related uses of Aspergillus spp. in the production of fermented beverages, see **Delosperma**.

For at least several decades, **Cannabis** smokers have on occasion buried their moist herb [packed in a tin or jar] to age underground for up to several weeks; another similar method adds a pinch of sugar to the small amount of water used to moisten the herb, but simply calls for storing the container in a 'cool, dark, damp place'. The aim is to increase the potency of the **Cannabis** by infecting it with a mould fungus, which often appears to be an Aspergillus sp. [probably A. flavus, A. fumigatus or A. niger]. The resulting foul mass must be dried to be used [usually smoked]. In the U.S., it has been known as 'black merta' or 'Harold's disease'. In Australia, it is sometimes called 'buddha', though sometimes this term is freely applied to any aged, compressed or imported Asian **Cannabis**. Although it would seem on occasion that such fungal infections can indeed synergise with smoked **Cannabis**, some users occasionally reporting minor psychedelic effects, the practice is anything but healthy. It is also quite risky as the user can have little control over which species and strains of mould will colonise the **Cannabis**. Many moulds will also decrease the potency of **Cannabis** if allowed to colonise, by degrading the herb and its active constituents (Bock & Voogelbreinder in press; Dennis & Barry 1978; Margolis & Clorfene 1978; pers. comms.).

The above common Aspergillus spp. have been shown to infect **Cannabis** [and **Nicotiana**] even when in storage. Sweat-curing increases the likelihood of infection. Spores and pathogens may be transferred to the user through smoke inhalation from infected herb, giving rise to a number of serious complications. Transmission is only partially blocked with the use of a water pipe, which should itself be cleaned regularly to prevent internal mould growth (Doctor 1993; Kagen et al. 1983; Llamas et al. 1978; Llewellyn & O'Rear 1977; Lucas 1965; Moody et al. 1982; Ungerleider et al. 1982).

One individual who had been attempting to grow psilocybian mushrooms [see **Psilocybe**] unintentionally inhaled spores from a green mould contaminating the culture [possibly A. fumigatus?]. Half an hour later, the person felt a chill run through the body, followed by other effects lasting c.48 hours and peaking at 12 hours. "At first it was like *psilocybin*, but it turned into high anxiety with the fear that something terrible was about to happen. Waves of relative relaxation alternated with high anxiety and ran from the base of my spine up into my thought processes" (C 1996a). Since that exposure, the same person had similar reactions whenever smelling clean mycelial cultures or aquariums containing living fruiting bodies of **Psilocybe**. "Seven to fifteen minutes after inhalation I get a speedy head buzz with tinnitus. My hands and feet become cold and clammy, my heart rate increases from 70 beats a minute to 100. There is usually some anxiety because I don't understand what the mechanism of this reaction is" (C 1996b).

Inhalation of Aspergillus is usually productive of Allergic Bronchopulmonary Aspergillosis [ABPA], which is characterised by symptoms of asthma, due to pulmonary inflammation causing saccular enlargement and plugging of the bronchial tracts. Infected subjects also become more sensitive to viral and bacterial infection, and the fungus may even grow inside internal cavities (Bennett & Klich 1992; Kozakiewicz 1984; Llamas et al. 1978; Rippon 1988).

A. alliaceus has yielded benzodiazepines called asperlicins; asperlicin is used to treat CNS and GI disorders (Rahbaek et al. 1999).

A. candidus cultivated on rice produced aflatoxins [see below] (Samajpati 1979).

A. flavipes has yielded spiroquinazoline and ascyl aszonalenin [substance-P inhibitors], benzodiazepinedione, N-benzoyl-L-phenylalaninol, and 7 diketopiperazines (Barrow & Sun 1994).

A. flavus has yielded 0.019% alkaloids from lab-grown cultures, containing the clavine alkaloids *agroclavine* and *elymoclavine*, as well as ergokryptine [see **Claviceps**] (El-Refai et al. 1970; Sallam et al. 1969) and coumarins called aflatoxins [extremely toxic and carcinogenic, affecting RNA & DNA synthesis], aspertoxin, flavotoxin, aspergillic acid, kojic acid, β-nitropropionic acid, thiamin and vitamin C (Harborne & Baxter ed. 1993; Kozakiewicz 1984; Llewellyn & O'Rear 1977; Samajpati 1979).

A. fumigatus has yielded moderate quantities of *agroclavine*, *elymoclavine*, *chanoclavine*, *festuclavine* and fumigaclavines A, B (Spilsbury & Wilkinson 1961; Yamano et al. 1962) and C [tremorgenic]; as well as a wide range of toxins, such as verruculogen, TR-2 [both tremorgens], fumitremorgins [6-MeO-indoles; tremorgens], tryptoquivalines [indole substances], gliotoxin [immunomodulating, antiviral, highly toxic], aflatoxins, the sesquiterpene fumagillin, fumigatin, sphingofungins, monotrypa-

cidin, helvolic acid and 1-trans-2,3-epoxysuccinic acid (Bennett & Klich 1992; Harborne & Baxter ed. 1993; Powell ed. 1994; Samorini 1997b). In cultures, the yield of clavine alkaloids was highest after 60 days (Spilsbury & Wilkinson 1961).

A. glaucus cultivated on rice produced aflatoxins (Samajpati 1979).

A. niger has yielded toxins such as genistein [MAOI (Hatano et al. 1991)], malformin and 3-(2-OH-ethyl)indole (Buckingham et al. ed. 1994); it tested weakly positive for alkaloids (Spilsbury & Wilkinson 1961).

A. ochraceus has yielded benzodiazepines called circumdatins, as well as mellein, viomellein, 4-OH-mellein, penicillic acid, vioxanthin and xanthomengin (Rahbaek & Breinholt 1999; Rahbaek et al. 1999); it tested positive for alkaloids (Spilsbury & Wilkinson 1961).

A. oryzae and A. restrictus cultivated on rice produced aflatoxins (Samajpati 1979); A. oryzae may also produce the toxin sporogen-AO1 (Demyttenaere et al. 2002).

A. terreus has been found to produce (+)-aristolochene and (-)-γ-cadinene in mycelial culture (Demyttenaere et al. 2002).

A. ustus strain TC 1118 yielded new isoquinoline alkaloids, TMC-120A, B and C (Kohno et al. 1999); an unspecified strain tested positive for alkaloids (Spilsbury & Wilkinson 1961).

A. zonatus has yielded the benzodiazepines aszonalenin and LL-S490β (Kimura et al. 1982).

An unidentified Aspergillus sp. yielded a new benzodiazepine, LL-S490β (Ellestad et al. 1973). A. fischeri, A. ruber, A. sulphureus and A. versicolor tested positive for alkaloids, A. ruber only weakly so (Spilsbury & Wilkinson 1961).

Aspergillus fumigatus is a mould with a texture ranging from velvety to deeply felted, white at first, becoming green with the development of columnar, conidial heads (shade of green varying considerably), becoming dark green to almost black in age. Conidial heads compact, densely crowded, up to 400 x 50µ, usually shorter; conidiophores short, smooth, up to 300(-500) x 5-8µ, +- green, esp. in upper part, arising directly from submerged hyphae or as very short branches from aerial hyphae, gradually enlarging upward, passing almost imperceptively into the apical vesicle; vesicles flask-shaped, up to 20-30µ diam., often same colour as conidiophores, usually fertile on upper half only; sterigmata similarly coloured, usually c.6-8 x 2-3µ, crowded, with axes roughly parallel to axis of conidiophores; conidia green in mass, echinulate, globose to subglobose, (2-)2.5-3(-3.5)µ diam.

There is apparently much variation in strains, and many different strains may be found in the one patch of growth. Chemical variation is also expected to exist across different strains (Thom & Raper 1945).

Common in soils at all altitudes, growing from 10-65°C and favouring moist conditions. Found on **Cannabis** and **Nicotiana**, in stored products that have heated and spoiled [such as hay, dried beans, grains], on wheat and barley just prior to and during harvest, in grain silos and active compost heaps [wear a face mask when turning your compost!]; has also been found on or in plastic, cotton, synthetic rubber, hydraulic oil, aircraft fuel, fuel filters and microscope lenses (Bennett & Klich 1992; Kagen et al. 1983; Kozakiewicz 1984; Llamas et al. 1978; Llewellyn & O'Rear 1977; Powell ed. 1994; Ungerleider et al. 1982). It is claimed that ultraviolet light will cause aflatoxin-producing A. flavus on **Cannabis** to fluoresce green (Doctor 1993).

ASPIDOSPERMA

(Apocynaceae)

Aspidosperma excelsum *Benth.* **(Macaglia excelsa** *(Benth.) Kuntze***)** – remocaspi

Aspidosperma quebracho-blanco *Schltdl.* **(A. chakensis** *Speg.***; A. crotalorum** *Speg.***; A. quebrachoideum** *Rojas Acosta***; Macaglia quebracho-blanco** *(Schltdl.) Kuntze***)** – quebracho ['axe-breaker'], white quebracho, ualek-eiaj

Aspidosperma spp.

A. quebracho-blanco was once used by natives of Paraguay in the preparation of a magical drink, which was based on a fermented product from the seeds of Schinus molle and a paste of corn [Zea mays]. After fermentation, several pieces of quebracho bark were added. The tree was also considered to have magical properties, by female shamans amongst the Mocoretas of Alto Parana. These shamans divined by chanting and dancing around a fire at the base of a quebracho tree, and interpreting the way in which the moonlight interacts with the tree's branches and foliage. Some native groups drink a bark decoction to treat coughs, colds, malaria and liver pain, and it was often decocted with 'maté' leaves [see **Ilex**], which would at least make for an effective asthma remedy. It is also esteemed by many indigenous peoples as an aphrodisiac – partly due to its rock-hard wood (Rätsch 1992), lending easily to metaphor, and partly due to chemical content. In Peru, A. excelsum is consumed under a strict diet to gain 'esoteric' knowledge. Death is said to result if the proper diet is not kept. It is also used in a dangerous initiation rite, involving the fermentation of a tobacco decoction in the sealed hollow of this tree [see **Nicotiana**]. These uses may, however, be a confusion with **Pithecellobium** laetum (Bear & Vasquez 2000; Luna & Amaringo 1991). The barks from Aspidosperma spp. have also been used in tanning leather (Usher 1974).

Plants of this genus have yielded a great variety of indole alkaloids [see also **Corynanthe**].

A. auriculatum bark yielded 0.03% dihydrocorynantheol, and traces of reserpinine [possibly *rescinnamine*?] (Gilbert et al. 1965).

A. exalatum bark has yielded *harman* 3-carboxylic acid (Shulgin & Shulgin 1997), as well as 21-oxoaspidoalbine and (+)-21-oxo-O-methylaspidoalbine (Ganzinger & Hesse 1976); seed has yielded mostly O-demethylpalosine, as well as aspidospermine, demethoxyaspidospermine, demethoxypalosine, limaspermine, cimicine, and 21-oxo-O-methylaspidoalbine (Medina & Hurtado 1977).

A. excelsum has yielded *yohimbine*, O-acetyl-*yohimbine* and excelsinine [10-MeO-corynantheine] (Burnell & Sen 1970).

A. polyneuron has yielded *harman* 3-carboxylic acid (Shulgin & Shulgin 1997).

A. pruinosum bark has yielded 0.076% *yohimbine*, 0.023% β-*yohimbine*, 0.0066% 10-MeO-*yohimbine*, 0.014% 10-MeO-dihydrocorynantheol, 0.003% compactinervine, 0.0022% normacusine B, 0.016% 10-MeO-geissoschizol, 0.008% 10-MeO-4-methylgeissoschizol and 0.028% 3,4,5,6-tetradehydrositsirikine (Nunes et al. 1992).

A. quebracho-blanco bark has yielded up to 1.5% *yohimbine*-type alkaloids (Rätsch 1992), including aspidochibine, aspidospermatidine, aspidospermatine, (+)-aspidospermidine, (-)-aspidospermine, dihydroaspidospermatine, N-methylaspidospermatidine, (-)-quebrachamine, quebrachidine, vincarine, rhazidigenine, rhazidigenine N-oxide, (R)-rhazinilam, (-)-pyrifolidine and 3-oxo-14,15-dehydrorhazinilam (Buckingham et al. ed. 1994; Ganzinger & Hesse 1976). As A. quebracho-blanco var. pendulae, the bark has yielded 4.098% alkaloids, consisting of *yohimbine*, aspidosamine, aspidospermine and aspidospermicine; as well as saponins, resins, fats and sugars (Floriani 1938).

A. ramiflorum bark has yielded indole alkaloids – 0.038% ramiflorine A, 0.046% ramiflorine B and 0.09% 10-MeO-geissoschizol. Seeds have yielded 0.3% β-*yohimbine* and 0.024% 10-MeO-geissoschizol (Marques et al. 1996).

A. rhombiosignatum has yielded 1-methyl-3-carboxyethyl-β-carboline (Shulgin & Shulgin 1997).

Aspidosperma quebracho-blanco is a tree 5-20m tall, trunk to 1m thick; bark corky, heavy, rugose, greyish-yellow; roots long, horizontal. Leaves simple, persistent, rigid, coriaceous, whorled in threes, rarely opposite, glabrous, elliptic-lanceolate, margins smooth, c.2-5cm x 5-15mm, acuminate with a spine in apex 1-4mm long, base decurrent, pinnately nerved, with c.10-20 secondary nerves on each side; petiole 1-3mm long. Inflorescences axillary and terminal; flowers hermaphroditic, actinomorphic, white-yellowish, very perfumed, 5-13mm; calyx of 5 triangular-ovate sepals, caducous, 1-1.5mm long, 0.8-1.5mm wide; corolla subhippocrateriform, slightly fleshy, with latex, tube 3-6mm long, glabrous externally, pubescent internally, with a ring of silky hairs, retrorse between filaments; lobules (4-)5, sublinear, involute, equal in length to tube; stamens 5, included, adhering until the upper 1/3 of the corolla tube, free portion of filaments very short; anthers ovate-lanceolate, dorsifixed, introrse; pollen grains elliptic, 4-colpate. Ovary superior, bilocular, glabrous, ovoid, bipartite; carpels 2; style cylindric, short; stigma slightly thickened, with a ring of hairs. Capsule lenose, dehiscent, clear greyish-green, verruculose, bivalvate, asymmetric, ovate, elliptic to orbicular, compressed laterally, 7-13cm long x 4-8cm wide x 1-2.5cm thick; seeds numerous, subcircular, white-yellowish, funicule large, erect, surrounded by a very thin, wide membranous wing, circular-oblong, 5-6cm x 4.5cm.

In xerophyll forest; Bolivia, Paraguay, Uruguay, Argentina [w. Gran Chaco, to San Juan, San Luis, south of Cordoba and Entre Rios] (Burkart 1979).

ATHEROSPERMA and DORYPHORA

(Monimiaceae)

Atherosperma moschatum *Labill.* – southern sassafras, black sassafras

Doryphora aromatica *(Bailey) L.S. Smith* – grey sassafras, northern grey sassafras, net sassafras, cheedingan

Doryphora sassafras *Endlicher* – yellow sassafras, New South Wales sassafras, canary sassafras, golden deal, boobin, caalang, tdjeundegong

Both of these similar Australian genera are unrelated to the true **Sassafras** of N. America, but share some similar chemical properties. A. moschatum bark was once sold in England as 'Victorian sassafras'. It was used as a tonic and laxative tea by early settlers and indigenous people in eastern Australia; the bark has also reportedly been used to treat venereal diseases. A tincture of the bark has been used to treat asthma, bronchitis, and as a cardiac sedative, diaphoretic and diuretic. Similar tonic teas

have been made from the barks of D. aromatica and D. sassafras (Cribb & Cribb 1981; Lassak & McCarthy 1990; Webb 1948). A. moschatum has reportedly been used in beer brewing, and in Tasmania it is made by some people into a psychoactive beer (Rätsch 1998).

The person who first made me aware of these plants reported that he often chews the leaves and stems of A. moschatum while bushwalking, and spits them out when he starts to feel an effect. He reported experiencing mild euphoria and colour-enhancement, lasting several hours. He also claimed that the root is more potent, and may be used as an aphrodisiac (Hastings pers. comm. 1996). After learning of this, I experimented with leaves and stems of D. sassafras collected from a botanical garden. I found that a good method was to fill one cheek with a sizeable wad of healthy leafy matter, preferably more tender leaves [as much as will comfortably fit] and to chew on the cud for about 1hr, stopping occasionally to suck and let the juices circulate in the mouth. Excess saliva is swallowed when the mouth becomes too full. The vegetable matter is expelled when one wishes to stop chewing, and the quid does taste quite nasty after a while. The effects seemed to creep up after an hour or more, and consisted of, at first, a brief, pleasant euphoria followed by a period of pleasant mental stimulation and mild physical tranquillity. Friends and associates who attempted to chew the leaves did not report any effects. I suspect they did not chew enough material, and did not persist for long enough, due to the taste!

A. moschatum bark contains aporphine alkaloids – berbamine [spasmolytic, vasodilator, antibiotic, tumour-inhibitor], isotetrandrine, isocorydine, moschatoline, atheroline, atherospermidine, atherosperminine [CNS stimulant, *dopamine*-receptor agonist], spermatheridine and MeO-atherosperminine. Leaves, bark and root yield an essential oil [1.7-2.65% from leaves] which may contain 50-60% *eugenol* methyl ether, 5-10% *safrole*, 15-20% *pinene*, and 15-20% *camphor* (Bhattacharya et al. 1978; CSIRO 1990; Harborne & Baxter ed. 1993; Lassak & McCarthy 1990; Scott 1912).

D. aromatica bark contains similar alkaloids – isocorydine, aromoline, homoaromoline, daphnoline, daphnandrine, isotetrandrine and 1,2-dehydroapetaline; the essential oil is rich in *safrole* (Lassak & McCarthy 1990).

D. sassafras bark has yielded 0.3% alkaloids, 11 different ones in total – the benzylisoquinoline reticuline, the isoquinolines corypalline, doryphorine and doryanine, the aporphines liriodenine, isocorydine [antiadrenergic, sedative, cataleptic at high doses] and anonaine, *choline*, alkaloids A & B and aristolactam alkaloids, as well as doryflavine (Chen et al. 1974). An older study found 0.63% alkaloids [as doryphorine] in the bark, 0.3% in the leaves, and 0.1% in the fruit (Webb 1948). Leaves have yielded 0.0019% liriodenine, 0.0023% doryafranine, 0.0005% doryanine, 0.0047% *choline*, and small amounts of alkaloids A, B, C & D (Gharbo et al. 1965). The leaves also yield an essential oil containing 30-65% *safrole*, 1-3.5% *eugenol*, 10-30% *camphor*, 10% *pinene*, 10% sesquiterpenes, and *eugenol* methyl ether (CSIRO 1990; Harborne & Baxter ed. 1993; Hurst 1942; Penfold 1922). In frogs, the alkaloid 'doryphorine' [may have been a complex of alkaloids] was shown to "produce loss of power of movement and of response to touch, then paralysis and death" (Webb 1948), presumably administered by injection.

Doryphora sassafras is a tree 10-42m tall, up to 1.2m diam.; bark grey or brownish-grey, finely scaly. Leaves opposite; in seedling, short petioles 2-4mm, broad-lanceolate with serrate margins, 10-14-toothed, 5-8 x 2-3cm, dark glossy green above, paler beneath, stems lightly quadrangular, venation reticulate with secondary venation; intermediate – leaves broadly lanceolate, up to 10 x 5cm, toothed; in adult – opposite, short petioles c.1cm long, simple, elliptical or oblong-lanceolate, acuminate, narrowed at base, 7-10 x 1.5-5cm, coarsely toothed, glossy green above, dull green beneath, glabrous, strongly fragrant of sassafras oil when crushed [see **Sassafras**], midrib distinct, lateral and net veins faintly visible on upper surface, raised and distinct on underside. Inflorescence axillary, usually 1-2 per leaf axil, usually 3-flowered, on short peduncle 0.2-1cm long; flowers white, silky-downy, 2-3cm across; perianth lobes 6, tapering to fine point; stamens 6, with anthers towards base of stamens and with long bristle-like points, with 6 alternating shorter staminodes; carpels several, free, superior; styles plumose. In fruit, lower perianth is enlarged, becoming narrowly egg-shaped, 0.6-2cm long with long neck, splitting down one side when ripe to expose several dark brown, hairy carpels. Fl. May-Jul.

Cool to warm temperate rainforest in a variety of sites, from near sea level to 1000m; from near the Victoria/NSW border, north along coastal areas [w. inland in NSW to localities near Oberon, Mt Wilson, Barrington Tops and Mt Coricudgy, near Mudgee] to Queensland, mostly in MacPherson Ranges and Kilarney and Tambourine districts (Boland et al. 1992).

ATROPA

(Solanaceae)

Atropa acuminata *Royle ex Lindl.* **(A. belladonna** *C.B. Clarke, non L.***)** – Indian Atropa, Indian belladonna, luckmuna, suchi, sage-angur

Atropa baetica *Willk.*

Atropa belladonna *L.* – belladonna ['beautiful lady'], banewort, deadly nightshade, death's herb, devil's cherries, sorcerer's berry, walkerbeere ['berry of the Valkyries'], dwayberry, dwale ['stupor'], naughty man's cherries, moonpods [referring to the fruits]

Atropos was one of the three Fates of Greek myth, who holds the power to cut the thread of life. The Italian name 'belladonna' refers to the use of A. belladonna extract to dilate the pupils of the eye, making a woman appear 'more beautiful and seductive'. This same property is now exploited for eye-examination. A. belladonna was reputedly a key ingredient in many witch's potions and flying ointments (Bremness 1994; Schultes & Hofmann 1980, 1992). Ancient Sumerians used it to treat problems associated with demons. According to tradition, priests worshipping Bellona, Roman war goddess, drank a potion of A. belladonna before calling on her. Early Germanic peoples knew the plant as 'berry of the Valkyries', hinting at a knowledge of its ability to produce 'violent' intoxication, and it has been added to wines and beers to strengthen their effects [see *Methods of Ingestion*] (Cunningham 1994; Rätsch 1990, 1992). Apparently, Duncan I of Scotland had MacBeth's soldiers drug a Danish army with belladonna-laced alcohol, so they could be easily killed in their comatose state (Polunin & Robbins 1992).

Today, A. belladonna is used in Morocco as an aphrodisiac and memory stimulant – this is odd due to the cognitive deficits that can be caused by the anticholinergic alkaloids present. In Nepal, it is used as a sedative (Ott 1993; Sitaram et al. 1978). In India, A. acuminata is used for similar medicinal purposes, and is sometimes adulterated or confused with Phytolacca acinosa [see *Endnotes*] (Chopra et al. 1965; Morton 1977). Also, bees feeding on the nectar of A. belladonna are known to produce intoxicating honey that has hallucinogenic effects in humans who consume it (Ott 1993, 1998a).

In medicine, A. belladonna is useful in relieving intestinal cramps by relaxing digestive tract muscles. The ability of *atropine* to reduce mucus led to its use in nasal sprays and decongestants, and its bronchodilating properties are useful for asthma. The plant has been used to control bedwetting, epileptic seizure, symptoms of Parkinson's disease, whooping-cough spasms, and to stimulate the heart after a heart-attack. It is also often administered to counter the effects of muscarinic mushroom poisoning [see **Amanita**, **Inocybe**], and for opiate overdose (Blackwell 1990). Effects of A. belladonna [30-200mg dried leaves or 30-120mg root] include trembling and excitement, sedation, delirium, hallucinations, pupil dilation, rapid heartbeat, weak pulse and dry mouth; overdose may result in coma and death by respiratory paralysis (Gottlieb 1992; Rätsch 1992; Tamplon 1977). In mice subjected to stress, low doses of A. belladonna had a neurotropic effect, and protected against stress-induced gastric alterations (Boustaa et al. 2001).

A. acuminata leaves have yielded 0.13-0.78% alkaloids, mostly *hyoscyamine*; roots yielded 0.29-0.8% alkaloids, mostly *hyoscyamine* – volatile bases are also present. Alkaloid content of aerial parts is highest when in flower [Jul.-Sep.], and in this period are best collected early August (Chopra et al. 1965).

A. baetica leaves have yielded 0.82-1.06% alkaloids, roots 0.94% and fruit 1.09% – these consisted of *hyoscyamine* and *atropine*.

A. belladonna contains mostly *hyoscyamine* [0.72-2.2% in leaves], as well as *hyoscine* [0.19% in leaves], *atropine*, and traces of *nicotine*, cuscohygrine [in roots only], hygrine, atropamine, belladonnine, and tropine, as well as flavonoid glycosides. Leaves have yielded 0.09-1.23% alkaloids [highest levels in young top leaves, lowest in bottom leaves], roots 0.1-0.7%, and seeds 0.83%. Young plants are high in *hyoscine* – alkaloid content increases with age, with *hyoscine* decreasing and *hyoscyamine* becoming dominant; *atropine* is found at its highest level when the fruits are ripening. Root alkaloid content is highest just before flowering; it may also be higher in younger roots, which are very small [up to 0.72% in 1yr-old roots]. Prolonged drying of the leaves decreases alkaloid content due to enzyme activity (Chopra et al. 1965; Evans 1979; Harborne & Baxter ed. 1993; Henry 1939; James 1953; Morton 1977; Rastogi & Mehrotra ed. 1990-1993; Rimpler 1965; Saber et al. 1962a; Schultes & Hofmann 1980; Wilms et al. 1977). Leaves have also yielded 0.014% of the coumarins *scopoletin* and aesculetin (Kala 1958), and aerial parts were shown to contain 5 calystegines [see **Convolvulus**] (Bekkouche et al. 2001). *Phenethylamine* has also been found in the plant (Hartmann et al. 1972).

Atropa belladonna is an erect perennial herb, green, glabrous to glandular-pubescent; stems 50-150(-200)cm long, much-branched. Leaves alternate or opposite, simple, entire, not crowded, up to 20cm, ovate, acuminate, cuneate at base; petiole short. Flowers solitary, axillary; pedicels nodding; calyx campanulate, with 5 acuminate lobes, somewhat accrescent, becoming stellate; corolla 2.5-3cm, tubular-campanulate, not more than 2.5 times as long as calyx, brownish-violet or greenish, limb short, 5-lobed, lobes up to ½ as long as tube; stamens 5(-8), included or slightly exserted, subequal, inserted at base of corolla, adnate to corolla tube and alternating with the lobes; filaments tomentose at base; anthers ellipsoid, whitish, usually dehiscing longitudinally. Ovary superior, with usually 2 loculi, with annular receptacular disc at base; style sim-

ple, included or slightly exserted; stigma peltate, entire to 2-lobed. Fruit a berry 15-20mm diam., globose, shiny, black, rarely yellowish-green, flesh usually reddish-purple, poisonous.

In damp or shady places, mainly in mountains, also woods and thickets on calcareous soils, in graveyards, and around old buildings and in hedges, rather rare; south, west and central Europe, east to w. Ukraine, and west to England and Wales, from Westmorland southwards; also cultivated and naturalised in some places (Clapham et al. 1987; Mabey 1997; Tutin et al. ed. 1964-1980).

Propagate from cuttings of new growth, or by rootstock division in spring; seed cultivation is more common. Requires rich, moist, well drained, limey, fertile soil. Weed regularly and protect from snails and slugs. Unfortunately, higher alkaloid content is achieved by growing in open, freshly cleared land, or burned forest, though the plants prefer shady spots (Morton 1977; pers. comm.). Gather leaves in late spring, flowers in early autumn (Chiej 1984).

There is also a yellow-flowered variety, A. belladonna var. lutea (theobromus pers. comm.).

AZTEKIUM

(Cactaceae)

Aztekium ritteri *(Böed.) Böed.* **(Echinocactus ritteri** *Böed.***)** – peyotl, peyote chino

This small and rare cactus, the only member of its genus, is known as a 'peyotl' by the Tarahumara of Mexico, though it is not actually known to be so used [see **Lophophora**] (Schultes 1937b, 1969c).

When fresh samples were analysed relatively recently, *mescaline* was found, although in small amounts [0.0009%], as well as 0.0036% N,N-dimethyl-*DMPEA*, 0.0031% N-methyl-*tyramine*, less than 0.0001% each of 3-MeO-*tyramine* and *hordenine*, 0.0008% anhalidine and 0.0026% *pellotine* (Štarha 1994); also detected were glucaric acid and quinic acid. A report of *caffeine* in this species needs verification (Trout ed. 1999).

Aztekium ritteri is a flattened, wrinkled, globular cactus, solitary to clustered, c.5cm wide, with 9-11 distinct lateral ribs, c.1cm high, 8mm wide, olive-green; areoles minute, closely spaced, forming continuous rows on ribs; spines none, except for 1-4 at tip, flattened, twisting, papery, white, 3-4mm long, soon falling. Flowers close to the crown from new areoles, scaleless, c.1cm long, 8mm wide, white or pink, petals and stamens few; seed with a membranous attachment point (strophiole).

On steep slate slopes; Nuevo León, Mexico.

May be difficult to grow successfully in very cold climates; grows very slowly. Needs porous, mineral-rich soil and full sun (Cullmann et al. 1986; Innes & Glass 1991). Does not need much water when young, but will take more when established. Can survive frosts if kept dry (Trout & Friends 1999).

BACOPA

(Scrophulariaceae)

Bacopa monnieri *(L.) Wettst.* **(B. monnieri** *(L.) Pennell***; Bramia indica** *Lam.***; Br. monniera** *(L.) Drake***; Br. monnieri** *(L.) Pennell***; Calytriplex obovata** *Ruiz et Pav.***; Gratiola monnieria** *L.***; Habershamia cuneifolia** *(Michx.) Raf.***; Herpestis cuneifolia** *Michx.***; He. monnieri** *(L.) Kunth***; He. procumbens** *Spreng.***; Limosella calycina** *Forssk.***; Lysimachia monnieri** *L.***; Monnieria africana** *Pers.***; M. brownei** *Pers.***; M. pedunculosa** *Pers.***; Septas reptans** *Lour.***)** – brahmi, jala-brahmi, neer-brahmi, safedkammi, sambranichettu, water hyssop, thyme-leaved gratiola

This herb is thought by some to represent the 'brahmi' tonic of the ancient Hindus, yet today, brahmi is commonly though to be represented by **Centella** asiatica. The Hindus do, however, infuse the plant as a brain tonic, and treatment for insanity and epilepsy; it also acts as a nerve and heart tonic, diuretic and laxative. The herb is the main constituent in an Ayurvedic compound medicine, 'brahmi rasayan', made up of 10 parts B. monniera leaf, 2 parts clove flowers [see **Syzygium**], 1 part **Piper** longum stalks [see **Piper 1**] and 1 part Elettaria cardamomum ['cardamom'] seed [see below]. The herb is used in China to warm the kidneys and stimulate yang energy. It treats impotence, premature ejaculation, irregular menstruation, rheumatism, and kidney-related back-ache. The succulent herbage may also be eaten as a salad herb which has a slight bite (Bremness 1994; Chopra et al. 1965; Lassak & McCarthy 1990; Malhotra & Das 1959; Nadkarni 1976; Shukia et al. 1987).

Given in doses of 2-6g a day, it acts as a sedative brain tonic [improving memory, concentration, and learning], mild anticonvulsant and anti-inflammatory, and protects against nervous deficit due to injury, stroke, nervous exhaustion, or chemical impairment [such as induced by phenytoin] (Bone 1996; Vohora et al. 2000). The herb increases oxidative free-radical scavenging activity (Bhattacharya et al. 2000; Tripathi et al. 1996). It is an ingredient [with **Cyperus** rotundus, and Saussurea lappa ('costus')] in the Ayurvedic preparation 'brahmighritham', which is used to control epilepsy (Shanmugasundaram et al. 1991). As a brain tonic, the herb synergises well with an equal amount of **Convolvulus** pluricaulis (friendly pers. comm.).

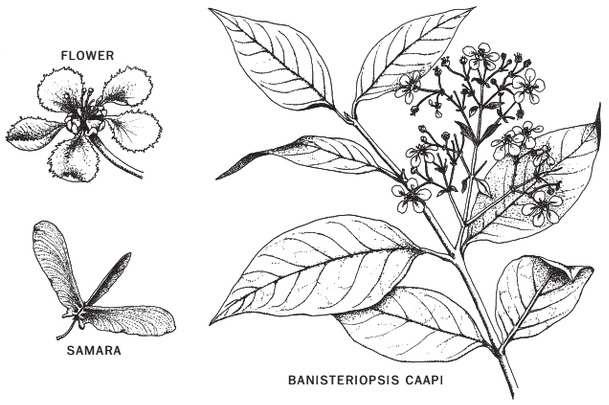
B. monnieri aerial parts have yielded saponins which are thought to be the main active constituents. These include bacosides A & B [which on acid hydrolysis yield bacogenins A1, A2 & A3, ebelin lactone, arabinose and glucose], bacopasaponins A-F and pseudojujubogenin. Octacosane, 3-formyl-OH-α-pyrone and d-mannitol have also been found. *Nicotine* was found, as one component of three from 0.05% total alkaloids. Extracts of the saponin and alkaloid fractions showed CNS-depressant, hypnotic, analgesic, vasoconstrictive and cardiotonic effects; the alkaloid fraction also showed neuromuscular-blocking effects. LD50 of the crude total extract was 33.1mg/100g [i.p.] in albino rats (Buckingham et al. ed. 1994; Chatterji et al. 1965; Chopra et al. 1965; Das et al. 1962; Garai et al. 1996; Kawai et al. 1974; Malhotra & Dass 1959). 'Brahmi rasayan' has been shown to posess CNS-depressant and anticonvulsant activity in rats and mice (Shukia et al. 1987). B. monnieri should probably not be combined with Viagra™, as bacoside A causes nitric oxide release and may result in dangerous interactions (theobromus pers. comm.).

Bacopa monnieri is a small herb of shallow water; stems creeping and forming mats, glabrous. Leaves sessile, opposite, entire, oblanceolate with a few obscure lateral veins diverging from the midvein, succulent. Flowers single from some of the nodes, on pedicels 1-2.5cm long; bracts linear, 2-3mm long; sepals 5, ovate-lanceolate to lanceolate, c.6mm long, the upper 2.5mm, the lateral 1.5mm wide; corolla white or nearly so, campanulate, nearly regular, 8-10mm long; lobes 5, obovate, rounded, or emarginate, slightly spreading, a little longer than tube; stamens (2-)4, didynamous, inserted below middle of corolla tube; anther sacs parallel; stigmas 2, distinct. Capsule ovoid, acute, 5-7mm long, septicidal. Fl. summer (Gleason 1952).

Marshes, pond edges, wet sandy shores, coastal areas in warm temperate areas and tropics; Australia [coastal areas of Qld and NSW to south of Sydney], US [s.e. Virginia to Florida and Texas], Asia.

BANISTERIOPSIS

(Malpighiaceae)



Banisteriopsis caapi *(Spruce ex Grisebach) Mort.* **(B. inebrians** *Mort.***; B. quitensis** *(Niedenzu) Mort.***; Banisteria caapi** *Spr. ex Gris.***)** – yajé, yagé, yagé delmonte, yagé sembrado, ayahuasca ['spirit vine'], caapi, nepe, name, natém, natema, bejuco, bejuco de oro ['vine of gold'], bejuco de boa, jagube, shuri, shuri-fisopa, rambi, rami appane, rami wetseni, rami, reé-ma, undi, tsipu, kamarampi, ammarón huasca, ambiwáska, sacawáska, biaj, bichemia, biáxa, batahua, batsikawa, hapataino', iñotaino', oo'-na'-oo, he-kahi-ma, kahi-ukó, kumuabasere-kahi-ma, suari-tukuro-kahi-ma, oo-fá, cauupuri mariri, tiwaco miriri, mão de onça

Banisteriopsis longialata *(Ndz.) Gates* **(B. rusbyana** *(Ndz.) Mort.***)** – ayahuasca, chagro-panga, oco-yajé, yagé

Banisteriopsis lutea *(Gris.) Cuatrecasas* **(B. nitrosiodora** *(Gris.) O'Donell et Lourteig***)** – huillca bejuco, cipó de São de Jõao

Banisteriopsis martiniana *(Jussieu) Cuatr.* **var. subenervia** *Cuatr.* **(B. martiniana var. laevis** *Cuatr.***)** – yagé, e-pe-pee-yoo-wee, ñuc-ña-wasca

Banisteriopsis muricata *(Cavanilles) Cuatr.* **(B. argentea** *(Humb., Bonp. et Kunth.) Rob.***; B. metallicolor** *(Juss.) O'Donell et Lourteig***)** – mii, ayahuasca, sacha ayahuasca ['wild ayahuasca'], ayahuasca de los brujos, ayahuasca rosada, sacha ayahuasca, ala de pompopo, bejuco de casa, bejuco hoja de planta, carapë nihi, pastora, sarcelo, sombra de tora

'Yajé' is one of many names given to represent both a species of Amazonian vine, and the visionary drink prepared from it. The species most commonly used is B. caapi, which is slowly becoming threatened due to both overharvesting and careless harvesting [ie. where the bottom parts of the climbing plant are cut out with a machete, leaving hundreds of kilos of the now rootless liana to rot in the canopy above]. B. muricata is much more commonly found, but is much less potent, and only rarely used. Also sometimes used as additives or foundations for the potion are B. longialata, B. lutea and B. martiniana var. subenervia [see below]. Yajé, more commonly referred to in the west as 'ayahuasca' [another indigenous (Quechua) name representing both the vine and the drink made from it], has been a vital healing agent amongst shamans in the jungles of the Amazon for centuries. It is still used widely in Ecuador, Bolivia, Peru, Colombia, Venezuela and Brazil. Its use has even spread to areas of Panama. The brew is prepared primarily from a Banisteriopsis sp., with other plants used as additives to modify or increase the effects [especially tobacco – see **Nicotiana**], or, in the case of *DMT*-rich plants such as 'chacruna' [**Psychotria** viridis] or 'oco-yajé' [**Diplopterys** cabrerana], largely create them (Bristol 1966; Ott 1994; McKenna 1991; McKenna et al. 1984a; Pinkley 1969; Prance 1970; Rivier & Lindgren 1972; Rätsch 1992; Schultes 1950, 1957, 1972; Schultes & Raffauf 1990; Uscategui 1959)! Some reported uses - and the common names - attributed to B. longialata might instead refer to D. cabrerana, arising from confusion between the two species related to the name 'B. rusbyana' [see **Diplopterys**]; Gates (1982) does not give any of these common names for B. longialata but does for D. cabrerana. For more discussion on ayahuasca admixture plants, consult *Methods of Ingestion* and *Endnotes*.

Sometimes, B. caapi is used alone as a beverage. It has also occasionally been observed to be snuffed or given as an enema (Ott 1994). Both B. lutea and B. leiocarpa are known as 'huillca bejuco', a name suggesting they may have been used as sources for a snuff [see **Anadenanthera**] (Trout ed. 1998). The legendary ethnobotanist Richard Evans Schultes [r.i.p.] witnessed leaves and young bark being smoked as cigarettes made from a leaf wrapping of a Heliconia sp. (Schultes 1985), and also witnessed the vine being chewed, while the user also snuffed 'yopo' [see **Anadenanthera**] (Davis 1996), a practice that would be expected to greatly increase the effects of the yopo snuff. Recently, this practice was observed amongst the Pume of Venezuela, who also chew the root (Gragson 1997). Incidentally, many 'Indians' recognise different varieties of yajé with different effects, which all seem to derive from the same species – these are different strains of the plants that presumably have slightly differing chemical makeup. A few examples are 'cají-vaíbucura-rijoma' [causes visions of howler monkeys], 'cielo-huasca' [used "for seeing heaven and the great protector spirits"], 'hapataino' [transforms one into a boa], and 'kadanytaino' [transforms one into a hawk] (Bristol 1966; Schultes 1972, 1986; Trout ed. 1998).

Other species, such as B. lutea, B. martiniana var. subenervia and B. muricata may sometimes be used in place of B. caapi as the base plant in the brew (Schultes 1950; Ott 1994). B. muricata is observed by the Witoto to be weaker than B. caapi. Shamans of the Waorani use B.muricata in secret to supposedly call upon evil spirits to wreak havoc on others [see **Dictyonema**]. When still young, Waorani boys sometimes have a tiny wad of it blown into their lungs through a bird windpipe by their uncle or grandfather, in order that they may grow up to be great hunters with powerful lungs (Davis & Yost 1983). The related B. lucida is used in fishing magic in Venezuela (Trout ed. 1998).

Shamans who use ayahuasca regularly and ritualistically adhere to a strict diet, usually of plantains and certain fish, and they abstain from sexual contact, for lengthy periods of time (Bear 1997; Bear & Vasquez 2000; Luna 1984). Before consuming ayahuasca, the participants are not to eat or drink anything except water for 6 hours or more (Flores & Lewis 1978); sometimes a ritual emetic is consumed the morning before the ceremony (Bear & Vasquez 2000; Schultes & Raffauf 1990).

Methods of preparing the brew differ in their approach – some simply crush the vine segments in a mortar and knead the material in cold water, straining and drinking after a period of steeping – this would not be a very efficient method of extraction. Others, such as in the Purús region, take stems totalling c.900 x 1-4cm, which after being sliced and crushed, are piled into a large pot in layers alternating with the admixture/s [in this case **Psychotria** sp.] and boiled with 10 litres of water for 1 hour before being cooled, strained and drunk. It was not stated how many people this should serve. Others may boil it down for hours, add more water and continue boiling for a total of up to 15 hours, which would probably result in a fair amount of degradation of the active chemicals, as well as a more thorough extraction (Bristol 1966; McKenna et al. 1984a; Ott 1994; Rivier & Lindgren 1972; Uscategui 1959). Sometimes, only the bark scrapings are used (Schultes 1957), and these would possibly contain the bulk of the stem alkaloids. The Machiguenga prepare a 10-dose brew by boiling a 5m length of vine, and 170 **Psychotria** leaves, for 2 hours (Russo undated). Western psychonauts have found 30g or more of dried liana [or even up to 500g w/w] to be effective as an MAOI. The leaves may be even more potent, and less damaging to harvest (Trout ed. 1998; pers. comms.). There is not really a 'typical' dose for ayahuasca in terms of volume, due to variations in concentration and potency, though in the Amazon doses have been reported to range from 55-200ml (McKenna et al. 1984a). For more discussion on ayahuasca preparation, see *Methods of Ingestion*. Once prepared, the brew will only retain its potency without refrigeration for a few days.

It is not exclusively used by shamans – often, most members of a community will consume it together, and it is usually prepared by the person who harvested the material. It is consumed usually in groups [though with some, such as the Shuar, it is consumed only by the shaman and the patient, or by the shaman alone] at night around a fire, or in darkness. Two reasons have been suggested to explain the adherence to night-time ceremonies – that the beverage induces sensitivity to light which can irritate the eyes; and that sorcerers work their malicious magic at this time, and is thus the best time to counteract such spirit attacks. The participants treat the beverage with reverence, and will often pray to the spirits for good visions before drinking their share. Vomiting usually occurs about half-an-hour later at most, and this is often considered a necessary and purifying aspect of the experience. The effects generally begin manifesting strongly at around this point, also, and singing and drumming commences. The melodies channelled through the shaman, known as 'icaros', are an integral part of the traditional ayahuasca experience. Indeed, for shamans, a primary purpose of dieting with ayahuasca is to learn the icaros of individual plants or other spirits. With these icaros [and sometimes the 'mariris', the words which go with an icaro] the shaman can call upon the desired spirit for its powers, whether they be for healing, for harm, or for divination. These songs are taught by the plants themselves, and serve other specific purposes within the session, including directing the visions of all participants. More experienced 'ayahuasqueros' [ayahuasca shamans] keep an eye on the other participants to make sure they do not have a bad experience – in this event they may cradle the person's head and blow tobacco smoke over it, or they may hand the person an aromatic plant such as the basil **Ocimum** micranthum, to produce a state of calm, as well as singing calming icaros. Tobacco [see **Nicotiana**] is often smoked throughout the ceremony, serving to protect against evil spirits (Bear & Vasquez 2000; Bennett 1992; Bristol 1966; Luna 1984; Prance 1970; Rivier & Lindgren 1972; Uscategui 1959).

The effects of Banisteriopsis alone are quite removed from those of the drink prepared from Banisteriopsis with what some would call [strictly speaking, falsely] its 'classic' partner, **Psychotria** viridis. Alone, the vine is a hypnotic sedative with relatively little vision-inducing capacity other than dancing colours behind closed eyes, and slight perceptual shifts. It is also a strong emetic and produces trembling, sweating and nausea. Greater doses increase the physical side-effects without greatly enhancing the mental experience. Addition of a *DMT*-containing admixture plant in the appropriate amount adds more of a mental stimulation to the experience, with extremely vivid and bizarre visual and psychological effects commencing after ½-1 hour and continuing for up to c.4 hours. This is made possible by the MAOI- and serotonergic-effects of the harmala alkaloids found in B. caapi [see *Methods of Ingestion*].

Today, ayahuasca is widely used throughout much of the Amazon, and even in urban areas. Many fraudulent self-proclaimed ayahuasqeros have sprung up, selling poorly prepared brews of dubious constituency, largely to cater to tourists, who have begun to flock to the Amazon. In many cases the 'ayahuasca tourism' that has been occurring is having a decidedly negative impact on the local traditional inhabitants, who are rapidly losing knowledge of their culture through Western contact [although, admittedly it may be helping some of them survive due to the small income derived from conducting ayahuasca sessions for such people]. There are at least two major recognised churches based on the use of ayahuasca [as B. caapi + **Psychotria**] as the sacrament in Brazil, the UDV [Uniao do Vegetal] and Santo Daime, who are not harassed anymore by government officials after the members were found to be well-adjusted, intelligent and non-violent people with a spiritual focus, rather than the rabid drug users previously depicted in anti-ayahuasca propaganda (Callaway et al. 1999; Grunwell 1998; McKenna 1991; Grob et al. 1996; Saunders et al. 2000; Shulgin & Shulgin 1997).

Tests in human volunteers from the UDV revealed peak plasma concentrations of alkaloids after ingesting ayahuasca [dose of 2ml/kg body weight; beverage contained 1.7mg/ml *harmine*, 0.2mg/ml *harmaline*, 1.07mg/ml *leptaflorine* and 0.24mg/ml *DMT*] – 36.4-222.3ng/ml *harmine*, <1-9.4ng/ml *harmaline*, 49.2-134.5ng/ml *leptaflorine* and 11.5-25.5ng/ml *DMT* (Callaway et al. 1996). Broader samples of prepared ayahuasca have yielded 5.85-8.19% alkaloids, consisting of 53-67% *harmine*, 18-30% *leptaflorine*, 5-6% *harmaline*, 6-11% *DMT* and traces of *harmol* (McKenna et al. 1984a). An earlier study obtained much lower yields from beverage samples [0.005-0.064% alkaloids], consisting of 22-62% *harmine*, 0-4% *harmaline*, 6-40% *leptaflorine*, 0-41% *DMT* and 0-20% of an unidentified alkaloid ['232'], probably a β-carboline (Rivier & Lindgren 1972). Prolonged heating of ayahuasca brews may result in the breakdown of some of the *harmaline* present, possibly forming extra *harmine* and/or *leptaflorine* as byproducts. In acidic conditions, *harmaline* may oxidise to *harmine*; under alkaline conditions it can be converted to *leptaflorine* (Ott 1994).

B. caapi stems have yielded 0.05-1.36[-1.6 crude]% alkaloids; the seeds contain similar amounts; roots yielded 0.61-1.95%; and leaves 0.25-1.9%. Of the stem alkaloids, *harmine* is the main constituent [36-96%], followed by d-*leptaflorine* [1-47%] and *harmaline* [1-44%]; also found in trace amounts are *harmol* [up to 2.6% of total alkaloids] (Der Marderosian et al. 1968; Hochstein & Paradies 1957; McKenna et al. 1984a; Ott 1994; Rivier & Lindgren 1972; Schultes et al. 1969), shihunine and dihydroshihunine (Kawanishi et al. 1982), and from leaves 0.0005% 1-OH-3,4-dihydronorharmine [keto-tetrahydronorharmine], 0.0005% *harmine* N-oxide, 0.005% harmalinic acid, 0.0002% harmic acid methyl ester, 0.007% harmic amide and 0.0001% 1-acetylnorharmine [arenarine C] (Hashimoto & Kawanishi 1975, 1976; Shulgin & Shulgin 1997). Unusually, 0.88% *caffeine* was reported from the plant (O'Connell 1969). This was most likely due to a confusion of plant material before the analysis, as O'Connell had been supplied with both B. caapi and **Paullinia** yoco [a *caffeine* containing species] by R.E. Schultes; these plants are both lianas (Rivier & Lindgren 1972). Different cultivars of this species have been analysed, but there seems to be no positive correlation between cultivar types and chemical content, though there is widespread variation in such chemical makeup across different collections (McKenna et al. 1984a).

A sample of 'epéna' snuff [of uncertain plant origin], as used by the Surára of n.w. Brazil, was found to contain c.1.3% *harmine* [0.38% purified] and 0.2% *leptaflorine* [0.08% purified] (Bernauer 1964). Similarly, a Tucano 'paricà' snuff [again of unknown plant origin] was found to contain only *harmine*, *harmaline*, and *leptaflorine* (Holmstedt & Lindgren 1967). These snuffs were probably manufactured from B. caapi, or a related species with similar chemistry. See also **Anadenanthera** and **Virola**.

Some specimens of B. lutea have been shown to yield *harmine* (Der Marderosian 1967), yet others have been almost free of alkaloids (Ott 1994).

B. muricata grown in India contained 0.02% alkaloids in its leaves, yielding in total 0.006% *harmine*, 0.005% *leptaflorine*, 0.004% 5-MeO-*tetrahydroharman*, 0.02% N-methyl-*tetrahydroharman*, 0.001% *harmaline*, 0.003% *DMT* and 0.001% *DMT* N-oxide, as well as smaller traces of *choline*, betaine and two unidentified indole-3-alkylamines (Ghosal 1972; Ghosal et al. 1971c; Ghosal & Mazumder 1971).

Banisteriopsis caapi is a liana; young branches sparsely appressed-sericeous to glabrate; old branches glabrous, terete, bark becoming fissured into shallow corky splits in age, sometimes with conspicuously lobed wood; stipules triangular, glabrous or appressed-sericeous, 0.5-1mm long. Leaves (4.8-)8.2-15.9(-20.5) x (2.5-)3.5-7.7(-11.5)cm, smaller in inflorescence, often coriaceous when mature, sparsely appressed-sericeous or glabrate, eglandular or with a pair of cupulate glands near apex, broadly ovate to ovate, base obtuse to truncate, apex short- to long-acuminate, margin flat to slightly revolute, bearing abaxially 2-5 pairs of sessile glands near or at margin, and another pair near midrib at base, glabrate adaxially, very sparsely appressed-sericeous to glabrate abaxially, hairs T-shaped; primary veins prominulous adaxially, reticulation sometimes impressed, primary and secondary nerves prominent abaxially; petiole 9-25mm long. Inflorescence of 4-flowered umbels in axillary cymes, subtended by very reduced leaves or inflorescence leaves deciduous before anthesis, sparsely tomentose to velutinous; bracts and bracteoles 1-1.8mm long, triangular to elliptic, appressed-pubescent abaxially, glabrous adaxially, caducous before or during flowering [rarely immediately after]; pedicels sessile, 7-11 x 0.4-0.6mm [0.3-0.5mm diam. without hairs], appressed-sericeous or tomentose-sericeous; sepals 5, elliptic, apex obtuse, 2-3.5mm long, 1.5-2mm wide, sericeous abaxially, minutely tomentose adaxially, all eglandular or the 4 lateral sepals biglandular; petals 5, pale pink, turning yellow in age, fimbriate, 4 lateral petals reflexed between sepals, claw 1-1.5mm long, 0.2-0.4mm diam., limb 5-8.5mm long, 4-6mm wide, broadly obovate, basal fimbriae tipped with glands; stamens with filaments 2-4mm long, basally connate, the posterior 3 flexuous and inflexed between posterior styles, locules sparsely pilose to glabrate, those of the 3 anterior stamens 0.7-1.2mm long, those of other 7 stamens 0.3-0.9mm long, connectives of 5 posterior stamens not glandular, those of 5 anterior stamens glandular, those opposite antero-lateral sepals enlarged and overtopping the locules by 0.5-1mm. Ovary 1-1.2mm tall, white-sericeous; anterior style straight, 2.8-3.2mm long, 0.2mm diam., posterior styles diverging and lyrate at base, 3-4mm long, 0.15mm diam.; stigmas capitate. Fruit a samara with carpophore up to 4mm long, 0.4mm wide, wing 18-42mm long, 8-22mm wide, appressed-pubescent becoming glabrate, wings of posterior samaras somewhat rotated to lie nearly parallel to wings of anterior samara, abaxial margin with tooth at base, appressed-pubescent to glabrate; nut 5-11mm tall, 3-5mm long, locule hairy throughout within. Fl. Dec.-Aug., fr. Mar.-Aug.

Amazonian Brazil, Bolivia, Ecuador, Peru, Colombia; found both wild and cultivated, origin uncertain (Gates 1982).

Can be cultivated from stem cuttings; leaf propagation might also be possible [see **Psychotria**, **Tabernanthe**]. Enjoys a mix of full sun and shade, with adequate watering. Water less frequently in winter. Responds well to high humidity. Best temperature range said to be 7-32°C; will tolerate lower temperatures if established, but is frost-sensitive. In areas with cold winters, plant survival may be ensured by trimming back heavily at the start of winter, and bringing indoors. Plants that have dropped all leaves due to transport-shock have been successfully nurtured back to health by keeping the plant in shade and spraying every few days with seaweed-emulsion. Otherwise, said to be very hardy once established (pers. comms.).

BEILSCHMIEDIA

(Lauraceae)

Beilschmiedia miersii *(Gay) Kosterm. nov. comb.* **(Bellota miersii** *Gay***;**
Peumus boldo *Mol.* (incorrect)**)** – bellota, belloto, belloto del norte
Beilschmiedia spp.

The Chilean B. miersii is of interest because of the presence of uncommon phenylpropenes in its essential oil [see below]. Beilschmiedia spp. are also known for their content of aporphine alkaloids. Several members of the genus have ethnobotanical uses. In Guinea, B. mannii ['spicy cedar'] bark and leaves are decocted to relieve headache; its seeds are commonly roasted and ground as food. In the Congo, B. gaboonensis bark is used as a topical analgesic (Burkill 1985-1997). B. giorgii ['djombi'] of the Congo is used to make body perfume. B. tawa [Nesodaphne tawa] of New Zealand has edible fruits which are eaten by Maoris. Many species are also used for their wood, which is useful in construction (Usher 1974).

B. elliptica from Australia has yielded large amounts of the aporphine alkaloids isoboldine [see Peumus boldo in *Endnotes*] and laurelliptine from its bark (Johns et al. 1969). Boldine itself is reputedly psychoactive [see Peumus boldus in *Endnotes*]. Plants from Toonumbar [NSW] yielded 2.17% alkaloids from bark, consisting mostly of laurelliptine. In mice, the alkaloid mixture [given orally] produced "ledge unsteadiness, slight ataxia, and slightly decreased activity" at 250mg/kg; 500-1,000mg/kg resulted in death (CSIRO 1990).

B. miersii has been found to contain contain *asaricin* and *carpacin* in its essential oil, as well as azaleatin (Buckingham et al. ed. 1994).

B. podagrica [from Omaura, Papua New Guinea] bark has yielded 1.15% alkaloids, consisting of laurelliptine, and what was probably isoboldine; leaf yielded up to 2.5% alkaloids, containing glaucine, (+)-2,11-dihydroxy-1,10-dimethoxyaporphine, (+)-2-OH-1,9,10-trimethoxyaporphine, (+)-2-OH-1,9,10-trimethoxynoraporphine and isocorydine (Johns et al. 1969). The leaf and bark alkaloids had similar effects in animals. Orally in mice, leaf alkaloids "produced intention tremors, seizures, dyspnea, gasping, asphyxial convulsions and death" at 1g/kg. Given i.p., 200mg/kg "resulted in slight stimulation in one animal, slight depression in another" (CSIRO 1990).

The genus Beilschmiedia has also yielded the aporphines N-methyllindcarpine, predicentrine, norpredicentrine and thaliporphine [O-methylisoboldine; thalicmidine] (Guinaudeau et al. 1975).

Beilschmiedia miersii is a tree to 25m tall; branchlets stout, subangular, compressed, dense rusty-tomentellous; branches cylindrical, dark brown, smooth, glabrous. Leaves subopposite, coriaceous, ovate to broadly ovate, rarely ovate-elliptical, 4-12 x 2-7cm, base obtuse or subcordate, rarely acutish, apex obtuse or slightly emarginate, rarely acutish, margin slightly recurved; young leaves sparsely appressed-pilose, adult ones glabrous, conspicuously, prominently and rather laxly reticulate on both sides, top surface green and shiny, midrib and primary nerves (10-12 pairs) prominent on both sides, straight, underside dull, pale or pruinose; petioles rather thick, densely rusty-tomentellous, slightly caniculate, 5-12mm long. Inflorescence axillary panicles, near apex of branchlets, densely rusty-tomentellous, many-flowered, broadly pyramidal, 2-10cm long; peduncles thick, compressed, 1-4cm long; bracts and bracteoles deciduous; pedicels rather slender, tomentellous, 1-3mm long; flowers greenish-yellow, broadly obconical, densely rusty-tomentellous, 3-4mm long, 2.5-3mm diam. at apex, tube 1mm long, pilose inside; tepals erect-patent, fleshy, acutish, 1.5mm long, outer ones narrowly ovate, inner ones ovate-orbicular, pilose inside; stamens included, as long as tepals, outer 6 with ovate, obtuse, glabrous anthers, filaments conspicuous, 0.5mm long, pilose, partly adnate to tepals, inner stamens with narrowly ovate, glabrous, truncate anthers; basal glands rather large, globose, sessile, touching each other; staminodes narrowly ovate, acute, pilose, 0.5mm long, cell-rudiments hardly conspicuous within. Ovary glabrous, ellipsoid, 1mm long, merging into a slightly shorter, cylindric-conical style with obtuse, sub-capitellate, papillose, rather small stigma. Immature fruit with persistent tepals, mature fruit ellipsoid, smooth, to 40mm long, 30mm diam., top obtuse, base sometimes with short, broad, obconical neck; pericarp 0.75mm thick, woody, brittle; testa membranaceous, dark, shining, adnate to pericarp.

Chile (Kostermans 1938).

BOLETUS, HEIMIELLA and RUSSULA

(Boletaceae)

Boletus flammeus *Heim* – nonda ulné kobi
Boletus kumaeus *Heim* – nonda ngamp-kindjkants, ngamp-kindjkants
Boletus manicus *Heim* – nonda gegwants ngimbigl, nondo galwans, gagwants ['penis']
Boletus nigerrimus *Heim* – nonda tua-rua, tuadwa, twaadwa
Boletus nigro-violaceus *Heim* – kermaipip, kermaiph, kermaikip
Boletus reayi *Heim* – nondo ngam-ngam, ngam-ngam
Boletus sp. – guukhraan, waakhriin
Heimiella anguiformis *Heim* – nonda mbolbe, nondo bolbe, mbolbe
Heimiella sp. – notiin

(Russulaceae)

Russula agglutinata *Heim* – nonda mosh, nonda mos
Russula kirinea *Heim* – nonda kirin, kirin
Russula maenadum *Heim* – nonda mosh, nonda mos
Russula nondorbingi *Singer* – nondo bingi, nonda bingi
Russula pseudomaenadum *Heim* – nonda wam
Russula sp. – wuutwuukiin

These fungi are part of a complex array of mushrooms used in parts of Papua New Guinea. Those named specifically have been implicated in the 'mushroom madness' epidemics that have been observed in the Western Highlands amongst the Minj [including the Kuma] of the Wahgi Valley. They are eaten apparently all year as food, only having psychoactive effects during the late dry season. Not everyone partaking experiences effects, and susceptibility to the mushrooms is said to be hereditary, but only to one sibling, usually the eldest, and they are usually not affected until age 17 or thereabouts, though there have been exceptions to these rules. One source has claimed that those susceptible may succumb to the mushroom madness whether they have eaten the mushrooms or not.

The fungi are taken without ritual, usually cooked in a number of ways, generally roasted in an earth oven or stewed in a pot with vegetables. B. reayi is usually cooked with the leaves of a shrub called 'kosgagl', or 'mosong kumu'. Large amounts of the mushrooms must be eaten to have any effect. Some are said to affect only one sex; others affect both. Different species are often consumed in a mixed collection, creating more confusion for ethnobotanists and pharmacologists! Amongst men, the intoxication is known as 'komugl tai'. They are seen to be tense and excited, with shivering or trembling of the extremities; they also suffer from double vision and intermittent aphasia, while running wildly through the village and surrounding forest. They usually arm themselves, and people tend to stay out of their way to avoid injury. People are not held accountable under tribal law for damages or injuries inflicted whilst komugl tai. Women who eat the mushrooms become 'ndaadl', a condition usually brought about by 'nonda mosh' [R. agglutinata and R. maenadum], and they become "delirious and irresponsible", bragging amongst themselves of their sexual exploits. Those who are unmarried may initiate sexual encounters with single and married men alike, whilst married women are expected to stay faithful to their husbands. On the morning of the second day, the women sometimes order their husbands to decorate them in their best feathers and weapons, while dancing in the formations of the men's sub-clans, something they would never be allowed to do when not ndaadl. Amongst the nearby Sina-Sina, mushroom madness is also known; the fungi responsible are known as 'kirin'. With one type of mushroom ['nonda namanotio'; still not identified], the madness [in this case called 'kegliotopogam'] may last 2-4 days, though one type known as 'nonda kandagegl' is known to cause a madness called 'wilopum', which may last 1-2 months, during which the person affected will live in the forest. These two conditions are feared amongst men. An episode of the madness apparently may be aborted by plunging into the nearest river (Heim 1963a, 1963b, 1965, 1967, 1973; Heim & Wasson 1965; Reay 1960; Schultes 1966; Singer 1958b). It should be noted that the term 'nonda' or 'nondo' applies to fungi in general. Researchers have found difficulty in properly collecting and identifying all of the mushroom species associated with the madness, as native systems of classification differ from strict botanical classification (Heim 1965).

Unidentified species from these three genera [Boletus, Heimiella, Russula] are crushed and eaten raw [usually up to 2 mushrooms] in the 3 final stages of initiation as an elder amongst the Bimin-Kuskusmin of West Sepik, New Guinea, along with an unidentified **Psilocybe**, probably P. kumaenorum, and many other substances [see *Endnotes*]. When found, patches of the mushrooms are anointed periodically with boar fat, cassowary faeces, and human semen; they have sacrificial meat placed around them shortly before picking for use. They may also be surrounded by crushed ginger [see *Endnotes*] and tobacco [see **Nicotiana**] to ward off pests and predators. Patches that become damaged or have a dead animal near them are assumed to have been contaminated by evil forces, and abandoned (Poole 1987).

Interestingly, Kuma men under the unfluence of nonda have been reported to perceive 'bush-demons' buzzing around their heads. These bush-demons as perceived through nonda are usually the size of wild bees, and were described as "tiny, two-dimensional, and often transparent" cartoonish creatures (Thomas 2001b). It has recently come to light that many bluing Boletaceae are sold and eaten in China, where it is well known that if not fully cooked before consumption, one will see 'the little men', and psychedelic experiences have been reported (Stijve 1997). It is also of interest that in Germany, B. luridus has been known as 'hexenpilz' ['witch's mushroom'] and 'hexenröhrling' ['witch's bolete'], suggesting association with magical practices (De Vries 1991).

Most researchers today believe the mushroom madness phenomenon to be a non-pharmacological one – that is, the apparent effects of the mushrooms are psychosomatic and constitute a complex social roleplay (Heim 1973; Ott 1993; Schultes & Hofmann 1980, 1992). Others suggest that any real effects come from other plants consumed with the mushrooms, particularly **Nicotiana** [of which handfuls are sometimes eaten with the mushrooms, by men], which are believed to be required to activate the mushrooms (Thomas 2001b). It seems premature to regard these fungi as entirely inactive, due to presumably wide variation in species consumed in combination, seasonal potency, interspecies chemical variation, and various positive reports of psychoactivity.

Roger Heim conducted a series of self-experiments with B. manicus, which is said to be one of the most powerful species in inducing the Kuma 'mushroom madness'. Heim consumed small quantities of dried, powdered B. manicus, less than 60mg in each experiment, though did not note the exact dose for each. The first bioassay revealed no activity. The second led to a sleep state in which he experienced fleeting brightly-coloured luminous visions. The third resulted only in slight stomach malaise (Heim 1965). Internet rumour suggests that B. erythropus [B. luridus var. erythropus] may be consumed in doses of at least 100g [fresh] for psychedelic effects, but it is very uncertain whether this is based in experience or supposition. Although B. satanas causes primarily gastrointestinal symptoms, some suspect it is also psychoactive (Toro 2004).

Many boletes exhibit blue staining when bruised, cut or aged, but this is not indicative of the presence of *psilocybin* or related products [see **Psilocybe**]. With these mushrooms, bluing results from the enzymatic oxidation of xerocomic acid, variegatic acid and gyrocyanin, producing hydroxyquinone derivatives. Some species exhibit black or bluish-black staining on bruising. Blackening in these species might be caused [as in the bolete Strobilomyces floccopus] by enzymatic oxidation of *L-DOPA* [see also **Hygrocybe**]. However, intense staining from the oxidation of variegatic acid [such as in B. erythropus] can result in blackish-violet tones (Gill & Steglich 1987).

Some people have been led by their curiosity to the point of intentionally consuming bluing boletes. One psychonaut consumed a 1-2cm cube of fresh flesh from a bluing bolete picked in Denmark, Western Australia; the same specimen was apparently inactive if cooked. He "became quite paranoid for a couple of days" after consumption. "He became concerned about the possibility of an attack by a tiger that may have escaped from a zoo passing through town, or of being struck by lightning. On the one hand he knew that these events were usually not things to worry about, but on the other hand, they were 'possible' and therefore 'real' concerns. He was able to talk himself out of being too paranoid, but acts such as walking through the forest at night, or being outside with a storm brewing, were accompanied by a considerable rise in adrenaline levels" (Santa pers. comm. 2001). Another psychonaut consumed 4 raw bluing boletes [size or weight of specimens not noted] harvested in Australia [location not noted], without any effects at all. The specimens had golden caps, and yellow-orange tubes below (Ramon pers. comm. 2001).

Boletus edulis is edible (Simonetti 1990), though many other species are considered inedible or toxic, especially when raw. Boletus spp. with red-mouthed tubes [such as B. frostii, B. luridus, and B. satanas] are considered particularly suspect. Symptoms often simply involve vomiting and diarrhoea, though episodes of paralysis have been reported. B. granulatus is often regarded as edible, though some people have suffered toxicity from consuming it (Benedict 1972; Heim 1963b). Russula emetica is well-known for its emetic properties, and R. virescens is also said to be toxic. R. squallida caused death in a guinea pig after 3 days, though it had no effect on rabbits (Ford 1910/1911b).

B. calopus has been shown to contain muscarines [36% muscarine and 64% epi-muscarine; see **Amanita** and **Inocybe**] (Stadelmann et al. 1976).

B. edulis has yielded *phenethylamine* and *tyramine* (Lundstrom 1989), as well as c.8.8% amino acids [including arginine, asparagine, leucine, *glutamine*, lysine, threonine, *tryptophan* and valine] (Zhuk & Tsapalova 1973).

B. erythropus has yielded *tryptamine* (Turowska et al. 1970), as well as 16.6-16.8% mannitol (Heim 1965) and variegatic acid (Gill & Steglich 1987).

B. luridus has been shown to contain <0.002% muscarines [8% muscarine and 92% epi-muscarine] (Stadelmann et al. 1976; Worthen et al. 1965), as well as 15.4-17.7% mannitol (Heim 1965).

B. luteus has yielded *phenethylamine* (Lundstrom 1989).

B. manicus has been shown to contain 3 unidentified indole bases [0.022-0.05% combined], as well as 0.002-0.005% *tryptophan* (Heim 1965, 1973) and 9.8-10.1% mannitol (Heim 1965).

B. nigro-violaceus has been shown to contain <0.005% of an unidentified indole substance; calcium oxalate was also found (Heim 1965).

B. satanas, which is comparable to B. manicus (Heim 1965), has been shown to contain muscarine (Worthen et al. 1965), as well as 19.3% mannitol (Heim 1965).

B. zelleri has been shown to contain *tyramine*, N-methyl-*tyramine*, *hordenine*, and 3 unidentified alkaloids (Lee et al. 1975).

A Boletus sp. harvested near Mt. Hagen, PNG, known as 'namanama', and claimed to be implicated in the 'mushroom madness', was analysed and found to contain 2.5% amino acids [alanine, arginine, *glycine*, histidine, leucine, isoleucine, *methionine*, valine, threonine, 0.04% L-2-amino-4-methyl-5-hexenoic acid], and sterols [ergosterol, as well as 2 unidentified steroids] (Gellert et al. 1973; Rudzats et al. 1972). The term 'namanama' used by these researchers may be a derivation of 'ngam-ngam', a Kuma word applied to some of the Boletus spp. associated with the madness, including B. reayi and three unidentified species (Heim 1965).

In addition, B. frostii, B. miniato-olivaceus and B. subvelutipes contain unidentified alkaloids (Worthen et al. 1965).

As mentioned above, some Russula spp. are known to be toxic, causing poisoning said to be similar to that caused by muscarine, and are often pungent-tasting; mild-tasting species are said to be edible (Bresinsky & Besl 1989).

R. cyanoxantha has been shown to contain *choline* (Turowska et al. 1970).

R. delica has yielded protoilludane sesquiterpenoids, stearoylplorantinone B [0.004%] and stearoyldelicone [0.009%], from intact specimens; the sesquiterpenes plorantinone A, B, and C [degradation products of the above sesquiterpenoids] were obtained from injured specimens (Clericuzio et al. 1997).

R. emetica has been shown to contain muscarines [41% muscarine, 59% epi-muscarine] (Stadelmann et al. 1976) and mannitol. The ethanol extract of fresh specimens showed muscarine-like activity (Balenović et al. 1955). From Japanese specimens, 0.4-0.7% lipids were extracted, with 22,23-dihydroergosterol as a major component (Yonezawa & Mitsuhashi 1969).

R. ochroleuca has yielded L-γ-glutamyl-2-amino-3-hexanone, an aminoketone (Welter et al. 1976).

Nothing seems to be known of the chemistry of Heimiella spp.

Boletus manicus has a pileus up to 13cm across, hemispheric-globose becoming convex or irregularly subhemispheric, very thick, dry, glabrous, matt, white or pallid or slightly greyish; margin incurved, funiculiform; surface covered by an irregular pile of narrow hyphal ends 3-10µ wide, some walls to 1µ thick. Stipe 9-15cm x 20-30mm, 30-55mm at base, rooting, attenuate upwards, white with red reticulation, pale yellowish towards apex, base fuscous vinaceous. Tubes to 5mm, adnexed (free or scarcely adnate), not ventricose, orange-yellow, cyanescent; pores small, round, orange-yellow then red-orange or crimson. Flesh thick, firm, pale yellow, slightly cyanescent. Smell strong, almost repulsive; taste bitter. Spores 9-11.6(-13.5) x 4-5µ, olive ochre in mass, smooth, oblong, hyaline, amygdaliform. Fr. Aug.-Sep.

Found on the ground in forest; New Guinea, Minj, 1500-1700m (Corner 1972; Heim 1963a).

Heimiella anguiformis has a dry pileus 4-8cm across, convex or umbonate, ruguloso-cerebriform, dry, dark- to fawn-brown or tinged orange; margin exceeding the tubes, membranous; surface of pileus rugulose, covered with a pile of moniliform hyphal ends, the pyriform cells 10-40µ wide and finally detaching. Stipe 12-20(-30?)cm x 7mm above, to 15mm at base, attenuate upwards, sinuous, glabrous, light yellow, pink upwards, fuscous and subsulcate downwards, otherwise smooth. Tubes to 15mm, sinuate, ventricose, citron-yellow to orange and olivaceous; pores concolorous. Flesh light citron-yellow, unchanging, rather tough. Smell sour. Spores 18-21 x 10-12.5µ, spore body 12.8-16.5 x 9.3-11.3µ, brown in mass, amygdaliform, base rounded, apex subacute, reticulate in the exospore, without a smooth adaxial patch.

In **Castanopsis** forest, New Guinea, 1500-1800m (Corner 1972; Heim 1963a).

Russula nondorbingi has a viscid, subglobose to convex (eventually convex to applanate) pileus 56-72mm across, slightly umbilicate, glabrous, light grey, deeper-coloured in centre, paler at margin, margin acute and smooth becoming short-sulcate, flesh firm. Stipe 58-90 x 15-28mm, white or whitish with small brown spots, glabrous, subrugulose, solid, then spongy-holey, equal or tapering upward; veil none. Gills cream or whitish, equal, simple, crowded, later close, varying from attingent-subfree to adnate-subdecurrent, but very narrowly attenuate at apex of stipe, to 6.5-7.5mm broad, distinctly anastomosing. Spores 10-13.5 x 8.7-12.7µ, almost globose and yellowish in larger spores, more so than in smaller spores, medium- and small-sized spores more subglobose and hyaline, echinate with isolated spinules 1.5-2µ long; spore print colour unknown.

In tropical forest; Minj, New Guinea (Singer 1958b).

BOOPHANE [Boophone, Buphane] and some relatives

(Amaryllidaceae)

Boophane disticha *(L. f.) Herb.* **(B. toxicaria** *Herb.***; Amaryllis disticha** *L. et Pat.***; Haemanthus toxicarius** *Thunb., Jacq. et Gawl.***)** – buphane, giftbol, seeroogblom, incotho, leshoma, sore-eye flower, Cape poison bulb, candelabra flower
Ammocharis coranica *(Ker-Gawl.) Herb.* – incotho
Brunsvigia radulosa *Herb.* **(B. cooperi** *Baker***)**

The bulbous African herb B. disticha has been used as an intoxicant, and also has several other recorded usages, such as in veterinary medicine. It has been used to poison hunting arrows, and as a suicide poison in the Orange Free State [administered by enema]. It is grown outside of the huts of the Manyika in order to bring good luck and rain, and to ward off nightmares when sleeping. The Xhosa use dried scales from the bulb as a dressing for circumcision wounds. The scales and the leaf have also been used as a dressing for wounds by Europeans in the area, due to the analgesic and pus-excluding actions of the scales, and the styptic action of the leaf. The bulb is used traditionally in Zimbabwe to "arouse ancestral spirits". It is also consumed [mixed with food and other ingredients] by Basuto boys for their initiation and circumcision, to "fill them with the spirit of their ancestors", and to enter manhood with this strength. The dose must be carefully measured, as the bulb of B. disticha is considered very toxic and frequently causes fatalities due to respiratory paralysis. The bulb has also been consumed as a 'recreational' hallucinogen in parts of southern Africa, and its effects are apparently similar to those of **Datura** and related plants. Even simply smelling the flowers is reputed to cause headache and drowsiness (De Smet 1995, 1996, 1998; Laydevant 1932; Usher 1974; Watt & Breyer-Brandwijk 1932, 1962).

An unidentified Boophane sp. is used in Natal to treat hysteria, asthma, and other disorders. Zulu women roll their snuff on dried bulb scales from the same plant, in order to "improve the snuff" (Watt & Breyer-Brandwijk 1962). In Zululand, A. coranica is used to treat mental illness when B. disticha is not available. The outer scales of the bulbs of the plant are partially burnt, before being made into headrings for tribal chiefs, in much of southern Africa. The related Brunsvigia radulosa is also considered narcotic (Koorbanally et al. 2000).

These plants contain a variety of 'Amaryllidaceae alkaloids' limited in their known occurrence to plants of this family (Harborne & Baxter ed. 1993; Martin 1987), as well as the genus **Dioscorea** (Mulholland et al. 2002). See also **Narcissus**, **Pancratium**.

B. disticha bulbs [fresh] have yielded 0.31% alkaloids – 19.4% buphanidrine, 18.6% undulatine, 16.9% buphanisine, 14.1% buphanamine, 11.1% nerbowdine, 7.2% crinine, 5.4% distichamine, 1.2% crinamidine, 0.6% acetylnerbowdine, 0.4% lycorine and 0.3% buphacetine. Other studies have found buphanine [similar to *hyoscine* in effect; on hydrolysis gives buphanitine] and haemanthine [similar in action to buphanine], as well as furfuraldehyde, acetovanillone, chelidonic acid, pentatriacontane, laevulose, ipuranol, a phytosterol, copper, and fatty acids. Dry bulbs have yielded up to 4% alkaloids; outer dry layers of bulb contain no alkaloids. Bulbs grown in shade are said to be more potent. The aerial portions appear not be toxic, as they are grazed harmlessly by animals (De Smet 1996; Watt & Breyer-Brandwijk 1932, 1962). Arrow poison made

from B. disticha, on a Bushman arrow over 60 years old, had retained so much potency that 100-300µg [s.c.] killed mice within 20-30 minutes (De Smet 1998).

A. coranica bulbs have yielded lycorine, 1-O-acetyl-lycorine, crinamine [hypnotic sedative; respiratory depressant and powerful transient hypotensive in dogs – LD50 10mg/kg], 6-OH-crinamine, buphanisine, epi-buphanisine, buphanidrine, ambelline, coranicine [an uncharacterised alkaloid], hippadine, hamayne, caranine, acetylcaranine, cycloeucalenol, cycloeucalenone, epi-vittatine, 24-methylene-pollinastanone, 24-methylene-cycloartan-3β-ol, 6α-OH-powelline and 1-O-acetyl-9-O-demethylpluviine (Buckingham et al. ed. 1994; Koorbanally et al. 2000).

Brunsvigia radulosa bulbs [fresh] harvested in summer have yielded brunsvigine, brunsvinine, and crinamine; in late autumn, lycorine replaces brunsvinine (Dry et al. 1958).

Boophane disticha is a bulbous scapose herb, with an annually-produced fan of leaves from the base. Leaves strap-shaped, not narrowed to base, distichous; leaf sheaths unspotted. Inflorescence a dense terminal umbel of numerous dull red flowers, pedicellate, bisexual, regular, at apex of a leafless stem, subtended by 2 or more membranous bracts; pedicels longer than perianth-tube, lengthening and spreading in fruit, becoming stiff and straight, so that the entire fruiting inflorescence can break away and roll over the ground, distributing seeds; perianth with the tube shorter than the lobes, of 6 equal segments; stamens 6, long. Ovary inferior or superior of 3 carpels with axile placentation; ovule solitary in each cell. Fruit a capsule; seeds few or numerous, often angular or winged.

Locally common in rocky grassland, 1500-2500m; S. Africa, upland Kenya (Agnew 1974), Zimbabwe (De Smet 1996).

BORONIA

(Rutaceae)

Boronia latipinna *J.H. Willis* – Grampians boronia
Boronia muelleri *(Benth.) Cheel*
Boronia pinnata *Smith*
Boronia rivularis *C.T. White* **(B. thujona var. 'a')**
Boronia safrolifera *Cheel*
Boronia thujona *Penfold et Welch*
Boronia spp.

Plants of this genus have been popular horticulturally as ornamentals, partially due to their pleasant fragrance, for which they are also used in perfumery. Some contain a variety of interesting compounds with psychoactive potential.

B. latipinna leaf yielded 0.9% essential oil, terminal branchlets yielded 1.4%, consisting of 60.6% bornyl acetate, 6.7% *camphor*, 9.5% camphene, 5.8% β-*pinene*, 0.6% *safrole*, 0.3% *borneol*, 0.1% humulene and others (Brophy et al. 1986).

B. muelleri essential oil has yielded *elemicin*, *pinene* and geraniol (Ghisalberti 1997).

B. pinnata flowers have yielded *elemicin* from their essential oil, as well as methyl anthranilate and anthocyanin malvidin 3,5-dimonoside; essential oil from the leaves has yielded limonene and d-α-*pinene* (Ghisalberti 1997; Shaw et al. comp. 1959).

B. rivularis essential oil has yielded *safrole* and l-limonene (Ghisalberti 1997).

B. safrolifera leaf essential oil has yielded *safrole*, *methyleugenol*, and d-α-*pinene* (Ghisalberti 1997).

B. thujona leaf and branch essential oil has yielded α- and β-*thujone* (Ghisalberti 1997; Shaw et al. comp. 1959).

Boronia thujona is a shrub or small tree 1-4m tall, glabrous, unarmed; branchlets with 2 grooves separated by decurrent leaf bases. Leaves aromatic, opposite, rarely subopposite, pinnate with 3-15 leaflets; leaflets narrow-elliptic to linear-oblong, 5-30 x 1-6mm, apex acute, margins finely glandular-crenate and revolute to recurved, lower surface slightly paler, lateral leaflets opposite, terminal leaflet often shortest; rachis 9-40mm long, slightly winged; petiole 7-17mm long. Inflorescences axillary, cymose or paniculate, 2-6-flowered; flowers bisexual; pedicels 5-15mm long; sepals 4(-5), free; petals 4(-5), free, not persistent in fruit, 6-9mm long, imbricate, bright pink; stamens 8(-10), free, erect or pyramidally arranged; carpels 4(-5), +- free, lacking a sterile apex; styles fused, arising terminally or subterminally from carpels; stigma scarcely differentiated from style or capitate or grossly swollen and almost sessile; ovules 2 in each carpel. Fruit of 1-4 cocci, cocci not transversely ridged, with rounded apices, glabrous; seeds released forcibly from dehiscing cocci, dull or shiny, black. Fl. Aug.-Nov.

In wet and dry sclerophyll forest, in damp shady spots on sandstone; from the Sydney region to the Budawang Ranges, NSW [Australia] (Harden ed. 1990-1993).

BOSWELLIA

(Burseraceae)

Boswellia carteri *Birdw.* **(B. sacra** *Flueck.***)** – African olibanum, oliban, frankincense tree
Boswellia thurifera *Roxb. ex Flem.* **(B. glabra** *Roxb.***; B. serrata** *Roxb. ex Colebr.***)** – Indian oliban, frankincense tree, salai

The delicious incense of 'frankincense', the oleo-resin from B. carteri, B. thurifera, or related species, has been used by Middle-Eastern cultures since time immemorial. A prosperous trade route for this commodity was centred around Yemen for many years. In the first century AD, Pliny wrote of the fact that it was a capital offence for a camel transporting frankincense to turn from the trade route – he also described the security measures at a major processing centre in Alexandria, where the workers were strip-searched before being allowed to leave the workplace. 'Myrrh', a stronger incense [from Commiphora spp.], commanded three times the price of frankincense, but the popularity of the latter was such that it enjoyed a demand five times greater. Ancient Egyptians used it in perfumes, cosmetics, and as an incense for temple rites; it was also highly esteemed by the Persians, Babylonians, Assyrians, Hebrews, Greeks and Romans. It was said to have been one of the gifts given to the baby Jesus, as well as being an ingredient of the holy incense given to Moses by God. In England today, the Lord Chamberlain makes an offering of frankincense during the feast of the Epiphany on Jan. 6. The incense is believed to be a purifier, used to drive out evil spirits, and its scent is said to be a manifestation of the 'presence of the divine' (Abercrombie 1985; Duke 1983; Lawless 1994).

In TCM, a decoction of B. thurifera resin [3-9g] is taken to treat chest and stomach pain, painful menstruation, amenorrhoea, nocturnal emission, epilepsy, poor circulation, boils and abscesses. An alternative means of ingestion is to let a piece of the resin dissolve in the mouth. In Ayurvedic medicine, it is used externally for carbuncles, and internally for lung infections and gonorrhoea; it is used in Indian folk medicine to treat CNS-disorders and rheumatism (Reid 1995; Watt & Breyer-Brandwijk 1962). Oleo-resins of both B. carteri and B. thurifera have been used in folk medicine to treat tumours (Pernet 1972). Frankincense vapours clear the head, and are considered warming, restorative, revitalising, uplifting, sedative and tonic; taken internally, frankincense is also an analgesic, emmenagogue, astringent, antiinflammatory, antiseptic, carminative, expectorant, digestive, and circulatory stimulant, also stimulating muscle-growth (Lawless 1994, 1995; Reid 1995). One psychonaut reported being "hardly able to walk", with perceived "opioid" effects, after heavy use of frankincense essential oil in a vapouriser, in a closed room (theobromus pers. comm.). See also the Catholic altar-boys below!

B. carteri oleo-resin has yielded 5-10% essential oil, containing *pinene*, dipentene, limonene, *thujone*, phellandrene, cadinene, cymene, p-cymol, myrcene, terpinene, camphene, olibanol, verbenol, verbenone, bornyl acetate, octyl acetate, incensyl acetate, octanol, linalool and incensole; as well as 60-65% resins [α- and β-boswellic acid], 20% gum [containing arabinose, galactose, galacturonic acid], and 5-8% bassorine, a polysaccharide (Battaglia 1995; Lawless 1995; Pernet 1972). Investigating the possible cause of habituation of some Catholic altar-boys to inhaling frankincense fumes, it was hypothesised that *THC* could be formed in the fumes, and possibly also from chewing or digesting the resin (Martinetz et al. 1989). However, this was not actually proven, and later research failed to detect *THC* in the pyrrolysis products of resin samples (Safayhi 2001). See also *citral* entry in *Chemical Index*.

B. thurifera oleo-resin has yielded an essential oil containing *estragole*, geraniol, terpineol, α-thujene, p-cymene, β-*pinene*, (+)-limonene, linalool, elemol and cadinene; as well as arabinose, rhamnose, glucose, galactose, fructose, digitoxose, xylose, polyuronic acids, glucuronic acid and galacturonic acid. The non-phenolic fraction showed analgesic, sedative and antitumour activity (Kar & Menon 1969; Pernet 1972; Rastogi & Mehrotra ed. 1990-1993).

Boswellia thurifera is a deciduous, middle-sized tree with a spreading, flat crown; bark c.1.2cm thick, greenish, ash-coloured, peeling off in thin, smooth flakes; young shoots and leaves pubescent with simple hairs. Leaves imparripinnate, crowded at ends of branches; leaflets 8-15 pairs, opposite or nearly opposite, sessile, lanceolate, +- deeply crenate, apex generally obtuse. Flowers bisexual, in small racemes; calyx small, 5-7-cleft; petals 5-7; stamens 10-12, inserted at base of red annular, fleshy disc; anthers 2-celled, dehiscent longitudinally. Ovary free, 3-celled, ½ immersed in the disc, 2 collateral ovules in each cell, hanging side by side from the top of the central angle. Fruit a 3-valved drupe, the valves separating from the dissepiments, which remain attached to the axis, dehiscent; seeds 3, enclosed in heart-shaped stones attached to the inner angle. Leaves fall Mar.-Apr., new foliage sprouts in Jun. Fl. when tree is leafless.

In deciduous forests, often gregarious, forming open forests with Sterculia urens; sub-Himalayan tract, from the Sutlej east and throughout the drier parts of the w. Peninsula to within 16-32km of the w. Ghats.

Easily grown from cuttings (Brandis 1906).

Frankincense resin [in this instance referring to that from B. carteri] is collected all year, except during rainy periods. A top layer of bark is scraped away, and globules of white resin ooze out; resin from the first two scrapings of one spot is discarded – it is the third cutting that produces what is regarded as 'real' incense. The best comes from Yemen and southern Arabia, with cheaper types coming from India and Somalia (Abercrombie 1985).

BRACHYCHITON

(Sterculiaceae)

Brachychiton diversifolius *(G. Don.) A. Terracc.* **(B. diversifolium** *(G. Don.) R. Br.***; B. populneum** *R. Br.***; B. populneus** *(Schott) R. Br.***; Sterculia diversifolia** *G. Don.***)** – nanungguwa, burdaga, marndaja, pirtpa, kurrajong, northern kurrajong

This tree, related to **Cola** and **Theobroma**, is utilised by indigenous groups in northern Australia. The seeds are eaten raw or cooked [sometimes with honey], though they are covered with irritating hairs; these hairs are usually removed in the process of roasting the seeds on hot coals. The roots of young plants are also eaten raw or cooked. The inner bark is made into an eyewash, and is also chewed to alleviate thirst and fatigue on long journeys. The outer bark is used to make rope, string and belts; the Ngarinyman prefer to use the inner bark for their fibre requirements. The wood is used to make fire sticks and some types of spears. The gummy bark exudate may be rubbed into cuts and sores to promote healing, and the inner bark is used to make bandages. The Ngarinyman use B. megaphyllus, B. spectabilis, and B. viscidulus [all known as 'jarrinkal'] in the same ways as they use B. diversifolius (Aboriginal Communities 1988; Brock 1988; Smith et al. 1993).

The seeds have caused intoxications in sheep and cattle, referred to as 'scrub-cramps', and observed as locomotor disturbance when affected animals were forced to move (Webb 1948).

The most interesting aspect of this plant, however, is that the seeds were shown to yield c.1.8% *caffeine* (Bock unpubl.; Turner 1903), which makes them potentially a stronger stimulant than some coffee [see **Coffea**].

Mature seeds of B. paradoxum [Sterculia ramiflora] from Chillagoe, Queensland [harv. Jun.], tested positive for alkaloids (Webb 1949). See also Sterculia in *Endnotes*.

Brachychiton diversifolius is a tree 7-15m tall, with a well-formed conical crown, semi-deciduous, glabrous except for flowers; bark tight, round, dark grey, finely fissured. Leaves alternate, smooth, ovate to elongate heart-shaped, 4.5-15 x 5-10.5cm, green, apex long-pointed, young leaves highly variable in size and shape, often 3-5-lobed, mature leaves ovate to lanceolate or 3-lobed. Inflorescence an axillary panicle; flowers unisexual, broadly campanulate, hairy and greenish-yellow or creamy-white externally, spotted red-brown and yellow within, 1.2-1.5(-2)cm high x 1.2-1.5cm wide, usually 5(-6)-lobed, valvate or induplicate-valvate; petals absent; anthers 10-30, subsessile on androgynophore, 2-locular; carpels 5, free, raised on short gynophore; staminodes 10-30 at base of carpels; styles cohering initially, later separating; stigmas ligulate, radiate. Fruit smooth, oblong to ovoid woody follicles, (4-)5-9.5 x 2.5-3.5cm, 5 or fewer by abortion, stipitate, short-pointed apex, dark grey to black, splitting open when ripe, prickly-hairy inside; seeds numerous, 2-seriate, yellow, with prickly hairs, surrounded by honeycomb-like compartments. Fl. Jun.-Sep.(-Oct.), fr. (Sep.-)Oct.-Dec.

Open forest and woodland, on a wide variety of well-drained soils, extending to sparse savannah woodlands in dry regions, or rocky hillsides; n. Qld, WA, NT, NSW, Vic. [Australia]. Cultivated as an ornamental (Brock 1988; Jessop ed. 1981; Stanley & Ross 1983-1989).

BRASSICA

(Cruciferae/Brassicaceae)

Brassica alba *Rabenh.* – white mustard, siddhartha, sufedrai

Brassica juncea *L.* – brown mustard, common Indian mustard, rajika, sarson

Brassica spp. – wild turnip, wild radish, wild mustard

Many Brassica spp. are common weeds all over the world, and their seeds may be made into mustards. The pungency that gives the characteristic taste of mustard develops when the seeds are crushed in water (Bremness 1994; Low 1991b). Some cultivars of B. oleracea are also common vegetables, such as B. oleracea cv. botrytis [cauliflower], B. oleracea cv. capitata [cabbage], B. oleracea cv. gemmifera [Brussels sprouts], and B. oleracea cv. cymosa [broccoli].

Mustard seed is associated with Aesculapius, the Roman god of healing. It is used in love and fertility potions, and some Italian peasants sprinkle the seeds on the doorstep as a protective agent. The seeds are also said to be effective in increasing mental powers (Cunningham 1994). Because they are believed to "promote virility", mustard seeds have been forbidden to monks (Rätsch 1990). In Tuscany, Italy, small pieces of wild B. oleracea ssp. robertiana ['cavolo di San Viano'] leaf are sometimes eaten to provide a good omen (Pieroni & Giusti 2002). The Cherokee use three species [B. hirta, B. napus and B. nigra] as tonic stimulants and appetite stimulants, as well as to treat fever, dropsy, palsy and asthma (Hamel & Chiltoskey 1975). The Chinese use B. juncea to treat colds, abscesses, ulcers, rheumatism, lumbago and stomach problems (Bremness 1994). It is said that the Hindus used mustard seed to 'travel through the air' (Cribb 1981; Cunningham 1994). In India, seeds of B. alba are used as a nerve stimulant, which is an emetic and narcotic poison in large doses; they also treat epilepsy and hysteria (Nadkarni 1976). In Tanzania, B. juncea leaves and flowers are smoked to 'get in touch with the spirits'; the effects are said to be **Cannabis**-like, but weaker (Burkill 1985-1997).

Mustard seeds stimulate the circulation, warm and stimulate the digestive system, treat bronchitis, and may reduce inflammation applied topically as a counter-irritant; mustard oil is also strongly antibacterial and antifungal, but may blister the skin (Bremness 1994; Low 1991b; Mabey et al. ed. 1990). Seeds contain the highest concentration of mustard oils; important constituents are the glycoside sinigrin, and the enzyme myrosinase [thioglucosidase], which react with water to release allyl isothiocyanate [a strong irritant], potassium bisulfate and glucose (Hall 1973; Harborne & Baxter ed. 1993; Rastogi & Mehrotra ed. 1990-1993).

Specifically, B. juncea has also yielded glucobrassicins, cyclobrassin sulfoxide, progoitrin, napoleiferin, 3-butenonitrile, phenylacetonitrile, 3-phenylpropionitrile, 3-phenylpropionamide, 5-isothiocyanato-1-pentene and 25-methyl-24-methylenecholesterol (Buckingham et al. ed. 1994; Rastogi & Mehrotra ed. 1990-1993; Wu & Sheng 1999). Benzyl-isothiocyanate and phenethyl-isothiocyanate inhibit enzyme P-450 [see *Neurochemistry*] (Teel & Huynh 1998).

The psychoactive effects of some Brassica spp., which have not been scientifically investigated, might possibly be partly due to circulatory stimulation, which could provide a 'circulatory rush' giving rise to a sensation of moving through air. Some of the compounds found in B. juncea and other B. spp. may produce potentially psychoactive byproducts on degradation. On hydrolysis, the glucobrassicins produce 3-indolemethanol, 3-indoleacetonitrile, 3,3'-diindolylmethane, and 4-OH-indolemethyl derivatives. Progoitrin and napoleiferin on hydrolysis produce goitrin derivatives; on pyrolysis they might produce compounds similar to sulphur analogues of muscazone [see **Amanita**] (theobromus pers. comm.; Wu & Sheng 1999).

Brassica juncea is an annual herb to 1m tall, with branches almost erect, glabrous. Leaves glaucous; basal leaves lyrate-pinnatisect with 1-2 pairs of lobes, to 20cm long, sparsely bristly; upper leaves reducing to +- entire, glabrous, +- petiolate. Inflorescence elongating from a flat corymb; flowers actinomorphic, bisexual, nectariferous; sepals 4, free, in 2 whorls; petals 4, free, usually clawed, cruciform, 7-9mm long, pale yellow; stamens usually 6 in 2 whorls, outer 2 filaments shorter than 2 inner ones; anthers dehiscing longitudinally. Gynoecium of 2 fused carpels; ovary superior, 2-locular, false septum dividing ovary typically present and persistent after seed dispersal; style single; stigma usually 2-lobed. Siliqua terete to somewhat flattened, partly contracted between seeds, spreading, 2-6cm x 2-4mm, +- 4-angled, lateral veins on valves anastomosing, beak 4-10mm long, narrower than stigma; pedicel 7-20mm long; seeds numerous in valve region, 1 row per loculus.

Native to Europe and Asia – a weed of agricultural lands; in Australia, found in Qld, NSW, SA & WA (Harden ed. 1990-1993).

BRUGMANSIA

(Solanaceae)

BRUGMANSIA X CANDIDA 'BUYÉS'

Brugmansia x candida *Persoon* **(B. arborea** *(L.) Lagerheim***; B. aurea** *Lagerh.***; Datura arborea** *L.***; D. candida** *(Pers.) Saff.***)** – tecomaxochitl, floripondio, floripondio blanco, floripondio amarillo, almizclillo, máma maikiwá, buyes, po:b piH, borrachero, borrachera de agua, munchira, tonga, misha, misha rastera blanca, cimora oso, cimora galga, cimora toro curandero

Brugmansia x insignis *(Barbosa-Rodr.) Lockwood ex Schultes* – toa-toé, sacha toé, danta borrachera, unt maikiwá, pehí, muhu pehí, seme pehí, sese pehí, tãkiyaí pehí, misha rastrera

Brugmansia sanguinea *(Ruiz et Pavón) D. Don* **(B. bicolor** *Lindl.***; B. bicolor** *Pers.***; D. sanguinea** *Ruiz et Pavón***)** – puca campancho, huaca, yerba de huaca, huacachaca ['plant of the tomb'], grave plant, misha toro, misha rastrera, tongo, tonga, borrachero, borrachero rojo, guamuco, guamuco borrachera, guamuco floripondio, chimite maikiwá, dóctor maikiwá

Brugmansia suaveolens *(Humb. et Bonp. ex Willd.) Bercht. et Presl* **(D. suaveolens** *H. et B. ex Willd.***)** – toé, flor de toé, floripondio, floripondio blanco, borrachero, misha colambo, tsuak, ain-vai, maikua, tsuakrutin maikua ['medicine maikua'], tuktur maikua ['doctor maikua'], ukunch maikua ['bone maikua'], yawa maikua ['dog maikua'], baikua, bikut, míkiut maikiwá, tsuak, fleur trompette

Brugmansia versicolor *Lagerheim* – misha del Inca

Brugmansia vulcanicola *(Barclay) Schultes* – yas

Brugmansia (Datura, section Brugmansia) spp. – borrachera, buyés borrachera, siva ghanta, dhodre phul, dhature phul, angel's trumpet, tree datura

These tree relatives of **Datura** have been cultivated as ornamentals and magical plants in S. America since pre-Columbian times. They reproduce only in cultivation through cuttings and planted seed, no truly wild forms being known. Many specimens exist as cultivars, and species such as B. x candida have many varieties with different names (Bristol 1969). Opinions also differ on the synonymy of some of these species, which is confused by their variability, and the existence of many cultivars and hybrids. In particular, B. arborea, B. aurea and B. x candida are sometimes considered separate species, and B. suaveolens is sometimes not considered to be a true species at all. They are, however, very similar both in appearance and chemistry, and for the sake of simplicity I will follow the classifications above and leave the definitive taxonomy of this genus for others to debate.

The Sibundoy Valley of the Colombian Andes is the centre of Brugmansia use, and indigenous people there grow the trees as private possessions. Their use also spreads south to Chile. The striking red-flowered B. sanguinea was sacred to priests of the Temple of the Sun at Sogamoza, Colombia. The Guambiano of s. Colombia say of B. vulcanicola – "How pleasant is the perfume of the long, bell-like flowers of the Yas, as one inhales it in the afternoon…But the tree has a spirit in the form of an eagle…The spirit is so evil that if a weak person stations himself at the foot of the tree, he will forget everything…feeling up in the air as if on the wings of the spirit of the Yas." The spirit jealously guards the plant where it lives, and is said to viciously pursue anyone who would try and fell it, ruining the offender's crops and plaguing their livestock. Apart from external application to rheumatic pain, Brugmansia spp. are often used for their hallucinogenic properties in divining, whereby an infusion or pressed juice of crushed seeds, stems or stem raspings, leaves and/or flowers is drunk. Leaves are usually taken in pairs. Sometimes the plant parts are added to chicha beer [see *Methods of Ingestion*], or are drunk with aguardiente [a distilled cane alcohol] or tobacco-water [see **Nicotiana**]. Fortifying recreational alcoholic beverages with Brugmansia is generally considered antisocial as it can lead to fighting and social disorder. Species and varieties are recognised as having differing potency or toxicity, and less toxic types are preferred for shamanic work. They may be taken with a sober assistant – like **Datura**, the intoxication induced by Brugmansia can be long-lasting, unpredictable and difficult to manage. The Jivaro administer the seeds to unruly children, so that their ancestors may punish them and show them the right way to live. They also give it to boys at the age of 6, to acquire an 'eternal soul' ['arutam wakani']. An infusion of 3-6 leaves of B. x insignis is sufficient to produce a hypnotic state of mild inebriation, to facilitate divination. Ground leaves and flowers of B. x candida are sometimes fed to hunting dogs to improve their senses (Bennett 1992; Bristol 1969; Schleiffer 1973; Schultes 1969c; Schultes & Hofmann 1980, 1992; Schultes & Raffauf 1990).

In Mochica, Peru, B. x candida is sometimes brewed together with San Pedro [see **Trichocereus**] (De Rios 1977). This is also the case in Huancabamba, Peru where B. x candida, B. sanguinea and other unidentified Brugmansia spp. are occasionally added to the brew for cases of difficult divination. Even amongst shamans of the area, many Brugmansia cultivars are considered too strong and dangerous to take internally, instead applying them externally for both medicine [inflammations, aches and pains, skin problems etc.] and divination. For example, rather than drinking the plant with San Pedro, some shamans may tie a couple of leaves to their head and absorb the drug that way, whilst drinking the San Pedro. However, some weaker cultivars are indeed taken internally, such as B. versicolor, of which an alcohol tincture is used as a sedative and analgesic. As with many potentially dangerous drugs used in n.e. Peru, the effects may be stopped by drinking 'arranque' or 'corte', a mix of water, sugar, corn [Zea mays - see *Endnotes*], white rose petals and **Citrus** aurantiifolia ['limón agrio'] juice (Davis 1983; De Feo 2003; Rätsch 1998).

B. suaveolens leaves are sometimes added to ayahuasca brews [see **Banisteriopsis**] by the Siona, Sharanahua, Shuar, Quichua and Ingano; leaves, stems, seeds and/or leaf ashes of other spp. [such as B. x insignis] have also been added to the brew. Often only 2 leaves are added. Shuar shamans consider B. suaveolens "to be the most powerful and the most dangerous hallucinogen" which can cause insanity with repeated use. This applies to all Brugmansia spp. (Bennett 1992; Luna & Amaringo 1991; McKenna et al. 1995; Ott 1994; Rivier & Lindgren 1972; Schultes 1957; Schultes & Raffauf 1990; Uscategui 1959). Besides being added to ayahuasca, in Peru B. suaveolens is also sometimes taken as a plant teacher, in a 1 month diet. For this purpose, one method of preparation consists of cooking the core of the stem in a double-boiler until it becomes rubbery. It is then consumed as it is (Bear & Vasquez 2000; Luna 1984). The Shuar also occasionally consume the raw juice from green bark of B. suaveolens to find their soul or 'arutam', or to see into the future. The plant is also used medicinally, to treat weakness and menstrual pain and to allay infections (Bennett 1992).

The Mixe of Oaxaca, Mexico, drink a diluted hot-water maceration of 3 B. x candida flowers [or 6 in total if there is no effect] at night for divinatory purposes (Lipp 1990). In Mexico, B. x candida is also used as an intoxicant, local analgesic and purgative, whilst B. suaveolens is used as a local analgesic and antipyretic (Diaz 1979). Interestingly, shamans in Nepal have taken to using Brugmansia spp. which have naturalised there; flowers and leaves are smoked or burned as incense, sometimes with **Cannabis**, for shamanic travel to the underworld or to visit the 'nagas' [see **Naja and Ophiophagus**]. Flowers are also used as offerings to Shiva (Müller-Ebeling et al. 2002).

In the West, intoxications from Brugmansia spp. ingestion are not uncommon. The ingestion is usually intentional, by young people seeking new [and free] psychedelic experiences, due to the fact that these plants are commonly grown as ornamentals and are thus easily available. These experiments sometimes result in temporary hospitalisation until symptoms subside [often with i.v. physostigmine administration to reverse anticholinergic effects], and people trying these plants alone often endanger themselves with bizarre behaviour and their lack of physical or mental control. In one case, "an 18-year-old boy was found wandering the streets naked and masturbating. He was confused, delirious, agitated, belligerent, eating tree bark, and complained of terrifying visual hallucinations". Symptoms closely follow those of **Datura** ingestion, due to similar chemistry; the typical anti-cholinergic syndrome is observed, featuring delirium, hallucinations, confusion, agitation, memory impairment, blurred vision, dilated pupils, dry mouth, hyperthermia, flushing, occasional tachycardia, and sometimes convulsions with very large doses. Death can result in overdose from respiratory and circulatory paralysis, though more often, death is due to misadventure whilst intoxicated. In one unfortunate incident, a boy "was found dead, lying face down in a shallow puddle of water". In most cases, there is full recovery after several days at the most (Hall et al. 1977, 1978b; Popkin et al. 1976). Every time I have ingest-

ed Brugmansia spp. [see below], I have felt absolutely fine the next day. Maybe I've just been lucky, and I have further limited my chances of disaster by ceasing my experiments with these plants many years ago.

I have experimented with what was believed to have been B. x candida [growing ornamentally] on several occasions. All experiments used flowers taken from the same tree within a 2 month period. The initial experiments involved drinking a flower decoction in increasing concentrations over a period of 1 week [3 separate ingestions, of 1, 2, and finally 3 flowers].

The first was without effect; the second induced a dry mouth, very mild sensory alterations and incoordination lasting several hours. The third experiment was fully active, and thankfully, was the only one conducted in a relatively safe environment. Effects were noted within 20-30 minutes after ingestion; shortly after, I experienced very dry 'cotton-mouth', gagging in the throat, and difficulty in breathing. Attempts to vomit were unsuccessful, and these uncomfortable side-effects diminished after another 20 minutes. After this point, the drug was in full effect for at least another 6-8 hours, after which I was put to bed by friends [still heavily affected], though in the condition I was then in, time could not reliably be measured. The course of events during the full intoxication could neither be adequately recorded; often I seemed to be existing in at least two places at once, and could not tell fully what I was doing at any time. Visual hallucinations were vivid, though not dominating the experience, which was more coloured by distortions of time, space and thought, as well as heavy confusion and delirium; my behaviour was bizarre, irrational and benignly uncontrollable [mainly in that I had little control over my actions]. Despite this, the portion of the experience following the initial breathing difficulties and 'gagging' was not unpleasant – rather, it was very interesting, but highly confusing. Sleep was sound, and I awoke the next morning free of after-effects or difficulty in focussing visually [many people speak of being 'blind' for several days afterwards]. There was little memory of the previous night, though certain brief events can still be recalled – the exact order in which they occurred, however, can not.

On another occasion, c.1 flower was eaten raw with pumpkin soup; this experiment was done under foolhardy circumstances with no forethought. I experienced the dry mouth, gagging and breathing difficulties mentioned above, as well as nausea, with little psychic component other than distress and mild confusion (pers. obs. 1993).

The dried leaves may also be smoked for mild effects, though care should be taken to not smoke too much; a headache emerging is a good sign to go no further (pers. comms.; pers. obs.). Some people have tried infusing the crushed seeds or leaves in water and leaving the mixture to ferment in the sun for up to several days before consumption – this is said to reliably result in a less toxic, more manageable experience (Wise pers. comm.). This may also be a reason why Brugmansia is sometimes drunk with alcohol – perhaps alcohol lessens the toxicity of these tropane alkaloids? Drinking the plant juice with tobacco-water would also be expected to alter some of the effects, due to the cholinergic pharmacology of **Nicotiana** alkaloids. Still, caution is advised with these plants.

B. x candida has yielded 0.23-0.55% total alkaloids from aerial parts, of which 31-60% may be *hyoscine*, with usually lesser amounts of *hyoscyamine*; other alkaloids present are *atropine*, noratropine, norhyoscine, meteloidine and oscine. Roots yielded *atropine*, noratropine, *hyoscine*, norhyoscine, meteloidine, oscine, tropine, pseudotropine, 3α-tigloyloxytropane and 3α,6β-ditigloyloxytropane (Bristol et al. 1969; Henry 1939). As hybrids between B. aurea and B. x candida, aerial parts yielded 0.65-0.72% *hyoscine* and 0.17-0.19% *hyoscyamine*; the B. x candida parent in this case yielded only 0.25% *hyoscine* and 0.04% *hyoscyamine* (El-Dabbas & Evans 1982). *Hyoscine* content in leaves decreases as they mature (Griffin & Lin 2000). The coumarins *scopoletin* and aesculetin have been found in aerial parts [0.0002% combined, w/w] (Kala 1958).

B. sanguinea flowers have yielded 0.34-0.89% *hyoscine* as well as 0.03-0.25% other alkaloids [flowers yielded 0.345% *atropine* in one test]; stems yielded 0.27% *hyoscine* and 0.05% other alkaloids; leaves yielded 0.07-0.97% *hyoscine* and 0.03-0.57% other alkaloids; roots yielded 0.12-0.28% *hyoscine* and 0.19-0.33% of a mixture of *hyoscyamine* and *atropine*; seeds yielded 0.16-0.172% alkaloids, consisting mostly [78%] of *hyoscine*, as well as apohyoscine, *hyoscyamine*, tropine, pseudotropine, *choline* and 2 unidentified alkaloids (Evans et al. 1965; Leary 1970).

B. suaveolens leaves from Brazilian plants have yielded 0.09-0.16% alkaloids, with the variations being unrelated to season – *hyoscine* may constitute up to 80% of total alkaloids, with lesser amounts of norhyoscine, apohyoscine, *atropine*, noratropine, meteloidine, teloidine, 6β-tigloyloxytropan-3α,7β-diol, 3α-tigloyloxytropan-6β-ol and 3α,6β-ditigloyloxytropan-7β-ol; roots yielded 0.13-0.21% alkaloids, consisting of *hyoscine*, *atropine*, meteloidine, cuscohygrine, tropine, 3α-acetoxytropane, (+-)-3α-tigloyloxytropan-6β-ol, 3α,6β-ditigloyloxytropan-7β-ol and 6β-(α-methylbutyryloxytropane); calyces yielded 0.29% alkaloids, and corollas yielded 0.35% alkaloids – in the corolla, norhyoscine was a major component (Evans & Lampard 1972).

Brugmansia x candida is a large shrub or small tree 3-5m tall, often spreading clonally, all parts densely pubescent with simple, erect, crisped hairs. Leaves simple, alternate, entire, rarely coarsely dentate or shallowly lobed, ovate or oblong-elliptic, 15-25[-40]cm long, 8-12cm wide or more, apex acute to acuminate, base oblique; petioles to 6cm long. Flowers pendulous, solitary; pedicels 3-5cm long, stout in fruit; calyx tubular, spathe-like, split on one side, lobes not clearly separated, 1-4-toothed, 1.5-3cm wide, to 12cm long; corolla white or pale apricot, 25-30cm long, trumpet-shaped, 5-lobed, tube slender, slender basal part wholly enclosed by calyx, gradually flaring to the limb, the limb flaring to broadly triangular apices, with recurved terminal cusps 2-9cm long; stamens 5, inserted below middle of corolla tube; filaments 4-5cm long; anthers distinct, linear, c.2.5cm long, dehiscing longitudinally. Ovary 2-celled; style slender, 17-19cm long; stigma oblong, 2-lobed, 5-7mm long, included in corolla throat. Fruit an oblong-cylindric to fusiform pod or capsule, rarely formed, 4-valved, up to 20cm long, 2cm wide, pendulous, lacking a persistent calyx, smooth; seeds numerous, angular, D-shaped, laterally compressed, 6-10mm long, testa thick and corky, embryo curved.

Native to Peru; widely cultivated as an ornamental. The most common cultivar is 'buyés'; the most toxic cultivars are reputedly 'salamán' and 'munchira', which are uncommon and have mutated leaf forms [as do some other cultivars] (Bristol 1969; Wagner et al. 1990).

With seed germination, bottom heat may be beneficial but is not always required; seeds germinate easily with no special treatment. Most plants rarely set seed. Cuttings root easily in water; in the Sibundoy, branch cuttings over 50cm long are often simply stuck in the ground to strike. The best portions to use for cuttings are stems which are thick and quite vigorous, as opposed to stems with woody growth. Water young plants frequently. Grow outdoors in a large tub or in a permanent position, protected from wind in rich, well-drained soil. In summer, water once a week with organic liquid fertiliser. In cold areas, plants go dormant in winter, and may be brought indoors (Bristol 1969; Grubber 1973; pers. obs.).

BRUNFELSIA

(Solanaceae)

Brunfelsia australis *Benth.* **(B. hopeana var. australis** *(Benth.) J.A. Schmidt***; B. paraguayensis** *Chodat***)** – yesterday today and tomorrow, Paraguay jasmine, francissia

Brunfelsia chiricaspi *Plowman* – chiricaspi ['cold tree' or 'fever tree'], chiricsanango ['cold medicine'], sanango, covi-tsontinba-ko, borrachera ['intoxicant']

Brunfelsia grandiflora *D. Don* **(B. tastevinii** *Benoist***; B. grandiflora ssp. schultesii** *Plowman***)** – borrachero, chiricsanango, chiriqsanango, chiriguayusa, chiricaspi picudo, chiricaspi salvaje, chiricaspi chacruco, chinikiasip, sanango, hu-ha-hai, yai-hu-ha-hai, chi-pi-ri-tsontinba-ka

Brunfelsia pauciflora *(Cham. et Schlect.) Benth.* **(B. calcyina** *Benth.* **var. floribunda** *Raffill***; B. calycina var. macrantha** *(Lem.) Bailey et Raffill***)** – yesterday today and tomorrow

Brunfelsia uniflora *(Pohl) D. Don* **(B. hopeana** *(Hook.) Benth.***)** – manacá, umbura puama, vegetable mercury, jerataca, Paraguay jasmine, white tree, good night

In southern Colombia and adjacent Ecuador, the Kofan, Siona, Shuar, Runa and Ingano [and probably other groups also] sometimes add the leaves of B. chiricaspi to their ayahuasca brews [see **Banisteriopsis**], it being considered the strongest species of Brunfelsia in use [more on B. chiricaspi below]. Addition of Brunfelsia spp. to ayahuasca is said to make the brew stronger, and make a sound 'like rain in the ears'. The Quechua name for the plant, 'chiricaspi', means 'cold tree' referring to the chills and tingling sensations that are felt after ingestion of the bark. It is said to act as a tonic over time, giving one strength and resistance to cold. Bark, stems, leaves or roots of B. grandiflora and/or B. grandiflora ssp. schultesii are also sometimes added [the former sometimes being taken with yoco (see **Paullinia**), though B. chiricaspi is preferred. This species, as well as B. grandiflora ssp. schultesii, are also used by some of the same tribal groups in the Colombian and Ecuadorian Putumayo as intoxicants ['borracheras'] without any other plants. In Peru, the roots are sometimes taken under a 1 month diet, as a plant teacher. It is said that old, thick roots are toxic, and that only roots c.1-1.5cm diameter should be used. A dose may consist of 2-3 roots (Bear & Vasquez 2000; Luna 1984; McKenna et al. 1995; Pinkley 1969; Plowman 1973, 1977; Schultes 1966, 1972, 1979; Schultes & Raffauf 1990). The Shuar infuse B. grandiflora stems and leaves and drink the resulting beverage for curing. This reportedly gives the shaman "strong feelings" making it easier to diagnose the sickness of the patient (Bennett 1992).

B. uniflora root constitutes the Brazilian medicinal drug 'manacá', which is used as an emetic, purgative, diuretic, antirheumatic, antisyphilitic and abortifacient. This plant is also occasionally used for shamanic purposes, and is known to cause delirium, tremors, salivation, vertigo, anaesthesia, swollen tongue, 'turbid vision', and partial paralysis of the face. It gained its name from the Tupi of Brazil, who honoured its beautiful flowers by naming it after the most beautiful girl in the tribe, Manacán. The root has been used in arrow poisons, and the Cambéba use its juice in the preparation of their 'curupá' snuff [see **Anadenanthera**]. The plant

has also occasionally been added to 'vinho de jurema' [see **Mimosa**]. In Candomblé [Brazil], the fragrant flowers ['macaçá'] are used in ritual baths, and as an offering to the goddesses Oxum, Nama, and Yemanjá. B. chiricaspi is also used to treat fever, rheumatism and arthritis. Its ingestion initially results in chills and cold sweats, followed up to 6 hours later by loss of coordination, inability to move [symptoms lasting up to 48 hours], visual disturbances, vertigo, spinal and body tingling, tremors, stomach ache, nausea, weak vomiting, urtication, frothing at the mouth, swollen lips and 'heavy tongue'. The plants are little used today as intoxicants, due to their unpleasant side-effects. It should be noted that use of B. grandiflora has sometimes been mistakenly reported as B. maritima [B. latifolia] or B. bonodora (Duke & Vasquez 1994; Narby 1999; Plowman 1973, 1977; Schultes 1966, 1979; Schultes & Raffauf 1990; Voeks 1997).

B. australis has been responsible for poisoning dogs who ate the berries of the plant – intoxicated dogs exhibited tremors, instability, lethargy, staring, frothing at the mouth, vomiting and other frequent excretions. This period was followed by collapse and convulsions, with rigidity but later relaxation; a hypersensitivity to stimulus remained. B. australis is often sold in horticultural circles as either B. bonodora or B. latifolia, which are both separate species, the latter being synonymous with B. maritima. B. pauciflora is also grown horticulturally (Bailey & Bailey 1976; Bor & Raizada 1954; McBarron 1983; McBarron & De Sarem 1975).

B. brasiliensis [as B. ramosissima] has yielded 0.1% *scopoletin* (Mors & Ribeiro 1957); leaves have been shown to contain brunfelsine and manacine [alkaloids of unknown structure]; seeds have yielded 1.14% brunfelsine, and no manacine, though manacine had earlier been reported from the seeds (Plowman 1977).

B. grandiflora has yielded c.0.1% *scopoletin* from unspecified parts (Mors & Ribeiro 1957); root bark has yielded *scopoletin*, as well as brunfelsamidine [pyrrole-3-carboxamidine], a convulsant (Lloyd et al. 1985). B. grandilfora ssp. schultesii tested positive for alkaloids; the parts analysed were not specified (Evans 1979), but may have been foliage.

B. nitida leaves have been found to contain 5 calystegines [see **Convolvulus**] (Bekkouche et al. 2001).

B. pauciflora [as B. calycina var. macrantha] has yielded *scopoletin* (Mors & Ribeiro 1957; Plowman 1977). B. pauciflora [as B. calcyina var. floribunda] has caused lethal and nonlethal poisoning in dogs; the active principles seem to act in the manner of a spinal convulsant, such as *strychnine* [not found in the plant], and are water soluble and very stable (Spainhour et al. 1990).

B. uniflora root acts as a CNS-depressant in rats; it has yielded 0.0033% *scopoletin* (Iyer et al. 1977) and cuscohygrine [mandragorine] (Plowman 1977). Other alkaloids have been found in the plant, such as hopeanine (Gellert et al. 1980), hopamidine [1H-pyrrol-3-amidine; inhibited rat-paw oedema induced by cobra venom – see **Naja**] from the leaves [0.015%], stems, and roots (Birkner et al. 1987), and the convulsants manacine and manaceine. Heated with water, manacine breaks down to manaceine and a substance that was thought to be aesculetin [see **Aesculus**] (Plowman 1977).

Brunfelsia chiricaspi is a shrub or small tree 1-3m tall; trunk to c.5cm diam. near base; bark thin, cracked lengthwise, roughish, greyish-brown; branches few, lax, spreading, naked; branchlets subterete, 5-6mm diam., glabrous, light brown to ochraceous, shiny, outer bark thin and splitting longitudinally, shedding in thin flakes; internodes c.1-3cm long. Leaves scattered along branchlets or somewhat crowded, elliptic to lanceolate, rarely obovate, 20-30 x 7-12cm, apex obtuse with short, subfalcate acumen or acuminate, base cuneate to obtuse, glabrous, smooth, subcoriaceous, dull, dark green above, paler beneath, lateral nerves 8-10, straight, spreading, arcuately anastomosing 2-8mm within margin; petiole short, stout, subterete, 5-10mm long, canaliculate above, glabrous, dark brown, roughish. Inflorescence corymbiform, terminal or axillary, 4-7(-20)-flowered, flowers puberulent or glabrous; bracts lanceolate, concave, 1-2mm long, glabrous; pedicel slender, terete, erect, 6-13mm long, glabrous; calyx tubular-campanulate, slightly inflated, 10-13mm long, 4-6mm diam., subcoriaceous, glabrous, teeth short, broadly triangular, acute to blunt with short glandular acumen, in fruit coriaceous, striately nerved, dotted with lenticels, to 13mm long; corolla tube twice as long as calyx, cylindric, straight, fleshy, slightly dilated and curved at apex, 22-25mm long, 3mm diam., glabrous, limb 25-30mm diam., glabrous, sky-blue to violet, fading to white, thickening prominently at mouth, fleshy, 5-angled, white, lobes subequal, the uppermost slightly larger, rounded, abruptly narrowed at base, strongly deflexed at anthesis; stamens inserted in upper part of corolla tube; filaments subligulate, curved at apex, lower inner pair 2.5mm long, upper outer pair 3.5mm long, reaching the mouth; anthers rounded-reniform, to 1.5mm long, light brown. Ovary ovoid-conical, gibbous at base, 2mm long, c.15-ovuled; style filamentous, curved at apex, equalling the filaments; stigma bifid, forcepiform, obtuse, upper lobe larger. Capsule subglobose, c.10mm long, 8mm diam., dry at maturity; seeds few, ellipsoid-reniform, 6 x 2.5mm, reticulate-pitted.

In forest; Colombia (Plowman 1973).

BUBBIA

(Winteraceae)

Bubbia sp. – kikisira

An unidentified Bubbia sp. from Papua New Guinea is sometimes used by Gimi shamans ['aona bana'] to divine the cause of illness. The bark is mixed with tobacco [see **Nicotiana**], and the mixture is smoked to enter a "dreamlike state" in which he may encounter his 'aona' ['vital force' or 'soul'], which will tell him what he needs to know (Bock unpubl.; Glick 1967).

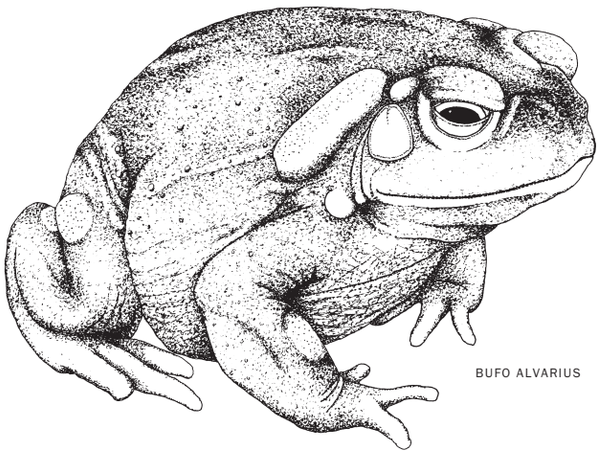
Stem bark of a Bubbia sp. from Papua New Guinea [harv. Feb.] gave positive tests for the presence of alkaloids (Fong et al. 1972).

Bubbia spp. are small shrubs or trees, often very variable; stipules none. Leaves alternate or rarely whorled, pellucid-punctate, aromatic, entire, pinnatinerved, petioled. Inflorescence a terminal cluster, each peduncled, few- to many-flowered, each lateral flower with 1 bracteole; flowers bisexual; sepals 2-6, regular, valvate, +- cup-like or short and dentate; petals in bud protruding past sepals, in 2-several series, imbricate, often soon caducous; stamens 1-many, in 1-several series, hypogynous; stigmas apical, sessile. Carpels 1-many, in a single whorl or rarely biseriate, free, with 1-many ovules; styles usually none. Fruit a capsule, pulpate, calyx persistent; seeds with copious endosperm.

At least 19 species have been recorded in Papua New Guinea, from a genus of 32 species (Van Royen 1979-1983).

BUFO

(Bufonidae)



BUFO ALVARIUS

Bufo alvarius *Girard* – Colorado River toad, Sonoran Desert toad, giant toad, Girar's toad, sapo grande
Bufo bufo ssp. bufo *L.* **(B. vulgaris** *Laurenti***)** – common European toad
Bufo bufo ssp. gargarizans *Cantor* **(B. bufo ssp. asiaticus** *Stejneger***; B. gargarizans** *Cantor***)**
Bufo marinus *L.* **(Chaunus marinus** *(L.) D.R. Frost et al.***; Rhinella marina** *(L.) Chaparro et al.***)** – cane toad, marine toad, giant toad, neotropical toad, aga toad
Bufo melanostictus *Schneider*
Bufo viridis *Laur.* – European green toad
Bufo spp. – toads, sapo

In Meso-American mythology, the toad is symbolic of the Earth Mother, the fertile giver and taker of life; the Aztec Tlaltecuhtli is one embodiment of this concept. Quetzalcoatl the bird-serpent, and Tezcatlipoca, sorcerer-jaguar, were said to have found her floating in the sea at the beginning of creation, whence they tore her body in two to form the sky and the earth; the remains of her body gave rise to the first food plants, in return for the death that eventually awaits all mortals. The association with birth and death springs in part from the toad's prolific breeding capabilities [also, male toads are sometimes able to revert to the female sex in order to reproduce under hardship], and the cannibalistic behaviour seen when a mother may eat her young. The change from egg to tadpole to toad is also symbolic of metamorphosis, itself representative of the endless cycle of life and death.

Toad remnants [usually of B. marinus], as well as carved artefacts such as statues, axe heads and bowls with toad representations, have been found in Mayan and Olmec burial sites dating back to 1250-900BC. Mayan art shows the toad as the servant of the rain gods. Likewise, with some tribes in the Orinoco basin of Amazonia, the toad is seen as the bringer of rain; there, toads are sometimes kept captive under pots in or-

der to obtain rain if needed (Degraaf 1991; De Rios 1974, 1990; Furst 1976; Hamblin 1979; Kennedy 1982; Morgan 1995).

In southern Veracruz, Mexico, B. marinus has been used as an unusual psychotrope for love magic or divination by shamans in the past. The venom from 10 toads was collected without harming them [or their parotoid glands are used], and mixed to a thick paste with plant ashes, 5 grains of sprouted corn, and limewater; this was boiled until its foul smell had passed, before being added to corn beer and strained. This liquid was mixed with corn meal and fermented in the sun for several days. It was then dried with heat, and rolled into a dough which would be reconstituted with water and drunk when required. One researcher who ingested this preparation noted sweating and hypertension within 30min of consumption, followed by a chilling sensation, muscle twitching, headache, immobility and delirium, lasting 3-5hrs (Davis 1988; Furst 1976). B. marinus and other **Bufo** spp. have reputedly also been added to the 'balché' brew of Central America [see **Lonchocarpus**] (Kennedy 1982; Rätsch 1992), and a live toad [species not noted] was observed to be added to a 'chicha' brew [see *Methods of Ingestion*] prepared by the Pakomam Maya of Guatemala in the 17th century (Kennedy 1982). B. marinus has been added to some Haitian zombi potions [see *Methods of Ingestion*] (Davis 1988).

Likewise, European witches have reputedly added **Bufo** spp. to some of their intoxicating magical brews. In rural England, a decoction or 'casserole' of a toad and 'certain' mushrooms [picked in full moonlight and not touched with the bare hands – see also **Psilocybe**] in spring water was said to be drunk [5 drops] as an aphrodisiac or love potion. Toad blood was said to be drunk for the same purpose in central Europe. Some European alchemists also used toads in various magical recipes. For example, "Five toads are shut up in a vessel and made to drink the juices of various herbs with vinegar as the first step in the preparation of a marvellous elixir for the purposes of transformation". The Taoists of China have a legend of the 'gama sennins' or 'toad-wizards', wise men who lived as mountain hermits with a giant toad, which taught the secrets of magic and herbalism, as well as how to make pills that could turn the gamma sennin into a toad. Earlier Chinese myths speak of toads that could conjure up visions of the Taoist 'Islands of Paradise' (Degraaf 1991; Kennedy 1982; Morgan 1995).

Toad preparations were prescribed to treat fever, dropsy and incontinence in numerous European pharmacopaeias of the 17th and 18th centuries (Chilton et al. 1979). Today, venom of B. bufo ssp. bufo, B. bufo ssp. gargarizans and/or B. melanostictus is still used in TCM as 'ch'an su'. Small doses [22-37mg] are used to treat heart problems, and externally as a surface anaesthetic, detoxicant and anodyne, and to treat sinusitis, toothache, bleeding gums, and inflammation. As an anaesthetic, it is sometimes applied as an alcoholic extract [30% concentration] comprising 9g ch'an su, 9g aconite root [see *Endnotes*], 16g **Datura** and 6g peppermint, a preparation that would presumably be very dangerous if taken internally. The venom alone is toxic, and can cause nausea, vomiting, abdominal pain, diarrhoea, irregular heart beat, vasodilation, dizziness and numb extremities. It has been sold in the US as a topical aphrodisiac, under names such as 'love stone', 'black stone' and 'rock hard', and has caused deaths when taken internally (Brubacher & Hoffmann 1996; Brubacher et al. 1995; Huang 1993; Keys 1976). Toad brains ['ch'an nao'] may be used to cure "nightblindness and to clarify the vision", according to some Chinese Materia Medicas (Kennedy 1982). In Nepal, some shamans use B. melanostictus venom for shamanic travel; it is taken simply by squeezing some onto the palm and licking it up (Müller-Ebeling et al. 2002).

Toad venom has a long history of use in poisoning – toads were apparently used for such murderous purposes by Roman poisoners, and much later in Italy toads were still noted to be in such use. These latter-day poisoners would sometimes prepare a poisonous salt by placing a toad in a sack containing ordinary salt, and shaking. Thus some of the toad venom would be secreted due to such irritation and become mixed with the salt, which was then used "for slow, chronic poisonings" (Chilton et al. 1979). In 19th century Amazonia, 'natives' were claimed to prepare an arrow poison from B. agua venom, probably synonymous with B. marinus (Abel & Macht 1911), though this appears to be supposition as the amphibians so used were not identified. The use of venomous frogs in that part of the world for such purposes is much better known [see **Phyllomedusa**].

Apparently, in parts of Somalia and Nigeria, weary travellers may pick up an available toad and rub it on their forehead for refreshing themselves and alleviating fatigue (Morgan 1995).

B. marinus was introduced to Queensland [Australia] in 1935 to control the 'cane beetle' [Phyllophaga vandinei], which was infesting sugar cane crops. The toads ignored the beetles, which lived mostly above the reach of the toad anyway, and have since spread to become a major pest threatening native and domestic fauna (Tyler 1994). However, many here still love the toads [many more hate them with vigour], and some Australians have even attempted their use as psychedelics, though this practice is not common today. It should be noted that possession of B. marinus venom is illegal in Australia [particularly in Queensland], and is seen as being equivalent to *bufotenine* [a prohibited substance]. This is unusual, given that B. marinus venom is usually low or deficient in its content of that alkaloid. The means of administration in Australia has usually been to either decoct toad skin in water to be drunk, or to simply lick the venom glands of the toad. Although *bufotenine*-like psychotropic symptoms have been reported from this, the practice is also highly dangerous due to toxic elements of the venom. Symptoms such as nausea, vomiting, sweating, burning in the mouth, salivation, convulsions, hypotension and hypertension, and tachycardia accompany the experience, which is usually very unpleasant (Hitt & Ettinger 1986; Lewis 1989; Pantanowitz et al. 1998; pers. comms.). Smoking the dried venom does not seem to produce toxic side-effects in moderate amounts, and it would seem that the toxins do not survive the heat. With hand-collected venom that I have experimented with, central effects were usually mild at best, and consisted of a calm, non-emotive 'stoned' state lasting about 30-60 minutes, as well as a sense of pressure in the head (pers. obs.).

B. viridis dried venom has been experimented with in the form of a snuff, causing local anaesthesia, sneezing, sweating, mild tachycardia, salivation, mild 'hallucinogenic' effects ['trails'], and later, burning sensation in nostrils and deep sedation; the bulk of the effects lasted about 1 hour. Other routes of administration were also used [licking the venom glands, ingesting venom dried on paper, rubbing venom glands across the forehead], and all produced mild effects with pupil dilation and mild colour enhancement. Overall, though, effects were not deemed as pleasant (Morgan 1995). Others have obtained positive entheogenic effects with smoked venom from a **Bufo** sp. in conjunction with tantric practices (Rätsch pers. comm.).

Most interestingly, B. alvarius has been used in recent times for its potent psychedelic venom, in the southern US. It is usually collected by squeezing the various venom glands on the live toad; the venom is dried, shaved off into small flakes and smoked in one deep inhalation. A piece the size of a paper match-head is usually sufficient to induce a powerful experience of the same nature as *5-methoxy-DMT* [*5-MeO-DMT*], its main constituent (Most 1984; Weil & Davis 1994). Illicit use of the venom has attracted the attention of police in the US, and some rare individuals who chose to use the venom as a sacrament and were reported to the authorities, have been arrested. Although *5-MeO-DMT* is currently still legal in the US [though not in Australia], *bufotenine* is not, and this has been used as a basis for prosecution [nearly all toad venoms, and some frog venoms, contain at least some *bufotenine*]. The toads have also become more difficult to obtain from pet stores in the US, presumably because of such illicit uses (pers. comms.).

Venoms from **Bufo** spp. usually consist of chemicals from several classes – the tryptamines [such as *bufotenine* (*5-OH-DMT*), bufoviridine (*bufotenine* O-sulfate), bufothionine (dehydro-*bufotenine* O-sulfate), dehydro-*bufotenine* and bufotenidine (N,N,N-trimethyl-*serotonin*; cinobufagin), a local anaesthetic 90x more potent than *cocaine* (Kennedy 1982)], the *phenethylamine*s [such as *dopamine* and *epinephrine*], and the cardioactive steroids [bufogenins or bufagins, bufadienolides, and bufotoxins]. B. alvarius is unique in containing *5-MeO-DMT*. The pharmacology of some of these alkaloids is discussed further in **Arundo**. Bufadienolides have also been found in some toxic plants, such as hellebrine in the seeds of Helleborus odorus (Kiβmer & Wichtl 1986).

These venoms should never be orally consumed except under expert supervision, and care should be taken to avoid contact with the eyes, mouth, nostrils and other openings in the skin after handling venom. Venom can be extracted without harming the toad, as follows – grip the toad firmly but gently in one hand, with its belly facing your palm. The parotoid glands [and any other venom glands present] may be squeezed at the base between thumb and forefinger. If the toad is distressed, venom may squirt for up to 1m or more, so some prefer to hold a sheet of glass above the toad to catch the venom; otherwise, the venom will simply ooze to the surface, and can be scraped off very gently from the amphibian with a blunt tool or spatula. Sometimes a popping sound is heard when 'milking' a toad. Each gland is composed of 50-60 lobules [in B. marinus], each discharging venom via a single duct, each duct being sealed with a small plug of tissue; when pressure in the gland is high enough, the plug will burst, resulting in this audible sound. The venom is then dried naturally and stored in an airtight container until use. Toads may yield more venom after a rest period of 30-40mins; after this, glands require 4-6 weeks to recuperate (Meyer & Linde 1971; Tyler 1994; pers. exp.).

As an interesting sidenote, hedgehogs seem to be immune to **Bufo** venoms. They are known to attack the toads, first biting and chewing the parotoid glands, then licking the venom over their spines, before eating the toad; this anointing of venom is believed to be a defensive technique (Brodie 1977).

B. alvarius venom glands yielded 5-16% *5-MeO-DMT* and <0.01-0.5% *bufotenine*; non-glandular skin yielded 0.05-0.4% *5-methoxy-DMT*, 0.017-0.22% *bufotenine*, 0.001-0.0023% 5-MeO-*N-methyltryptamine*, 0.004% 5-MeO-indoleacetic acid [5-MIAA], 0.0015-0.002% bufoviridine, 0.003-0.004% N-methyl-*serotonin*, 0.0011-0.0012% 5-OH-indoleacetic acid [5-HIAA], 0.0004-0.0006% *serotonin* and 0.0004-0.0008% 5-OH-tryptophol, as well as small amounts of several unidentified amines. 5-MeO-tryptophol is also found in the pineal tissue of the toad, as the major

metabolite from deamination of the endogenous 5-methoxy-tryptamines (Erspamer et al. 1965, 1967). Each toad may yield c.400mg of dried venom per milking (Meyer & Linde 1971).

Fresh skin of B. bufo ssp. bufo yielded 0.0145-0.045% *bufotenine*, 0.0287-0.0353% bufothionine, 0.0087-0.013% dehydrobufotenine, 0.0044-0.0064% bufotenidine, N-methyl-*serotonin*, and traces of *serotonin*. The dried venom yielded 0.3-0.33% *bufotenine* and 0.53-0.62% bufotenidine, as well as bufotalin, bufotalidin [hellebrigenin], bufotalinin, marinobufagin and telocinobufagin. Each toad may yield c.13mg dried venom per milking. B. bufo ssp. formosus fresh skin yielded 0.015% *bufotenine*, 0.0375% bufothionine, 0.014% bufotenidine, 0.0025% dehydrobufotenine, 0.0065% *serotonin*, and 0.006% N-methyl-*serotonin* (Cei et al. 1968; Deulofeu & Rúveda 1971; Meyer & Linde 1971). B. bufo ssp. gargarizans venom was found to contain 0.001-0.01% each of bufotenidine, *serotonin* and N-methyl-*serotonin*, as well as *epinephrine*, arenobufagin, bufalin, bufarenogin, bufotalidin, bufotalin, desacetylbufotalin, cinobufagin, desacetylcinobufagin, cinobufotalin, desacetylcinobufotalin, gamabufotalin, resinobufogenin and telocinobufagin (Daly & Witkop 1971; Meyer & Linde 1971).

B. marinus skin yielded 0.003-0.0671% *serotonin*, 0.004-0.051% N-methyl-*serotonin*, 0-0.003% *bufotenine*, 0.22-0.6% dehydrobufotenine, 0.003-0.0465% bufothionine, *dopamine*, N-methyldopamine, *norepinephrine*, *epinephrine* [c.4-7% of venom] (Cei et al. 1968; Daly & Witkop 1971; Deulofeu & Rúveda 1971; Märki et al. 1962), bufalin, argentonogenin, bufotalidin, gammabufotalin, hellebrigenol, marinobufagin, resibufogenin, telocinobufagin and marinobufotoxin. Each toad may yield c.580mg dried venom per milking (Meyer & Linde 1971). B. marinus ssp. horribilis [from Veracruz, Mexico] skin yielded 0.3% dehydrobufotenine, 0.05% *serotonin*, 0.03% N-methyl-*serotonin*, 0.004% bufothionine, 0.003% *bufotenine* and 0.0025% bufotenidine. B. marinus ssp. poeppigi skin yielded 0.014-0.11% dehydrobufotenine, 0.016-0.097% *serotonin*, 0.01-0.04% N-methyl-*serotonin*, and 0.001-0.03% bufothionine (Cei et al. 1968). Surprisingly, small amounts [1.53-4.49 pmol/g] of *morphine* have been found in B. marinus skin (Oka et al. 1985). As B. agua, early studies of the venom found 4.48% *epinephrine* [estimated total 6.72%] and c.36% bufogenins [estimated content] (Abel & Macht 1911).

B. melanostictus yielded around 90mg venom per animal, consisting of 0.001-0.01% *bufotenine*, 0.001-0.01% dehydrobufotenine, 0.1-1% bufotenidine, 0.01-0.1% *serotonin*, bufalin, bufotalidin, bufotalin, marinobufagin and resibufogenin (Daly & Witkop 1971; Meyer & Linde 1971).

B. viridis skin yielded 0.1-1.0% *bufotenine*, 0.01-0.1% bufotenidine, 0.01-0.1% bufoviridine, 0.001-0.01% *serotonin*, 0.001-0.01% N-methyl-*serotonin*, 0.001-0.01% dehydrobufotenine, 0.001-0.01% bufothionine (Cei et al. 1968; Daly & Witkop 1971), arenobufotoxin, marinobufotoxin, telocinobufotoxin, hellebritoxin, arenobufagin, marinobufagin, telocinobufagin, hellebrigenin and bufotalinin (Shimada et al. 1986); viridobufagin and viridobufotoxin have also been found. Each toad may yield c.27mg dried venom per milking (Meyer & Linde 1971). Females apparently contain more *bufotenine* in their venom than males (Morgan 1995).

'Chan su' [from one of a number of species - see above] contains *bufotenine*, bufotenidine, desacetylbufotenidine, bufadienolide, cinobufaginol, resibufogenin, cinobufotoxin, bufotalin, many other bufogenins, *epinephrine* and cholesterol (Brubacher et al. 1995; Huang 1993).

Bufotenine is also found as a major venom constituent in B. arenarum, B. boreas, B. calamita, B. fernandezae, B. hemiophrys [also high in dehydrobufotenine], B. major, B. marmoreus, B. paracnemis, B. perplexus, B. pygmaeus [also high in dehydrobufotenine], B. spinulosus [also high in dehydrobufotenine], B. trifolium and B. variegatus. B. debilis, B. haematiticus, B. ictericus, B. major and B. punctatus are rich in dehydrobufotenine. African species [such as B. berghei, B. funereus, B. kisoloensis, B. mauretanicus and B. regularis] seem to contain only *serotonin*, and no other tryptamines (Cei et al. 1968; Daly & Witkop 1971).

Bufo alvarius males are 80-156mm long, females 87-178mm; stout, with a broad, flat head with raised eyes, low crescent-shaped crests curving around rear of eye like fleshy folds; body smooth and leathery, scattered with pale orange warts, skin colour ranging from dark brown, to olive or grey-green; belly cream-coloured; 1-4 prominent white warts at corner of mouth; large parotoid glands on shoulders c.2.5 x 1cm, each with 50-60 lobules, subreniform, spreading down at shoulder; femoral glands on outside of each hind leg between knee and thigh, tibial glands between knee and ankle, as well as glands on forearms. Nocturnal, living in underground burrows during daytime; at night, gathering near springs, streams, water pools, puddles, and irrigated fields. Most active in breeding season, May-Jul. Voice seldom used; a quiet chirping sound.

Near rivers and streams, as well as around water troughs in Sonoran Desert; s. California, through Arizona and Colorado into n.w. Mexico (Cannon & Hostetler 1975; Wright & Wright 1995).

BURKEA

(Leguminosae/Caesalpiniaceae)

Burkea africana *Hooker* – Rhodesian ash, wild seringa, wild syringa, wilde sering, umu nene

The wood of this African tree, the only member of its genus, is hardy and of good quality, and has been much used in construction. In central Africa, a leaf decoction is rubbed on the head to relieve headache. Bark and leaf decoctions are used as mouthwashes to treat scurvy and trachoma. The Zezuru of s. Rhodesia chew the bark to break and moisten it, before placing it on septic sores; they also use the leaves to treat gastric complaints. The Ila throw the pulverised fruit and bark into water to stupefy fish, making them easier to catch. The stem of the plant yields a soluble, translucent yellowish to brownish-red gum, which is used to treat dysentery; the fruit is used for the same purpose in Natal. In n. Nigeria, the twigs are used as chew-sticks for oral hygiene (Allen & Allen 1981; Watt & Breyer-Brandwijk 1932, 1962). Also of interest to us are the chemical constituents of the stem bark.

B. africana stem bark has yielded the indole alkaloids *tryptamine* (Correia da Silva & Paiva 1973; Ferreira 1974a), *harman*, *tetrahydroharman*, *harmalan*, and Burkea alkaloid E [which is possibly *harmalan* N-oxide]; 3 other alkaloids were detected, which have not been identified. Also found in the stem bark were β-sitosterol (Ferreira 1974b, 1974c), 5-OH-piperidine-2-carboxylic acid, and tannins (Allen & Allen 1981; International… 1994). The plant has also yielded fisetinidol-(4-α→β)3-O-galloylcatechin, fisetinidol-(4-β→6)ampelopsin, fisetinidol-(4-α→2')robinetin, fisetinidol-(4-β→6)robinetindol, fisetinidol-(4-α→6)taxifolin, and 3-galloylrobinetinidol (Buckingham et al. ed. 1994).

Burkea africana is a tall shrub to deciduous tree 10-21m tall, with a 2m girth and stout, knotted branchlets, straight bole of 6-7m or more, flattened crown; bark corrugated and blackish. Leaves light and silky, young parts reddish-tomentose, leaves bipinnate, 2-5-jugate, jugae opposite; leaflets alternate up to c.12, petioluled or sessile, elliptic-ovate, ovate-lanceolate or elliptic-oblong, obtuse or emarginate at apex, unequal-sided at base, up to 5 x 3.5cm, at first silky, at length glabrous and +- glaucous beneath; petioles often rusty-tomentose; stipules filiform, early caducous. Flowers in panicles of slender spikes to 30cm long, small creamy-white fragrant flowers crowded with the leaves at ends of branchlets; axis pubescent; bracts small; calyx campanulate, 1.5mm long, lobes 5, ciliate, rounded, oblong, equal; petals 5, subequal, obovate or elliptic, obtuse, imbricate, glabrous, +- twice as long as calyx; stamens 10, subequal, shorter than petals; filaments linear, uniform, oblong-oblanceolate, longitudinally dehiscent, connective pointed, bearing an inflexed sessile apical gland. Ovary sessile or shortly stipitate, densely villous, superior, 1-celled; ovules 1-2; style short, thick; stigma terminal, truncate or concave. Pods elliptic- to oblong-lanceolate, flat, compressed, reticulate, brittle, subcoriaceous, c.6 x 2.3cm, shortly appressed-pubescent, persistent after new leaves appear; 1-seeded, seeds compressed, suborbicular.

Dry sandy soil in savannahs and woodlands up to 1500m; mainly in Zambia, present throughout Africa as north as Ethiopia and west to Nigeria (Allen & Allen 1981; Hutchinson & Dalziel 1954-1972).

CAESALPINIA

(Leguminosae/Caesalpiniaceae)

Caesalpinia bonduc *(L.) Roxb.* **(C. crista** *L.***)** – putikaranja, katkaranj, katkaliji, sagur-ghota, khayahe-i-iblis ['devil's testicle'], bonducella nut, Molucca bean, fever nut, physic nut, senna

Caesalpinia digyna *Rottler* – vakeri-mul, vakeriche-bhat, umul-kuchi, nuni-gatcha, nooniglika, senna

Caesalpinia echinata *Lamarck* **(Guilandina echinata** *(Lam.) Spreng.***)** – cumaseba, su-mu

Caesalpinia gilliesii *(Wall. ex Hook.) D. Dietr.* **(C. gilliesii** *(Wall. ex Hook.) Benth.***; Erythrostemon gilliesii** *(Wall. ex Hook.) Klotzsch***; Poinciana gilliesii** *Wall. ex Hook.***)** – bird of paradise bush, yellow bird of paradise, desert bird of paradise, Barbados pride, pride of China, Mimosa of Japan, blazing Poinciana, Brazilwood, flower fence

Caesalpinia pulcherrima *(L.) Sw. non G. Don.* **(Poinciana bijuga** *Lour.***; P. elata** *Lour.***; P. pulcherrima** *L.***)** – peacock flower, paradise flower, Spanish carnation, Barbados pride, dok fanf, fang ham, krishnachuda, sidhakhya, sidhanasha, guletura, caballero

Caesalpinia sappan *L.* **(Biancaea sappan** *(L.) Tod.***)** – false sandalwood, sappan wood, bois sappan, sappanga, pattanga, parthangi, chappanam, bakan, brasiletto, gango

Caesalpinia sepiaria *Roxb.* **(C. benguetensis** *Elm.***; C. crista** *Thunb. non. L.***; C. decapetala** *(Roth) Alston***; C. decapetala var. japonica** *(Sieb. et Zucc.) H. Ohashi***; C. decapetala var. japonica** *(Sieb. et Zucc.) Isely***; C. sepiaria var. japonica** *(Sieb. et Zucc.) Gagnep.***; Biancaea decapetala** *(Roth) O. Deg.***; B. sepiaria** *(Roxb.) Isely***; Reichardia decapetala** *Roth***; Mezoneurum bengetense** *Elm.***)** –

peacock flower, wait-a-bit, mysore thorn, thorny Poinciana, bahama sappan, black bonduc, yun-shih, puakelekino, chillara, karanj, kando, puto, mala bung, mala mukhi

'Yun-shih', C. sepiaria, has enjoyed a history of use in Chinese medicine – the seeds as an astringent, anthelmintic, antipyretic and antimalarial; and the root to 'assist removal of a bone in the throat'. The root is a purgative and emmenagogue. The flowers, and possibly also the seeds, have more mystical properties. They are said to "enable one to see spirits, and when taken in excess, cause one to stagger madly. If taken over a long period, they produce somatic levitation and effect communication with the spirits." They are also said to be able to drive away evil spirits, and "when put in water and burned, spirits can be summoned…the seeds are like lang-tang [**Hyoscyamus**], if burned, spirits can be summoned; but this method has not been observed" (Kirtikar & Basu 1980; Li 1978). In Japan, roots have been used in folk medicine to treat neuralgia (Ogawa et al. 1992). In Nepal [as C. decapetala; Müller-Ebeling et al. considered it a synonym of C. pulcherrima, yet I could find no other litertaure that supports this view], shamans use the seeds for shamanic travel, although in small doses they are sometimes used as a spice or food with pickles and curry. The flowers are used as an offering to Shiva, and the plant is regarded as being protective. The seeds are said to "cleanse the entire human system" (Müller-Ebeling et al. 2002), hinting at possible purgative and emetic properties (pers. obs.).

C. sappan wood ['su-mu', 'su-feng-mu'] is used in TCM to control pain, improve circulation, and control bleeding. It has tranquillising and soporific properties, and is paralytic in high doses; it has been shown to antagonise the stimulant effects of *brucine* [see **Strychnos**] (Hsu et al. 1986). In India, it is used as an astringent and emmenagogue (Nadkarni 1976). In Indo-China, C. pulcherrima is used as a tonic, stimulant and emmenagogue; in the Philippines, a flower infusion is used to treat asthma, bronchitis and malaria (Kirtikar & Basu 1980). In Peru, bark from the related C. echinata has been added to ayahuasca brews [see **Banisteriopsis**] (Ott 1994). Ritual pipes for use in healing are also made from this species in Peru (Luna & Amaringo 1991).

The leaves of C. bonduc are known as 'senna' in Nigeria, and are infused as a purgative [see **Laburnum**, **Cassia**] (Nwosu 1999). The seed oil is used there as an anticonvulsant; in s. Vietnam, the leaf oil is used similarly. The plant is also sometimes used to treat malaria (Lassak & McCarthy 1990; Watt 1967). In India, the pressed oil from the tender leaves is used as an anticonvulsant, as well as to treat "palsy and similar nervous complaints". In Burma, C. digyna root is pounded and soaked in water, and drunk to relieve fevers; the drink is reported to have an "intoxicating" effect (Nadkarni 1976), though the exact nature of this intoxication was not made clear. A root bark decoction of this species is used in Nigeria to treat senile dementia (Nwosu 1999). C. bonducella seeds are used in Tanzania to treat diabetes mellitus, though experiments with rabbits did not reveal any effect on blood glucose (Moshi & Nagpa 2000).

C. bonduc roots yielded 0.00284% cassane-furanoditerpenes, bonducellpins A-D (Peter & Tinto 1997). The plant has also yielded homoisoflavones, peltogynoids, caesalpins, a benzoquinone and a chalcone (Che et al. 1986).

C. bonducella seeds yielded α- and β-caesalpin, as well as unidentified protein fractions (Qudrat-i-Khuda et al. 1961).

C. gilliesii has yielded 0.63-0.7% alkaloids from leaves, and 0.4-0.45% from stems; flowers contained 4 different alkaloids (Abdulla-Zade & Agamirova 1965). Stem-bark and roots [summer collections] tentatively tested positive for the presence of *5-methoxy-DMT* and other compounds (Trout ed. 1997d). In another assay, no alkaloids were found in stems, leaves, and flowers combined [harv. Mar., New Zealand] (White 1951). The seeds have yielded the amino acids 3-OH-proline [main], γ-methyl-*glutamic acid* and γ-methylene-*glutamic acid* [traces] (Watson & Fowden 1973). Caution may be advised with this and other Caesalpinia spp. – in a case of sober plant-human communication, a reliable friend was surprised to be 'told' by an ornamental C. gilliesii specimen that it was a 'hallucinogen' that would kill him if he did not learn how to use it correctly (Trout pers. comm.).

C. pulcherrima flowers, buds and roots [summer collections] tested strongly positive for the presence of *5-methoxy-DMT*, though results are still tentative, and the presence of large quantities of unidentified alkaloids was also noted. Flower petals contained no *5-methoxy-DMT*, but did contain small amounts of an unidentified indole (Trout ed. 1997d; Trout pers. comm.). Stems have yielded the peltogynoids pulcherrimin [0.00015%] and 6-MeO-pulcherrimin [0.00012%], the homoisoflavonoids bonducellin [0.00072%] and 8-MeO-bonducellin [0.000009%], the chalcone 4'-methylisoliquiritigenin [0.0007%], and 0.000006% 2,6-dimethoxybenzoquinone (McPherson et al. 1983). Roots have yielded the diterpenoids vouacapen-5α-ol [0.008%], 6β-cinnamoyl-7β-OH-vouacapen-5α-ol [0.0059%] and 8,9,11,14-didehydrovouacapen-5α-ol [0.00017%], as well as 0.006% β-sitosterol (McPherson et al. 1986). Seeds contain traces of γ-methyl-*glutamic acid* and γ-methylene-*glutamic acid* (Watson & Fowden 1973). In separate tests, whole plant and leaf material gave positive tests for HCN (Watt & Breyer-Brandwijk 1962).

C. sepiaria contains an alkaloid of unknown structure (Schultes & Hofmann 1980); leaf and stem from Brisbane, Queensland [Australia], harvested in April, tested positive for alkaloids (Webb 1949). Seeds contain small amounts of pipecolic acid, 4-OH-pipecolic acid, m-carboxy-*phenylalanine* and γ-ethylidine-*glutamic acid* (Watson & Fowden 1973). Stems have yielded 0.0015% pulcherralpin [a cassane-diterpene ester] (Che et al. 1986). The closely related C. sepiaria var. japonica has yielded [from roots, w/w] the cassane-diterpenoid caesaljapin [0.024%], triterpenoids betulinic acid [0.00012%] and lup-20(29)-en-3β-ol [0.004%], and the phenolics sappanchalcone [0.0011%], 3-deoxysappanchalcone [0.00032%], catechin [0.00037%], methyl gallate [0.00015%] and 3-OH-1-(4-OH-3-MeO-phenyl)-1-propanone [0.00042%]; bark has yielded chalcones and homoisoflavones (Ogawa et al. 1992).

Caesalpinia sepiaria is a climber or shrub with sprawling branches, forming large, impenetrable thickets; stem stout, woody, armed with strong, sharp, hooked yellowish prickles; young branches finely downy, and as with leaf rachis, bearing recurved prickles as above. Leaves 23-38cm long, with 3-15 pairs of subequal pinnae, pinnae 5-7.5cm long, with slender pubescent rachis; leaflets 5-12 pairs per pinna, subsessile, oblong-elliptic, 1-2.2 x 0.4-1.1cm, apex rounded, base rounded and somewhat oblique, glabrous or faintly puberulous above, glaucous and slightly pubescent beneath, pale green; stipules deciduous, obliquely ovate, entire, 8-20mm long. Flowers perfect, yellow, 25-30mm diam., in simple axillary and/or terminal racemes 15-30cm long; pedicels 1.3-2cm long, densely pubescent, articulate near flower; bracts 1cm long, ovate-lanceolate, caducous, densely pubescent; calyx 1-1.25cm long, deeply 5-cleft, densely pubescent, upper sepals oblong, obtuse, pubescent on both sides, lower concave or boat-shaped; corolla 1.3-2.2cm diam., petals suborbicular, clawed, spreading, imbricate, bright yellow, upper one veined or blotched with red, the lower c.1.3cm diam., the upper 6mm diam.; stamens 10, free, declinate, filaments densely wooly in lower half; anthers uniform, dehiscing longitudinally. Ovary sessile or subsessile; ovules few; style filiform, sometimes clavate at apex; stigma terminal. Seed pods dehiscent, slightly swollen, straight or slightly recurved, linear-oblong, with long beak, not stalked, somewhat turgid, 6.5-11.5 x 2-3cm, smooth, reticulately veined, especially on lower half; seeds 4-9, ellipsoid, laterally flattened, narrowly winged, 8-12 x 6-8mm, greenish or black, mottled.

Native to tropical Asia, grows along roadsides and disturbed areas; naturalised in Hawaii (Kirtikar & Basu 1980; Wagner et al. 1990).

CALEA

(Compositae/Asteraceae)

Calea zacatechichi *Schlechtendal* – zacatechichi, zacachichi, thlepelakano ['leaf of God'], hoja de dios, hoja madre ['mother's leaf'], zacate de perro ['dog's grass'], bitter grass, prodigiosa, garañona

The flowers of C. zacatechichi have been tentatively identified adorning parts of the statue of the Aztec deity Xochipilli [see **Turbina**] (Wasson 1973). The herb is used by the Chontal of Oaxaca, Mexico, for medicinal purposes. It may be used to treat fevers, diabetes, nausea and diarrhoea, acting as a purgative, antiperiodic and astringent. Its shamanic use amongst the Chontal is less common. To divine the cause of an illness, or locate lost objects or people, a tea of the dried [some prefer fresh], crushed leaves is prepared. A handful, or c.60g, is steeped in boiling wa-

ter [grain alcohol extracts the active compounds more efficiently], and after cooling and straining is drunk slowly, previous to reclining in a dark and quiet position [sometimes with more leaves under a pillow] to smoke a cigarette of the leaves and await the effects. These mostly occur in the sleep that soon follows. The herb can cause slight enhancement of the senses, mild thought discontinuity, rapid 'influx of ideas', and later sedation, and brief sleep with vivid dreams. A feeling of well-being is often reported, which may last for a day or more. The consumer often may become more aware of their pulse and heartbeat, voices or whispers may be heard, and sometimes visual imagery is reported from behind closed eyes. In controlled tests, an increase in the frequency, lucidity and recall of dreams was noted, as well as slowed EEG patterns and an increase in reaction time. Paradoxically, REM sleep was reduced, and the dreaming seems to occur as 'lively hypnagogic images' in slow-wave sleep (Diaz 1979; Emboden 1979a; Jiu 1966; Mayagoitia et al. 1986; Rätsch 1992; Schultes 1969c).

Many westerners experimenting with this plant report no effects, or consider it too mild to be worthwhile – however, it works well for some who give it their attention, and it certainly has its adherents (pers. comms.). Some varieties seem to be much more potent than others – from a 10:1 vodka tincture made from fresh leaves of one strain, as little as 10 drops were required to elicit strong effects (theobromus pers. comm.).

Apparently, there are both active and inactive varieties of this plant, which may actually be distinct species. Although Diaz (1979) promised taxonomic study on this point, I am not aware of any such work having been published to date. Active varieties contain a group of terpenoids called germacranolides.

C. zacatechichi has yielded caleicin I & II, caleins A-F, 0.02% 1-β-acetoxyzacatechinolide, 0.01% 1-oxo-zacatechinolide [all germacranolides], caleochromenes A & B, acacetin, O-methylacacetin, zexbrevin, calaxin, ciliarin, 2,8,10,16-heptadecatetraene-4,6-diyn-1-ol, 2,9,16-heptadecatriene-4,6-diynal, and traces of an undefined alkaloid (Bohlmann & Zdero 1977; Buckingham et al. ed. 1994; Diaz 1979; Herz & Kumar 1980; Mayagoitia et al. 1986; Quijano et al. 1979).

C. urticifolia from Honduras has yielded sesquiterpene lactones similar to some of those found in C. zacatechichi (Herz & Kumar 1980); it is not known whether they have psychoactive properties.

Chemotaxonomic studies suggest that a revision of the genus Calea and its close relatives is needed (Bohlmann et al. 1981).

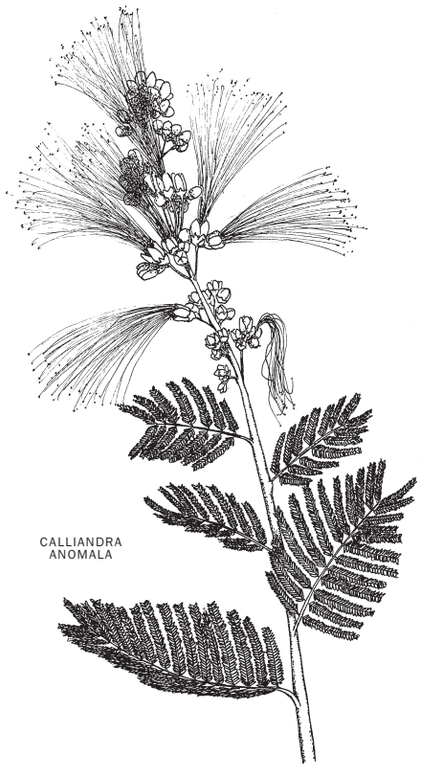
Calea zacatechichi is an erect-stemmed shrub or bush, stems several feet long, terete, subtrichotomous, glabrous beneath, ashy-grey, epidermis lenticellate, above with branches subfastigiate and patently-spreading, purplish and pubescent. Leaves rigid-membranaceous, decussate, subtriplinerved, venose, rugose, ovate, acute, strongly crenate, base shortly cuneate, above hispid and scabrous, below pale and pubescent, c.1.9-3.8 x 1.2-1.9cm; petiole hispid-puberulous, 4-7mm long. Inflorescence small, terminal cymes, irregular, usually arranged simply; capitula c.4mm high, 12-flowered, discoid, with rounded blade and thickened margin, flowers usually paired in each female capitula, whitish, subequal; involucre cylindric, leaflets concave, lutescent, margin scariose undulate, obtuse, entire, erect, rotundate-elliptic to slightly oblong-elliptic, c.4mm long, plurinerved; bracteoles scariose, inner leaflets not very short, obovate, clasping the flowers, plurinerved, subtruncate, erose-denticulate, equal when fruiting and mature; corolla glabrous, disc strongly 5-fid, lacinia reflexed, rays tongue-shaped, elliptic, obsolete, tube short. Fruit an achene with pappus, base long turbinate, terete, hirsute, to c.3mm long, blackish-dark brown. Fl. Aug.

On exposed hills (Schiede 1834); Mexico to Guatemala and Costa Rica (Schultes & Hofmann 1980).

This plant has proven difficult to grow from seed (DeKorne 1994), though fresh seed may give better results. May be propagated from cuttings. Do not allow the plants to dry out as they will wilt rapidly; some find standing the pot [if the plant is potted] in several cm of water helps minimise watering troubles (theobromus pers. comm.).

CALLIANDRA

(Leguminosae/Mimosaceae)



Calliandra angustifolia *Spruce ex Benth.* **(C. sodiroi** *Harms***; C. subnervosa** *Benth.***)** – bobinsana, bobinzana, chipero, quinilla blanca, poi-fa'-ko, sin-sin-ño

Calliandra anomala *(Kunth) Macbr.* **(C. grandiflora** *(L'Hér) Benth.***; C. grandiflora fo. pubescens** *Micheli***; C. kunthii** *Benth.***; Acacia callistemon** *Schltdl.***; Anneslia albescens** *Br. et R.***; An. bella** *Br. et R.***; An. chihuahuana** *Br. et R.***; An. colomasensis** *Br. et R.***; Inga anomala** *Kunth***; Mimosa grandiflora** *L'Hér***)** – cabeza de angel, cabellos de angel, pambonato, pombotano, tlacoxiloxochitl, angel's hair, red powder puff

Calliandra antifebrile *(Gris.) Johnson*

Calliandra pentandra – samiki

Calliandra spp. – powder-puff trees

C. anomala was used by the Aztecs as a psychotropic medicine. The root was chewed, or peeled and ground with water and honey, to treat coughs, eye diseases, dysentery, diarrhoea, swollen anus and indigestion. The branches are still used in Mexico to treat malaria. Shallow, narrow incisions were made in the bark early in the morning, and the resin collected a few days later. When dry, it was powdered and mixed with ash to be used as a hypnotic, soporific snuff. In Mexico and other parts of C. America, the root may be added to 'tepache' [a fermented drink made from 'pulqué', in turn made from **Agave** spp.; see *Methods of Ingestion*] to retard fermentation (Allen & Allen 1981; Emboden 1979a; Tani et al. 1998; Tyler 1966; Usher 1974). A dog has died from a dose of 90g of C. anomala snuff – it is recommended that humans take not more than 120g at a time (Rätsch 1998).

Some inhabitants of the Rio Pastaza area [through Ecuador and Peru] lightly decoct C. angustifolia roots as a stimulant, "taken for strength when [a man] must swim a river or fight" (Schultes & Raffauf 1990). In Peru, C. angustifolia is sometimes used as an additive to ayahuasca brews [see **Banisteriopsis**]. A recipe reportedly used by one ayahuasquero called for 3.5kg **Banisteriopsis** caapi vine, 500g **Psychotria** viridis leaves, 3 **Brugmansia** suaveolens leaves, 10-20 **Nicotiana** tabacum leaves, and 4 C. angustifolia flowers. It was not reported how many serves this was intended to provide (Gnostic Garden 2001). C. angustifolia is said to increase the purgative properties of ayahuasca. An unidentified Calliandra sp., known as 'samik', is sometimes added by the Shuar of Ecuador in place of 'chacruna' [see **Psychotria**], producing a visionary brew. C. pentandra [an elusive species name for which I can find no author or description] is also known as 'samik', and might represent the same plant. C. pentandra (Luna 1984; Luna & Amaringo 1991; Ott 1994; Rätsch 1998) and C. antifebrile have also been used in ayahuasca. C. calothrysus has been known as 'yajé' [see **Banisteriopsis**], though it is not known to have been associated with the brew (Trout ed. 1998).

The Yagua of Peru have been known to snuff the dried, powdered seeds of C. angustifolia mixed with the seeds of 'pashaco' [see *Endnotes*], and sometimes with 'toad' venom [see **Phyllomedusa** and **Bufo**]. The addition of 'bobinsana' [C. angustifolia] to pashaco gives the snuff its visionary power, which pashaco seeds lack on their own (Bear & Vasquez 2000). In Nigeria, C. portoricensis root and stem are used as an anticonvulsant and treatment for gastrointestinal disorders; the stems are also chewed as an analgesic (Akah & Nwaiwu 1988). The Mexican C. houstoniana ['tabardillo'] is said to paralyse the heart (Jiu 1966).

C. angustifolia has yielded *harman* (Rätsch 1998); leaves contain pipecolic acid, trans-4-OH-pipecolic acid, cis-5-OH-pipecolic acid and trans-trans-4,5-dihydroxypipecolic acid. These compounds have insecticidal properties, and are present at roughly 1% combined (Romeo 1984).

C. anomala has yielded *harman* from the root bark, as well as possibly *DMT*, though other tests found no *DMT* above the detection limit of 0.1%. Root also contains calliandrin [a resinous glycoside], tannins, fats, and an essential oil (Rätsch 1998). Branches yielded triterpene saponins [Calliandra saponins A-O] (Tani et al. 1998). Seeds [as C. grandiflora] were shown to contain mainly S-(β-carboxyethyl)-cysteine, as well as 5-OH-pipecolic acid, and smaller amounts of S-(β-carboxyisopropyl)-cysteine and pipecolic acid (Krauss & Reinbothe 1973).

C. haematocephala leaves have yielded 0.0118% [w/w] *tyramine* (Wheaton & Stewart 1970), 2S,4R-carboxy-2-acetylamino-4-piperidine (Marlier et al. 1979), pipecolic acid, trans-4- and trans-5-OH-pipecolic acid, trans-cis-4,5-dihydroxypipecolic acid and trans-4-acetylaminopipecolic acid [the pipecolic acids present at roughly 1% combined] (Romeo 1984).

C. pentandra has yielded *leptaflorine* (Shulgin & Shulgin 1997) and *harman* (Rätsch 1998). C. sp. 'samik' [probably C. pentandra] was analysed in the form of a sample of prepared ayahuasca [also containing **Banisteriopsis** sp.], and was shown by UV-HPLC to contain a compound which may have been *DMT* (Luna & Amaringo 1991, quoting pers. comm. from J.C. Callaway).

C. portoricensis root yielded 1.9% alkaloids, stem yielded 1.2% – at least some of these appear to be quinine-like alkaloids. Also found were glycosides, sterols, saponins, flavonoids, triterpenes and tannins (Akah & Nwaiwu 1988).

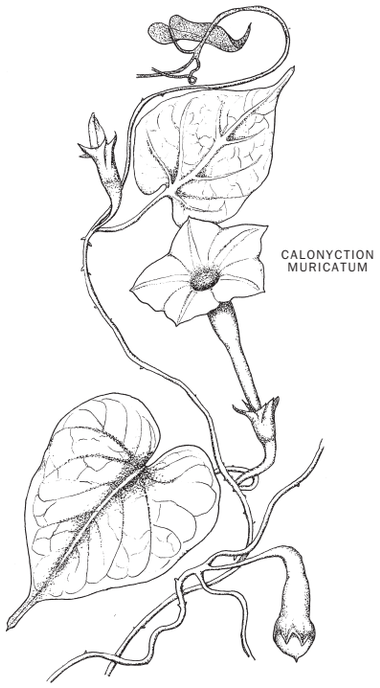
Chemistry of these plants is otherwise obscure.

Calliandra angustifolia is a glabrous tree, c.4.5-6m tall; branches spreading, long, rigid. Leaves dense, bipinnate; pinnae 1-paired; leaflets 1-paired, narrowly oblong, strongly oblique, terminal leaflets 2.5-5.1cm long, coriaceous, shiny, sub-2-nerved, with many minor tertiary nerves; stipules short, membranous, rigid, acute. Inflorescence composed of compound glomerules or heads; peduncule 4-8mm long, rigid; flowers sessile; calyx c.2mm; corolla c.6.5mm long; stamens more than 10; filaments coalesce basally into a tube prolonged above apex of floral cup. Fruit a subwoody legume, c.7-8cm x 6-8.5mm, flattish, slightly bulged over seeds, tapered towards base, margin strongly thickened, valves scarcely veined (sharply recurved after dehiscence), elastically dehiscent, persistent; seeds (1-)2-6, small and flattish.

Eastern Peru; abundant on banks of Huallaga and Mayo rivers (Bentham 1875; Correll & Johnston 1970 [for additional genus information]).

CALONYCTION

(Convolvulaceae)



Calonyction muricatum *G. Don* **(Ipomoea muricata** *Jacq.***; I. turbinata** *Lag.***)** – lakshmana, gariya, barikbhauri, tukhm-i-nil, kaladana ['black seed']

'Lakshmana' is a very important plant in Ayurvedic medicine, mostly for use as an aphrodisiac, having been named after Lakshmi, the beautiful goddess of love and luck. It is also used as a yoga medicine, and is considered to be food for the kundalini energy [see *Influencing Endogenous Chemistry*]. Those practicing tantric yoga make an ointment using lakshmana herbage and a bezoar stone [silicate of magnesia and iron – a type of soapstone], which is massaged into the '3rd eye' area on the forehead to create "irresistable love magic" and "mystical insights". The herb is also considered a tonic elixir of longevity. The root is considered a universal poison antidote, and is carried in many forms as a charm against snakebite (Nadkarni 1976; Rätsch 1992). Otherwise, the plant juice is used to destroy bugs, and the seed is said to have the same properties as those of **Ipomoea** hederacea, ie. purgative. The Munda of Chota Nagpur take a couple of the powdered, bitter seeds to treat fever (Chopra et al. 1965; Kirtikar & Basu 1980; Nadkarni 1976). As 'kaladana', the seed has been used in Pakistan as a purgative, though the identification as C. muricatum was doubted for some time (Abou-Chaar 1970; Abou-Chaar & Digenis 1966). 'Kaladana' is also used to refer to the purgative seeds of **Ipomoea** nil, and sometimes to black seeds of other plants (Austin 2000).

C. muricatum seeds have yielded 7.53% lipids and 0.0192-0.49% indole alkaloids [53% *lysergol*, 37% *chanoclavine*], as well as a new alkaloid, ipomine [1β-ipalbidinyl-(6'-O-p-coumaryl)-β-D-glucopyranoside]; leaves yielded kaempferol [MAOI (Sloley et al. 2000)], 4'-MeO-kaempferol, 7-MeO-kaempferol, p-OH-benzoic acid, vanillic acid and β-resorcylic acid. The plant has also yielded up to 3.7% behenic acid [said to be a CNS-stimulant (Rätsch 1992)], julandine, and muricatin, with lysine, histidine, threonine, valine, leucine, isoleucine, palmitic acid, stearic acid, oleic acid, palmitoleic acid and linoleic acid in the seed oil (Abou-Chaar 1970; Abou-Chaar & Digenis 1966; Nair et al. 1986; Rastogi & Mehrotra ed. 1990-1993).

Calonyction muricatum is a large twining herb, stems often muricate. Leaves 7.5-15 x 6.3-12.5cm, broadly ovate, acuminate, glabrous, entire, base deeply cordate with rounded basal lobes; petioles 7.5-15cm long. Peduncles 1-5-flowered, variable in length; bracts caducous; pedicels usually much thickened upwards in fruit; sepals 5, 1.3-1.6cm long, smooth, elliptic-oblong, aristate, subequal in length, 3 outer sepals much broader than the 2 inner ones; corolla salver-shaped, tube 2.5-5cm long, narrow, cylindric, 5-7.5cm long, rose purple, hairy within; stamens 5, exserted. Ovary 2-celled; ovules 4; style filiform; stigma 2-globose; anthers not twisted; pollen grains spinulose. Fruit a 4-valved capsule, 1.3-1.7cm diam., globose, apiculate; seeds 4, 1cm long, glabrous, black.

Himalayas from Kangra to Sikkim up to 1530m, Upper Gangetic Plain, Bengal, Bihar, Orissa, Bombay, Deccan Hills, upper Burma, Ceylon; possibly naturalised in China and Japan (Chopra et al. 1965; Kirtikar & Basu 1980).

CALYCANTHUS

(Calycanthaceae)

Calycanthus occidentalis *Hooker et Arnot*

C. occidentalis, which has interesting chemistry, is related to 'California allspice', C. floridus, the aromatic bark of which is used as a cooking spice, and as a medicine to ease muscle cramps and toothache. The leaves of C. floridus may also be used to treat fevers (Bremness 1994). The Cherokee use it to make eyedrops to treat poor eyesight, as well as using the plant as an emetic, and to treat hives and bladder complaints (Hamel & Chiltoskey 1975). C. glaucus [C. fertilis] is also known as California allspice [as well as 'sweet-scented shrub' and 'bubby']; its seeds have been reported to have killed cattle (Gordin 1905), with symptoms compared to those of *strychnine* poisoning (Anon. 1888a). In parts of eastern US, it is used to regulate menstruation (Usher 1974).

C. occidentalis has been shown to contain the β-carboline alkaloids *harmine* [0.0197%] in aerial parts (Lutomski & Nowicka 1969; Lutomski et al. 1968b), and *harman* in the leaf [leaf contained 0.000004% alkaloids calculated as *harman*] (Lutomski & Malek 1975b), as well as the indoles calycanthine [0.8% from seeds], folicanthine [0.14% from leaves] (Hodson & Smith 1957; Manske & Marion 1939) and calycanthoside (Buckingham et al. ed. 1994). Calycanthine [not the same as calycanthin, a glucoside] is a spinal stimulant and cardiac depressant in cats and rabbits; 5mg/kg [i.v.] induced *strychnine*-like "violent tetanic spasms". In frogs, it had a weak curare-like paralytic activity at doses of 5-10mg [injected into the anterior lymph-sac], with the 10mg dose causing spasms as above; 15mg caused death within a few days (Gordin 1905). Calycanthine also has uterine-stimulant activity (Harborne & Baxter ed. 1993). When reacted under heat with selenium in a stream of nitrogen, it degrades to *norharman*, skatole, β-ethyl-indole, lepidine, and an unidentified base; when benzoylated and oxidised in acetone with potassium permanganate, it forms benzoyl-*N*-*methyltryptamine* (Manske & Marion 1939).

C. floridus seeds have yielded c.1% alkaloids (Manske 1950), including calycanthine and isocalycanthine (Henry 1939); isocalycanthine is believed to be an artefact of extraction. Leaves have yielded 0.34% folicanthine (Hodson & Smith 1957).

C. glaucus seeds have yielded c.2% calycanthine and isocalycanthine, as well as 39-47% fixed oils; bark, leaves and flowers [but not seeds] contain an essential oil (Anon. 1888a; Gordin 1905; Henry 1939).

Calycanthus occidentalis is an aromatic, erect branching deciduous shrub 1-3m tall, foliage pleasantly aromatic when bruised. Leaves opposite, entire, 7-10cm long, ovate to oblong-lanceolate, acute at apex, rounded or cordate at base, firm in texture, dark glossy green and scabrous, very short-petioled. Flowers solitary, pedunculate, terminal; sepals and petals several, 2-6cm long, linear-spatulate, reddish-purple, emitting the odour of wine; stamens many, inserted on receptacle in several rows, the inner sterile; pistils many, enclosed in the hollow receptacle. Ovary 1-celled; 1-2-ovuled; style filiform; sterile filaments densely villous. Fruiting hypanthium ovoid, slightly constricted at apex, 25-35mm long; achenes numerous, smooth, oblong, 7-8mm long, villous. Fl. May-Sep.

In moist places, along streams and borders of lakes and ponds; Upper Sonoran and Arid Transition zones [Sonoran Desert], California, in north coast ranges and Sierra Nevada foothills (Abrams 1940-1944).

CAMELLIA

(Theaceae)

Camellia assamica *(J. W. Mast.) H. T. Chang* **(C. sinensis var. assamica** *(J. W. Mast.) Kitam.***; Thea assamica** *J. W. Mast.***; T. chinensis var. assamica** *(J. W. Mast.) Pierre***; T. viridis var. assamica** *(J. W. Mast.) Choisy***)** – cha-gaca
Camellia assamica var. kucha *Chang et Wang* – kucha
Camellia irrawadiensis *Barua*
Camellia ptilophylla *Chang* – cocoa tea
Camellia sinensis *(L.) Kuntze* **(C. thea** *Link.***; C. theifera** *Griff.***; Thea sinensis** *L.***)** – tea, thea, cha, chaha, chavika, chai
Camellia taliensis *(W. W. Sm.) Melch.* **(Thea taliensis** *W. W. Sm.***)**

The 'tea' bush, C. sinensis, is an ancient plant thought to have originated in China or Assam (Rätsch 1992). Its use is recorded from China as early as 2700BC, and the plant has been applied there as a tonic and ritual stimulant drink. Buddhists utilised it to keep them awake during lengthy meditations, and Taoists valued it as an ingredient of elixirs of immortality [see *Methods of Ingestion*]. In Tibet, tea is given to revive weary horses, and early herbals have always claimed [in various terms] that it could relieve fatigue, strengthen the will, delight the soul and repair eyesight. Tea cultivation gradually spread to other regions, being grown in Japan by c.800AD, and the consumption of the beverage made from the leaves gradually evolved into what is now known as the 'tea ceremony'. Such a ceremony is rigorously prepared for by the host, and is held in a room that is sparsely but tastefully decorated. The mood of the tea ceremony is one of silent contemplation and artistic appreciation. Tea was introduced to English society c.1840, after which the British established tea plantations in India and Sri Lanka. The popularity of the drink spread rapidly from there, and it is now consumed worldwide. The related C. assamica is used in India as a tea substitute; this species is considered to be the parent species of the cultivated plant, C. sinensis. The leaves of tea are 'gently exhilarating' if infused for a long time; overdoses are said to have a "degenerative effect on the nervous system analogous to what follows even the moderate dose of alcohol". It has even been said that "at times...the disorder of the mental faculties under the influence of strong tea, amounts nearly to insanity" (Emboden 1979a; Huang 1993; Nadkarni 1976; Okakura 1964; Schapira et al. 1975). For most people, however, tea acts as a mildly stimulating and relaxant beverage.

An early method of preparing tea in the Yangtse-Kiang Valley of China was to steam the leaves, crush them in a mortar, press them into a cake and boil it in water with rice, ginger [see *Endnotes*], salt, orange peel [see **Citrus**], milk, onions and other spices. Later, the only extra ingredient was salt – this was added to the water when it began to simmer, and the tea added when it began to boil. When a rapid boil commenced, a ladle of cold water was poured into the brew [to 'revive the youth of the water'] and the beverage consumed immediately. In the Sung Dynasty, tea was prepared in the 'whipped tea' fashion, in which the ground leaves were whipped in hot water with a bamboo whisk (Okakura 1964; Schapira et al. 1975). Tea is now usually prepared by pouring boiling water on the dried tea leaves and letting them infuse in a covered pot [or in a cup, if using teabags] for 1-5 minutes. Sometimes milk and/or sugar or honey are added, usually only to black tea [see below].

In western countries, 'chai' often refers not to simple tea itself, but to 'masala chai', a spiced tea blend popular in n. India. Masala chai is based on black tea [usually cheaper grades], with spice additives varying, but usually including 'cardamom', cinnamon bark [see **Cinnamomum**], cloves [see **Syzygium**] and black pepper [see **Piper 1**]. Sometimes ginger [see Endnotes] and other spices are also added. Masala chai is usually boiled in water, with milk added near the end of brewing, and sugar or honey added before serving (pers. obs.).

Tea leaves have been smoked on occasion – 'haysan tea' [see below] was much smoked in cigarettes by women earlier last century (Chopra et al. 1965; Emboden 1979a). Some desperate **Cannabis** smokers have been known to use black tea mixed with pipe residue and strained solids from bong-water [often referred to as 'dregs'], to help make such resinous gunk more readily smokeable. For this purpose, the powdered tea and residual matter are lightly heated in a frying pan, mixing all the while with a spatula, in order to dry and mix the two more effectively. The frying process is stopped when fumes are first observed arising from the mixture, which can then be mixed with a small amount of tobacco [see **Nicotiana**] if desired, and smoked through a water-pipe. This tastes quite filthy and is probably very unhealthy, but is psychoactive (pers. obs.).

Leaves are harvested in early spring from plants at least 4-5 years old, and for quality teas the tender young shoots, buds and immature leaves are plucked. Harvesting may take place often throughout the year, but those picked in early spring are considered the best. Stems and other impurities are removed before processing. How they are then processed determines what type of tea will result, the main types being green, black, and semi-fermented ['oolong'] teas. [However, beyond this, Chinese connoisseurs recognise up to 330 different kinds of tea (Huang 1993) – see also Von Bibra (1855) for descriptions of some of them].

Japan produces only green tea, and some also originates from China. Freshly harvested leaves are quickly roasted in a pan over a fire to remove excess moisture, and thus, prevent fermentation. The leaves are then rolled into sticks or balls; these are fired again, before being sifted and graded according to quality. Those rolled into balls are known as 'gunpowder' or 'imperials', and those rolled lengthwise are known as 'hyson' or 'haysan'. In Japan, the fresh leaves are steamed before the firing stage.

Oolong ['black dragon'] or semi-fermented tea is produced in Formosa [Taiwan]. Picked leaves are partially dried and fermented in the sun on bamboo trays, while repeatedly being rolled and crushed by hand.

The leaf soon changes to a darker colour, and while still moist it is dried in bamboo baskets over burning charcoal. A popular variant on this is 'jasmine tea', or 'jasmine oolong tea' [see **Jasminum**], grown in the Foochow Province of China. The semi-dried leaves are spread on the ground and covered with several layers alternating with jasmine blossoms and tea leaves. This is left to sit for several hours before the whole mass is heated to dryness, and the jasmine flowers removed.

'Black tea' or 'pu-erh tea' is manufactured in India, Sri Lanka, Java and Sumatra, as well as China, the best being that grown in the Keemun district. Fresh leaves are first withered on racks in specially designed lofts for 24 hours. They are then rigorously rolled and crushed – this is now done by machines. The fermentation room is structured to be a cool and moist environment, free from direct sunlight – here, the leaves are spread out to a depth of c.1.25cm, and fermented for 4-4.5 hours, until the leaf is a rich golden brown and has acquired the characteristic aroma, which is absent from unfermented tea leaves. They are then dried by firing, and sorted according to grades – usually divided into broken and unbroken, and further categorised into types such as 'orange pekoe', 'souchong', 'broken orange pekoe', and the 'dust' grades. Tea quality is often judged by the size of the leaf, the tightness of the curl of the whole dried leaf, aroma, colour, flavour etc. A less common and cruder variant is 'brick tea', produced chiefly in w. China, and used in parts of Russia and Tibet. Small twigs and coarse leaves are heated in an iron pan for a few minutes, bundled, and taken to the factory. Here it is fermented, sun-dried, graded, steamed and pressed in brick-shaped moulds for 3-4 days until dry (Dowell & Bailey 1980; Schapira et al. 1975; Williams 1937).

Tea is a CNS-stimulant, astringent [due to tannin content], diuretic, digestive and sudorific. Overdose of tea can cause symptoms such as nausea, vomiting, trembling, weakened pulse, paleness, headache, hallucinations and nightmares. New studies show tea may help reduce tooth decay, due to antibacterial and anticaries actions, as well as showing success in treating bacterial dysentery. Green tea has also shown antitumour and antioxidant activity, partially due to the polyphenolic catechins present, as well as the non-polyphenolic fraction, containing pheophytins A and B; it may also boost the immune system and inhibit MAO-B (Bremness 1994; Higashi-Okai et al. 2000; Huang 1993; Mazzio et al. 1998; Miketova et al. 1998; Nadkarni 1976; Simonetti 1990). Theanine, an amino acid which is abundant in Japanese green tea, has been shown to increase brain concentrations of *serotonin* and *dopamine* in the striatum, hypothalamus, and hippocampus, as well as stimulating *dopamine* release in the striatum (Yokogoshi et al. 1998). Tea has also shown antimutagenic activity against various mutagenic chemicals, with oolong and 'pouchong' [a type of black tea which is packaged in light yellow paper (Von Bibra 1855)] teas being most active (Yen & Chen 1996).

Green teas retain more of their ascorbic acid [vitamin C] content than fermented teas. Catechin content is highest in green teas, and lowest in fermented teas. In fermentation, the catechins are oxidised by the enzyme polyphenol oxidase and then polymerised to result in formation of theaflavins, thearubigins and other compounds. In the phenolic fraction, gallic acid content is increased from fermentation, as it is released from its bound form in catechin gallates. However, some studies found green tea to contain greater levels of phenols than black tea; others have found them to be similar in content; others have found black tea to contain greater levels than green tea. On average, fermented teas contain more *caffeine* than green teas, with oolong tea and Ceylon black tea sometimes bearing the highest levels [as well as highest levels of phenolic compounds] (Khokhar & Magnusdottir 2002; Lin et al. 1998; Yen & Chen 1996). The fermentation apparently slightly increases *caffeine* levels through breakdown of nucleic acids (Suzuki et al. 1992). The great chemical variation of different teas makes it difficult to generalise about yields or types of compounds likely to be present in any given sample, unless perhaps one is a true 'tea expert'. It is worth noting, however, that commonly-available commercial teas in non-Asian countries [especially those pre-packaged in tea bags] are generally of much lower quality [both chemically and subjectively], compared to the teas consumed by connoisseurs (eg. see Khokhar & Magnusdottir 2002; Lin et al. 1998).

Although tea, on average, contains more *caffeine* by weight than coffee [see **Coffea**], it is usually less stimulating due to the smaller weight of tea used in the average brew (pers. obs.). One cup of tea brewed with black tea bags may contain 8-67.4mg *caffeine*, or 9-19mg with green tea bags; up to 150mg per cup has been found, from tea of unspecified type [probably black] (De Camargo & Toledo 1999; Gilbert et al. 1976; Karch 1996). 'De-caffeinated' teas still contain small amounts of *caffeine* [c.0.27% of dried leaf, in one sample]. Infusing tea for a longer time than is usual [c.10min. rather than 1-5min.] gives greater extraction of catechins (Khokhar & Magnusdottir 2002).

C. assamica var. kucha [cultivated in Guangzhou, China; harv. Oct. and May] expanding buds yielded c.2.7% *caffeine*, 1.45% *theobromine* and 2.8% theacrine [1,3,7,9-tetramethyluric acid]; young leaves yielded c.0.55% *caffeine*, 0.35% *theobromine* and 2.75% theacrine; mature leaves yielded c.0.7% *caffeine*, 0.12% *theobromine* and 1.25% theacrine; old leaves from near the base of the tree yielded c.0.1-0.5% theacrine, with *caffeine* absent or present only in traces (Zheng et al. 2002).

C. irrawadiensis leaves have yielded up to 0.02% *caffeine* and 0.53-0.81% *theobromine* (Nagata & Sakai 1985).

C. ptilophylla leaves have yielded *theobromine* as the major alkaloid (Zheng et al. 2002).

C. sinensis leaves may yield 1-5% purine alkaloids, most of which [c.3.5% of leaves, even up to 4.5% in some] is *caffeine* [green tea has yielded 1.15-2.01% *caffeine*; oolong tea 2.43-2.44%; black tea 1.5-4%], with modest amounts of *theobromine* [0.1-0.17%; 0.2-0.4% in black tea; up to c.0.96% in green tea], *theophylline* [c.0.02% in black tea, up to c.0.13% in green tea], methylxanthine, xanthine, adenine and a guanine-derivative; as well as *phenethylamine*, *DMPEA*, theanine [γ-glutamylethylamide], methyl salicylate, c.30% fixed oil, 9.5-21% tannins [tannic acids], catechins [c.3-30%, lowest values in black teas], mineral salts, saponins, cis-3-hexanal, gallic acid, angelic acid, cinnamic acid, glucuronic acid, linoleic acid and tiglic acid (Gilbert 1986; Huang 1993; Khokhar & Magnusdottir 2002; Kirtikar & Basu 1980; Lewis & Elvin-Lewis 1977; Lin et al. 1998; Lindner 1956; Lovenberg 1973; Lundstrom 1989; Nadkarni 1976; Nagata & Sakai 1985; Power & Chestnut 1919a; Rastogi & Mehrotra ed. 1990-1993; Simonetti 1990; Yokogoshi et al. 1998). Theacrine [see above] also occurs in traces (Zheng et al. 2002). The pericarp of the fruit has yielded 1-2% *caffeine* [w/w] and 0.05-0.1% *theobromine* (Suzuki et al. 1992). One study reported finding up to c.17% *caffeine* in Chinese green tea, and c.16% *caffeine* in a black tea made from a Taiwanese C. sinenis hybrid called TTE 12. In this study, the average yield of *caffeine* from a wide variety of teas was c.7-8%. [Many of the figures given in this paper were not incorporated into the yields of C. sinenis alkaloids given above, due to their great difference compared to other research]. Chinese green teas contained more *theobromine* and *theophylline* than did Japanese green teas, which in turn contained more catechins. In general, however [and in conflict with other research], this study did not find a very significant difference between alkaloid content of non-fermented, semi-fermented and fully-fermented teas (Lin et al. 1998).

C. taliensis leaves have yielded 2.28% *caffeine* and 0.14% *theobromine* (Nagata & Sakai 1985).

Camellia sinensis is a shrub or small tree, glabrous or slightly pubescent. Leaves evergreen, alternate, serrate, coriaceous or membranaceous, glossy, +- ovate. Flowers axillary, solitary, in peduncles with a few distinct bracts, sometimes a second flower in the axil of one of them, sessile or shortly stalked; sepals 5-6, round, very obtuse, unequal; petals usually 5, white, obovate-obtuse, glabrous or pubescent on the back; stamens numerous, glabrous, adherent to base of petals, the innermost 5-12 free. Ovary villous, 3-5 celled; ovules 4-5 in each cell, pendulous; styles 3, glabrous, connate beyond middle. Capsule woody, usually short, loculicidal, depressed, 3-cornered, 3-seeded; seeds mostly solitary in each cell, wingless, testa hard and shining.

India to Japan (Chopra et al. 1965; Kirtikar & Basu 1980).

Tea is best grown at a high altitude, with temperatures from 18-25°C., and wind protection. Soil should be rich, loamy and well-drained. Can be grown from cuttings. Seeds that sink in water are planted c.10-20cm apart, 2cm deep, and covered with thatch to prevent sunburn. Tea is often grown under the shade of legumes. Regular pruning is later required to maintain a good-yielding bush (Simonetti 1990; Williams 1937).

CANANGA

(Annonaceae)

Cananga odorata *(Lam.) Hook. f. et Thomson* **(Canangium odoratum** *(Lam.) Baill.***; Uvaria odorata** *Lam.***)** – ylang-ylang, perfume tree, alangigan, anangiran, tangit, burak

'Ylang-ylang' ['flower of flowers'] is a popular aphrodisiac perfume obtained from the flowers of C. odorata. It is commonly available as an essential oil, and in perfumes, soaps and skin lotions. In Indonesia, the flowers are spread on the bed of newlyweds for the honeymoon. The effects of the oil have been compared to those of **Narcissus** oil, acting as a CNS-depressant and regulating heart action – aromatherapists say it may also be calming, antidepressant, aphrodisiac, euphoric and narcotic. Used in excess, ylang-ylang can cause headaches and nausea. The best oil is considered to come from C. odorata var. genuina – C. odorata var. macrophylla is known simply as 'cananga', and yields an inferior quality oil. Different quality essential oils are collected at different stages of fractional steam distillation [or fractional steam and water distillation], with the first portion being of the highest quality [known as 'ylang-ylang extra']. Best grade ylang-ylang steam-distilled oils are almost colourless, with a slight yellowish tint, though a high-grade oil which is very dark is extracted from the flowers with petroleum ether (Battaglia 1995; Bremness 1994; Lawless 1994, 1995; Rätsch 1990; West & Brown 1920).

C. odorata flowers have yielded up to 0.45% essential oil, containing linalool, geraniol, *pinene*, cadinene, p-cresol, methyl benzoate, benzyl benzoate, benzyl acetate, benzyl valerianate, methyl paracretol, methyl salicylate [see **Gaultheria**], *eugenol*, isoeugenol, *safrole* (Erickson 1976; Lawless 1995; West & Brown 1920) and *isosafrole* (Harborne & Baxter ed.

1993). Best quality oil may contain 25.1% benzyl acetate, 8.7% methyl benzoate, 2.2% benzyl benzoate, 16.5% p-cresyl methyl ether, 13.6% linalool, 5.3% geranyl acetate, 1.7% caryophyllene and 7.4% other sesquiterpenes; in contrast, lowest quality oil may contain 9% caryophyllene, 4.3% benzyl benzoate, 3.7% benzyl acetate, 1% methyl benzoate, 3.5% geranyl acetate, 1% linalool, 0.5% p-cresyl methyl ether and up to 97% other sesquiterpenes (Battaglia 1995). Eupolauridine, sampangine and 3,7,11-trimethyl-2,4,6,10-dodecatetraene have also been found in the plant. The alkaloids liriodenine and ushinsunine have also been reported from the genus (Buckingham et al. ed. 1994).

Cananga odorata is a tall tree, trunk straight; bark smooth, ashy; shoots glabrous. Leaves alternate, 12.7-20.3 x 5-7.6cm, ovate-oblong, finely acuminate, base rounded, margins waved, puberulous beneath, especially on veins, veins furrowed; petiole c.1.3cm. Flowers odorous, large, 7.6cm long, usually 3-nate, yellow, solitary or fascicled on short axillary peduncles, drooping; peduncles solitary or several from old scars; pedicels c.2.5cm, recurved, hoary, with a few basal bracts and a median scaly bract; sepals 3, ovate or triangular, valvate; petals 6, 8-9mm, 2-seriate, subequal, narrow, linear, base broad, silky when young, long, flat, valvate; stamens linear; anther cells approximate extrorse, connective produced into a lanceolate acute process. Ovaries many; style oblong or none; ovules numerous, 2-seriate; stigmas subcapitate. Carpels c.12, 1.3-1.7cm, ovoid or obovoid, black, glabrous, long-stalked, berried, 6-12-seeded; seed testa crustaceous, pitted, sending spinous processes into the albumen.

In moist or seasonal forests; Java, Philippines, India, Indonesia, Burma – cultivated throughout India and the tropics (Bremness 1994; Hooker 1954-1961); 700m and above.

Seeds have a low germination rate. Flowers are usually harvested at night from May to June, when mature and yellow; their essential oil is usually collected by steam distillation (West & Brown 1920). Battaglia (1995) noted that the flowers may sometimes be mauve or pink, but that yellow flowers are best for essential oil extraction.

CANARIUM

(Burseraceae)

Canarium album *(Lour.) Räusch*
Canarium commune *L.* – Java almond tree, jangali badam, canari, badamee, elemi
Canarium cumingii *Engl.*
Canarium luzonicum *A. Gray* – elemi
Canarium madagascariense *Engl.* – ramy
Canarium microcarpum *Willd.* – elemi
Canarium spp. – elemi

Trees of this genus, particularly C. commune and C. luzonicum, yield a pale yellow resin from incisions in the bark, called 'gum elemi', which is distilled to make 'oil of elemi' [also known as 'manila elemi', or 'brea']. The gum has a sharp lemon scent, and is used in the manufacture of soaps, as well as being used as an incense, and applied topically to persistent ulcers; the oil is similarly used in soaps, perfumes and cosmetics. The seeds treat beri-beri, and their oil is used in cooking; the fruit is laxative, and is considered fattening. In India, the seeds and their oil are used medicinally, and are considered stimulant in action. In Indonesia, the leaves are used to treat vertigo, and the bark for malaria. In Cambodia, the tubers of the trees are used as a stimulant, diaphoretic and styptic; they are taken internally to treat vertigo, chronic bronchitis, inflamed uterus, headache, and jaundice; and externally for neuralgia, rheumatism and liver complaints (Bremness 1994; Bruneton 1995; Kirtikar & Basu 1980; Nadkarni 1976; Pernet 1972).

In Madagascar, C. madagascariense bark is used as a disinfectant fumigant, and a stem decoction is sometimes prepared to cause fatal poisoning (Pernet 1972). The seeds of C. pimela are used as a sedative and nutrient in Hainan, China. The fruit of C. album has similar properties, and is also used raw as an antidote for intoxication, alcohol poisoning, fish poisoning, diarrhoea, and swollen sore throat (Perry & Metzger 1980). The Hmong of n. Thailand bathe in a wash of C. subulatum, as a tonic treatment (Anderson 1993). In the coastal Rai region of Papua New Guinea, a Canarium sp. is used in magic to promote a successful garden (Paijmans ed. 1976).

'Oil of elemi' prepared from the oleo-resins of C. commune bark has yielded 65-75% resinous triterpenes [including amyrenol, α-manelemic acid, elemolic acid] and 15-25% essential oil [including 0.5-8% *elemicin*, 45-72% limonene, 10-24% α-phellandrene, 3-8% sabinene, 1-15% elemol, 0.4-2% α-terpineol, carvone, dipentene] (Bruneton 1995; Pernet 1972); fruit essential oil contains *anethole* (Nadkarni 1976).

C. cumingii oleo-resin contains *elemicin* and amyrenol; leaves yielded camphene, cymol, dipentene and formic acid.

C. madagascariense oleo-resin contains *elemicin*, citronellol, dipentene and phellandrene. An extract of the aerial parts showed cardiac activity.

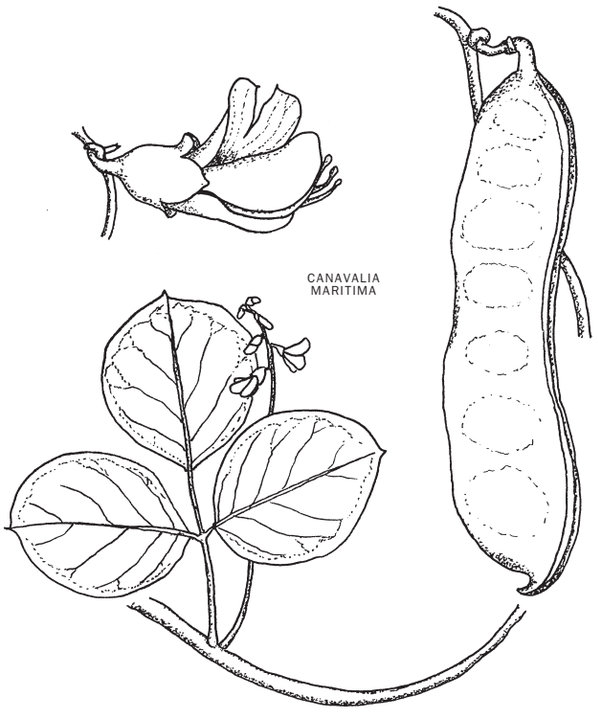
C. microcarpum has yielded *elemicin* and elemol (Pernet 1972).

Canarium commune is a tall balsamiferous tree; extremities of branches tawny-puberulous or glabrate. Leaves alternate, distant, imparipinnate, of flowering branches 25-45cm; leaflets 7-9, ovate to oblong, elliptical, acuminate, glabrous, usually opposite, usually petioluled, often very unequal, the lowest rotund, remote from base, or sessile at base of leaf and stipuliform, upper leaflets 10-15 x 3-6.5cm; lateral nerves c.10-15 pairs; stipules elliptic or rotundate, auricled, often very early deciduous; petiolules 12-25mm long. Flowers hermaphrodite or polygamous, in axillary and terminal branched panicles, panicles puberulous, with spreading successively shorter lateral branches; buds enclosed in ovate or rotundate tomentose deciduous bracts; flowers variable in size, female 8-12mm long or more; calyx campanulate, broadly 3-lobed, valvate, persistent; petals 3, imbricate below, tomentose above, thick, usually longer than calyx; disc annular, entire or lobed; stamens 6-10, in males inserted around hairy rudimentary ovary; filaments free or connate at base with each other and the disc. Ovary ovoid, glabrous, thickened above, usually 3-celled; ovules 2 in each cell; style short or equalling ovary in length; stigma capitate, 2-4-lobed. Drupe ellipsoidal, subtrigonous, with a bony 1-3-celled stone; seed conform to the cell, testa membranous.

Tropical forests; native to Moluccas, introduced to India, Malay Peninsula (Kirtikar & Basu 1980), and also found in n. Australia.

CANAVALIA

(Leguminosae/Fabaceae)



Canavalia maritima *Petit-Thouars* **(C. maritima** *(Aubl.) Urb.***; C. obcordata** *(Roxb.) Voigt***; C. obtusifolia** *DC.***; C. rosea** *(Sw.) DC.***; Dolichos emarginatus** *Jacq.***; D. maritimus** *Aubl.***; D. obcordatus** *Roxb.***; D. obtusifolius** *Lam.***; D. roseus** *Sw.***; D. rotundifolius** *Vahl.***)** – coastal jack bean, sea bean, horse bean, bay-bean, frijol de mar, poiszombi, pois lan mer, pois liane, pois maldioc, graines ouari, mate de costa

Canavalia virosa *(Roxb.) Wight et Arn.* **(C. africana** *Dunn ex Hutch.***; C. ensiformis var. virosa** *(Roxb.) Baker***; C. ferruginea** *Piper***; C. polystachya** *Schweinf.***; C. virosa** *Naves ex Villar***; Dolichos polystachios** *Forssk.***; D. virosus** *Roxb.***)** – kath-shim, kudsumbar

The mashed roots of C. maritima have been used by indigenous north Australians, infused and rubbed on the body to treat aches and pains, rheumatism, colds, leprosy and broken bones (Lassak & McCarthy 1990). Apparently, sailors in the Gulf of Mexico sometimes smoke the dried, ground seed-pods of this plant [minus the seeds] as a 'narcotic' **Cannabis** substitute. It is also said to guard against the 'evil eye'. Although there is no record of ancient drug-use of this plant, seeds have been recovered from graves in Mexico [Oaxaca and Yucatan] and Peru, dating back to times between 300BC and 900AD. It is also reported from Java that the plant is narcotic. Likewise, in India, C. virosa is reported to be narcotic. However, the unripe seeds and pods of C. virosa are eaten in China, India, Arabia and Africa, presumably after cooking. In the West Indies, mature seeds of C. ensiformis are roasted and used as a coffee substitute [see **Coffea**] (Emboden 1979a; Nadkarni 1976; Ott 1993; Schultes &

Hofmann 1980; Watt 1967). The seeds are toxic when raw or improperly prepared; roasting for 15-45min. destroys most [not all] of the canavanine present [see below], and boiling in water for a similar period leaches most [again, not all] of the canavanine present into the water. However, heated seeds are still toxic to rats (Bell 1973). Canavalia spp. are generally grown across the globe for cattle forage and green manure, as well as for their nitrogen-fixing capabilities (Allen & Allen 1981).

C. ensiformis leaves [or leaflets] produce the amino acid canavanine, with levels increasing as leaves develop (Rosenthal 1972). Canavanine has insecticidal, phytotoxic and cytotoxic effects; it antagonises metabolism of the amino acid arginine, increases clumping of red blood cells and was shown to be toxic to mice at 200mg/g [oral] (Bell 1973; Harborne & Baxter ed. 1993; Rosenthal 1977). Leaflets have also yielded the flavonoids cajanin, genistein [MAOI (Hatano et al. 1991)], 2'-OH-genistein, maackiain, medicarpin, quercitrin, rutin and vestitol. Seeds have yielded the alkaloids betonicine, canavalmine, caneine, kitagine, spermine, spermidine, trigonelline, 1,4-butanediamine, 4,4'-diaminobutylamine, 1,5-pentanediamine, and 3-isoxazolidinone; the amino acids canavanine, 2,4-diaminobutanoic acid, 2-amino-4-OH-butanoic acid, 2-amino-5-OH-pentanoic acid, and hexahydro-3-imino-1,2,4-oxadiazepine-3-carboxylic acid; as well as lupeol, lupeoside, stigmasterol and β-sitosterol (International... 1994).

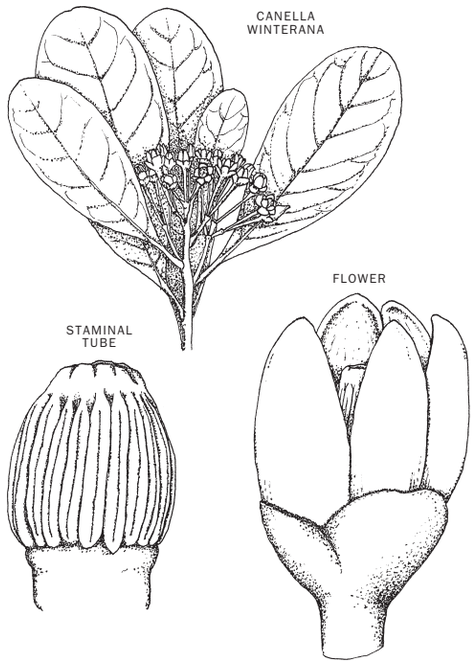
C. maritima seed pods have yielded L-betonicine, but no constituents known to be psychoactive have been found (Schultes & Hofmann 1980). The seeds have yielded 6.25% canavanine (Rosenthal 1977), and leaflets have yielded the flavonoids maackiain, medicarpin, and vestitol (International... 1994). Stem, leaf and fruit have tested positive for presence of alkaloids (Fong et al. 1972). A crude mix of unspecified leaf-alkaloids was shown, in very high doses [2g/kg oral], to exhibit low-level CNS activity, lowered arterial blood pressure, and an antiinflammatory effect in mice (CSIRO 1990).

Canavalia maritima is a climbing or trailing herb; stems 2-3m long, silky or glabrous. Leaves alternate, pinnately 3-foliate; leaflets circular to oblong, 4-12cm long, 3-10cm wide, leathery, glabrous at maturity, apex mucronate to retuse; stipules gland-like or minute, stipels usually not present. Inflorescences axillary c.8-flowered racemes; bracts minute, bracteoles +- circular, caducous; peduncle erect, 15-30cm long; calyx 2-lipped, c.12mm long; corolla mauve to white; standard rounded, reflexed, mostly 2-3cm long; keel incurved, sometimes beaked; stamens diadelphous; anthers uniform. Ovary many-ovuled; style beardless; stigma terminal. Fruit an oblong pod, +- compressed, 10-15cm x 25mm, c.6-seeded; seeds ovoid, c.18mm long, without obvious aril, poisonous. Fl. most of the year.

Mostly on sand dunes in coastal areas; Asia, Africa, Central America, Australia [WA, NT, Qld, north of Shellharbour in NSW] (Harden ed. 1990-1993).

CANELLA and DRIMYS

(Canellaceae)



Canella winterana *(L.) Gaertn.* **(C. alba** *Murray***; Laurus winterana** *L.***; Winterana canella** *L.***)** – wild cinnamon, white cinnamon, canella, canela, pepper cinnamon, Bahama whitewood, whitewood bark, false Winter's bark

(Winteraceae)

Drimys winteri *J.R. Forst. et G. Forst.* **(D. aromatica** *Descourt ex Baill., non F. Muell.***; D. chilensis** *DC.***; D. granatensis** *Mutis ex L. f.***; D. magnoliaefolia** *Kunth ex Eichl.***; D. paniculata** *Steud.***; D. polymorpha** *Spach ex Baill.***; D. punctata** *Lam.***; D. winterana** *Thell.***; Wintera aromatica** *Murr.***; Winterana aromatica** *Soland. ex Fothergill***)** – canelo, canelón, canellilo, boigue, boiye, boique, fune boighe, foie, foike, foige, foye, foikelawen, palo piquante, ciûla, shâahlku, shâlakuâhr, usskútta, wa-tsuts-ñee-ñoo-ssê, pepper bark, Winter's bark, Winter's cinnamon

Drimys winteri is highly venerated amongst the Mapuche [main survivors of the Araucano] of the southern Andes, Chile. To them it represents the world tree, with roots in the underworld, and above reaching towards the heavens. The tree, sometimes called 'iñ chao rayülelu' ['our flowery father'], is considered a manifestation of the divine, and its wood is used to make the drums ['kultrun'] of Mapuche shamans. Shamans ['machi', usually female] also have their own personal 'ritual pillar' ['rewe'] made from the wood, which they climb during ecstatic trance (Aukanaw 1983-2000; Plowman et al. 1971; Titiev 1951). The branches are burned during all shamanic ritual, to release the spirit of the tree and allow it to carry the machi to the otherworld. Divination with the plant was done in a dark hut with a leafless branch of it stuck in the ground, with a tuft of llama wool on the end. The scent of the wood alone is said to produce the desired effect. Spells or prayers were made effective by blowing tobacco smoke [see **Nicotiana**] over one of the trees, and the leaves of the tree may be rubbed on the body of a sick person to 'draw out the illness' [it is possible that the 'tobacco' reported to be used by the Mapuche is not **Nicotiana**, but rather **Lobelia** tupa (pers. obs.), which is an important visionary plant to the Mapuche (Rätsch 2001)]. Sometimes, a tree is planted during the festivities surrounding the naming of a child, so that the spirit of the tree will be an ally and protector throughout the life of that person (Rätsch 1992).

Rätsch (1992) reported this erroneously as referring to Canella winterana, which is not found in the Andes (theobromus pers. comm.). In the 16th century, Captain William Winter [a member of Captain Drake's expedition through the Straits of Magellan] was given the bark of D. winteri by natives to treat scurvy, during a land stop-over in s. Argentina. After noting its efficacy, the bark then became widely used in Europe as a medicine. Ever since, the true identity of what became known as 'Winter's bark' has been obscured, with C. winterana and/or Cinnamodendron corticosum often offered as substitutes (Felter & Lloyd 1898; Smith 1943). However, C. winterana is native to the West Indies, Florida, and southern Mexico, and Cinnamodendron corticosum is native to Jamaica (Adams 1972; Fawcett & Rendle 1926). Further confusion exists amongst plants known as 'canela' [Spanish] or 'canelo' [Portuguese], names which have also been used to refer to Miconia serialis, Ocotea spp., Nectandra mollis [see *Endnotes*], and **Cinnamomum** spp.

The Mapuche also recognise two varieties of D. winteri that are not held to be of sacred significance. 'Canelo de la paz' has leaves that are narrower and longer than the norm, and ash-grey beneath; carrying a branch of this plant symbolises peace. The similar 'canelo crespo' has ruffled leaves, and its bark [credited with powerful narcotic properties] is used to stun fish (Aukanaw 1983-2000; Titiev 1951).

D. winteri leaves and bark have a peppery taste, and are used to treat gastric disorders and diarrhoea; they have aromatic, aphrodisiac, stimulant, antispasmodic, antipyretic, tonic, and stomachic properties. About 2g of the powdered bark is considered a medicinal dose (Aukanaw 1983-2000; Felter & Lloyd 1898; Mendes et al. 1998; Titiev 1951). The leaves are also used in the Sibundoy Valley [Colombia] as a stimulant and tonic (Schultes & Raffauf 1990). As D. winteri does not naturally occur outside of Chile and Argentina (Moore 1983; Smith 1943), the use recorded in Colombia may represent cultivated or naturalised specimens, or perhaps a similar Drimys sp. that was mistaken for D. winteri. See also the closely-related **Tasmannia**.

The bark of C. winterana is used as a cooking spice and tobacco flavouring, as well as treating stomach upsets and restoring menstrual flow. It is commonly used as a substitute for cinnamon [see **Cinnamomum**] in Central and South America, and a bark infusion is drunk as an aphrodisiac and tonic (Chevallier 1996; Kioy et al. 1989; Usher 1974).

C. winterana stem bark has yielded up to 1.25% essential oil, containing *eugenol* [0.07% of bark], *myristicin* [0.012% of bark], *safrole*, *camphor*, 1-α-*pinene*, cineole, caryophyllene and canellal [0.04% of bark]; the essential oil has stimulating effects (El-Feraly & Hoffstetter 1980; Kioy et al. 1989; Rätsch 1992; Schermerhorn et al. ed. 1957-1974). The stem bark has also yielded 0.02% 3-MeO-4,5-methylenedioxy-cinnamaldehyde (El-Feraly & Hoffstetter 1980), 0.007% 3β,9α-di-OH-cinnamolide, 0.03% 9-α-OH-cinnamolide, 0.02% clovanediol, 0.06% warburganal, 0.096% mu-

kaadial, 0.008% heliocid, 3.5% mannitol and 0.035% β-sitosterol glucoside (Kioy et al. 1989, 1990).

D. winteri bark has yielded c.1.2% essential oil (Felter & Lloyd 1898); sesquiterpene drimanes, including polygodial [0.032-0.17%], 1-β-(p-MeO-cinnamoyl)polygodial [0.0017%], drimanial [0.024%], and mukaadial [0.001%]; and the flavonoids astilbin and taxifolin. The water/alcohol extract showed anti-asthmatic, anti-inflammatory, anti-allergenic, and analgesic properties. The analgesic properties were largely ascribed to the drimanes, with polygodial, 1-β-(p-MeO-cinnamoyl) polygodial, and drimanial all exerting marked pain-killing effects in mice; the first two were the most potent [being more potent than acetylsalicylic acid (aspirin) and acetaminophen (paracetamol)], with drimanial having approximately 1/3 the potency of polygodial (Cechinel-Filho et al. 1998; Malheiros et al. 2001; Mendes et al. 1998). Astilbin and taxifolin also have analgesic properties, and are likewise more potent than acetylsalicylic acid or acetaminophen (Cechinel-Filho et al. 2000). The leaves [harv. Mar.] have yielded 0.09% polygodial, 0.07% drimenol, 0.02% 3β-acetoxydrimenin, cryptomeridiol, cirsimaritin, astilbin, quercetin, quercitrin, and 0.19% safrol [a drimane sesquiterpene, not the same as *safrole* which is nevertheless sometimes spelled as safrol] (Sierra et al. 1986).

Canella winterana is a shrub or tree 2-10m tall; bark grey to white, deeply fissured into lozenge-shaped patches, aromatic. Leaves alternate, simple, entire, obovate to oblanceolate, rounded at apex, cuneate and decurrent on petiole at base, 2.5-7(-10) x 1.5-3(-4)cm, with pellucid glands, leathery, glossy or dull on upper side, paler beneath, nerves prominulous on both sides; petiole short; stipules none. Inflorescence a terminal cymose panicle; flowers bisexual; perianth bi-triseriate, actinomorphic; sepals 3, broadly imbricate, 2-3mm long, glaucous; petals 5 in one or more series, usually free, imbricate, 4-5mm long, crimson with yellowish mark at base within, fragrant; stamens 5-12, filaments connate; anthers bright red, 2-locular, extrorse, opening lengthwise. Ovary superior, 1-locular, with 2-6 carpels; placentas parietal each with 2 or more half-anatropous ovules; style short, persistent; stigma obscurely 2-lobed. Fruit a subglobose berry c.1cm long, turning red or purplish-black, placentas not evident in fruit, sweet and aromatic when ripe, 'hot like black pepper' [see **Piper**] when unripe and dry; seeds 1-4, filling the cavity of the fruit, black, hard, shiny, curved at one end, rounded on one side, 5mm long, 4-5mm wide, with oily endosperm. Fl. Apr.-Jul.; fr. Aug.-Feb. or all year.

Common in thickets and woodlands, in arid areas, to c.400m; Florida, Bahamas, Cayman Islands, West Indies on the drier islands, to Barbados (Adams 1972; Fawcett & Rendle 1926), and southern Mexico.

Drimys winteri is a shrub or small tree, to 20m tall; trunk to 1m diam.; branchlets brownish or dark cinereous, rugulose or sometimes smooth, subterete, 3-6mm diam. towards apex. Leaves coriaceous or thick-coriaceous, pale green to dark brown above when dried, glaucous or at least paler below and usually distinctly punctate, usually obovate-oblong to elliptic, (2.5-)6-15(-18)cm long, (1-)1.8-6.5(-7)cm wide, attenuate to obtuse at base and decurrent on petiole, obtuse or rounded and sometimes faintly emarginate at apex, margin slightly recurved, costa nearly plane or shallowly canaliculate above, prominent beneath, secondary nerves 5-15 per side, ascending or erect-patent, prominulous or immersed, obscurely anastomosing towards margin; petioles rugulose, canaliculate, 3-27 x 1-4mm, slightly swollen at base. Inflorescences usually clustered at or near branchlet apices, umbellate, fasciculate, or flowers single; peduncles up to 50mm long when present; pedicels 10-70mm long; sepals 2, reddish, caducous, membranaceous to submembranaceous, usually obscurely pellucid-glandular, sometimes copiously so, broadly ovate to suborbicular or reniform, 4-7mm long, 4-12mm wide, apex apiculate to rounded; petals 4-14, shiny, white, membranaceous, sparsely pellucid-glandular, oblong to narrowly-obovate, 6-20mm long, 2-6(-7)mm wide, apex obtuse; stamens 15-40, 2-4-seriate; filaments carnose, eglandular or nearly so, 0.8-3mm long, the connective eglandular or rarely with few very inconspicuous colourless apical glands, locules 0.5-1mm long. Carpels (2-)3-10, obovoid to ellipsoid, 2-3.5mm long at anthesis; ovules 9-18 on short or slightly elongate placentas; stigma lateral near apex or rarely subterminal, peltate, subsessile or short-stipitate, exceeded or equalled by the body of the carpel. Berry 5-9mm diam.; seeds 3-4mm, black, shiny, lunate. Fl. Oct.-Mar.

Often in lowland areas with abundant water supply [0-300m], though some varieties are found up to 2300m; Chile south of 36ºS, w. Argentina south of 38ºS, to Tierra del Fuego (Moore 1983; Smith 1943). Some Drimys spp. previously classified as synonymous with D. winteri exist north to Mexico (theobromus pers. comm.).

CANNABIS

(Cannabaceae)

Cannabis indica *Lamarck* **(C. sativa ssp. indica** *(Lam.) E. Small et Cronquist***)** – Indian hemp, Afghan hemp, hash plant, da ma, huo ma, bang, kif, quinib, kinnab, sharâneq, shâhdânag, taima, maconha, dagga, dakka [other common names as for C. sativa may also be applied in some instances, and vice versa]

Cannabis ruderalis *Janischewsky* **(C. sativa f. ruderalis** *(Janisch.) Chu***)** – Russian hemp, ye da ma

Cannabis sativa *L.* **(C. gigantea** *Hort.***)** – hemp, common hemp, ganja, ganjika, gajima, siddhi, siddhapatri, bhang, bhangi, bhango, hanga, kinnab, hinab, quinnib, cares, ben, til, jaya, ununda, vijaya, kendir, kenevir, xian ma, ye ma, canapa, cáñamo, chanvre, chanvrier sauvage, echter hanf, riesen hanf, marihuana, marijuana, pot, mull, green, weed, dope, grass, kief [many, many other names]

Cannabis is the most widely-used illicit drug in the world [although not illicit everywhere], and has been used by Eurasian cultures for thousands of years for religion, medicine and fibre. Its history is long, intricate and colourful, and due to this, and the many excellent books devoted wholly to the subject, this history of use will only be discussed briefly here.

In India, Cannabis is compared to Soma [see **Amanita**], and is said to be a 'liberator of sin'. It is widely used by saddhus in consecration to Shiva, who is said to be perpetually intoxicated by it. The rest of the populace consumed it more commonly when it was not restricted there. Indians know the herb in three main forms – 'bhang' [the large fan-leaves of the wild plant made into a drink with water, milk and/or butter/ghee (clarified butter), sometimes fortified and flavoured with spices such as black pepper (see **Piper**) and aniseed (see **Pimpinella**)]; 'ganja', the dried, flowering tops, often seedless ['sinsemilla' in Spanish], with some leaves and stems; and 'charas' or 'hashish', the compressed resin from the flowering tops. Cannabis is also sometimes made into a confectionery called 'majun' or 'majoon', of Middle-Eastern origin. There are many recipes for this, but basically it is a blend of Cannabis, ghee, milk and sugar, as well as a selection of intoxicating herbs such as **Strychnos**, **Datura** seeds, **Areca** nut and poppy seeds or opium [see **Papaver**]. A blend using *camphor*, cloves [see **Syzygium**], nutmeg and mace [see **Myristica**] was said to be good for inducing fantastic dreams; one using 'ambergris' [a secretion from sperm whales] and 'musk' [see *Endnotes*] was suggested for enhancing mood and sexual adventures (Chopra et al. 1958, 1965; Clarke 1998; Kirtikar & Basu 1980; Mills 2003; Nadkarni 1976).

Cannabis is used by shamans in Nepal, for ritual incense, sacred offerings, pleasure and trance, either eaten, smoked or snuffed; it is also used for its variety of medicinal effects (Müller-Ebeling et al. 2002). Other cultures and sects are known to have used Cannabis sacramentally or medicinally, such as the Zoroastrians, Assyrians, Scythians, Taoists, ancient Buddhists, ancient Germans, the Essenes, Islamic Sufis, Bantus, the Hottentot, Rastafarians, and many others. It is generally ascribed powers that can allow one to come into contact with spirits. Cannabis was the main ingredient [with olive oil] of the anointing oil used by Moses to talk to God. Patanjali, founder of classical yoga, wrote that it "refreshes the intellect...fills the mind with happiness...the spirit of hemp is the spirit of peace and knowledge. In hemp ecstasy, the flash of eternity transforms the haziness of matter into pure light". It is also valued by many as an aphrodisiac [though excessive use can be anaphrodisiac], and is used in Indian tantric practices (Aldrich 1977; Herer & Jiggens 1995; Preston 2002; Rätsch 1990, 1992; Robinson 1996). It is widely used in Africa as a medicine and inebriant. In southern Africa, Suto women smoke themselves into a stupor during childbirth (Watt & Breyer-Brandwijk 1932). Traces of cannabinoids [see below] found in Ethiopian pipes dating to c.1320AD suggest that Cannabis has been a smoking herb in Africa since before the introduction of tobacco, which is now also widely consumed on that continent [see **Nicotiana**] (De Smet 1998).

The ancient Chinese knew of the psychoactive properties of C. sativa, though they usually used it only for seed and fibre – it was said that taking the fruits ['ma-fên'] in excess would cause one to "see devils" and, if taken over time, to "communicate with spirits". Necromancers were said to use it with ginseng [see **Panax**] to see forward in time. It was also sometimes used to see spirits, the 'raw fruits' mixed in equal quantities with **Acorus** gramineus and Podophyllum pleianthum ['k'uei-chiu'; see **Mandragora**], made into pills of marble-size; one was taken facing the sun every day, and after 100 days the desired effect ensued. In medicine, the fruits [which presumably included flower-bracts, as the seeds are non-psychoactive] were usually used as an anaesthetic (Li 1978). Today in TCM, as 'huo ma ren', they are used in doses of 9-15g as a mild purgative to treat constipation in elderly or debilitated people (Huang 1993). The seeds are a popular and nutritious food in China.

The Rastafarians are best known as a modern 'sect' who smoke Cannabis almost constantly, as they believe it is a gift from God that allows them to attain wisdom, and commune with God and all living things (Chevannes 1994; pers. obs.).

Cannabis was once better known by most for the fibre it produces, called hemp [or 'true' hemp], which has long strands of great strength. It has been used with great success in the manufacture of quality textiles, fabrics, paper, rope, string, art canvas, biomass fuel and building materials. Hemp plants are selected for high-fibre and low-*THC* content. The seeds and their nutritious oil can be used as food, and as a base for paints, varnishes and lighting oil. Being such a highly useful plant, Cannabis in all its forms was made illegal in the US in 1937, followed shortly by most

other countries in the world following US pressure. Although the public campaign of misinformation perpetuated by the media and narcotics agencies made it seem that the threat was a highly dangerous [even deadly!] and addictive drug that caused psychosis, the real threat seemed to be to the paper and newspaper industry giant W.R. Hearst [and other timber-based industries], petrochemical giant Du Pont, and then-head of the Federal Bureau of Narcotic and Dangerous Drugs Harry Anslinger [keeping his job required finding drugs and drug-users to persecute]. Legislation was rushed through congress, without the American Medical Association [AMA] being properly consulted, and with no pro-Cannabis evidence of any kind admitted. Most of the evidence produced against the herb was either a distortion of the facts, or simply fallacious. Even today, much of the so-called 'scientific' evidence against Cannabis on grounds of physical and psychological health, is based on faulty, misleading or false data. Gabriel Nahas, who was responsible for producing much of the older evidence, adopted his basic premises on the drug from the propaganda of his employers [probably coupled with his own subjective bias], and based his methods of research upon those of Nazi scientists; he thus proceeded to construct experiments to prove the false assumptions already in place. His work is now decried in the scientific community, and he still only holds a good reputation with those who are unaware of his being exposed as a fraudster (Herer & Jiggens 1995; Robinson 1996; Solomon ed. 1970). It should be noted that Cannabis research is illegal without Government permission and funding, and that in the United States at least, no such research will be funded unless it intends to show that Cannabis is a harmful substance. This in itself is a rather obvious perversion of science – to decide the outcome before conducting the experiments! 'Just Say No'-style groups are also mostly Government funded and backed, and seem to spend more time spreading ignorant fear-based factual distortions and lies about Cannabis, than any more dangerous illicit substances, such as heroin.

Prior to all of this, some countries had placed restrictions of one kind or another on the sale of Cannabis and preparations derived from it. 'Hashish' [see below] was banned in Egypt in 1879, though it was commonly smoked there in water pipes, mixed with tobacco and molasses; wealthier Egyptians were accustomed to smoking it in cigarettes, drinking it in coffee, or eating it. Great Britain enjoyed considerable profits from its taxation and control of Indian opium [see **Papaver**] and Cannabis crops, and for years resisted calls from the Egyptian government to curtail the flow of the latter drug across their borders, and from wowsers at home who wished to see the stuff banned. After delegates from the US and other smaller countries at the 1925 League of Nations Opium Convention ganged up to push the matter, Great Britain eventually tightened up controls on import and export and effectively turned Cannabis into a prescription-only medicine at home, a situation which stood until the 1971 Misuse of Drugs Act made it fully illegal (Mills 2003).

It should also lastly be said that numerous major, exhaustive studies on Cannabis use have been commissioned by various governments. In all cases, said governments have rejected the unanimous results obtained by impartial researchers – that casual Cannabis use is not a significantly harmful practice in the majority of users, that it causes no long-term deterioration of health, intelligence or work capacity, and that prohibition of the herb is a futile exercise that is doing much more harm than good. Some of these studies have been done in countries with a high rate of chronic use, such as India [the Indian Hemp Drugs Commission Report, 1894] and Jamaica [Jamaican Study, 1975]. Other studies have included The Panama Canal Zone Military Investigations [1916-1929], the 1981 UCLA Coptic Study [of Jamaican Rastafarians in Florida, smoking 16 large 'spliffs' a day], the 1980 Costa Rican Study, Mayor Laguardia's 1944 Committee on Marijuana [New York City], The Baroness Wootton Report [U.K., 1968], Nixon's 1972 Blue Ribbon Report [The Shafer Commission], Canada's 1970 Le Dain Commission, the 1996 Victorian Premier's Drug Advisory Council Report [The Pennington Report, Australia], and the Canadian Senate Special Committee on Illegal Drugs [2002]. Even the World Health Organization's [WHO's] own report, completed in 1998, has been suppressed from publication because it shows that Cannabis is safer than alcohol (Chopra et al. 1958; Concar 1998a; Herer & Jiggens 1995; Mills 2003; Solomon ed. 1970). Even studies finding that Cannabis and some of its individual constituents may be useful in destroying tumours (eg. Galve-Roperh et al. 2000; Piomelli 2000) have been routinely ignored, and other existing studies showing medicinal usefulness have similarly remained obscure. This situation of information control is at its worst in the US, where during the Reagan era, such studies were systematically removed from libraries across the country and destroyed (Trout pers. comm.).

As I write, and as has occurred whenever it seems that Cannabis may be becoming more socially acceptable and/or tolerated, and suggestions for decriminalisation are made publicly, there is yet another flourish of Nahas-like anti-Cannabis 'science' in popular circulation. Again we are being told that smoking Cannabis causes psychosis and schizophrenia, despite strong evidence to the contrary [ironically, in the 19th century some British doctors used it successfully (sometimes with potassium bromide) to treat insanity (most effectively for manic patients), as well as migraine, menorrhagia and tetanus (Mills 2003)]. It should be stressed that Cannabis can indeed exacerbate pre-existing or latent schizophrenia in some people [though I know one schizophrenic person, and have heard of many others, for whom it helps keep symptoms at bay]. However, the overwhelming quota of perfectly sane and relatively healthy Cannabis users is adequate testimony to the relative innocuity of the herb in well-adjusted individuals. For such people, it is generally true that the only adverse effects would result from the act of smoking burning plant matter. This is, of course, avoided if the herb is prepared and eaten, or if Cannabis resin or a purified 'hash oil' is vapourised and inhaled. Incidentally, anti-Cannabis groups have made much mention in recent years of the higher potency of today's marijuana being of great concern. Despite average potencies generally being greatly exaggerated in such arguments, both common sense (pers. obs.) and laboratory experiments show that Cannabis of higher potency leads to less inhalation of tars, as less of the herb needs to be smoked to obtain a satisfactory effect, and of the herb smoked, there is less chlorophyllous matter (Matthias et al. 1997). Needless to say, even with such potent material, some users - especially young males - still will smoke large quantities all day long, often staring at a screen and eating junk food the whole time, and it is little wonder that some such people experience problems after a while, but no excuse to ban the drug for everyone. Also, many psychological problems experienced by people who abuse Cannabis are simply part of the spiritual journey that the user probably doesn't even know they're on, and could be worked through healthily in a society where such realms of consciousness were appreciated and understood to a greater degree [see *Questions and Answers*, *A Primer on Tripping*], rather than requiring psychiatric intervention. Recent reports of deaths from Cannabis overdose appear to have little scientific basis, jumping to conclusions where cause of death is not actually known, and/or a connection with Cannabis as a causative agent is not proven, only assumed. Even if such reports were accurate, Cannabis would still be safer than many legal drugs, alcohol and tobacco included. However, people with heart conditions should take special care, as smoking – Cannabis or anything else – may increase the risk of heart attack (pers. obs.; Sidney 2003).

Cannabis is often smoked in hand-rolled cigarettes ['joints', 'reefers'], very large joints ['spliffs', 'carrots', 'Cambridge carrots'], wrapped in a cigar leaf ['blunts'; in tobacconists in some countries, cigar leaf wrappings may be purchased in packets, exclusively for the purpose of rolling blunts], in a dry pipe, in a 'chillum' or 'chilam', or in a water pipe ['bongs', 'cones', 'pipes', 'billies'] [see *Methods of Ingestion*]. It is often chopped with tobacco [see **Nicotiana**] for use, though many prefer to smoke it by itself, sometimes even unchopped, simply putting a chunk in a pipe and lighting it. Oddly, in view of the large number of Cannabis smokers who mix with tobacco and like it that way, Rätsch (1990) stated that "tobacco is fully unsuited as an admixture, for its effects directly contradict those of marijuana".

With fine quality flowering tops ['buds', a term that is botanically incorrect in this application, but is widely used nevertheless], less than 50mg of herb may be required, depending on individual tolerance. Perhaps 300mg or so is often needed to make an average-sized joint, more if no tobacco or other mixing herb is used. Effects are felt within several minutes, often almost immediately. It may also be eaten, in which case the resins of the herb must be dissolved in a fat before consumption to be effective. Roughly 3-4 times the amount used for smoking is required, and effects are usually not felt until 0.5-2 hours after consumption, lasting 6-8 hours or so [depending on dose] (pers. obs.). The qualitative and quantitative differences in the eating experience are partly explained by the metabolism of *THC* via this route to the more potent 11-OH-*THC* (Clarke 1998).

A preparation much sought-after is 'hashish' ['hash', 'charas'], which consists of the pressed resin glands of the flower-heads and potent leaves, as noted above. These glands coat the surface of the plant, and are most concentrated in the female flowers; they contain the psychoactive terpenoids of Cannabis spp., often referred to collectively as cannabinoids. Hashish is produced in many countries famed for their export [mostly to Europe], ranging from n. Africa to s.e. Asia, and samples from different regions often have recognisable differences in appearance, smell, psychoactivity and method of manufacture. This resin is traditionally collected in one of two ways – hand-rubbing, involving literally rubbing the mature flower-heads of a live plant, and scraping the accumulated resin from the hands [after blowing away other plant debris]; or sifting, whereby the mature plants are harvested and thoroughly dried, before being lightly threshed over a silkscreen sieve, with a bowl underneath to collect the finest quality resin glands, visible in mass as a sandy-yellowish powder [or clear, resinous globules under a microscope]. The flower heads are never sieved for too long, to maintain a high quality of potency, as dried plant-matter can begin to crumble finely enough to pass through the sieve. Sifting can usually be done only in dry, relatively cool, and breeze-free conditions; this is perhaps one reason why it has always been a more popular method in the Middle-Eastern hashish-producing countries than in s.e. Asian hashish-producing countries, where hand-rubbing is often preferred [although sifting is sometimes practiced in India]. Hand-rubbing may be more convenient under some circumstances, but sifting produces

a better yield for less effort, and collects resin of a higher quality and purity if done properly. Once the resin is collected, it must be further processed to produce a quality hashish product for trade, or it can be smoked or vapourised as it is. Hand-rubbed resin is usually rubbed from the hands [which warms and softens it], pressed together, and hand-rolled vigorously for hours until a ball or other desired shape is formed with an even consistency, and smooth, shiny, unbroken skin. Sifted resin may be either hand-pressed, or poured into bags which are usually heated before pressing in a hashish-press, forming solid slabs. Poorly pressed hashish will usually deteriorate rapidly, often due to internal mould-growth and excessive drying. Hashish should be stored in a cool, dark, airtight space as for most other active substances. It may be smoked by inhaling the fumes from a smouldering ball or stick of the resin – once lit and any flames have died or been blown out, it should burn with a slow glowing ember like an incense stick. A popular method is the 'hot-knives' approach, which involves pressing a lump of hashish or resin-powder between two heated knives, and inhaling the vapours emitted through a bottomless bottle, inverted funnel, or similar device. Otherwise, it may be smoked in a pipe fitted with a metal screen, or may be crumbled, heated slightly, and mixed with Cannabis herb and/or tobacco [see **Nicotiana**] or other smoking herbs, and smoked in other ways. Hashish may contain on average up to 26% *THC* or more, 16.5% *cannabidiol* [CBD] and 9.1% *cannabinol* [CBN], though levels can be very variable (Cherniak 1995; Chopra et al. 1958; Clarke 1998; Nadkarni 1976).

Modern innovations in home hashmaking have resulted in some simple technology for collecting Cannabis resin. The Dutch Pollinator Company [www.pollinator.nl] have invented a small motorised tumbler, fitted internally with a fine mesh screen, called the Pollinator®, which collects resin on the inside walls of the unit due to centrifugal force. This was recently followed by the Ice-o-lator®, a specialised fine mesh bag device which operates on the principle that powdered Cannabis immersed in ice-chilled water will separate into plant matter and resin, allowing the resin to be retrieved and dried (Pollinator staff pers. comm. 2002). The finer grades of resin collected using such bags produce what has become known as 'bubble hash', a very pure and potent product so-called because it bubbles when heated (pers. comms.). The tumbler technique can also be adapted for hand-powered rather than motorised use. The water separation technique can be more crudely achieved by vigourously shaking very dry powdered, sieved Cannabis in chilled water and leaving to settle; plant matter should float to the top, and resinous material should collect at the bottom of the vessel (Clarke 1998).

In some countries today, the hash available on the street is sometimes a brown, oily, soapy substance which is highly adulterated with non-psychoactive contaminants, as well as possibly others such as animal tranquillisers; it is known as 'soapbar' in the UK, 'chocolate' in Spain and 'Chernobyl' in France (Preston 2002).

Several interesting Cannabis preparations have been observed within modern drug culture, as attempts to increase the potency of the herb. One involves boiling the herb in water for 1-3hrs, adding water as needed, before cooling and straining through cheesecloth; the liquid is set aside under refrigeration, while the remaining herb pulp is air-dried. The tea is consumed, followed by smoking of the herb, and the experience is said to be more psychoactive than usual (Segelman & Sofia 1973). If accurate, this may be due to the added activity of trace water-soluble constituents, such as the uninvestigated alkaloids [see below]. Another preparation is not so innocuous, and has been called 'AMP' – it is Cannabis that has been soaked in formaldehyde and dried. The preparation is more psychoactive than untreated Cannabis, but causes lasting psychomotor retardation, as well as tachycardia, salivation, sweating and tremors whilst intoxicated (Spector 1985). Solvents such as this might have occasionally been encountered as contaminants when 'Skunk' [see below] first became more widely available, as naïve customers would have been looking for 'stinky' flower heads with an aroma unlike Cannabis encountered previously [except perhaps for some high-quality Afghan C. indica] (pers. obs.). The sought-after 'Thai sticks', Thai C. sativa flower heads wrapped around a stem with bamboo fibre, are apparently laced with fresh opium juice from the first lancing of poppy pods [see **Papaver**], although many non-native consumers are unaware of this (Preston 2002).

Over the last couple of decades, great advances have been made in Cannabis cultivation, with innovations in indoor growing technology and breeding largely coming from Amsterdam [the Netherlands] and British Columbia [Canada]. Indoor cultivation, especially, has become a valued option in climates where outdoor cultivation would not produce quality plants, in areas where outdoor cultivation is too risky a venture, and in locales where no outdoor garden space is available for use. As a result, more potent strains and hybrids with larger flower heads and greater resin-production have been made more and more available. Needless to say, this is also thanks to the efforts of brave cultivators and breeders worldwide, wherever these plants are not tolerated. The popular 'Skunk' was one of the first 'super strains' to emerge in the 1980's [though developed by growers in The Netherlands in the late 1970's]. It was a plant c.60cm at maturity with one very large terminal inflorescence and several smaller ones, bred specifically for a short growing season [several months], high-yield and high-potency, to be grown indoors under high-powered grow-lights in a hydroponic system. The original Skunk ['Skunk #1'] was a hybrid between two C. sativa strains [50% 'Colombian Gold', 25% Mexican 'Acapulco Gold'] and a C. indica strain [25% 'Afghani']. More recently, a C. ruderalis 'Skunk' strain has been developed. Seeds of the notorious S. African C. sativa strain known as 'Durban Poison' [named from its origin] are now also available to cultivators through Dutch seed companies. The current variety of available strains is mind-boggling even for the Cannabis connoisseur, with varieties to cater for every taste in appearance, aroma, taste, qualitative/quantitative effect and other delicate characteristics (Dutch Passion 2002; pers. comms.; pers. obs.). They are truly beautiful flowers!

Cannabis is euphoric, hypnotic, sedative, mildly psychedelic, antidepressant, antispasmodic, analgesic, expectorant, antibiotic and appetite stimulant. It also relieves nausea and reduces saliva. It treats glaucoma by reducing intra-ocular pressure. Cancer patients find it invaluable in relieving the nausea, vomiting, and loss of appetite associated with chemotherapy. AIDS patients suffering the 'wasting syndrome' also benefit from this stimulation of appetite. However, too much may cause nausea and sometimes vomiting. People with spastic disorders may obtain remarkable relief due to the anticonvulsant and muscle-relaxant effects. It may also treat asthma – in some people it acts as a bronchodilator, but in a minority the condition is worsened [for these people, oral ingestion is preferred over smoking]. Cannabis can also supress some tumours, and relieve some types of chronic pain, such as migraine. In many cases where Cannabis is most useful medicinally, it provides therapeutic relief where all other available drugs have failed. The use of whole Cannabis herb is more effective than *THC* alone. Cannabis is also very non-toxic. As Grinspoon & Bakalar (1995) put it, "the ratio of lethal to effective dose is estimated as 40,000 to 1. By comparison, the ratio is between 3 and 50 to 1 for secobarbital and between 4 and 10 to 1 for ethanol." Although the cannabinoid resins are highly lipid-soluble, and remain in body fat for 48 hours or more after consumption, brain levels are relatively low. The cannabinoids are metabolised rapidly. There is no evidence that they cause breakage of chromosomes, immune-suppression in reasonable doses, or brain damage [one major component, *cannabidiol*, actually protects neurons from damage (Aesoph 1998)!].

The interactions between several important cannabinoids [*THC*, *cannabidiol* (*CBD*) and *cannabinol* (*CBN*)] are discussed further in the *Chemical Index*. It is worth noting that the amount of resin present does not necessarily dictate potency – this quality lies in the constituents of the resin and their relative proportions. Likewise, a sample of Cannabis high in *THC* is not necessarily more subjectively potent than another sample which may be low in *THC*, but richer in other related compounds. The field of subjective potency is also confused by the observation that different people prefer different kinds of effects from this plant. Varying proportions of *THC*, *CBD* and *CBN* give differing subjective experiences. Some people prefer the cerebral 'high' of material high in *THC* and low in other cannabinoids, whilst others prefer the heavy 'stone' resulting from material also high in *CBD* and *CBN*. Short-term side-effects include red eyes, dry mouth, raised pulse rate, raised body temperature and tachycardia. Short-term memory recall is also affected. Some people develop panic-attacks at higher doses; this is usually environment-related, or based on fears of insanity [from experiencing a stronger-than-expected altered state of consciousness] or arrest by police. Paranoia sometimes occurs during the intoxication, usually for similar reasons. Some people just seem to be very sensitive to the herb, and may 'freak out' at any dose. People with latent schizophrenic tendencies should not use Cannabis. Any negative psychological, cognitive or physical effects of Cannabis use are reversed with abstinence, even after heavy long-term use (Grunfeld & Edery 1969; Pope et al. 2001; Weil et al. 1968; pers. comms.; pers. obs.). One of the best-known effects of Cannabis is the stimulation of appetite, fondly referred to by users as 'the munchies'; if Cannabis is smoked regularly mixed with tobacco, this effect may be at least partially counteracted. Recent research has demonstrated that endogenous cannabinoids [eg. *anandamide*, 2-AG – see *Neurochemistry*] stimulate feeding in newborns, and are very important in survival and development in the early stages of life (Phillips 2000).

Although Cannabis can hinder 'normal' cognition, concentration, coordination and reaction speed during the normal course of effects, for most regular users it usually does not adversely affect driving ability except in high doses, or in combination with certain other drugs, particularly alcohol. Drivers affected by Cannabis alone tend to be more careful on the road to compensate for any impairment, as opposed to drivers under the influence of alcohol, who tend to over-estimate their abilities and under-estimate their degree of inebriation, often driving recklessly as a result. A person who is too stoned to drive is more likely to wait until the effects wear off before taking to the road (Cohen & Stillman ed. 1976; Coper 1982; DETR 2000; Dews et al. 1973; Goode 1970; Grinspoon & Bakalar 1995; Herer & Jiggens 1995; Mendelson et al. 1974; pers. comms.; pers. obs.; Robinson 1996; Weil et al. 1968). Nevertheless, this is not always the case, and it is never advisable to operate dangerous machinery [such as a vehicle] whilst intoxicated, as in the unpredictability of life a

minor degree of impairment can make the difference between having an accident or not.

Flowers of male plants contain some active resins, but are usually not very potent. Bracts of male flowers generally produce more *CBD* and cannabichromene than *THC*. Leaves can also bear resin glands, generally higher in *CBD* and *CBN* than *THC*, and are also not very potent, with some exceptions. Small upper leaves and new shoots can be sometimes quite potent, though leaves lose potency as they mature. Central leaflets may contain slightly higher cannabinoid levels than the adjacent leaflets, with concentration decreasing slightly in each subsequent adjacent leaflet. Leaves subtending flower bracts have similar cannabinoid profiles to the accompanying bracts, but in lower concentration. Potency of plant parts generally decreases going down the plant. Stems can bear some resin glands on the surface. Even cotyledons of seedlings have been shown to accumulate cannabinoids. Weaker plant parts may be used to make 'hash oil', or in cooking (Hemphill et al. 1980; pers. obs.).

Fresh or growing plants contain the *THC*s and other cannabinoids mostly in the inactive acid forms; heating [such as when smoking or cooking the herb] decarboxylates them to their neutral, active forms [eg. THCA decarboxylated to form *THC*]. Drying is thought to achieve some degree of decarboxylation. A small amount of decarboxylation occurs in the gut, but large amounts of unheated fresh Cannabis would have to be eaten to produce much effect. However, in the absence of air, cannabinoids are stable to heat (Clarke 1981, 1998; Mechoulam 1970; Turner et al. 1980).

C. indica contains similar constituents to C. sativa [and is reputedly often high in *CBD*] (Clarke 1998); verifiable analyses of this species are scarce, as many researchers do not distinguish it from C. sativa. Many studies that do purport to analyse C. indica are actually analysing hashish that was presumed to have come from C. indica.

C. ruderalis has yielded c.0.45% cannabinoids, less than 40% of which was *THC*. C. sativa x ruderalis yielded 0.36-1.3% cannabinoids, of which 30-60% was *THC* (Beutler & Der Marderosian 1979).

C. sativa has been found to be represented by 4 chemotypes – 'fibre' types, which are low in Δ-9-*THC* [<0.3%] and high in *CBD* [>0.5-2.4%]; 'intermediate' types which contain Δ-9-*THC* and *CBD* in amounts greater than 0.5%; 'drug' types, which are high in Δ-9-*THC* [>2%] and low or deficient in *CBD*; and uncommon 'cannabigerol-dominant' types, which contained low quantities of Δ-9-*THC* [0.001%], 0.04% *CBD* and 1.15% cannabigerol (Fournier et al. 1987). In general, C. sativa may yield mostly [0.3-20% or more] Δ-1-tetrahydrocannabinol [Δ-9-*THC*; *THC*], as well as Δ-6-*THC* [Δ-8-*THC*; similar activity to Δ-9-*THC*, but ¾ as potent], their 11-OH-derivatives [of similar activity, but with more intense onset of effects, and longer duration], 8-α-OH-*THC* [similar activity to Δ-9-*THC*, milder, c.¼ the potency], tetrahydrocannabinolic acid [THCA], Δ-9-tetrahydrocannabivarin [THCV; similar effect to Δ-9-*THC*, but ¼ as potent], *CBN*, *CBD*, cannabidiolic acid [CBDA], 10-ethoxy-9-OH-Δ-6a(10a)-*THC*, cannabitriol [9,10-dihydroxy-Δ6a(10a)-*THC*], cannabigerol, cannabicitran, cannabichromene, cannabichromanon, cannabielsoic acid A and other cannabinoid-acids, cannabicyclol, 4,4-dihydroxy-5-MeO-bibenzyl [shows some estrogenic activity], *eugenol*, guaiacol, humulene, *camphor*, camphene, *borneol*, 1,8-cineole, *pinene*, safranal, nerol, neral, ocimene, limonene, linalool, citronellol, α-*thujone*, pulegone, fenchone, myrcene, α-trans-bergamotene, piperitone, ledol [see **Ledum**], longifolene, 0.001% *hordenine*, *choline*, piperidine, muscarine [see **Amanita**], trigonelline, cannabamines A-D, anhydrocannabisativine [a spermidine alkaloid], cannabispiran, flavocannabiside, flavosativaside and orientin; many other trace compounds are present. Roots have been shown to contain the alkaloid cannabisativine (Clarke 1981, 1998; Dews et al. 1973; El-Feraly & Turner 1975a, 1975b; El-Feraly et al. 1976; Hollister 1974; Lotter et al. 1975; Mechoulam 1970, 1982; Rastogi & Mehrotra ed. 1990-1993; Segelman et al. 1976c; Turner & Elsohley 1976; Turner et al. 1976, 1980; Wirth et al. 1981), and surprisingly, roots also contain cannabinoids – one study found Δ-9-*THC*, Δ-9-THCA, Δ-8-*THC*, *CBD*, CBDA, *CBN*, cannabichroman, cannabicyclol, and cannabigerol in roots of a hemp strain of C. sativa (Hanus & Tesarik 1987).

Experiments with Italian cultivated C. sativa found that plants which were shaded and not irrigated were higher in *THC* [1.59%]; plants which were exposed to more light, but also not irrigated, contained the highest levels of *CBD* [0.67%]. Levels of *CBN* were low [0.03-0.07%] in all plants (Siniscalco 1985).

C. sativa seed contains a nutritious oil, with c.80% essential fatty acids; total oil may yield c.55% linoleic acid and 25% linolenic acid [supports immune function, maintains healthy skin, hair, eyes, nervous system and other tissue]. It is high in the edible proteins edestin and albumin, and also contains trigonelline, 2(d)-isoleucine, betaine, choline, vitamins B1 and B2, and traces of muscarine, *THC*, *CBD* and *CBN* (Herer & Jiggens 1995; Huang 1993); the traces of cannabinoids may possibly be due to contamination with flower-bracts. Others have noted the absence of cannabinoids in seeds from both 'drug' and 'fibre' strains (Hemphill et al. 1980), though the detection apparatus may not have been sensitive enough.

C. sativa pollen has been reported to be rich in Δ-9-*THC* [traces-0.26%] and THCA [levels were highest in plants grown under 16hr light at 24°C], also containing Δ-6-*THC* [0-0.02%], *CBD* [0-0.02%], *CBN* [0-0.05%] and cannabichromene [0-0.2%], as well as *apigenin* and luteolin. The analyses conducted by Hemphill et al., however, revealed [by electron microscope] the pollen samples of their study to be contaminated by resin glands. This common and unavoidable contamination is thought to be responsible for all reports of cannabinoids in the pollen (Hemphill et al. 1980; Paris et al. 1975).

It is of interest to note that Phelipaea ramosa [Orobanchaceae], a plant parasitic on C. sativa, has yielded 0.5-1% cannabinoids, of which c.95% was *CBD*, with traces of Δ-9-*THC* (Fournier & Paris 1983).

Cannabis sativa is an aromatic, resinous, scarcely branched erect annual herb to 2(-6)m high; usually dioecious, but sometimes hermaphroditic. Staminate plants tall, slender, dying after anthesis; pistillate stockier, more densely leaved in flowering, rarely perennial. Stems furrowed, often hollow, roundish, or angular in cross-section, scabrous, resin-dotted on younger growth. Leaves alternate, the lower leaves opposite, 5-15-partite, upper leaves often only 1-3-partite, palmatinerved, serrate, apex acuminate; leaflets sessile, +- slender-lanceolate, long-acuminate, very variable in size, 6-11(-20 or more)cm x 0.2-1.5(-3)cm, upper surface dark green with stiff, conic trichomes, underside pale green with distant brownish resin dots and strigose hairs; petioles 4-6cm long; stipules small, triangular, lateral, persistent. Flowers small, axillary, dioecious – males in short, pendulous cymose panicles; females crowded in leafy, convolute resinous bracts in dense axillary and terminal clusters. Males: pedicellate, pendent at maturity, falling after shedding pollen; tepals greenish, sometimes yellow or brownish purple, quincuncial in bud, spreading at anthesis, usually c.5mm long; perianth segments 5, imbricate; stamens 5, erect in bud; anthers pendent, dehiscing by apical pore, glandular hairs at junction of anther lobes. Females: usually in pairs, sessile, each enclosed in membranous green perigynous bracteole, subtended by bract; perianth hyaline, entire, embracing the base of the ovary, or 0; ovary sessile; style central, deeply bifid, c.5mm long, filiform, caducous, white at first, turning brown-reddish; ovule pendulous. Fertilised female bracts bear a single achene, c.3-5 x 2mm, ovoid, slightly compressed, with 2 faces, aril on flattened base, tip pointed, testa shiny, often reticulate, sometimes brownish, olivaceous-brown to ash-grey, sometimes mottled with black, covered by persistent calyx and enveloped by bract. Immature or infertile seeds are easily crushed with light pressure between the fingers. Fl. mid/late summer to late autumn; often forced to flower out of season with indoor cultivation, by manipulation of the light/dark cycle.

Native to temperate central Asia; widespread in cultivation and as a weed in temperate and dry-tropical parts of both hemispheres (Chopra et al. 1965; Schultes & Hofmann 1980; pers. obs.).

Cannabis indica is usually smaller and more compact, being much-branched. Its leaflets are shorter and wider, and flower clusters are often more compact and resinous.

Cannabis ruderalis is a wild Russian species that is even smaller [10-50cm high], and has a shorter life-cycle [8-10 weeks], though generally not of much use as a psychotrope (Clarke 1981).

Cannabis spp. are easy to cultivate, though to do so is illegal in most countries. There are many excellent and detailed books on its cultivation, some of the best written by Mel Frank and Ed Rosenthal. So, we will not go into detail about that here... There are two things which I believe should be stated, though. One is that a strong light source is essential for producing dense, resinous flowers. Another is that continuing regular application of fertiliser into the late flowering period can result in undesirable accumulation of nutrients in the flower heads, adversely affecting aroma, flavour and presumably, health [a hint to those inexperienced cultivators everywhere who are supplying such questionable produce].

Flower heads are considered mature for harvesting when maximum size development seems to have been reached, and many [but not all] of the styles have turned reddish-brown and begun to shrivel. The exact time of harvest is a matter of choice, with later harvests tending to be a little lower in *THC* and higher in *cannabinol*. Subjectively, however, some such late harvests can be exceedingly potent! Often, crops are tended so that no male flowers are allowed to pollinate the females [which is done easily by wind]. This requires constant observation for the first signs of developing sexual characteristics, so that male plants can be weeded out. Female plants also need to be watched after this period, as they may sometimes turn hermaphroditic and develop male flowers in amongst the female majority, which need to be picked carefully off before opening and releasing their pollen. When pollination is thus prevented, no seeds develop in female flowers, and greater energy is diverted to resin production. Such a seedless bud is called 'sinsemilla' [Spanish, roughly 'seedless-one']. However, it is difficult to follow this method to perfection, as all it takes is one male flower to produce some small amount of seed throughout a crop. This is generally regarded as acceptable, as long as the seed content is kept to a minimum. It can be very disappointing to find that much of the weight of a bud consist of seeds, especially if you have had to purchase it.

After harvest, some people simply hang the whole plant upside down to dry. It is preferable to cut individual branches for drying, to decrease

the drying time. When cut individually, branches or buds may also be dried carefully in cardboard boxes or paper bags. They must be checked regularly for mould or insect infestation, and turned for even drying. Turning should be done carefully as resin glands can easily dislodge or be crushed with careless handling. Drying should be done in a dark or dimly-lit cool area. The herb is considered ready when mostly dry and slightly flexible, not brittle. Although drying quickly in a conventional or microwave oven is feasible, Cannabis must be dried slowly and carefully [cured] without heat to maintain its aroma and develop its full potential of flavour and quality of effect (Clarke 1981; pers. obs.). In 19th century India, harvested bundles of the plant were trampled under mats for 4 days [rolling the plants was preferred in Bengal], believed to be necessary to properly develop the chemistry of the herb (Chopra et al. 1958; Mills 2003). Much commercially-available Cannabis in countries where it is illegal appears to have been treated in this way, but this is due to carelessness and compression for ease of smuggling, rather than out of an attempt to improve the product. It is doubtful that compression is necessary, as processing without such rough treatment often produces a superior drug, due to the resin glands remaining mostly intact until consumption (pers. obs.).

Hemp strains are usually grown close together, to encourage long, straight stems with few lateral branches. Stems can be harvested any time for fibre once sufficiently large, but before the fibres start to become too hard. Stems are 'retted' to free the fibres; this involves repeated soaking in water and laying out on the ground to be attacked by microorganisms. After this process is complete, the fibres are dried thoroughly and bundled for storage. Leaves and waste after retrieving fibre from the stems are used for pulping. Seeds are collected from fertilised female flower heads when ripe – that is, when the seeds easily fall from the flower calyces. They must be cleaned of plant matter and dried before storage (Clarke 1981).

The closely related **Humulus** lupulus ['hops'] has been experimentally grafted onto Cannabis sativa root-stock, but cannabinoids did not carry through to the hops grafts (Crombie & Crombie 1975). Cannabis growers had hoped that such a graft could be used to produce inconspicuous hops vines containing cannabinoids.

For excellent coverage of Cannabis in detail see the great works of Cherniak (1995), Clarke (1981, 1998), Herer & Jiggens (1995), Frank & Rosenthal (1978), Robinson (1996) and Solomon ed. (1970).

CAPSICUM

(Solanaceae)

Capsicum annuum *L.* **(C. conoide** *Mill.***; C. fasciculatum** *Sturtev.***; C. frutescens** *L.***; C. grossum** *L.***; C. longum** *DC.***; C. minimum** *Mill.***)** – sweet pepper, cayenne pepper, goat pepper, bird pepper, spur pepper, chilli, chili, hot chilli, capsicum
Capsicum chinense *Jacq.* – giimo
Capsicum spp. – khursani ['millipede']

It may come as a surprise to see these common fruits included here, yet several points of reference suggest that they may be considered to have psychoactive properties. Chillis are, of course, much used in cooking, and are known to stimulate circulation, preserve or disinfect foods, and ease sore throats; they are also high in vitamin C (Bremness 1994). However, the Culina of the Amazon sometimes eat a Capsicum sp. known as 'catsi' when they take ayahuasca [see **Banisteriopsis**] (Rivier & Lindgren 1972), and wives of Waorani shamans give their husbands C. chinense to bring them out of the effects of **Banisteriopsis** muricata (Davis et al. 1983). The Kakusi of British Guiana use a Capsicum sp. as a stimulant and excitant (Schultes 1966, 1967a). In Peru, the fruits have sometimes been used with tobacco [see **Nicotiana**] as a hunting aid. One person smokes the mixture, and blows the smoke up the nose of another, to improve their sense of smell (Bear & Vasquez 2000). In n. Ghana, red peppers are an ingredient of a composite intoxicating snuff, taken for shamanic initiation [see **Piper 1**]. In Angola, red pepper is sometimes added to tobacco snuff [see **Nicotiana**] if a 'stronger stimulation' is required (De Smet 1998).

In India, Capsicum spp. are considered powerful stimulants, and Ayurvedists use C. annuum fruit to treat delirium or loss of consciousness; the same fruit is also used to treat delirium tremens in Madagascar. Fruits of C. annuum and C. baccatum are also used in preparation of some arrow poisons (Kirtikar & Basu 1980). The Lisu of n. Thailand use the roots of C. annuum to treat numbness or paralysis (Anderson 1993). In Nepal, Capsicum spp. fruits [such as the very hot C. annuum variety, 'dhalo khursani'] are an ingredient of 'bokshi dhup', an incense used to protect against witches (Müller-Ebeling et al. 2002). The Cherokee also consider C. annuum to be a powerful stimulant (Hamel & Chiltoskey 1975).

Nowadays, hot chillis are extracted and concentrated into 'capsicum spray' or 'pepper spray', used by police forces in many countries. This is sprayed into the eyes and face to incapacitate felons [as well as passive protesters], a very dangerous useage which can lead to asphyxiation in some asthmatics if medical attention is not provided quickly. These substances are also highly irritating and painful when brought into contact with facial openings.

Smoking 'paprika' [which is prepared from a variety of C. annuum] has been rumoured to lead to a "powerful experience". A similar rumour has been circulating for decades about 'sweet green peppers' [also derived from C. annuum]. These are apparently left to rot until well-decomposed, and the rotted pulp is either smeared onto a cigarette and smoked, or a cigarette is inserted into the hollow of the pepper and the smoke drawn through the vapours of the decomposition by-products. This is claimed to produce hallucinations within 1 hour of smoking (Moore 1967; Weil 1969). Personal experiments have been inconclusive, and these claims may well be fallacious 'street myth'. There is the possibility that the initial experiments that led to these claims involved a specific mould-infection that could have contributed to, or created, the effects. Such a chance infection would be unlikely to be repeated reliably by chance, and would probably also be detrimental to health if inhaled [see also **Aspergillus**] (pers. obs.). As far as 'powerful experiences' go, one friend who smoked **Cannabis** which had inadvertently been chopped in a bowl previously used for chilli, did indeed report a powerful experience – powerfully hot and irritating (pers. comm.)! However, people who enjoy eating hot chillies undeniably do so because of the high that is experienced after pushing through the pain barrier; this is best achived by continuing to eat more chilli rather than taking breaks to recover. In the words of Andrew Weil, "One is then able to glide along on the strong stimulation, experiencing it as something between pleasure and pain that enforces concentration and brings about a high state of consciousness." As chilli eaters know, drinking water does not ease the heat and may even intensify it (Weil 1976a).

Capsicum spp. contain capsaicin, which is largely responsible for chilli's physiological effects, acting as a 'neurotoxin', stimulating gastric and nasal secretion, stimulating respiration, stimulating subtance P release [see *Neurochemistry*], and causing inflammation of mucous membranes, hypertension and later hypotension, brachycardia, broncho-constriction, hypothermia, long-term analgesia and peripheral vasodilation. The fruit also potentiates the activity of *theophylline*, increasing its absorption and bioavailability (Fugh-Berman 2000; Hall 1973; Nemeth et al. 1999; Suzuki & Iwai 1984), and is rich in vitamin C. Interestingly, even high doses of chilli do not harm the stomach or skin, and the fruit is used by herbalists to treat digestive complaints, ulcers and pain [it may be applied as a poultice, gargled for sore throat, and used (as the oil) to give long-term relief of toothache] (Weil 1976a).

C. annuum leaves have yielded the *phenethylamine* octopamine [0.0234% w/w] and an unidentified alkaloid (Wheaton & Stewart 1970), and roots have yielded *scopoletin* [0.0008% w/w] (Kala 1958). Rotten peppers [C. annuum] were reported to contain a *tryptamine*-like substance, which has not been formally identified (Weil 1969). The endosperm and embryo of the seed have yielded solanine and solanidine [see **Solanum**] (Wojciechowska & Dombrowicz 1966).

Leaf and root-bark of C. fastigiatum from Rockhampton, Queensland [Australia], harvested in December, tested strongly positive for alkaloids (Webb 1949).

Capsicum annuum is a shrubby perennial herb 75-180cm tall, glabrous or nearly so; branches angular. Leaves broadly ovate, acuminate, usually wrinkled, +- pubescent. Pedicels slender, usually 2 or more together, 2.5-5cm long; calyx embracing base of fruit, usually cup-shaped; corolla rotate, white or greenish white, often with ochreous markings in throat, 5-lobed, valvate in bud; stamens 5, attached near base of corolla; anthers not longer than filaments, dehiscing longitudinally. Ovary 2- or rarely 3-celled; style linear; stigma subcapitate. Fruit red, ovoid, obtuse or oblong, acuminate, many-seeded; seeds discoid, smooth or subscabrous.

Native to tropical America, widely cultivated (Kirtikar & Basu 1980).

Some consider C. frutescens and C. annuum to be separate species; even in this case, both are very variable and can be easily confused. Many hybrid strains and cultivars exist of these plants, giving rise to the wide variety of different chilli and capsicum fruits.

CARDAMINE

(Brassicaceae)

Cardamine concatenata *(Michx.) O. Schwarz* **(Dentaria concatenata** *Michx.***)** – toothwort
Cardamine hirsuta *L.* – common bitter cress
Cardamine spp. – pepper root

The little-known herb C. concatenata has been used by Iroquois shamans as a hallucinogen, and to 'mesmerise' (Ott 1993). C. hirsuta, growing as a weed in Victoria [Australia], has mild sedative and hypnotic effects when smoked. A large joint containing the dried and chopped whole plant [including roots and immature fruits] was sufficient to produce these effects, though the smoke was very hot and the taste chlorophyllous (pers. obs.). The related C. diphylla, 'crinkled toothwort', is used by the Cherokee as a poultice for headaches; the root may also be chewed for colds, or a root tea gargled to treat sore throats. The leafy parts of many

Cardamine spp. are eaten by indigenous peoples as a vegetable (Hamel & Chiltoskey 1975; Usher 1974). In Germany, the related C. pratensis has been known as 'hexenblume' ['witches flower'] (DeVries 1991).

As far as I am aware, nothing is known of the chemistry of C. concatenata. However, the roots and aerial parts of some Cardamine spp. [such as C. cordifolia] have been shown to contain isothiocyanate-yielding glucosinolates (Louda & Rodman 1983; Rodman & Louda 1984), well-known compounds in plants from the Brassicaceae, particularly **Brassica**.

Cardamine concatenata is a winter perennial herb with elongated, jointed white rhizomes, with segments 1-2cm long; stems glabrous, 20-40cm tall. 2-3 approximate, subopposite or subwhorled leaves 10-15cm above the base of stem, deeply palmately dissected, glabrous or pubescent; stem leaves subwhorled or proximate, with 3-5 divisions, each division 0.5-3cm wide, lobed or deeply toothed, teeth dentate or serrate, mucronate; basal leaves similar to stem leaves, often absent – when present, arising from the rhizome. Flowers white, pink or lavender; pedicels 1-2cm long in flower, to 3cm long in fruit; rachis of inflorescence pubescent; sepals 4; petals 4, 1-2cm long, entire; stamens 6. Ovary sessile. Fruit a 2-carpellate capsule called a silique, terete, 1-4cm x 2-3mm, beak 3-12mm long, round or elliptic in cross-section; valves of mature fruit coil elastically from base to apex and drop. Fl. Mar.-May.

Alluvial woods and adjacent slopes; N. & S. Carolina, Virginia, W. Virginia, Kentucky, Tennessee, Florida (Radford et al. 1964).

CAREX

(Cyperaceae)

Carex brevicollis *DC.* – rabid grass, parvsk sedge

'Rabid grass', one of the common names for this Russian sedge grass, suggests that it may be known for intoxicating stock animals, although it is reported that livestock choose not to eat it (Komarov & Shishkin ed. 1985a). It contains several interesting β-carboline alkaloids.

C. brevicollis leaves have yielded mostly [0.195-0.3%] brevicolline [4-(N-methylpyrrod-2-yl)-β-carboline; vasodilator, uterine contractant, inhibits peristalsis], as well as dehydrobrevicolline, brevicarine, *harmine*, *harmol* [0.041%], *harman* and *norharman*. Homobrevicolline [4-(1-methyl-2-piperidinyl)-β-carboline] is also known from the genus (Shcherbinina et al. 1969; Shulgin & Shulgin 1997; Terent'eva et al. 1969a, 1969b; Zsadon et al. 1978).

Alkaloids have also been detected in C. acuta, C. acutiformis, C. contigua and C. nigra (Hultin & Torssell 1965; Willaman & Li 1970).

Carex brevicollis is a perennial, light-green, densely caespitose plant with a long rhizome. Culms flattened-triangular, scabrous above, 30-45cm tall, covered at base with brown sheaths disintegrating into fibres; leaves rather soft, 3-5mm wide, rather abruptly pointed, equalling the culm, margin revolute. Spikelets 2-3, distant, the terminal spikelet staminate, clavate to obovoid, 1.5-2.5cm long, with oblong-ovate acute ferruginous scales; other spikelets pistillate, ovoid to oblong-ovoid, 1.5-2.5cm long, erect; lowest bract with spathiform sheath 1.5-2cm long, and a blade of equal length; pistillate scales abruptly attenuate into a subulate point, castaneous, 3-nerved, with green internerves, shorter than to nearly as long as perigynea; perigynea obovoid or broadly ellipsoid, terete, 5mm long, yellowish-green, scattered-setulose to glabrescent, obsoletely many-nerved, rather abruptly terminating in a broad, short, scabrous-margined, bidentate, subferruginous beak with spreading teeth. Fr. May.

Open forests, coppices and mountain slopes of e. Europe and Asia Minor (Komarov & Shishkin ed. 1985a).

CARNEGIEA

(Cactaceae)

Carnegiea gigantea *(Engelmann) Britton et Rose* **(Cereus giganteus** *Engel.*; **Pilocereus engelmannii** *Lemaire*; **P. giganteus** *Rümpler*) – saguaro, sahuaro, organ pipe cactus, giant cactus, hoshan, ha'rsany, harsee, moxéppe

The Pima and Papago of n. Mexico and Arizona [Sonoran Desert] make a fermented beverage from the fruits of this cactus. The beverage is called 'tiswin', 'sawado', 'haren', 'ha'san na'vai', 'nawai' or 'sitoli' and is used in their rain ceremonies, to receive rain and healing songs. They say that the preparation of the beverage, and its use to bring rain every year, was taught to them by the spirits of the crow, and of the 'elder brother' I'itoi. The annual rituals centred around saguaro are the highlight of Papago culture. The fruits of the cactus ripen at a time when food is scarce, and their ripening marks the end of the Papago calendar year, before the rains come. Thus, the preparation and group consumption of tiswin also marks a time in which to purify and renew for a new cycle of seasons. Unfortunately, as with 'peyote' [see **Lophophora**], the tiswin ceremony was subject to legal prohibitions early last century, on both sides of the border, due almost entirely to the wishes of Christian puritans. Although this prohibition is no longer in place [unlike peyote], the traditional ways of the Papago are dying out, partly as a result of this past oppression and the gap in tradition which it created. Both the fruit and the tiswin made from it are emetic in high doses (Bruhn 1971; Buhner 1998; Diaz 1979).

The stems have on occasion been tapped for 'cactus water' by besieged 'Indians' during battle with other tribes, though this liquid nourishment is bitter and nauseating to those unaccustomed to it (Bruhn 1971; Bruhn & Lundstrom 1976). The Seri of Sonora apply a heated slice of the stem externally, to ease rheumatic pains (Felger & Moser 1974). The fruits are much used as food, made into preserves and syrups, and the seeds eaten, either whole or as a ground meal. The ribs of the dried vascular bundle from dead plants have been used to make arrows, pole tools for harvesting the fruit from the top of the plant, and in construction, amongst other uses. However, the 'wood' of the plant contains mineral crystals that can dull the sharp edges of woodworking tools. The spines were once used as tattooing needles (Benson 1982; Bruhn 1971).

A tiswin beer or 'wine' may be prepared with c.8 litres of fruit pulp [free of seeds], 4 litres of water, and wine yeast. The measures can be adjusted to suit the desired size of the batch. The pulp and water are heated to a boil, and cooked for 1-2 hours, before cooling, straining, and slowly simmering to a syrup for another hour. The shaman of the tribe will usually purify the syrup by blowing tobacco smoke [see **Nicotiana**] over it. The syrup is generally diluted with water [syrup/water ratios varying from 1:1 to 1:16], mixed by hand. Before mixing, the syrup is spoken to – "I am now mixing you up. Do me the favour to bring good wind and clouds and rain, and to keep the people from bad behaviour after they have drunk the wine." Throughout the process, the cactus and its parts may be prayed to, spoken to, and generally treated with a great deal of respect and focus. When ready, the mixture [at c.21°C] is taken into a round hut [the 'yahki' or 'rain house'] and poured into 4 fermentation vessels, each settled into the ground at a point of one of the four cardinal directions; straw lines the depressions in the ground, and a fire is kept burning inside to keep a constant temperature. The fermenting mixture is watched over and sung to in shifts [never left unattended], for 4 days. When finished, the tiswin should contain c.5% alcohol. The beverage is consumed together by the whole group, with a sincere mood prevailing. Tiswin origin stories are told, portions of the beverage are given to the 4 directions, the earth mother, and the I'itoi, and everyone drinks until there is none left. To close, here is a translated excerpt from the Papago tiswin ritual – "Ready, friend! Are we not here drinking the shaman's drink, the magician's drink! We mix it with our drunken tears and drink." Also, this Papago song is sung after drinking tiswin – "Dizziness is following me! Close it is following me. Ah, but I like it. Yonder far, far on the flat land it is taking me. Dizziness I see. High up there I see it. Truly I like it. Yonder they lead me, and dizziness they give me to drink. 'Tis at the foot of little Gray Mountain I am sitting and getting drunk. Beautiful songs I shall unfold." (Buhner 1998).*

The yeasts for the fermentation can rely on a number of factors. Firstly, yeasts grow in association with the plant, aided by Drosophila sp. flies which have a specific relationship with C. gigantea. The main species associated with this plant is D. nigrospiracula (Kirscher & Heed 1970). The primary yeasts are Pichia spp., particularly P. heedii. Due to this relationship, stem injuries ferment readily in the plant (Holzschu & Phaff 1982). Just to be sure, sometimes there may be the addition of a yeast starter culture from the previous year's batch, and the residual yeast inside the used fermentation vessels would further ensure dominance of the desired yeasts. The reader would probably use store-bought wine yeast if requiring an extra yeast source (Buhner 1998); this may be necessary when using plants grown outside of their native range, as the Drosophila sp. relationship would probably be absent.

C. gigantea has yielded 0.6-1.7% alkaloids and 2.5% lipids. Those alkaloids found to date include [0.019% w/w] 0.575-0.7% carnegine [6,7-dimethoxy-1,2-dimethyl-THIQ; increases reflex-excitability in frog, MAOI], [0.0016% w/w] 0.18% *gigantine* [5-OH-carnegine; found in quantity only in old, wild plants; 25-30% of alkaloids in whole plant, but 50% in growing tip], [0.02% w/w] 0.096-0.47% salsolidine [N-norcarnegine; 6,7-dimethoxy-1-methyl-THIQ; see **Pachycereus**], 0.006% dehydrosalsolidine, 0.006% 1,2-dehydrosalsolidine, 0.007% heliamine [6,7-dimethoxy-THIQ], 0.0008% dehydroheliamine, 0.0036% [w/w] arizonine [1-methyl-7-MeO-8-OH-THIQ], 0.26% *dopamine* [from young, cultivated plants; 1% has been found in the cortex; higher content observed in callus-tissue and the areas near it, than healthy tissue], <0.00145% *DMPEA* and traces of 3-MeO-*tyramine*; other compounds found are glucaric acid, quinic acid, isocitric acid, ferulic acid, p-coumaric acid, 3,4-dihydroxybenzoic acid, p-OH-benzoic acid, vanillin, syringaldehyde, p-OH-benzaldehyde, campesterol, sitosterol, glucose, galactose, arabinose and xylose (Bembenek et al. 1990; Brown et al. 1968; Bruhn et al. 1970; Bruhn & Lundstrom 1976; Diaz 1979; Hodgkins et al. 1967; Pummangura et al. 1982a; Trout ed. 1999; Unger et al. 1980). As Cereus giganteus, this species has been claimed to contain *mescaline* (Štarha 2001), though this is not supported by any of the references given.

The psychoactivity of tiswin wine is thought to be entirely due to the

alcohol content, rather than any alkaloids that might be present in traces in the fruit (Bruhn 1971; Trout pers. comm.).

Carnegiea gigantea is a large, columnar cactus; stem simple and upright, stout, up to 12m tall, or with 1-2(-12) lateral branches, branches 30-65cm diam.; ribs 12-24, obtuse, 1-3cm high; areoles c.2.5cm apart or nearly contiguous on upper part of plant, densely brown-felted; spines of 2 kinds – those at top of flowering plants acicular, yellowish-brown, porrect, those of sterile plants and on lower parts of flowering plants +- subulate, central ones stouter than radials, often to 7cm long, usually 2.5-3.8cm long, to 1.3mm diam. at base; spines 15-30 per areole. Flowers borne singly at uppermost areoles, diurnal, funnelform-campanulate, 10-12cm long, sometimes nearly as wide when fully expanded; tube c.1.5cm long, stout, nearly cylindric, expanding into throat, green, scales broad and short, white-felted in axils; scales on tube few, broadly ovate to oblong, acute, bearing small tufts of hair in axils; throat c.3cm long, covered with numerous white stamens (c.¾ as long as inner perianth segments); inner perianth segments white, short, widely spreading or somewhat reflexed when fully expanded; stigma lobes 12-18, narrowly linear, reaching a little above the stamens; style stout, 5-6cm long, white or cream-coloured; ovary oblong, somewhat tuberculate, bearing scales with wooly axils; ovules numerous. Berry red or purple, obtuse, 6-9cm long, oblong, ellipsoid or somewhat obovoid, edible, splitting down from top into 2-3 sections, containing red pulp, scales few, distant, ovate, 2-4mm long, with or without 1-3 short acicular spines in axils; seeds very numerous, black and shiny, irregularly obovoid, 2 x 1.3 x 1mm, hilum oblique.

In coarse, rocky ground, adjacent to mountain ranges and hills, 180-1080[-1350]m; Arizona, s.e. California, Sonora [Mexico]. Shade is necessary for successfully establishing seedlings and young plants. Care should be taken in wet weather, as even in large plants, small wounds can quickly lead to rot of bacterial origin, which can kill the plant (Benson 1982; Britton & Rose 1963). This species is currently under threat in the wild due to disease, changes in local ecosystems due to grazing of stock animals, vandalism and illicit collecting of wild plants for horticultural purposes (Benson 1982; Bruhn 1971).

* I apologise to Stephen H. Buhner for borrowing so heavily from his work. However, his 1998 book contains much fascinating information on this topic which was hard to ignore, and the primary references were difficult for me to locate. I recommend anyone interested in 'indigenous beers' and brewing of a sacred nature to seek it out. The main references of interest used by Buhner were – Crosswhite, F. 1980. "The annual saguaro harvest and crop cycle of the Papago." Desert Plants 2(1):7. Univ. Arizona; Densmore, F. 1929. Papago Music. Smithsonian Institution Bureau of American Ethnology Bulletin 90; Lumholtz, C. 1912. New Trails in Mexico. Unwin, London; Underhill, R. 1936. Autobiography of a Papago Woman. Memoirs of the American Anthropological Assoc. 46; and Underhill, R. 1938. Singing For Power. Univ. California Press.

CASIMIROA

(Rutaceae)

Casimiroa edulis *Llave et Lex.* **(Fagara bombacifolia** *(A. Rich.) Krug et Urb.***; Zanthoxylum araliaceum** *Turcz.***; Z. bombacifolium** *A. Rich.***)** – cochiztzapotl, zapote blanco, white sapote, Mexican apple

This Central American tree is cultivated for its tart, aromatic fruit. However, in the translation of the Badianus Codex, the seeds of C. edulis were referred to as being powdered and burned by the Aztecs for their action as a sedative hypnotic. They are still used as a tranquilliser today in rural Mexico. In Monterrey, the leaves are infused as a sedative antispasmodic which calms the nerves and heart, treats insomnia, and lowers high blood pressure. A seed extract is also given to produce sleep for 5-6hrs, without negative side-effects. From 1-2tsp of the extract is said to be sufficient (Emboden 1979a; Heffern 1974; Nicholson & Arzeni 1993; Ruiz et al. 1995; Usher 1974). The Tarahumara of n. Mexico have been reported to use the bark from C. edulis and C. sapota, crushed and thrown into water to stupefy fish and make them easy to catch (Pennington 1958).

Seeds, root, and bark of C. edulis have been shown to contain *histamine* derivatives with hypotensive activities, including N,N-dimethyl-*histamine* [0.05% in seed], casimidine [1-β-D-glucosyl-D-N-methyl-*histamine*] and casimiroedine [major seed constituent; N-cinnamoyl-N-methyl-*histamine* N-glucoside]. Seeds have also yielded N-methyl-*histamine*, N-benzoyl-*tyramine* [possibly an artefact of extraction], 4'-dehydrogeranyl-N-benzoyl-*tyramine* [tentatively identified, possibly an artefact] and zapotidin [6-methylimidozo(1,5-C)-tetrahydropyrimidine-5-thione; hypotensive]; the quinolines casimiroine, eduline, edulein, β-fagarine [analgesic, anticonvulsant, antipyretic, CNS-depressant], phellopterin, 5-MeO-8-geranyloxypsoralen and 1-methyl-2-phenyl-4-quinolone; the limonoid nortriterpenoids zapoterin [12α-OH-obacunone], 7α-obacunol and deacetylnomilin; and the flavonoids zapotin [2',5,6,6'-tetramethoxyflavone], 2',5,6-trimethoxyflavone, 3',5,6-trimethoxyflavone and 3',5,5',6-tetramethoxyflavone. Leaves and twigs also yielded quinolines [0.00016% casimiroine, 0.0003% edulein, 0.00055% 1-methyl-2-phenyl-4-quinolone, 0.00063% *skimmianine*], coumarins [0.0003% isopimpinellin, 0.00016% *scopoletin* methyl ether], 0.0083% n-hentriacontane [antiinflammatory] and 0.00166% carnoubyl cerotate. Bark also yielded [as % from trunk bark/root bark] the quinolines casimiroine [0.0052/0.225], edulein [0.0021/0.043], edulinine [0.003/0.0026], edulitine [0.0006/-], dictamnine [0.0008/0.0038], *skimmianine* [0.002/-] and γ-fagarine [0.0024/0.01]; the coumarins *scopoletin* [0.0015/-], bergapten [-/0.0035] and isopimpinellin [-/0.0122]; and the flavonoids zapotin [0.122/0.425] and 5,6-dimethoxyflavone [0.0122/0.645] (Djerassi et al. 1956; Dreyer 1968; Harborne & Baxter ed. 1993; Iriarte et al. 1956; Major & Dürsch 1958; Rizvi et al. 1985). The plant has also yielded stemmadenine, obacunone [casimirolide], condylocarpine [methyl-2,14,16,19-tetradehydrocondyfolan-16-carboxylate], hexadecanamide [palmitamide] and 9-OH-4-MeO-psoralen (Buckingham et al. ed. 1994; Rastogi & Mehrotra ed. 1990-1993).

Casimiroa edulis is a large or medium sized tree. Leaves digitately 3-7-foliate, leaflets ovate to ovate-oblong, lanceolate, or sometimes obovate, 4.5-12 x 1.7-5.5cm, obtuse or retuse at apex, base cuneate, glabrous or sometimes minutely puberulous above, densely papillose and +- puberulent, especially on midrib and veins, coriaceous beneath, margin entire or obscurely crenate, petioluled; petioles 2.5-9cm long, puberulent. Inflorescence terminal or axillary; sepals usually 5, triangular, ciliate; petals usually 5, greenish, lanceolate to oblong-ovate, ovate or oval, 4-5mm long, 2-2.5mm broad; stamens as many as petals, inserted at base of disc; filaments subulate or linear-lanceolate; anthers elliptic, ovate or oval. Ovary subglobose or obovoid, (2-)4-5(-8)-celled, usually 5-lobed; stigma 5-lobed or entire; ovules solitary in each cell. Drupe greenish-yellow, subglobose, 8-10cm diam., pubescent, 2-5-celled; pulp soft, cream-coloured, very sweet; seeds 2-5, 1.8-2.3cm long, 1-1.5cm broad.

Mexico, Guatemala, Nicaragua; cultivated in Cuba (Wilson et al. 1911), Florida and s. California; naturalised in India; usually above 910m (Bailey & Bailey 1976).

Propagate from seed; best planted immediately after removal from the fruit, or else store the seed in sterilised slightly damp peat-moss in refrigeration; seedlings may grow quickly. If purchasing a plant, check that you have a self-fertile variety, or if not, one which has a pollinating branch grafted to it. Plant out in spring [in cold climates] or autumn [everywhere else] when 1m tall. Plant away from water pipes and paths; the strong roots can cause problems with these later. Water liberally when young and remove tip to promote branching; cut back the new main shoot when 30cm long; trim side branches and long, thin, whippy shoots regularly, though do not prune excessively. Established trees are partially drought-tolerant, and cold tolerant to c.-5°C [even though trees may defoliate at such low temperatures, they can recover well]. In warm areas, water mature trees less during late autumn and winter to encourage flowering; water well during flowering and fruiting. Prefers well-drained soil or sandy loam, in a sunny position. Does not like true tropical humid conditions [it will still grow but not necessarily produce fruit]. May need to be staked when young to protect against wind damage. Trees grow well with less fertilisation than **Citrus**, and may be able to subsist on the nutrients gained from their own leaf litter. Some say annual dolomite supplementation is beneficial after harvesting fruit; 250g per year of age [to a max. of 2kg] is suggested for each tree. Trees may yield fruit very heavily. Harvest fruit when mature [ie. when it easily detaches from the tree] and ripen off the tree [may take 1-2 weeks]; such fruits store for longer than those picked at full ripeness, though once ripe, they will keep for only a couple of days. Also, fruits which are allowed to drop to the ground can rot and ferment within hours. Fruits of some varieties do not considerably change colour when ripening, though others do. The fruit bruises easily due to its thin skin, and is generally considered delicious, with a taste and texture compared by some to banana custard. Some strains, however, as well as fruit-bearing 'seedlings', may bear fruit with a bitter after-taste (Bailey & Bailey 1976; Glowinski 1997).

CASTANOPSIS

(Fagaceae/Cupuliferae)

Castanopsis acuminatissima *(Bl.) A. DC.* **(C. carlesii** *(Hemsl.) Hayata***; C. hamata** *M.S. Duan***; C. longispicata** *Hu***; Quercus carlesii** *Hemsl.***; Q. lanceaefolia** *Roxb.***)** – kawang, tuktukiin

Native peoples of Banz, in the Western Highlands of Papua New Guinea, steam the seeds ['kawang'] of this tree and eat them in large quantities as an intoxicant. They are said to produce the same effects as the 'nonda' mushrooms [see **Boletus, Heimiella, Russula**], many of which actually grow beneath this tree. The Bimin-Kuskusmin of West Sepik call the seeds 'tuktukiin', and use them in the highest two levels of shamanic initiation. At these proceedings [see also *Endnotes*], they are consumed with other plants. In the 11th stage, they are taken with a **Heimiella** sp., a **Russula** sp. [see **Boletus**], **Pandanus** julianettii, 'agara' bark [see **Galbulimima**], 'ereriba' leaves [see **Homalomena**], **Kaempferia** galanga rhizome, **Musa** sp. flowers, Baccaurea sp. fruits, and

the skin of the frog Litoria angiana [see *Endnotes*]. In the 12th stage, they are taken with **Psilocybe** mushrooms, **Pandanus** brosimos, P. julianettii, Lithocarpus sp. nuts [see *Endnotes*], agara leaves and bark, **Kaempferia** galanga, Colocasia esculenta and skin of the frog Phyrnomantis lateralis [see *Endnotes*] (Bock unpubl.; Heim & Wasson 1965; Poole 1987).

C. indica ['phang-rang-araung'] is used by the Mikir of India "in their various ceremonies of worship" (Jain & Borthakur 1980); no further details were given. In Nepal, Castanopsis spp. ['katus'] and the interior of their fruits are considered to be a form of 'amrita' (Müller-Ebeling et al. 2002). Castanopsis spp. are related to 'oaks', Quercus spp., which were very sacred trees to the Celtic Druids. Oak has numerous medicinal uses, and was believed to offer protection against evil (Bremness 1994; Cunningham 1994). In Mexico, inflorescences of a Quercus sp. are decocted to counter nervous excitation (Heffern 1974).

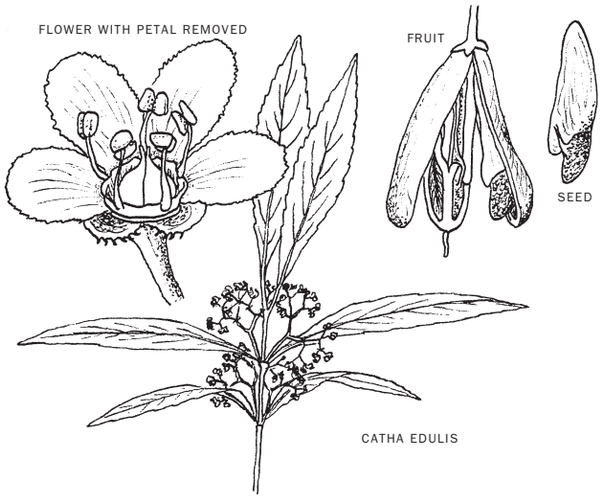
Apparently nothing is known of the chemistry of C. acuminatissima. The raw seeds can cause emaciation, anaemia and mouth ulcerations when eaten (Thomas 2001a).

Castanopsis acuminatissima is a small to large tree, glabrous. Leaves alternate, entire, very variable in size, c.10.1-25.4cm long, thin, lanceolate, membranous, subcaudate, base acute or rarely rounded, grey-green above, pale reddish-grey to subsilvery below; nerves reticulate, 8-15 pairs, slender, arched and raised on both surfaces; petiole to 2.54cm long. Flowers monoecious, small, spicate; male in pendulous or erect spikes; female erect; bracts small; involucre 2.5-3.8cm long, very stoutly pedicelled, in long spikes obliquely ascending, ovoid, hoary, with 3-4 broad, wavy, often interrupted concentric ridges enclosing the nut, bursting irregularly. Male – perianth campanulate, 4-7-lobed; stamens indefinite, filaments slender; anther cells contiguous. Female – enclosed in imbricate bracts; perianth tube adnate to ovary, limb very minutely lobed or toothed; staminodes minute or none; ovary after fecundation +- perfectly 3(-5)-celled; styles 3-5, short; ovules 2 in each cell. Nut ovoid, thin, puberulous, 1-celled, attached to involucre of imbricate hardened bracts; seeds 1-2, testa membranous.

India, Upper Burma (Hooker 1954-1961), Papua New Guinea (Paijmans ed. 1976).

CATHA

(Celastraceae)



Catha edulis *Forssk.* **(Celastrus edulis** *(Forssk.) Vahl.***; Methyscophyllum glaucum** *Eckl. et Zeyh.***)** – khat, qat, chat, gaat, miraa, marongi, kafta, Abyssinian tea

Khat is a tall tree [often kept bushy by pruning] which grows both wild and cultivated in the fertile plains and mountains of northern, eastern and southern Africa, as well as Saudi Arabia and Yemen. Yemen is considered the centre of khat use, though it is also widely used in Somalia, Kenya and Ethiopia. It was known by the 13th century that the plant was being taken as a tea by Sufis and other spiritually-inclined persons to 'intensify their mystical experiences'. Its use is now common where available, and it is often consumed daily as a euphoric stimulant. Khat is said to stimulate mental faculties ['widens the mind'], relax the body, give good spirit, endurance, concentration, alertness and confidence, as well as relieving colds, fevers and headaches.

The herb is purchased fresh daily from stores or street vendors, in bundles of varying quality and composition. The most expensive types come in slender, leafy bunches 60-76cm long; the cheapest usually come in 12-15cm packets of pre-picked leaves, which have been brought over a greater distance wrapped in banana-leaf containers [see **Musa**]. Users recognise many varieties, mostly 'red' and 'white', but also 'blue' and 'yellow'. 'Red' is considered to possess negative qualities, often due to the maturity of the herb [see below]. Cheaper types, such as the red, are said to be 'strong', and cause more negative side-effects, ie. insomnia, anaphrodisia, confusion, and irritability. Overly-astringent khat is called 'weak'. Good quality khat is young, tender growth, not too bitter, and produces euphoria and mental stimulation with few side-effects, followed by a 'coming down' period of detached contemplation and somnolence. Chewing too much can produce confusion, delirium, dizziness, and the sensation of insects crawling on or under the skin. Khat is usually consumed by picking the choicest leaves from their branches and chewing them in large amounts [100g or more per session, sometimes up to 500g or more per day], swallowing the juice; only rarely is the plant matter also swallowed. Sometimes a chunk of sugar or a clove [see **Syzygium**] is taken with the leaf. Khat has also been brewed into coffee [see **Coffea**], or the fresh flowers brewed as a tea [see **Camellia**]. It is usually consumed only from the early afternoon onwards. On a Friday, more than 80% of adult Yemenis will be chewing khat, whilst on other days, this is only 50-60%. At such times, most businesses close and the streets are empty, while people chew khat and smoke tobacco [see **Nicotiana**] in water pipes inside in social groups [sometimes khat is also smoked]. Khat sessions are predominantly a male affair, though a smaller proportion of women also chew and have khat gatherings of their own. Such sessions are important for social bonding and diplomatic affairs, and its use during the working day is valuable for its stimulant effects. Today, khat is illegal in some countries [such as Australia and the US, where there are strong Somali communities], and its negative impact in its area of use has been somewhat exaggerated. Khat use on the whole has had little negative social influence, with difficulties arising only from excessive and compulsive use, which is often seen more with the poor and unemployed (Gess 1998; Getahun & Krikorian 1973; Kalix 1991; Kennedy 1987; Tyler 1966; Von Bibra 1855; Watt & Breyer-Brandwijk 1962). It should be noted, however, that the poor and unemployed are a group becoming more and more common throughout the world.

C. edulis leaves and twigs have yielded 0.02-5% phenylpropylamine or phenylalkylamine alkaloids [*phenethylamine* derivatives; those found in khat are referred to as khatamines], consisting of *cathinone* [up to 70% of total bases in fresh material], d-*norpseudoephedrine* [cathine], l-*ephedrine* [needs verification], (-)-norephedrine, merucathine, merucathinone, pseudomerucathine; as well as sesquiterpene-derived alkaloids called cathedulins or cathedulines, including cathidines A-D; flavonoids such as kaempferol [MAOI (Sloley et al. 2000)], quercetin and myricetin; the sugar alcohol mannitol; glucose, fructose, rhamnose, galactose, xylose, dulcitol, 0.136-0.324% ascorbic acid [vitamin C], 0.0148% niacin [vitamin B3], 0.0185% iron, 0.29% calcium, and traces of β-carotene [vitamin A], thiamin [vitamin B1] and riboflavin [vitamin B2]; 0.04-0.08% essential oil, containing α- and β-*thujone*, fenchone, linalool, α-terpineol, nerol, *pinene*, terpinolene, ocimene and β-phellandrene; 5.5-14% condensed tannins, 2.7% fibre, 5.2% protein and 17 amino acids [including *aspartic acid*, *glutamic acid*, *glycine*, *phenylalanine*, α-aminobutyric acid, lysine, threonine, serine, phenylserine, proline, alanine, valine and 0.05% *choline*] (Al-Meshal et al. 1986; Brenneisen & Geisshusler 1987; Brenneisen et al. 1984; Bruneton 1995; Crombie et al. 1990; El Sissi & Abd Alla 1966; Kalix 1991; Krikorian & Getahun 1973; Qédan 1972; Rastogi & Mehrotra ed. 1990-1993; Szendrei 1980).

Cathinone [the keto-analogue of *norpseudoephedrine*, existing in dynamic equilibrium with the enol-analogue] is considered the most important active chemical in C. edulis, and is mainly present in young, fresh leafy tips – it is 7-10 times as potent as cathine, and has more desirable effects [see *Chemical Index*]. In older, wilted or dry leaves, the unstable *cathinone* is believed to have converted to an 80/20% mix of *norpseudoephedrine* and norephedrine. This has been presumed to be due to enzymatic activity (Bruneton 1995; Kalix 1991; Kennedy 1987), though the precise process occurring here is still not fully understood. 3,6-Dimethyl-2,5-diphenylpyrazine has been isolated as a probable product of the oxidative dimerisation of *cathinone*; 1-phenyl-1,2-propanedione has also been isolated as a degradation product (Szendrei 1980). It has been suggested that the pyrazine derivative, or possibly the propanedione, might be responsible for some side-effects of stale or old khat (theobromus pers. comm. 2001), such as a strong and unpleasant 'drying' action on mucous membranes; the enol-analogue may also contribute to this (Torsten pers. comm. 2001). Tannins are thought to be responsible for gastrointestinal side-effects (Kennedy 1987).

C. edulis, as well as *cathinone* and *norpseudoephedrine*, produced an increase in adrenal phosphorylase and *adrenocorticotropin* activity, and a decrease in cholesterol, glycogen and ascorbic acid levels in rabbits (Ahmed & El-Qirbi 1993).

C. transvaalensis leaves have yielded at least four sesquiterpenes [vaalens 1, vaalens 3, vaalens 5, vaalens 7] (Crombie et al. 1990).

Catha edulis is an evergreen shrub or tree 2-15(-25)m tall; stems pale green-grey and flattened when young, becoming wine-red and rounded with age. Leaves dark green or grey-green, glossy above, paler beneath, (3.7-)5.5-11 x (0.8-)1.5-6cm, oblong to elliptic or obovate, apex acute

to acuminate, rarely obtuse, margin glandular, crenulate to dentate, base narrow-cuneate, texture tough, venation finely networked, more prominent below than above; petiole 3-10mm long; stipules c.2mm long, triangular-needle-like. Flowers many; peduncle 6-12mm long; bracts 0.5-1mm long, triangular-needle-like; sepals 0.5-0.7mm long, broadly ovate to semicircular, rounded, with margin fringed with fine, soft hairs; petals 1-1.5mm long, elliptic-oblong, margin minutely haired and paler when dry. Ovary broadly ovoid; styles short. Capsule red, 6-10mm long, narrowly oblong with 3 segments, pendulous; seeds wrinkled, with a basal wing.

Usually near margins of forest or woodland, often on rocky hills, 1100-1435m; from Cape Province [S. Africa] to eastern Africa from Ethiopia to s.w. Arabia (Exell et al. ed. 1960-1993).

Ideal growth requires a min. temp. of 19°C., and rainfall of 600mm per year; too much humidity can result in fungal damage. When grown below its preferred altitude, alkaloid levels are said to be greatly diminished. The best khat is grown from suckers or cuttings, not from seed. Cuttings are sometimes stripped of leaves, and planted in the ground [1-4 together] at a 45° angle, 20-25cm deep, and watered regularly while the roots form; water less regularly later in life. The soil should be well-drained, and khat tolerates a variety of soil types. Each year the ground at the base of the plant must be hoed to aerate the soil. Harvesting can begin after 4-5 years, and healthy plants may yield for up to 50 years. Harvest may occur in all times of year, but mostly in the latter part of rainy seasons (Getahun & Krikorian 1973; Kennedy 1987).

There appear to be two noticeably different plants circulating as C. edulis. The more typical form has broader leaves with a more obtuse apex, and often with a reddish tint on petioles, midribs and leaf margins; the other has slightly tougher leaves which are narrower, and more of a grey-green in colour. Both are psychoactive, though people have their preferences (pers. comms.; pers. obs.). The description of C. edulis given above does not refer to the reddish tint often observed, though the leaf dimensions do encompass those of both varieties; the accompanying picture depicts a plant more typical of the narrow-leaf form.

In Australian-grown plants [n.e. New South Wales], winter harvests may be noticeably weaker in potency, compared to harvests in warmer times of year with plentiful new growth. Khat also seems to be less psychoactive when harvested in the middle of a hot day (Torsten pers. comm.), which may be due to an increase in the degradation of *cathinone*, perhaps stimulated by a combination of heat, oxygen, and dehydration (theobromus pers. comm.).

Cultivation from seed should preferably be done using fresh seed; germination is easy (pers. comms.; pers. obs.).

The only other members of this genus are C. abbottii, known only from a small area in s. Natal and Pondoland, and C. transvaalensis [Lydenburgia cassinoides], known only from a small area in n.e. Transvaal. Neither have been analysed for alkaloids (Wyk & Prins 1987).

CECROPIA

(Cecropiaceae/Moraceae)

Cecropia glaziovi *Snethlage* – embaúba

Cecropia mexicana *Hemsl.* **(C. burriada** *Cuatrec.***; C. mexicana var. macrostachya** *Donn.-Sm.***; C. obtusifolia** *Bertol.***; C. obtusifolia ssp. burriada** *(Cuatrec.) Berg et Franco***; C. panamensis** *Hemsl.***)** – guaruma, guarumo, trumpet tree

In Veracruz, Mexico, dried leaves of C. mexicana are known as 'guaruma', and are smoked as a **Cannabis** substitute (Ott 1993), as well as being used to treat diabetes (Jiu 1966). I recently verified that C. mexicana [harv. Feb., Chiapas] is psychoactive when smoked, and that the fallen, dead leaves retain their activity. Effects of the inebriation are felt rather rapidly after smoking, building gently to a peak over c.30 minutes, and lasting several hours, perceived as a pronounced sedation and inebriation, accompanied by confusion of thought and mild perceptual alterations. The effect was not overly pleasant, but definitely intoxicating. The leaves are seemingly high in tars, and smoking them is rough on the lungs as an after-effect (pers. obs. 1999).

The Candomblé of Brazil use leaves of C. pachystachys [the 'hands of Omulu'] as trays for offerings to Omulu, god of skin diseases. A leaf decoction is also used to treat urinary disorders (Voeks 1997). Leaves of several species, such as C. ficifolia and C. sciadophylla, are burnt to provide alkaline ashes for use in coca chewing in parts of n.w. Amazonia [see **Erythroxylum**] (Schultes & Raffauf 1990; Uscategui 1959). In Central and South America, C. glaziovi has been used as an antiasthmatic, antihypertensive and cardiotonic (Rocha et al. 2002).

Chemical and pharmacological studies of this genus are few.

C. adenopus has yielded triterpenes and sterols (Schultes & Raffauf 1990).

C. carbonaria extracts had antispasmodic activity in animals (Schultes & Raffauf 1990).

C. glaziovi aqueous extracts had anxiolytic activity in mice [given p.o.]; such extracts contained mostly flavonoids and terpenes (Rocha et al. 2002).

C. mexicana leaf aqueous extract [as C. obtusifolia] had CNS-depressant, muscle relaxant, peripheral analgesic and antiinflammatory effects in animals, as well as impairing motor coordination and showing low toxicity (Perez-Guerrero et al. 2001); a lyophilised aqueous leaf extract also had antihypertensive effects in rats [given i.v.] (Salas et al. 1987).

Cecropia mexicana is a dioecious tree with milky sap; trunk and branches stout, hollow, divided by partitions, to 5-10m tall. Leaf blades usually 20-30cm long or more, divided more than ½ to the centre, palmately 9-15-lobed, lobes occasionally with 1-several lateral lobes, upper surface scabridulous and sparsely web-like pubescent, lower surface very pale to nearly white, minutely and usually densely puberulent; petioles usually 22-30cm long; stipules 7-11cm long, amplexicaul, leaving a scar completely surrounding the stem. Flowers in palmately arranged spikes; staminate flowers in spikes (10-)12-18cm long, in clusters of 3-9, spathes (11-)12-20 x 0.3-0.4cm; calyx tubular, entire or 2-lobed; stamens 2; ovary absent. Pistillate flowers in spikes 17-30cm long, c.0.5cm diam. at flowering, enlarging to 0.6-0.9cm diam. in fruit, spikes in clusters of 2-4, spathes 16-20cm long, outer face usually web-like pubescent, inner face shaggy; calyx tubular, apex porelike. Ovary included; style short; stigma exserted. Fruit ovoid to oblong-ovoid, somewhat flattened, 3.3-3.7mm long, enclosed by thin calyx.

Native from s. Mexico to Ecuador and Colombia; naturalised in pastures and low, wet forests in Hawaii (Wagner et al. 1990).

CENTELLA [including Hydrocotyle]

(Umbelliferae/Apiaceae)

Centella asiatica *L.* **(C. biflora** *(P. Vell.) Nannf.***; C. coriacea** *Nannf.***; C. dusenii** *Nannf.***; C. erecta** *(L. f.) Fernald***; C. floridana** *(Coult. et Rose) Nannf.***; C. hirtella** *Nannf.***; C. repanda** *(Pers.) Small***; C. triflora** *(Ruiz et Pav.) Nannf.***; Hydrocotyle asiatica** *L.***)** – gotu-kola, marsh pennywort, Asiatic pennywort, Indian pennywort, waternavel, centella, di chien tsao, di qien cao, brahmi, manduka-parni, cheka-parni, khulakudi, brahma-manduki, karinga, tholkuri, kutakam

Hydrocotyle javanica *Thunb.* **(H. nepalensis** *Hook.***; H. polycephala** *Wight et Arn.***)** – rau mo Java

C. asiatica, a small Asian herb with tonic properties, is well-known today as the subject of a widespread scam perpetrated by hack journalists and the health supplements industry. Some time in the early 1970's or earlier, stories began to circulate about 'fo-ti-tieng', an 'elixir of long life' reputed to have been responsible for the longevity of several famed Chinese hermits. Herbal preparations consisting of C. asiatica, **Cola** nuts, and 'meadowsweet' [Filipendula ulmaria] were subsequently sold as fo-ti-tieng® to an unsuspecting public. Further deception was found in the marketing of Polygonum multiflorum ['he-shou-wou' – see *Endnotes*] as 'fo ti', to take advantage of customers looking for the famed fo-ti-tieng. The toxic aconite [see **Aconitum** in *Methods of Ingestion*] was also sold as fo-ti by unscrupulous 'herbalists', due to the similarity of the English bastardisation ['fo-tse'] of the Pinyin word for aconite ['fuzi']. In fact, both 'fo-ti' and 'fo-ti-tieng' are invented names and can not be found in any Chinese Materia Medica. Furthermore, the original cases of longevity that inspired these marketing scams are most likely attributable to Polygonum multiflorum, and a combination of Lycium sp. fruits [see *Endnotes*] and Tai-Ch'i exercises, in separate cases (Dharmananda undated). The 'fo-ti-tieng' deception continues to this day, with such preparations often consisting of C. asiatica alone. The fraud is exacerbated by claims that 'true' fo-ti-tieng is made using Hydrocotyle asiatica minor, a non-existant variety of an old synonym for C. asiatica. Some companies even offer separate products consisting of what is labelled as both C. asiatica and H. asiatica minor, giving them different names [including 'fo-ti-tieng', 'fo-ti', 'gotu-kola' and 'brahmi' (see also **Bacopa**)] to maintain the impression that they are different herbs (Dharmananda undated; pers. obs.).

C. asiatica is reputed to have been used as a longevity tonic by Taoist hermits and Himalayan yogis (Rätsch 1992), though this might be a confusion of facts relating to the 'fo-ti-tieng myth' discussed above, and thus may refer to Polygonum multiflorum [see *Endnotes*]. The Lahu of n. Thailand say that if you eat C. asiatica at every meal of every day for 3 years, one becomes invulnerable, and cannot be harmed in any way. The Chinese name for the herb, 'di chien tsao', means 'ground coin grass', referring to the resemblance of the leaves to Chinese copper coins. In TCM, it is used as a rejuvenative, nerve tonic, immune stimulant, diuretic and antipyretic. In Ayurvedic medicine, is it used as a blood-purifier and nerve tonic, and to treat skin diseases and insanity – it is said to "improve the colour of the body, youth, memory and give long life". An infusion with honey is recommended as a supplement to meditation. Incidentally, the herb is the favourite food of the Indian elephant (Anderson 1993; Kirtikar & Basu 1980; Nadkarni 1976; Reid 1995; Watt & Breyer-Brandwijk 1962). Perhaps this is why it is said that elephants never forget? As C. coriacea, it is said to be narcotic in Africa (Watt 1967).

Infusion of the related Hydrocotyle javanica is said to act as a hypnotic (Perry & Metzger 1980).

Last century, modern methods confirmed many of the virtues of C. asiatica. It balances brain function across the hemispheres, improves learning and memory processes, restores nerves, accelerates cellular repair [especially skin and connective tissue], improves peripheral circulation, tones and stimulates the immune system and stimulates digestion; it also shows antiinflammatory, antioxidant, antitumour and diuretic effects, and has been used to treat asthma and bronchitis. It may cause itching of the skin and genito-urinary tract; if so, use should be discontinued. It is a mild sedative, and large doses may cause narcosis, headache and vertigo (Babu et al. 1995; Bremness 1994; Huang 1993; Kirtikar & Basu 1980; Miller 1985; Nadkarni 1976; Reid 1995). Some Thai kick-boxers have been reported to use C. asiatica to aid in recovery from injury; the herb is known to have a powerful healing action on both internal and external bruises (theobromus pers. comm.).

It is best to use the fresh herb, in which case 2 or more leaves and stems should be chewed daily. Best results are obtained if used daily in moderate amounts, as the effects are often cumulative. If it is to be dried, this should be done in a cool, shady place to preserve the volatile constituents. In dried form, ½ tsp is taken as a hot water infusion. A dose of 1-2 tab. may act as an aphrodisiac. In TCM, 3-5g is decocted and taken in 2 doses on an empty stomach, for short-term use (Chopra et al. 1965; Huang 1993; Miller 1985; Rätsch 1990). It is recommended that you grow your own, as much of the dried herb of commerce is collected from irrigation ditches in Asia (pers. comm.). Although aerial parts are usually used, the roots are said to be the most potent part (Nadkarni 1976).

C. asiatica contains an alkaloid, hydrocotyline, but its main medicinal efficacy comes from its saponin ester content – including asiaticoside, brahmoside, brahmissoside, brahminoside, madecassoside, thankuniside, and isothankuniside; as well as its triterpene acid content – brahmic acid, isobrahmic acid, thankunic acid, isothankunic acid, asiatic acid, betulic acid and madecassic acid are produced on hydrolysis. Flavonoids are found, such as 3-glucosylquercetin, 3-glucosylkaempferol and 7-glucosylkaempferol; as well as tannins, sterols, volatile oil and vitamin C (Bruneton 1995; Chopra et al. 1965; Huang 1993; Rastogi & Mehrotra ed. 1990-1993; Singh & Rastogi 1968). Leaf gave positive tests for HCN (Watt & Breyer-Brandwijk 1962).

Centella asiatica is a slender annual-perennial creeping herb; stems long, prostrate, spreading from leaf axils of a vertical rootstock, filiform, often reddish and with long internodes, rooting at the nodes. Leaves 1.3-6.3cm diam., several from stems, orbicular-reniform, rather broader than long, +- cupped, entire or shallowly crenate, glabrous on both sides, with numerous slender nerves from a deeply cordate base; petioles very variable in length, 1.5-15cm long or more, channeled, glabrous or nearly so; stipule short, adnate to the petioles forming a sheathing base. Flowers in fascicled umbels, each umbel consisting of 3-4 pink, sessile (rarely pedicelled) flowers; peduncles pubescent or glabrous, short, pink; bracts ovate, acute, concave, 2 beneath each umbel; calyx truncate, toothless; petals minute, pink, ovate, acute. Fruit 4mm long, longer than broad, ovoid, hard, with thickened pericarp, reticulate-rugose, often crowned by persistent petals, primary and secondary ridges distinct.

In marshy or damp places throughout Asia, up to 1800m; also in parts of Africa and Australia (Chopra et al. 1965; Kirtikar & Basu 1980).

Easy to grow, given space to spread, constant moisture and indirect sunlight. This species can sometimes be purchased from nurseries, though the uninvestigated C. cordifolia is often sold as C. asiatica, at least in Australia (pers. obs.).

CESTRUM

(Solanaceae)

Cestrum aurantiacum *Lindl.* **(C. chaculanum** *Loes.***; C. paucinervium** *Francey***)** – orange flowered cestrum

Cestrum diurnum *L.* **(C. album** *Ferrero ex Dunal***; C. elongatum** *Steud.***; C. fastigiatum** *Jacq.***; C. fastigiatum** *Jan***; C. tinctorium** *Griseb.***)** – day blooming jessamine

Cestrum laevigatum *Schltdl.* **(C. axillare** *Vell.***; C. foetidissimum** *Dunal***; C. multiflorum** *Schott ex Sendtn.***; C. pendulinum** *Hort. Monsp. ex Dunal***; C. undulatum var. orites** *Dunal***)** – dama de noite ['lady of the night'], coerana

Cestrum nocturnum *L.* **(C. hirtellum** *Schltdl.***; C. leucocarpum** *Dunal***; C. scandens** *Thib. ex Dunal***; C. suberosum** *Jacq.***)** – night blooming jessamine, hierba hedionda, pipiloxihuitl, galan de noche, hasana, bounwat, michili boung, ati bas aune, jahiko phul, pahelo jayi phul

Cestrum ochraceum *Francey*

Cestrum parqui *L'Hér.* **(C. campestre** *Griseb.***; C. foetidissimum var. pallidisimum** *Dunal***; C. jamaicense var. parqui** *Lam.***; C. mandoni** *Rusby***; C. pseudo-quina** *Mart.***; C. salicifolium** *Hort. Monsp. ex Dunal***; C. salicifolium** *Kunth ex Spreng.***; C. virgatum** *Ruiz et Pav.***)** – green cestrum, Chilean cestrum, green jessamine, willow leaved jessamine, green poison berry

Cestrum spp.

Attention was brought to these plants by the announcement that a Cestrum sp., probably C. laevigatum, is smoked by seafarers around the southern coast of Brazil, as a **Cannabis** substitute (Schultes & Hofmann 1980). C. laevigatum is used as a fish poison, and a sedative dressing for wounds and ulcers. In Brazil the leaf has been used as a soap substitute, and is also considered antispasmodic and diuretic. C. aurantiacum is reported as narcotic in Guatemala, and has poisoned cattle in Africa [resulting in irritability, hypersensitivity to stimuli, and paralysis]. In the Sibundoy Valley of the Amazon, shamans use a tea of C. ochraceum fruits to induce sweating in rheumatic patients. It is said that the patient experiences slight delirium if too much is taken. A leaf infusion is also applied to swollen joints. Kamsa shamans consume a cold water leaf infusion from a Cestrum sp. known as 'borrachera andoke', in order to "see all things like yajé" [see **Banisteriopsis**]. C. nocturnum is used in Martinique and Mexico to treat epilepsy, and in the West Indies as a stupefying charm medicine (Schultes & Raffauf 1990; Watt 1967; Watt & Breyer-Brandwijk 1962). In the Kathmandu Valley, the flowers are used as offerings to Shiva and Ganesha. Nepalese shamans use the aerial parts as ritual incense, as well as sometimes consuming the flowers [eaten fresh, or smoked when dry] to increase their spiritual healing energy. In the Kalinchok region, the plant is sometimes added to liquor (Müller-Ebeling et al. 2002).

It seems that many members of the genus share similar properties, and have been reported on occasion to cause stock poisonings (McBarron 1983). C. parqui has poisoned animals in Australia, with symptoms including "fever, gastroenteritis [including bloody faeces], and occasionally excitement. Death usually follows within a few hours after onset of symptoms." C. diurnum and C. nocturnum have caused poisonings in humans as well as other animals. "Symptoms are largely nervous in character and resemble those produced by *atropine* [...] Included were hallucinations, muscular and nervous irritability, tachycardia, elevated temperature, salivation, dyspnoea, and paralysis" (Kingsbury 1964; Tamplon 1977). However, in some feeding tests, C. nocturnum displayed no apparent toxicity (Watt & Breyer-Brandwijk 1932). Many are naturalised weeds or garden plants in some parts of the world, the most common in cultivation probably being C. parqui.

C. parqui leaves, when smoked as a large cigarette, can produce a mild narcotic effect, yet the smoke is very harsh (pers. obs.). Overdose symptoms include gastric pain and slight convulsions; children have died from eating the fruits. The fruit is considered to be more toxic than the leaf; however, leafy tips can still be quite potent (Watt & Breyer-Brandwijk 1962).

C. diurnum leaves have yielded saponins with cardioactive properties, as well as traces of *nicotine*, *nornicotine* and *anabasine* from plants harvested in mid-summer (Halim et al. 1971). As with **Bufo** venom, the cardioactive saponins should presumably be largely destroyed on smoking.

C. laevigatum unripe fruit contains saponins [which yield gitogenin and digitogenin on hydrolysis]; these saponins are also found in other parts of the plant (Schultes 1979; Schultes & Hofmann 1980).

C. nocturnum has yielded 0.5% yuccagenin, 0.04% gitogenin (Rastogi & Mehrotra ed. 1990-1993), parquine, and volatile oil (Schermerhorn et al. ed. 1957-1974); leaves also yielded traces of *nicotine*, *nornicotine* and *anabasine* (Halim et al. 1971).

C. parqui contains saponins, and has yielded gitogenin, digitogenin, parquinoside, and the alkaloids parquine, carboxyparquine, solasonine (Buckingham et al. ed. 1994; Schermerhorn et al. ed. 1957-1974; Schultes 1979), and solasodine (Willaman & Li 1970). Leaf and stem from Brisbane, Australia [harv. Apr.] gave weak to strong positive tests for alkaloids (Webb 1949).

C. purpureum has yielded solasodine and solanidine [see **Solanum**] (Schultes & Raffauf 1990).

C. lanatum and C. strigillatum have tested alkaloid-positive (Fong et al. 1972).

Cestrum parqui is an erect glabrous shrub to 3m tall, spreading by creeping roots; young branches whitish, older stems darker, woody, striate at base, mottled above, one or more stems emerging from each crown; roots yellow, shallow, extensive, producing new plants from suckers. Leaves alternate, lanceolate, entire, glabrous, 5-14 x 1-2.5cm, margin undulate, base cuneate, apex acuminate, older leaves dark green, younger leaves lighter, slightly paler beneath; unpleasant odour when crushed; petioles 5-10mm long. Flowers greenish-yellow, sessile, borne in axillary and terminal panicular cymes; calyx 5-toothed, short; corolla yellowish-green, tubular, salverform or funnelform, with slender tube to 2.5cm long, with 5 small terminal spreading acute lobes, dilated at mouth; unpleasant odour by day, powerfully fragrant by night; stamens inserted around middle of corolla tube, included; filaments filiform, often pilose below, sometimes with a tooth-like appendage; anthers small, with parallel sacs. Ovary 2-celled, usually short-stipitate; ovules few; style filiform; stigma dilated, entire or 2-lobed. Fruit a purplish to black shiny ovoid berry, c.1cm long,

1-4-seeded, in dark purple pulp; seeds dark green to brown, 3-4mm long, irregularly shaped with sharp angles, surface roughened.

Native to Chile and Peru; naturalised in parts of eastern Australia, mainly on alluvial soils along streams; widely cultivated as an ornamental, sometimes escaping [eg. in Texas].

Sow seed in autumn; plants flower after 2 years (Correll & Johnston 1970; Parsons & Cuthbertson 1992).

CINNAMOMUM

(Lauraceae)

Cinnamomum camphora *(L.) J. Presl.* **(C. camphora** *(L.) Nees et Eber.***; C. camphora** *(L.) Sieb.***; C. camphoroides** *Hayata***; C. nominale** *(Hayata) Hayata***; C. simondii** *Lecomte***; Camphora camphora** *(L.) Karst.***; Ca. japonica** *Garsault***; Ca. officinarum** *Bauh.***; Ca. officinarum** *Nees***; Laurus camphora** *L.***; Ocotea japonica** *(Gars.) Thell.***; Persea camphora** *(L.) Spreng.***)** – camphor laurel, Chinese sassafras, Japanese camphor tree, kapuru-gaha, chang nao, karpoor, kapur, himavulaka, obchoei-yuan

Cinnamomum sp. 'Carpano' – carpano

Cinnamomum cassia *L. Presl.* **(C. aromaticum** *Nees.***; Laurus cassia** *L.***; L. cassia** *Nees et Nees***; L. cinnamomum** *Andrews***)** – cassia, Chinese cinnamon, wood cinnamon, mu gui, rou qui, gudatvak, dalchini, daruchini, darasini

Cinnamomum iners *Reinw. ex Blume* – chiad

Cinnamomum laubatii *F. Muell.* **(C. tamala** *(Buch.-Ham.) T. Nees et Eberm.***; Laurus tamala** *Buch.-Ham.***)** – Indian cassia, camphorwood, pepperwood, pepperberry, brown beech, tamal, tejpat, dalchini

Cinnamomum mercadoi *Vidal* – kalingag, canela, kanila, kandoroma, kasiu, samiling

Cinnamomum micranthum *(Hayata) Hayata* **(C. kanehirai** *Hayata***; C. xanthophyllum** *H.W. Li***; Machilus micranthum** *Hayata***)** – camphor tree, micranthum

Cinnamomum mindanaense *Elmer* – Mindanao cinnamon, canela, kalingag

Cinnamomum mollissimum *Hook. f.* – obchoei

Cinnamomum oliveri *Bailey* – camphorwood, sassafras, Oliver's sassafras

Cinnamomum porrectum *(Roxb.) Kosterman* **(C. barbato-axillatum** *N. Chao***; Camphora porrecta** *(Roxb.) Voigt***; Laurus porrecta** *Roxb.***; Phoebe latifolia** *Champ. ex Benth.***)** – theptaro

Cinnamomum siamense *Craib* – trakraiton

Cinnamomum zeylanicum *Blume* **(C. verum** *J. Presl.***; C. zeylanicum** *Breyn.***; Laurus cinnamomum** *L.***; L. cinnamomum** *Roxb.***)** – cinnamon, true cinnamon, Ceylon cinnamon, kurundu, kuruva, dalchini, bahugandha, shakala, karaboon

Cinnamomum spp.

Cinnamon trees have enjoyed a lofty medicinal reputation since antiquity. Cinnamon spice [usually C. zeylanicum bark] was used by the ancient Egyptians as a medicine, incense and perfume, and it was one of the important ingredients in the mummification process. Moses used it, with 'myrrh', to make a holy ointment, and the Arabs valued it as a symbol of wealth, using it to anoint sacred vessels used in important ceremonies. When it was introduced into Europe at the time of the Crusades, it acquired a reputation as an aphrodisiac; the oil may be rubbed on the genitals for this purpose, or the bark may be taken internally. The bark of the very similar C. cassia used in TCM has pungent, sweet and hot characteristics, and bears an affinity for the liver, spleen and kidneys. Decocted in doses of 2-5g, it is considered stomachic, analgesic, stimulant, astringent, diaphoretic, and improves vision and circulation. In India, C. cassia is considered an antispasmodic, aphrodisiac and nervine stimulant, which acts as an irritant narcotic poison in large doses. C. zeylanicum ['true' cinnamon] has similar properties, though its aroma is generally considered superior to that of C. cassia. Leaves, twigs and bark fragments are used to produce 'cassia oil'. C. zeylanicum is also considered aphrodisiac, antispasmodic, anthelmintic, antiputrescent, carminative, antimicrobial, antiseptic, digestive, emmenagogic, haemostatic, parasiticidal and stimulant to respiratory and circulatory functions. Both herbs are still widely used as a cooking spice and flavouring (Bremness 1994; FAO 1995; Lawless 1994, 1995; Nadkarni 1976; Rätsch 1990; Reid 1995; Watt & Breyer-Brandwijk 1962). Barks from other species have been used to adulterate or replace C. zeylanicum as cinnamon, such as C. iners, C. mercadoi and C. mindanaense (Lawrence & Hogg 1974; West & Brown 1920).

The ingestion of powdered cinnamon is said by some nutmeg users [see **Myristica**] to produce a dreamy sedation. It has been claimed that cinnamon sticks are smoked ritually in rural Mexico (Weil 1969), and may be smoked with **Cannabis** as a mild stimulant (Siegel 1976). More recently, in some areas of the US, cinnamon oil has become popular with teenagers as a mild psychoactive drug. It is generally used for this purpose by sucking on a finger or toothpick which has been dipped in cinnamon oil. Effects reported include "a rush or sensation of warmth, facial flushing, and oral burning", sometimes also with nausea or abdominal pain (Perry et al. 1990).

In some areas of Papua New Guinea, a Cinnamomum sp. is used "to make young warriors fierce" (Paijmans ed. 1976). On Mailu Island, near PNG, sorcerers chew the bark of a Cinnamomum sp. to make themselves magically powerful (Thomas 2001a).

Camphor from C. camphora is sometimes consumed by shamans in Peru to prevent sexual thoughts and nocturnal emissions during plant diets (Bear & Vasquez 2000). Some take it by itself as a teacher (Luna 1984). In Nepal it is used as a shamanic and medicinal incense, and is invoked with a mantra for shamanic travel. C. laubatii and C. glanduliferum are also used as incense (Müller-Ebeling et al. 2002). *Camphor* has been used by the Arabs as an anaphrodisiac, and was sometimes worn in a pouch around the neck to ward off colds and flu. It has been burned as an incense in s.e. Asia to ward off demons. It was used to make the original moth balls, and has been used medicinally to treat various nervous system conditions. Swahili natives wash their dead with *camphor* water, and insert pieces of it into the orifices. In India, c.1.2g is given with plantain [see **Musa**] to procure abortion. It is also given there to treat many other disorders, including nymphomania, and is said to act as a sedative in treatment of delirium tremens. The plant is sometimes used in TCM as an antibacterial, to relieve skin itches, relax gastrointestinal muscles, and to stop vomiting and pain. C. camphora otherwise has similar uses to cinnamon spice, but is more toxic, largely due to the high *camphor* content. In excess, *camphor* is a powerful irritant narcotic poison, causing 'maniacal delirium', convulsions, nausea, vomiting and epigastric pain. *Camphor* is distilled from the plant for commercial and industrial uses (Chopra et al. 1965; Huang 1993; Lawless 1994; Morton 1977; Nadkarni 1976; Rätsch 1992; Watt & Breyer-Brandwijk 1962). Essential oil extracted from the leaves is called 'Ho leaf oil'. C. camphora wood has also been used in China and Vietnam to produce 'Chinese sassafras oil' [see **Sassafras**], though wild stands are becoming depleted from overharvesting (FAO 1995).

C. camphora is very chemically variable, and appears to exist in numerous chemical races (FAO 1995). From C. camphora, both crude *camphor* and oil of *camphor* may be obtained. In some old trees, the *camphor* may actually be found concentrated in solid lumps, whereas some varieties have no *camphor* at all. It is found mainly in the yellow oil fractions; white *camphor* is the more or less pure form that is generally used, as it is safer than brown or yellow *camphor*. *Camphor* is most concentrated in the roots and base of the trunk [said to bear the most *safrole*], and some is found in leaves, with younger leaves bearing higher concentrations. Leaves from shaded trees, or harvested in overcast or rainy conditions, yield less *camphor*, though shade is known to increase the *safrole* content. Leaf may yield 0.1-4.4% *camphor*, and 0.3-4.2% oil of *camphor*; wood may yield 0.6% *camphor*, and 0.15% oil of *camphor*. Seeds are reported to produce hydrocyanic acid [HCN], which is also found in traces in the leaves, bark and flowers (Lawless 1994; Morton 1977; Nadkarni 1976; Watt & Breyer-Brandwijk 1962); seed essential oil also contains *safrole* (Lakanavichian 2007). The roots have also yielded the alkaloids norboldine [laurolitsine] and reticuline [see **Magnolia**] (Rastogi & Mehrotra ed. 1990-1993). White oil of *camphor* contains mainly cineol, and no *safrole*; the yellow oil contains 10-20% *safrole*, as well as sesquiterpenes; and the brown oil contains up to 80% *safrole*. *Camphor* is still often a component of oil of *camphor*, sometimes accounting for more than 50%. *Eugenol* may be present at up to 0.12% of the oil; *elemicin* is found in some oils of *camphor*, as is *anethole* (Battaglia 1995; Lawless 1995); other essential oil constituents include humulene, selinene, d-nerolidol, calamenene, calacorene, camphorenone, camphorenol and α-ylangene (Rastogi & Mehrotra ed. 1990-1993). Although the wood from which 'Chinese sassafras oil' is obtained is richest in *camphor*, fractional distillation is used to yield an essential oil richest in *safrole* (FAO 1995).

C. sp. 'carpano' from Bouganville yielded 0.085% *carpacin* from heat-dried bark (Mohandas et al. 1969).

C. cassia essential oil ['oil of cassia', 'oil of cinnamon' (not to be confused with 'cinnamon oil' from C. zeylanicum)] is obtained from the bark in a yield of c.0.9%, and may contain 50-90% cinnamaldehyde [sedative, analgesic] and up to 10% *eugenol* (Chevallier 1996; Watt & Breyer-Brandwijk 1962).

C. iners from Thailand contains over 50% *safrole* in essential oils from bark, root, leaf and seed (Lakanavichian 2007).

C. laubatii from Queensland [Australia] contains the alkaloid reticuline in the bark; bark [harv. Jul.] tested weakly positive for alkaloids in an alkaloid screening. Bark essential oil contains *safrole* (Lawrence & Hogg 1974; Webb 1949; West & Brown 1920). As C. tamala, the leaves have yielded an essential oil containing mostly [c.78%] *eugenol* and d-α-phellandrene. The leaves ['tejpat'] are used in India as a cooking spice (Anon. 1911b; Ilyas 1978).

C. mercadoi bark yielded 1.2% essential oil, consisting of c.30% *safrole*, 29% 1,8-cineole, and 15% *eugenol*; early studies suggested that the oil was composed almost entirely of *safrole* (Lawrence & Hogg 1974; West & Brown 1920).

C. micranthum essential oil ['micranthum oil'] may contain c.95%

safrole (Hall 1973).

C. mindanaense bark yielded 0.9% essential oil, consisting of c.39% *eugenol*, 19% linalool, 15% *safrole*, 0.5% geraniol, <0.1% *methyleugenol* and <0.1% *camphor* (Lawrence & Hogg 1974).

C. mollissimum from Thailand contains over 50% *safrole* in its bark essential oil (Lakanavichian 2007).

C. oliveri from NSW and Queensland [Australia] is known to exist in several chemical varieties – one contains a bark oil rich in *camphor*, *safrole* and *methyleugenol*, and another is richest in *eugenol* and cinnamaldehyde (Lassak & McCarthy 1990). Leaves [harv. Jan.] tested weakly positive for alkaloids (Webb 1949).

C. porrectum from Thailand contains over 50% *safrole* in essential oils from bark, wood and seed; leaf essential oil has yielded 99.8% *safrole*, and that from root yielded 95.5-97.8% *safrole* (Lakanavichian 2007).

C. siamense from Thailand contains over 50% *safrole* in essential oils from leaf and bark (Lakanavichian 2007).

C. zeylanicum bark may yield 0.5-2% essential oil, of which 40-75% may be cinnamaldehyde, 4-10% *eugenol*, and lesser amounts of 1,8-cineole, *pinene*, benzyl benzoate, linalool, caryophyllene and other compounds; the essential oil is yellow at first, but turns red on storage. *Safrole* was found as a major component in Thai bark and leaf oils. Leaves may yield c.0.1-0.15% greenish essential oil, consisting of 80-96% *eugenol*, 1% *eugenol* acetate, 3% cinnamaldehyde, 3% benzyl benzoate, and lesser amounts of *safrole* and other compounds. The leaf oil is less irritating to the skin than the bark oil. Trees that are highly fertilised give poor-quality essential oil (Battaglia 1995; Bruneton 1995; Ilyas 1978; Lakanavichian 2007; Lawless 1994, 1995).

As a note of interest, C. triplinervis has yielded 3-[2-(trans)-cinnamoylamino-ethyl]-3-OH-indolin-2-one-oxo-2-*tryptamine* (Husson 1985).

Cinnamomum zeylanicum is a moderate-sized evergreen tree; bark rather thick, smooth, pale; twigs often compressed; young parts glabrous except the buds, which are finely silky. Leaves opposite or subopposite (rarely alternate), hard and coriaceous, 7.5-20 x 3.8-7.5cm, ovate or ovate-lanceolate, subacute or shortly acuminate, glabrous and shining above, slightly paler beneath, base acute or rounded, main nerves 3-5 from the base or nearly so, strong, with fine reticulate venation between; petioles 1.3-2.5cm long, flattened above. Flowers hermaphrodite, numerous, in silky-pubescent lax panicles usually longer than the leaves; peduncles long, often clustered, glabrous or pubescent; pedicels long; perianth 5-6mm long, tube 2-5mm long, lobes of limb subequal, segments pubescent on both sides, oblong or somewhat obovate, usually obtuse; stamens 9, perfect, or by abortion fewer, those of the 2 outer rows with eglandular filaments and introrse 4-celled anthers, those of the third row with glandular filaments, the glands subsessile or stipitate, and extrorse (2-)4-celled anthers, those of the fourth row replaced by shortly stipitate cordate or sagittate staminodes. Ovary sessile, free from the perianth, narrowed into the style; stigma discoid or obscurely 3-lobed. Fruit a berry, 1.3-1.7cm long, oblong or ovoid-oblong, minutely apiculate, dry or slightly fleshy, dark purple, surrounded by the enlarged campanulate perianth which is 8mm in diameter.

Burma, w. Peninsula [India], Ceylon, Malay Peninsula; indigenous or cultivated (Kirtikar & Basu 1980).

Cultivate from seed or cuttings [though cuttings from *camphor*-rich trees are difficult to root]. Seed should be taken from 20-30 year old trees and planted [cleaned free of pulp] as soon as possible when dry, as the period of viability is short, and germination rate is low. May also be cultivated by layering and grafting young shoots on old stumps [see below]. Plant seeds in shaded raised beds of light sandy loam enriched with manure, water regularly; should germinate in 20-90 days. Shade is removed when 12-15cm high. When 6 months old, transfer the seedlings to pots, grass baskets or polythene bags filled with fertilised soil for another 6 months, before transferring to the final bed during the rainy seasons. Should be mulched and watered immediately after planting out. Prefers humus-rich sandy loam, some shading, 20-35°C temps., and average annual rainfall of 150-300cm. These trees are prone to manganese deficiency. Every year in the rainy season, young trees two years and older are cut back to c.10-15cm above the ground, the stump covered with earth, and shoots allowed to re-grow from the stump. After 3-5 years of growth, the bark from these new branches may be harvested to prepare cinnamon. Bark from shoots that are too young is too thin and scentless to be desired. The first bark peelings of a plant are also not of good quality. The main shoot gives the best quality essential oil. Longitudinal slits are made with a knife, and a rounded blade inserted to test for peelability; if the bark peels away easily, the branch shoots are cut off for processing. The peelings of bark are stacked and sweated, wrapped in coir, for 24hrs; this softens the bark to make it easy to scrape off the outer bark, which is not used. The inner bark peelings [the 'cinnamon quills'] are sun-dried for 3-5 days, then lightly rolled and pressed by hand, to prevent the bark swelling or cracking. Bark portions that do not roll easily to form quills [called 'quillings'], and rough bark chips, are used locally in cooking, as well as the buds and flowers of the tree; the neat quills themselves are usually reserved for export. Quillings and bark powder are also used in the manufacture of essential oil (Chevallier 1996; Ilyas 1978; Morton 1977).

CITRUS

(Rutaceae)

Citrus aurantiifolia *(Christm.) Swingle* **(Limonia aurantifolia** *Christm.***)** – lime tree, limón agrio

Citrus aurantium *L.* **(C. bigaradia** *Loisel.***; C. hystrix** *H. Perrier***; C. vulgaris** *Risso***; Aurantium acre** *Mill.***)** – bitter orange, zorange si ['sour orange'], zhi shi

Citrus aurantium var. amara *L.* – neroli, neroli bigaradia, petit-grain

Citrus limon *(L.) Burm. f.* **(C. limonelloides** *Hayata***; C. x limonum** *Risso***; C. medica var. limon** *L.***)** – lemon tree

Citrus maxima *(Rumph. ex Burm.) Merr.* **(C. aurantium var. decumana** *L.***; C. aurantium var. grandis** *L.***; C. grandis** *(L.) Osbeck***; C. kwangsiensis** *Hu***; C. x aurantiifolia** *(Christm.) Swindl.***; C. x aurantium** *L.***; C. x limetta** *Risso***; C. x nobilis** *Lour.***; C. x paradisi** *MacFad.***; C. x sinensis** *(L.) Osbeck***; Aurantium maximum** *Rumph. ex Burm.***; Limonia x aurantiifolia** *Christm.***)**

Citrus medica *L.* **(C. x limon** *(L.) Burm. f.***; C. x limon** *(L.) Osbeck***; C. limonia** *(L.) Osbeck***; C. limonum** *Risso***; Aurantium medicum** *(L.) M. Gómez***)** – citron, Rangpur lime

Citrus paradisi *MacFad.* **(C. decumana** *L.* **var. paradisi** *Nich.***)** – grapefruit, pomelo

Citrus reticulata *Blanco* **(C. deliciosa** *Ten.***; C. depressa** *Hayata***; C. nobilis** *Lour.***; C. reticulata** *Blanco***; C. reticulata var. austera** *Swingle***)** – mandarin, tangerine, satsuma

Citrus sinensis *Osbeck* **(C. aurantium var. sinensis** *L.***; Aurantium sinensis** *Mill.***)** – sweet orange, hojas de naranja

Citrus trifoliata *L.* **(Poncirus trifoliata** *(L.) Raf.***)**

Citrus unshiu *(Makino) Marcovitch* **(C. nobilis** *Lour.* **var. unshiu** *Swingle***; C. reticulata** *Blanco* **var. unshiu** *(Marco.) H.H. Hu***)** – unshiu orange, mandarin orange, satsuma orange, satsuma mandarin, cheju mandarin, Japanese mandarin, unshuu mikan, wen zhou mi gan

Citrus spp.

Citrus trees are well known for their delicious, edible fruits and associated perfumes – however, they are less known for their mood-altering properties and their chemical content. Modern 'orange' varieties derive from C. aurantium, whose properties were recognised by the Arabs and the Chinese. The Arabs brought it to the Mediterranean in 0AD, and by 9AD it was being used in Europe for epilepsy and heart problems, as well as to strengthen the brain and lift the spirits. The essential oil of the fruit peel acts as a soothing sedative and uplifting nervous tonic, and is considered warming and comforting by aromatherapists. 'Neroli oil' was distilled [now extracted with spirits] from the flowers of C. aurantium var. amara, and was used by inhabitants of Venice to cure bad nerves, plague and fever. Once it was so widely used by the prostitutes of Madrid, that the smell of it came to represent prostitution in that city. In Europe today, the flowers are infused and drunk as a tasty nerve tonic, tranquilliser, and blood cleanser. 'Petit-grain oil' is distilled from the young shoots and leaves, but is weaker and has slightly different properties to neroli. Neroli oil is soothing, tranquillising, hypnotic, antidepressant, aphrodisiac, restorative and uplifting; petit-grain oil is more a relaxing sedative and cardiac tonic (Chiej 1984; Lawless 1994; theobromus pers. comm.).

C. aurantium is used almost world-wide as a nervous tonic, digestive and purgative. It has many uses on Haiti, in medicine and magic. Medicinally, the leaves treat fever and flu, or they may be heated and tied to the forehead for headaches. A leaf tea with equal amounts of coffee leaves [see **Coffea**] treats emotional shock. The juice is used to treat anaemia, digestive disorders and skin problems. It is also very important as a 'cleanser' in wanga potions used in some Voodoo ceremonies. The fruit itself is used as a power-object in various magic spells – eg. to strengthen or call up one's own spirit, the orange is peeled, and the ½ attached to the branch is cut into 7 pieces. 'Castor oil' [from Ricinus communis] is poured over the skins, and a piece of cotton is set on fire in the middle. The skins of the fruit of this species and of C. sinensis are exported from Haiti to be used in the manufacture of 'Grand Marnier' liqueur; they are also used domestically to flavour rum (Paul & Cox 1995).

In Nuevo Leon, Mexico, C. sinensis is used as a flower and leaf infusion to calm the nerves (Nicholson & Arzeni 1993), and C. aurantium leaves ['hojas de naranjo agrio'] are used as a relaxing nerve tonic (Heffern 1974). In Peru, C. aurantiifolia juice is mixed with water, sugar, corn [Zea mays - see *Endnotes*] and white rose petals to make 'arranque' or 'corte', a substance used to terminate the effects of various psychoactive or potentially toxic plants [eg. see **Brugmansia**, **Trichocereus**] (De Feo 2003). In Irian Jaya, the Marind-Anim use leaves of an unidentified Citrus sp. "to induce ecstasy". In intitiation ceremonies for becoming sorcerers, they also consume leaves of C. aurantium [as C. hystrix; 'tadi'] mixed with Codiaeum variegatum ['kundama'], Cordyline fruticosa ['ngasi'], Crinum asiaticum ['jarangar'], and other unidentified plants

(Thomas 2001a).

In TCM, the dried peel of the unripe fruit of Citrus spp. ['jih shih', 'zhi shi'] is used – C. reticulata is used to treat chest pain, congestion and malaria (Bremness 1994); C. trifoliata is used to treat sluggish digestion and low vitality, as well as being an expectorant (Reid 1995); and the dried fruit of C. aurantium is used to treat shock (Huang 1993). The essential oil of C. reticulata is sedative, tonic, stimulant to digestion and lymph glands, antiseptic, antispasmodic, carminative, mildly laxative, and diuretic (Lawless 1995). Butanol and water extracts of the unripe fruit peel appear to have antidepressant activity in mice, given orally (Song et al. 1996).

Many Citrus spp. contain a variety of simple *phenethylamine* alkaloids, some in high enough amounts to be pharmacologically significant [such as p-synephrine – see *Neurochemistry*], as well as indole and purine alkaloids. Following the banning in some countries of *ephedrine* and Ephedra spp. extracts due to adverse cardiovascular reactions in some consumers, synephrine and extracts from Citrus spp. containing it have recently become popular for weight loss and bodybuilding [with weight loss doses being c.32mg a day of synephrine], as they are not yet regulated and are believed [possibly incorrectly] to be safer; their efficacy for these purposes has also not been well demonstrated (Arbo et al. 2008; Dragull et al. 2008). They are also seeing use as main ingredients of some 'herbal ecstasy party pills' currently being sold (pers. obs.). Also of importance are terpenoids in their essential oils [usually from the fruit peel], some of which are useful in the synthesis of other compounds [see below].

C. aurantiifolia essential oil contains limonene and *citral* (Erickson 1976); the peel has also yielded 6,7-dimethoxycoumarin (Tatum & Berry 1977) – coumarin itself is a sedative hypnotic in high [near toxic] doses (Macrae & Towers 1984b); flowers yielded c.0.0028% *caffeine* (Stewart 1985).

C. aurantium leaves have yielded 0.006-0.007% [w/w] synephrine; fruit has yielded *tryptamine*, synephrine [0.041-0.048% from unripe Brazilian fruits] and N-methyltyramine, as well as the flavones nobiletin and tangeratin; unripe fruit peel has yielded 0.056% synephrine, albedo 0.028%, and pulp 0.019%; peel has also yielded 6,7-dimethoxycoumarin (Arbo et al. 2008; Huang 1993; Schneider et al. 1972; Tatum & Berry 1977); flowers yielded c.0.0031% *caffeine* (Stewart 1985), synephrine, neohesperidin, *adenosine*, asparagine, alanine, isoleucine, tyrosine, valine, β-sitosterol, β-daucosterol and 5,8-epidioxyergosta-6,22-dien-3β-ol (Huang et al. 2001). Bitter orange jam was found to contain c.0.0000019% trans-1,2,3,4,5-pentahydroxypentyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid, and c.0.0000115% of the cis-isomer (Herraiz & Galisteo 2002). Extracts of the fruit [containing 2.5% synephrine] were non-toxic in mice, and 1-5g/kg [oral] reduced locomotor activity; synephrine alone caused gasping and salivation at 150mg/kg, and reduced locomotor activity at 300-2,000mg/kg. It is thought the cardiovascular activity of both may be enhanced by the stimulants with which they are sometimes combined in weight-loss or other products (Arbo et al. 2008).

C. aurantium var. amara leaf essential oil contains limonene, aurantiamarin, hesperidin, neohesperidin and stachydrine; flower oil contains limonene, *pinene*, linalool, citronellol, nerol, camphene and geraniol; peel oil contains d-limonene, *citral*, *citronellal*, hesperidin and methyl anthranilate (Chiej 1984; Erickson 1976); fruit has yielded 0.1-0.35% synephrine, and the flavonoids naringin, naringenin, neohesperidin, hesperidin, hesperetin, neoeriocitrin and narirutin (Pellati et al. 2004).

C. australis bark and wood [from Queensland, Australia] tested weakly positive for alkaloids (Webb 1949).

C. limon has yielded *tyramine*, N-methyltyramine, synephrine and octopamine from unspecified parts (Smith 1977a); unripe fruits yielded 0.037-0.045% synephrine, and leaves 0.01% [w/w] (Arbo et al. 2008); fruits have also yielded up to 0.000205% 1-methyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid [MTCA], as well as 1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid [THCA] (Herraiz 1999); flowers yielded *caffeine* [major alkaloid; c.0.005% in the 'Lisbon' variety], *theobromine*, *theophylline* and paraxanthine, almost entirely concentrated in the stamens, especially the anthers. The small, round flower buds were almost alkaloid-free, but the elongated buds just before anthesis show the first signs of alkaloidal concentration, which increases during anthesis. Anthers yielded c.0.9% total alkaloids, with 0.7-0.8% *caffeine* (Kretschmar & Baumann 1999; Stewart 1985).

C. macroptera [from Papua New Guinea] yielded 0.02% alkaloids from bark, consisting mostly of edulinine [see **Casimiroa**]; in very large doses [500-2,000mg/kg (oral) in mice], the total alkaloids acted as a respiratory toxin (CSIRO 1990).

C. maxima flowers yielded purine alkaloids of similar proportions to C. limon.

C. medica unripe fruits yielded 0.012-0.051% synephrine, and leaves 0.016-0.025% [w/w] (`Arbo et al. 2008); pollen contained similar levels of purine alkaloids to anthers of C. limon (Kretschmar & Baumann 1999).

C. medica x sinensis has yielded *tyramine*, octopamine and synephrine from unspecified parts (Lundstrom 1989).

C. paradisi flowers of the 'Ruby Red' variety yielded c.0.0029% *caffeine* (Stewart 1985), as well as *theobromine*, *theophylline* and paraxanthine (Kretschmar & Baumann 1999). Leaves and fruit contained no *tyramine*, N-methyltyramine, *hordenine*, synephrine or octopamine (Wheaton & Stewart 1970). Fruits have yielded up to 0.000837% MTCA, as well as THCA (Herraiz 1999); fruit rind essential oil may contain c.26% *citral* (Watt & Breyer-Brandwijk 1932). Fruit juice contains, besides vitamin C [ascorbic acid], flavonoids including c.2% naringin [which is metabolised to its aglycone form, naringenin, after consumption], and the furanocoumarin 6',7'-dihydroxybergamottin; this latter compound, as well as naringenin [but not naringin], inhibits cytochrome P450 isoenzymes 1A2, 2A6, 3A4 and 3A5, leading to potentiation of *caffeine*, *theophylline*, *diazepam*, coumarin, and many other drugs [see *Neurochemistry*] (Chan et al. 1998; Edwards et al. 1996; Fuhr & Kummert 1995; Fuhr et al. 1993; Runkel et al. 1997; Watt & Breyer-Brandwijk 1932). Anecdotal reports suggest the juice is also useful in potentiating the effects of *THC*, opiates and MDMA (pers. comm.).

C. reshni has yielded *tyramine*, N-methyltyramine, octopamine and synephrine from unspecified parts (Lundstrom 1989).

C. reticulata leaves have yielded [as % (w/w) from 'tangerine' and 'Cleopatra mandarin', respectively] *tyramine* [0.0011, 0.0028], N-methyltyramine [0.0019, 0.0031], *hordenine* [0, 0.0008], synephrine [0.2031, 0.2215] and octopamine [0.0024, 0.0012]. Fruits yielded [% as above] *tyramine* [0.0001, <0.0001], N-methyltyramine [0.0015, 0.0058], *hordenine* [0, 0.0007], synephrine [0.0125, 0.028] and octopamine [0.0001, 0.0002] (Wheaton & Stewart 1969, 1970); juice of 'Dancy' tangerines has yielded 125mg/L synephrine, and that of 'Cleopatra' mandarins yielded 280mg/L (Dragull et al. 2008); tangerine fruit juice concentrate yielded 24.5-34.6mg/6oz synephrine (Stewart 1963); fruits have also yielded up to 0.00025% MTCA, as well as THCA (Herraiz 1999). As C. deliciosa, Brazilian trees yielded 0.077-0.197% [w/w] synephrine from unripe fruits, and 0.028-0.087% from leaves (Arbo et al. 2008). Flowers of the 'Dancy' tangerine variety yielded c.0.0019% *caffeine*; flowers of the 'Willow leaf' variety of mandarin yielded c.0.0032% *caffeine*; and flowers of the 'Cleopatra' variety of mandarin yielded c.0.0021% *caffeine* (Stewart 1985). Essential oil contains limonene, geraniol, *citral*, *citronellal* and methyl anthranilate (Lawless 1995); the plant has also yielded nobiletin, 5-demethylnobiletin, ponkanetin, 4,5,7,8-tetramethoxyflavone, 6,7-dimethoxycoumarin, 6,7-dimethylaesculetin, cholesterol, campesterol, stigmasterol and β-sitosterol (Rastogi & Mehrotra ed. 1990-1993).

C. sinensis has yielded *narcotine*, *tryptamine* [0.00001% in fruit pulp], *tyramine* [0.001% from fruit pulp, 0.0006% (w/w) from leaf], N-methyltyramine [0.0007% (w/w) from leaf, 0.0001% from fruit], synephrine [0.016-0.032% (w/w) from leaf, 0.0019-0.148% from fruit (decreasing with maturity), up to 61mg/L in juice, up to 29.8mg/6oz in juice concentrate (highest levels in Murcott variety)], and *norepinephrine* (Dragull et al. 2008; Rimpler 1965; Smith 1977a; Stewart 1963; Udenfriend et al. 1959; Wheaton & Stewart 1970); peel contains 6,7-dimethoxycoumarin (Tatum & Berry 1977); fruit has also yielded up to 0.000188% MTCA, as well as THCA (Herraiz 1999); fruit juice [orange juice] was found to contain 0.02-0.063mg/L trans-1,2,3,4,5-pentahydroxypentyl-THβC-3-carboxylic acid, and 0.1-0.28mg/L of the cis-isomer (Herraiz & Galisteo 2002). The essential oil contains limonene and other terpenes (Erickson 1976). Flowers of the 'Valencia' orange variety yielded c.0.0003% [bud 8mm diam.] to 0.0062% *caffeine* [fully opened flower]; leaves yielded c.0.0006% (Stewart 1985).

C. trifoliata flowers yielded purine alkaloids as for C. limon, but in lesser quantities (Kretschmar & Baumann 1999).

C. unshiu leaf has yielded *bufotenine*, 5-OH-*N*-*methyltryptamine*, (-)-synephrine, (-)-stachydrine, *adenosine*, rutin, narirutin, hesperidin, vicenin-2 and (+)-chiro-inositol. This mixture of compounds acts as an oviposition-stimulant in female 'swallowtail butterflies', Papilio xuthus [see *Endnotes* for chemistry of some Papilio spp.], which feed on some Rutaceous plants (Ohsugi et al. 1991). Fruit juice yielded 54.5-160.2mg/L synephrine (Dragull et al. 2008).

Citrus spp. fruits also contain vitamin C and other nutrients, as well as pectin. *Citral*, found in most Citrus spp. essential oils, can be condensed with olivetol to produce Δ-1-*THC*, when *citral* is present as the trans-isomer [*citral* A, or geranial (not gerianiol)] (Mechoulam et al. 1972).

Citrus reticulata is a small, spreading tree; twigs with single spines in leaf axils, slender. Leaves alternate, simple, coriaceous, thin, narrowly elliptical, lateral veins few; petioles distinctly winged and articulated with the lamina. Flowers usually all hermaphrodite, actinomorphic, solitary or in small axillary clusters, white; sepals 4-5; petals (4-)5(-8); disc present; stamens c.4x as many as petals, free or rarely monadelphous. Ovary superior, usually 10- to 14-locular; ovules in 2 rows; styles as many as carpels, free or connate. Fruit 5-7.5cm diam., depressed-globose; rind thin, easily separated from pulp, bright orange when ripe; pulp sweet, slightly tangy; seeds surrounded by stipitate, fusiform pulp-vesicles.

Much cultivated worldwide.

Members of the genus Citrus can be quite difficult to differentiate taxonomically, particularly due to the wide range of cultivars currently being grown (Tutin et al. ed. 1964-1980). Nitrogen appears to increase synephrine production, whilst manganese deficiency abolishes it (Dragull et al. 2008).

CLAVICEPS, including some Paspalum host grasses

(Ascomycetae/Clavicipitaceae)

Claviceps africana *Frederickson et al.* – African sorghum ergot
Claviceps fusiformis *Loveless* – Pennisetum ergot, bajra ergot, pearl millet ergot
Claviceps gigantea *Fuentes et al.* **(**imperfect stage known as **Sphacelia sp.)** – corn ergot
Claviceps paspali *Stevens et Hall* – Paspalum ergot
Claviceps purpurea *(Fr.) Tul.* – ergot of rye, rye smut, spurred rye, blight kernels, horn seed, mother of rye, mutterkorn, tollkorn ['mad grain'], seigle ivre ['inebriating rye']
Claviceps sorghi *Kulkarni et al.* – sorghum ergot
Claviceps sorghicola *Tsukiboshi et al. sp. nov.* – sorghum ergot
Claviceps spp. – ergots

(Gramineae)

Paspalum dilatatum *Poir.* – paspalum, water couch, caterpillar grass
Paspalum paspaloides *(Michx.) Scrbn.* **(P. distichum** *auct. non L.***)** – jointgrass, knotgrass
Paspalum scrobiculatum *L.* **(P. orbiculare** *Forst. f.***; P. polystachyum** *R. Br.***)** – kodo millet, kodrava, jome
[note: P. distichum *L.* is now considered to be a name not clearly attributable to any particular species (Samorini 2001)]

'Ergots', the best known species being C. purpurea, are fungal parasites on grasses, described by the Assyrians [who knew of its abortive properties] in 600BC as a "noxious pustule in the ear of grain". European midwives have long used it as a uterotonic to bring on birth contractions; ergot has since fallen into disrepute for this purpose due to its toxicity, but ergot alkaloids are still used as vasoconstrictors to stop post-partum haemorrhage. Cases of ergot-poisoning ['ergotism'] have been reported since the Middle Ages, when rye was introduced to Europe as a food crop [C. purpurea being parasitic on rye]. Ergot-infected grains were commonly milled in with 'clean' grains when making flour for bread-making. Those who consumed the resultant bread over time were struck by a violent poisoning manifesting in two forms. 'Convulsive ergotism' included symptoms such as nervous convulsions and epileptic fits; sometimes called 'Saint Vitus' Dance', that name now generally refers to the convulsive symptoms of chorea. 'Gangrenous ergotism' ['ignis sacer' – 'holy fire'] included gangrene, atrophy, and sometimes the loss of extremities. Both usually also involved 'delirium and hallucinations', and were often fatal. The gangrenous form of ergotism was also called 'Saint Anthony's fire', after a hermit who was considered the saint of infection, eplilepsy and fire. Those affected would often make pilgrimages to his shrines to seek a cure. Since the cause of ergotism was discovered, outbreaks have been much less common (Hofmann 1978; Ott 1993; Schultes & Hofmann 1980, 1992). Convulsive ergotism generally develops only in those who also have vitamin A deficiency, or in children, who are more susceptible. Gangrenous ergotism may develop instead in people with adequate vitamin A levels (Spanos & Gottlieb 1976). Lesser poisonings may result in nausea, vomiting, diarrhoea, thirst, restlessness, vertigo, headache, 'heaviness of the head', confusion, vasoconstriction, tachycardia, stimulation or depression of the cardiovascular system, and sometimes coma. Ergot should be avoided by people with liver impairment, hyperthyroidism or sepsis; in pregnancy, it should only be used by professionals in the third stage and not before (Felter & Lloyd 1898; Hobbs 1995).

Convulsive ergotism has been suggested as the cause of the symptoms leading to the infamous Salem witch trials of 1692 (Caporael 1976), though closer inspection of the evidence shows that this is an unlikely explanation (Spanos & Gottlieb 1976). C. purpurea ergot growing on Elymus arenarius [Leymus arenarius], or possibly on imported rye grain, is also suspected of being involved in similar events leading up to the Finnmark [Norway] witch trials in the 1600's. Interestingly, historical periods of epidemic ergotism in Europe coincide with "surges of Jewish mystical movements" (Alm 2003). Ergot has also been considered the cause of a mass-poisoning in France, in 1951 [see **Aspergillus**], despite evidence to the contrary (Ott 1993).

The ancient Greek Mysteries at Eleusis were a yearly initiation ceremony associated with the goddess Demeter, which could be attended only once in a lifetime. They were a sacred ritual celebration of agriculture and fertility, which appear to have been adopted from the Egyptian Isis cult, via Crete. The Lesser Mysteries took place in February at Agrai, where candidates for initiation witnessed re-enactments of myths related to Persephone's kidnapping by Hades [see also **Narcissus**, **Pancratium**]; a psychoactive mushroom appears to have been involved [see also **Amanita**, **Panaeolus**]. The ritual culminated 6 months later in the Greater Mysteries at Eleusis, based around Persephone's rebirth from the underworld. The rites continued for 2,000 years until the 4th century, when they were suppressed by the Christians. Attendees were required to speak Greek, and to stay in Athens for more than half a year and be able to pay for a sacrificial pig and the wages of the guides and priests, before joining the procession of initiates along the Sacred Road to the sanctuary at Eleusis. Once there, the rites took place in a hall ['telesterion'], where the initiates were served a potion [the 'kykeon' – roughly, 'mixture' or 'that which is mixed' in Greek] and beheld wondrous visions, accompanied by physical symptoms of fear, trembling, nausea, vertigo, and cold sweat. Once the initiates had 'seen', they were to tell no-one of what transpired, other than to say they had seen 'the holy'; the price of loose-lips in this case was death. Many great philosophers of science attended the Mysteries, including Plato and Aristotle. C. paspali or a similar visionary ergot-fungus has been proposed to have been the major active ingredient of the Eleusinian kykeon, a possibly 'beer-like' concoction thought to have contained a water infusion of C. paspali infected grain, barley, Mentha aquatica or M. pulegium ['stream mint', 'pennyroyal' – possibly to counteract nausea produced by ergot-alkaloids] and perhaps **Papaver** somniferum. In essence this use of ergot may be feasible, as the more psychoactive and less toxic chemicals of C. paspali are water soluble, whereas the toxic components are not, to any appreciable degree, and Paspalum paspaloides grass infected with C. paspali still grows in the area (Ott 1993; Riedlinger 2002; Samorini 2001; Wasson 1961; Wasson et al. 1978). However, it is now known that P. paspaloides was not introduced to Europe until after Columbus (Heinrich et al. 1999a), so either another grass-host bearing C. paspali was used [unlikely due to the lack of native Paspalum spp., the only known hosts to C. paspali], or other plant/s or fungi were responsible for the entheogenic effects of the kykeon. The central involvement of some kind of ergot does, however, still seem likely based on the known evidence to date (Samorini 2001).

Although no one has reported preparing a theoretical kykeon beverage using ergot, either for chemical analysis or bioassay, it has been proposed that a 'safe' kykeon could have been prepared for the original Eleusinian Mysteries using C. purpurea, generally considered too toxic to ingest. The proposition rests on the observation that hydrolysis of ergot alkaloids in basic solution converts the more toxic ergot-peptides into a mixture of *ergine* and isoergine. This could have been achieved in ancient Greece by boiling the ergot infusion with wood ashes [a source of potassium carbonate]. Excess basicity [which would hinder consumption] could have been neutralised by adding wine or vinegar, or by letting the mixture stand for several days. It was also suggested that fasting before the Greater Mysteries could have increased the subjective CNS effects of such a brew rich in *ergine* and isoergine, which are normally not particularly psychedelic in effect (Webster, P. et al. 2001). Another suggested method involves a beer brewing method thought to have been used in ancient Egypt, except stopping short of fermentation [alcohol was forbidden from the Mysteries]. A blending of two separate concoctions - one consisting of an infusion of malted grain, the other a boiled brew of ergotised grain - strained and drunk shortly after preparation may have produced an active beverage with enough tannin to bind to and inactivate the toxic alkaloids, hopefully leaving the desired alkaloids in solution and not being so rich in tannin to be undrinkable (Riedlinger 2002).

The closest examples we have of humans relatively safely consuming ergot extracts mainly come from the medical literature in days when ergot was still used therapeutically. A tincture of ergot and sodium phosphate used medicinally in the 19th century was found to produce pleasant psychotropic effects when given in moderate doses [5g tincture of ergot, 15g of 1/10 solution of sodium phosphate, poured into sugar water and consumed during a fast]. This may perhaps involve similar chemical conversions to those just mentioned. Oddly, this combined tincture was reported to only reliably produce these effects in women, "especially those of a nervous temperament." It was claimed that the resistence of males to the effects of moderate doses was "in consequence of their being more accustomed to alcohol." Effects were compared to "the slight intoxication produced by light wines and champagne", with "the most exhilarating effects, exciting loquacity and irresistible laughter, which lasted for several hours" (Anon. 1881c). Other medicinal preparations included tincture of ergot [250g powdered ergot to 1 pint proof spirit], ammoniated tincture of ergot [a more complicated, basified extract], infusion of ergot [7g powdered ergot to c.280ml boiling distilled water], fluid extract of ergot [an acidified alcohol extract], extract of ergot [the fluid extract reduced to a thick consistency] and wine of ergot [150g powdered ergot to 150cc alcohol and enough white wine to bring the whole to 1000cc]; these fluid extracts were generally strained of residue before being bottled and stored. Doses were different for different preparations, and depending on what purpose they were being used for, but were generally kept as low as possible, eg. 5-10 drops (Felter & Lloyd 1898). Medicinal doses of the freshly powdered fungus itself may range from 150-500mg (Hobbs 1995). One person with an LSD-tolerance consumed a few sips of a homemade ergot wine, made by infusing ergot in wine and ageing for 10 years or more; its maker did not divulge the quantity of ergot used and was [worryingly] casual and vague about dose. The effects were reported as broadly LSD-like, but with a heavy body load, particularly on the cardiovascular system, and with other side effects reminiscent of those of morning glory seeds [see **Argyreia**, **Ipomoea**, **Turbina**], and afterwards, weakness lasting for

around 10 days (Cole 2005).

Incidentally, ergot-infected specimens of the grasses Eleusine coracana ['finger millet', 'soma'] or Paspalum scrobiculatum ['kodo millet', 'kodrava'] have been proposed as possible identities of the Vedic soma [see **Amanita**]; Setaria indica ['sayamaka'] is also sometimes known as 'soma' in India, and S. italica has reportedly been used as a soma substitute (Ott 1998b). The Indian Pennisetum typhoides ['bajra', 'pearl millet'], a commonly cultivated food plant, is sometimes infected with ergot [often C. fusiformis], and human intoxications from such 'ergoty' bajra have been reported in the state of Maharashtra. Symptoms included "giddiness, nausea, vomiting, diarrhoea, and dehydration", and some fatalities have resulted (Bhat et al. 1976).

In Paraguay, an intoxicating beer is made by the Macai, using honey collected from bees that have fed on the 'honeydew' secretions [see below] of C. paspali infecting Paspalum plicatilum and P. unispicatum. The beer is reported to have 'disruptive effects', and to cause 'vertigo, headaches and drunkenness' (Rätsch 1998; Samorini 2001). P. scrobiculatum, which grows in moist or shady places in tropical and subtropical zones, is known to be toxic after rains, and may cause "deliriums and violent tremors"; it is said that elephants have died from eating it [presumably in large amounts]. The carefully dehusked grains are cooked and eaten as a rice-substitute in India. In West Africa, the plant grows as a weed of rice crops, and is similarly eaten (De Wet et al. 1983; Nadkarni 1976). The Lodha of the Midnapur district, w. Bengal, know P. scrobiculatum as 'jome', and they consume the outer covering of its dehusked grains for "hallucination" (Pal & Jain 1989); it is most likely infected with C. paspali. Dried ethanol extracts of the seed husk have been used to treat 'acutely disturbed schizophrenics' and 'psychotics', and have also been taken by the researchers involved. They found that 20-70mg of the extract was tranquillising and hypotensive, and had low toxicity – some tremors and rigidity occurred for short periods (Deo & Bhide 1961; Deo 1964).

In Queensland, Australia, Paspalum scrobiculatum [as P. orbiculare] has been shown to be infected by an indigenous species, C. queenslandica, as well as by C. paspali. Australian P. dilatatum is frequently found to be infected with C. paspali [but not C. queenslandica] (Langdon 1963), and has been responsible for cattle intoxications (Noble 1985).

Claviceps spp. are very variable in alkaloidal yield and composition, depending on the strain, the host grass and environmental variables. Some contain no alkaloids at all, such as French C. purpurea growing on Glyceria fluitans (Reicher et al. 1983). The alkaloids usually encountered include the ergolines [such as *ergine*, *ergonovine*], clavines [such as *agroclavine*, *chanoclavine*, *elymoclavine*], and ergot-peptides [such as *ergotamine*, ergosine, and including the 'ergotoxines' ergokryptine (ergocryptine), ergocristine, ergocornine]. These alkaloids [particularly the lysergic acid amides] are generally well-known for their potent *serotonin*-antagonist properties, though at levels required for such activity, the peptide alkaloids also stimulate uterine contractions (Cerletti & Doepfner 1958). The ergolines are often used as precursors in the licit or illicit synthesis of d-lysergic acid diethylamide [LSD, LSD-25]. Indeed, it was this factor that brought ergot back into the spotlight last century, ever since Albert Hofmann first synthesised LSD in 1938, in his search for medically-useful ergot-derivatives. LSD itself has not yet been found to occur naturally. For more discussion on some of these alkaloids, see also **Ipomoea** and the *Chemical Index*.

C. africana is an African species, parasitic of Sorghum bicoloris (Frederickson et al. 1991) and S. vulgare; it has recently also been found in India, Thailand, Japan, Australia, and the Americas (Bogo & Mantle 1999). The sclerotia has yielded 0.2-0.5% alkaloids, mostly dihydroergosine, as well as *chanoclavine*, *festuclavine*, and dihydro-*elymoclavine* (Frederickson et al. 1991); dihydroergosine antagonises *serotonin* [with slightly over twice the potency of ergosine] (Cerletti & Doepfner 1958), decreases brain *serotonin* turnover, enhances convulsive effects of picrotoxin in rats, decreases them in mice, shows antiaggressive and possibly antidepressant activity, and appears to act on *GABA* and BZ receptors (Peričić& Manev 1990).

C. fusiformis has been shown to form *agroclavine* [major alkaloid], *elymoclavine*, *chanoclavine*, *festuclavine*, 2-bromo-*festuclavine*, lysergene, isolysergene and 6-nor-*agroclavine* in culture (Banks et al. 1974; Eich & Sieben 1985). See also under C. purpurea below.

C. gigantea growing on corn [Zea mays] in Mexico has yielded 0.026-0.03% alkaloids, which was made up of 65-68% *festuclavine*, 15% dihydro-*elymoclavine*, 7-11% *chanoclavine*, 1.5-3% pyroclavine, 3% *agroclavine*, 0.5% *elymoclavine*, and traces of unidentified clavine alkaloids (Agurell & Ramstad 1965; Agurell et al. 1963).

C. paspali from Australia growing on Paspalum dilatatum yielded 0.001-0.005% alkaloids, consisting of *chanoclavine*, *ergonovine* and *ergine*; American samples from this grass yielded only 0.1-0.25 times this amount. C. paspali growing on P. paspaloides near Rome contained *ergine*, isoergine, lysergic acid methyl carbinolamide and its iso derivative (Gröger et al. 1961); lysergic acid N-1-hydroxyethylamide has also been found (Bock & Parbery unpubl.). Submerged cultures of strain MG-6 from P. dilatatum near Rome yielded 8-OH-*ergine* and 8-OH-erginine during the post-production phase (Flieger et al. 1989), as well as 10-OH-cis- and 10-OH-trans-paspalic acid amide (Flieger et al. 1993). The fungus has also yielded isolysergic acid, lysergic acid α-hydroxyethylamide, its iso derivative, dihydrochanoclavine I, its iso derivative, clavicepamine, paliclavine, paspaclavine, paspalic acid, paspalicine, paspaline [tremorgen], paspalinine [tremorgen], paspalitrems A-C [tremorgens] and aflatrem (Buckingham et al. ed. 1994; Cole et al. 1977). This fungus has been responsible for causing an intoxication known as 'Paspalum staggers' amongst stock animals feeding on infected P. dilatatum; once the animals begin eating it, they develop a liking for it. The mature ergots in this case are considered less toxic than when still in the 'honeydew' stage [see below] (Cole et al. 1977; Hungerford 1990).

C. purpurea has yielded 0.01-0.4% alkaloids [or more], often mainly [c.80%] *ergotamine*, ergokryptine, ergocornine and ergocristine, with smaller amounts of ergosine [*serotonin* antagonist (Cerletti & Doepfner 1958), peripheral vasoconstrictor, raises body temp., inhibits ovulation, oxytocic (Porter et al. 1979)], ergosinine, ergometrinine, ergoptine, ergostine, ergokryptinine, ergobine, ergonine, ergobutine, ergobutyrine and ergovaline; lysergic acid amides represent c.20% or less of the alkaloids, consisting mainly of *ergonovine* [up to 0.23% has been isolated in India] and small amounts of *ergine* and isoergine. Strains vary in their ability to produce decent yields of alkaloids, and also vary in the alkaloids present and their relative proportions. Many other compounds have been found, such as *acetylcholine*, *choline*, histidine, thiolhistidine, *histamine*, *tryptophan*, *tryptamine*, tyrosine, *tyramine*, *phenethylamine*, clavine, clavicepsin, betaine, cadaverine, putrescine, isoamylamine, trimethylamine, agmatine, ergotic acid, ergosterol, ergochrysin, ergoflavin, fungisterol, endocrocin, clavorubin, scelerythin and inorganic salts (Annis & Panaccione 1998; Bruneton 1995; Henry 1939; Lundstrom 1989; Morton 1977; Smith 1977a, 1977b; Taber & Vining 1958).

C. purpurea growing on Arthraxon lancifolius was adapted to grow on rye [Secale cereale], and thus yielded 0.5% alkaloids, consisting of 33% *ergonovine*, 22% ergokryptine, 18.7% ergocornine and 17.6% *ergotamine*. Sclerotia that were slender and elongated yielded [as % of total alkaloids] 59.6% ergokryptine and 11.2% ergocornine (Janardhanan et al. 1982a). Canadian sclerotia on rye yielded 0.011-0.452% alkaloids, consisting mainly of *ergotamine* and ergocristine, as well as *ergonovine*, ergosine, ergocornine and ergokryptine (Young 1981a). Canadian sclerotia on wheat [Triticum vulgare] yielded 0.013-0.307% alkaloids, consisting mostly [46%] of ergocristine and ergocristinine, as well as *ergotamine* [17%], *ergonovine* [7%], ergokryptine [12%], ergocornine [11%] and ergosine [5%] (Young 1981b). Canadian sclerotia on barley [Hordeum vulgare] yielded 0.082-1.04% alkaloids, of similar composition to the above Canadian C. purpurea on wheat (Young & Chen 1982). Dutch C. purpurea growing on a variety of grasses was studied for alkaloids – Dactylis glomerata [0.481-0.753%; 30-40% ergosine, 5-30% *ergotamine*, 10-20% ergocristine, 1-5% *ergonovine*], Arrhenatherum elatius [0.323%; 30-40% ergosine, 20-30% ergocornine, 5-10% *ergonovine*], Molinea caerulea [0.549-0.658%; 30-40% ergocristine, 20-30% ergosine, 5-20% *ergonovine*], Secale cereale [0.321%; 20-30% ergocristinine, 10-20% each of ergocristine and ergotaminine, 5-10% *ergonovine*], **Festuca** arundinacea [0.206%; 20-30% ergocornine, 10-20% ergosine, 5-10% *ergonovine*], **Lolium** perenne [0.221-0.317%; 30-40% ergocornine, 10-20% each of ergosine and α-ergokryptine, 1-10% *ergonovine*] and **Phalaris** arundinacea [0.458%; 30-40% ergosine, 20-30% ergocristine, 5-10% *ergotamine*, 1-5% *ergonovine*] (Reicher et al. 1983). Indian ergot of rye and wheat have yielded 0.07-0.092% alkaloids, consisting mainly of *ergotamine*, as well as *chanoclavine* and ergobasine. A strain of ergot which may have been C. purpurea [more recently claimed to be C. fusiformis – see above], growing on Pennisetum typhoides ['pearl millet'], yielded 0.032-1% alkaloids, comprised of 47.9% *elymoclavine*, 47.6% *agroclavine*, 1.55% *chanoclavine*, 1.3% isochanoclavine, 1.3% *penniclavine*, and 0.07% isopenniclavine (Bhat et al. 1976; Hofmann et al. 1957). Ergot growing on rye [hence probably C. purpurea], Agropyrum spp., Elymus spp. [see *Endnotes*], **Phalaris** spp. and **Phragmites** spp. yielded *chanoclavine* and *festuclavine* (Abe & Yamatodani 1963). Saprophytic cultures of 'Agropyrum-type ergot' [which was originally found growing on Agropyrum semicostatum, **Festuca** rubra and Trisetum bifidum in Japan] yielded *elymoclavine*, *agroclavine*, *festuclavine*, *chanoclavine*, isochanoclavine, pyroclavine and costaclavine (Spilsbury & Wilkinson 1961). Ergot infecting Calamagrostis epigeios, near the Baltic Sea, yielded 0.6% alkaloids, consisting of ergosine [46.6%], ergocornine [38.8%], ergokryptine [14.5%], and traces of water-soluble alkaloids (Kaczmarek et al. 1968). C. purpurea infecting **Lolium**, **Festuca** and other grains has caused intoxications in stock animals (Hungerford 1990).

C. sorghi is a possibly extinct species from India, which grows on Sorghum spp.; sclerotia from archives was shown to contain *caffeine* (Bogo & Mantle 2000). No ergoline alkaloids have been detected in sclerotia, though traces of *agroclavine* have been found in cultured mycelium, and in Burmese herbarium specimens (Frederickson et al. 1991).

C. sorghicola, another parasite of Sorghum spp. [originally from Japan], was cultivated on S. bicolor, and the sclerotia shown to contain [w/w] 0.03% *caffeine*, and [from different specimens] 0.0002% of an unidentified "clavine-like" alkaloid (Bogo & Mantle 2000).

An unidentified Claviceps sp. ['feather ergot'] growing on Spartina alterniflora, S. cynosuroides and S. patens yielded 0.2-1.23% alkaloids, consisting of 25-88% ergokryptine, 9-50% ergokryptinine, 2-20% lysergylvalylmethyl ester, and 1-5% clavines (Eleuterius & Meyers 1977). Another undientified Claviceps sp., growing on Cynodon dactylon ['Bermuda grass'], yielded *ergonovine* [30% of total alkaloids], ergovinine [22% of total alkaloids], *penniclavine* and *chanoclavine* in liquid culture. This grass, when infected with Claviceps sp., has caused an intoxication in cattle known as 'Bermuda grass tremors', symptomised by nervousness and twitching, sometimes accompanied by an apparent inability to walk or stand (Porter et al. 1974). An unidentified Claviceps sp., growing on Panicum antidotale and P. repens in India, yielded 0.68-0.71% alkaloids, consisting mainly of *agroclavine*, *chanoclavine* and *festuclavine* (Janardhanan et al. 1982b).

Paspalum paspaloides from Castlemaine, Victoria [Australia] tested positive for alkaloids (CSIRO 1990).

P. scrobiculatum seed [presumably ergot-infected] tested positive for alkaloids (Fong et al. 1972).

Remember, ergots can be very toxic, and should be handled with great care. Some of their alkaloids may be absorbed through the skin. There are, to my current knowledge, no reports of modern-day ingestion of Claviceps spp.; if you wish to experiment, the fungus should never be ingested directly – rather, a cold-water infusion should be made, and this should be finely filtered before consumption. Be **very careful** with dosage, as unless you have access to testing equipment, you will have very little idea of the concentration or type of alkaloids present. C. paspali would probably be preferable to C. purpurea for experimentation.

Claviceps paspali has yellowish to grey sclerotia, globose, roughened when mature, c.3mm diam., 1-several stromata per sclerotium; stroma erect, capitate-stipitate, fleshy, head of stroma dull yellow; stipe short to medium, 3-15mm; perithecia completely covering head, numerous, ovoid, 340 x 119µ; asci cylindric, unitunicate, 15-175µ long, with a thickened apical cap, 8-spored; spores hyaline, filiform, 101 x 0.5-1µ, multiseptate upon discharge.

Parasitic on Paspalum spp.; has been reported on P. ciliatifolium, P. dilatatum, P. floridanum, P. intermedium, P. laevae, P. langei, P. longipilum, P. notatum [rarely observed], P. paspaloides, P. plicatilum [not forming sclerotia], P. pubescens, P. pubiflorum, and P. urvillei. USA, Central & South America, Hawaii, Australia, New Zealand, China (Hanlin 1990; Langdon 1963; Lefebvre 1939; Sprague 1950), India, Mediterranean.

Claviceps purpurea is parasitic on a large variety of grass spp. – including Agropyrum, Agrostis, Alopecuris, Andropogon, Avena ['oats'], Bromus, Calamagrostis, Dactylis glomerata ['cock's foot'], Elymus [Leymus], **Festuca**, Glyceria, Hordeum ['barley'], **Lolium**, **Phalaris**, **Phragmites**, Poa, Secale ['rye'], **Stipa**, Triticum ['wheat'] and many others (Pammel 1911; Sprague 1950).

An Australian species temporarily named Claviceps phalaridis *Walker*, but not considered to be a true Claviceps sp., has been observed on **Phalaris**, as well as on Dactylis glomerata, Danthonia spp. ['wallaby grass'], Vulpia bromoides ['rat's tail fescue'] and **Lolium** rigidum ['Wimmera rye grass']. The sclerotia are inconspicuous, and therefore difficult to detect in the field without close examination (Walker 1970).

Heavy infestations of ergot occur more frequently in periods of humid but cool weather (Morton 1977). The sclerotia, formed in the inflorescence of the host-grass out of a sticky 'honeydew' phase, falls to the ground when mature in autumn, where it lays dormant until spring ['overwintering']; after a period of cold weather, it sprouts tiny fruiting-bodies, which release spores to re-infect host-grasses and renew the cycle.

CLEMATIS

(Ranunculaceae)

Clematis hirsutissima *Pursh* **(C. douglasii** *Hook.***)** – sugar bowls
Clematis triloba *Heyne.* – moravela, laghukarni
Clematis virginiana *L.* **(C. canadensis** *Mill.***; C. holosericea** *Pursh***; C. lingusticifolia** *Nutt.***; C. missouriensis** *Rydb.***)** – virgin's bower, lady's bower, love vine, traveller's joy
Clematis vitalba *L.* – traveller's joy, vezzandro, hexenfinger ['witches fingers'], hexenhaar ['witches hair'], hexenseil ['witches rope'], hexenwinde ['witches wind']
Clematis spp. – traveller's joy, old man's beard

In Germany, C. vitalba has several common names [see above] that are suggestive of past magical uses (De Vries 1991). In Tuscany, Italy, a decoction of the shoots is sometimes used as a body wash to prevent the 'evil eye' (Pieroni & Giusti 2002). As a Bach Flower Remedy, the herb is used to counter absent-mindedness. The plant juice is said to relieve headaches if taken nasally, but is considered caustic and toxic, and is probably dangerous taken internally (Chevallier 1996). In e. Australia, C. glycinoides ['headache vine'] is sometimes used to treat headaches, by crushing the leaves between the palms of the hands, holding them briefly to warm them, and inhaling the fumes of the plant. However, those with sensitive skin may suffer irritation and sometimes blistering, from crushing the vegetation with bare hands. Of the headache cure, it has been said that "the patient immediately forgets the headache as a minor ailment compared with the sensation of exploding head, smarting nose and watering eyes, which fortunately lasts only momentarily". Sometimes there is no effect, suggesting variation in chemistry due to undetermined factors (Cribb & Cribb 1981).

In India, C. triloba leaves are infused as a sedative and antipyretic (Nadkarni 1976). In Greece, a Clematis sp. [probably either C. cirrhosa or C. sylvestris] was reported to cure a case of epilepsy that had resisted all other treatments (Felter & Lloyd 1898).

C. virginiana and C. recta have been used medicinally in N. America; the fresh bark, leaves, and flowers are the parts used, in the form of a tincture or infusion. In this form they have been taken internally as diuretics and sudorifics, as well as to relieve insomnia, neuralgia, toothache, cystitis, gonorrhoea, and numerous other complaints. An infusion of the dried leaves of C. virginiana has been used as a "nervine in uterine diseases" (Felter & Lloyd 1898). The Iroquois of North America use a stem decoction of C. virginiana as a body-wash, to 'induce strange dreams'. The Nez Perce of n.w. US were reported in the 19th century to insert a peeled root of C. hirsutissima into the nostrils of their horses, as a stimulant to revive the exhausted animals during strenuous races. The Teton Sioux also used the root for their horses, administering it as a snuff when being chased by foes (Morgan 1981; Ott 1993).

This stimulant action may be merely due to the irritant action of the protoanemonin in these plants, in low doses. Many Clematis spp., including C. vitalba, contain the lactinic glucoside ranunculin, which is enzymatically converted to protoanemonin [isomycin; 5-methylene-2(5H)-furanone; 4-OH-2,4-pentadienoic acid γ-lactone] when the fresh plant is bruised. Protoanemonin is a bitter γ-butyrolactone derivative, which causes blistering on contact [see also **Ranunculus**] (Budavari et al. ed. 1989; Chevallier 1996; Harborne & Baxter ed. 1993; Turner & Szczawinski 1991). The irritant/blistering properties are lost when the herb is dried. On drying, protoanemonin is converted to anemonin [1,2-dihydroxy-1,2-cyclobutanediacrylic acid di-γ-lactone]. The structural similarity of protoanemonin to γ-butyrolactone [GBL, which has similar effects to *GHB*] may imply that it could have similarly interesting 'narcotic' effects that could account for the psychoactivity of these plants (Budavari et al. ed. 1989; theobromus pers. comm.). Both protoanemonin and anemonin have shown sedative activity, and anemonin also acts as an antipyretic (Martin et al. 1988).

C. glycinoides from Brisbane [harv. Jul.] and Rockhampton, Queensland [harv. Jan.] [Australia] was found to contain alkaloids in the leaves (Webb 1949).

C. hirsutissima was found to contain anemonin (Kern & Cardellina 1983).

Clematis virginiana is a perennial with stems climbing 2-3m high. Leaves usually trifoliate; lateral and terminal leaflets similar, ovate, acuminate, rarely entire, commonly coarsely toothed with mucronate teeth, occasionally lobed, the uppermost smaller and sometimes simple; petiolules of roughly equal length. Flowers in panicles from many axils, roughly equalling the subtending leaves; sepals white or dull white, commonly 4, oval or oblong, 10-15mm long, pubescent on back, glabrous or pubescent on upper side; petals none; stamens numerous. Ovule 1; style elongate, flexuous, strongly plumose, 2-4cm long. Fruit a flattened achene, terminated by the style, numerous in a globose head, pubescent, c.4mm long.

N.w. United States (Gleason 1952).

Seeds should be sown soon after collection; may also be cultivated by layering, or from cuttings taken before the late spring flowering period (Burras ed. 1994).

CLERODENDRUM [Clerodendron]

(Verbenaceae)


CLERODENDRUM FLORIBUNDUM

Clerodendrum floribundum *Hort. ex Schau.* **(C. emirnense** *Bojer ex Hook.***)** – buwatanganing, dutji, milorrk, marbordalla, lollybush, smooth spiderbush, smooth clerodendrum
Clerodendrum glabrum *E. Mey.* **(Siphonanthus glabra** *(E. Mey.) Hiern***)** – Natal glory bower, white cat's whiskers
Clerodendrum ovalifolium *Engl.* – ngula
Clerodendrum polycephalum *Baker* – fani koron lafra
Clerodendrum serratum *(L.) Moon* **(Rotheca serrata** *(L.) Steane et Mabb.***; Volkameria serrata** *L.***)** – bharangi, bala, kaattu yerukku, neera thekku, siru thaeku
Clerodendrum trichotomum *Thunb.* – chou-wu-tong, kusagi, harlequin glory bower, peanut butter tree

In Australia, C. floribundum and C. ovalifolium are mixed with ashes and chewed as stimulants. The former is used as such in the Northern Territory, and the latter in n.w. districts of Western Australia. C. floribundum has also demonstrated many medicinal uses, differing slightly from tribe to tribe. Generally, a decoction is made from 3-6 young leaves, which is then applied externally for sores or itchy skin, or taken internally to treat headache, backache, internal pains, diarrhoea, colds and bronchial congestion. The plant has shown analgesic, decongestant, antidiarrhoeal and antipruritic effects (Aboriginal Communities 1988; Lassak & McCarthy 1990; Low 1990).

Many other Clerodendrum spp. are used medicinally in the regions where they grow, particularly in Asia and s.w. Pacific. Uses include treatment of fevers, malaria, dropsy, venereal diseases, scabies and internal parasites (Lassak & McCarthy 1990; Low 1990).

In n. Thailand, C. serratum is used by hill tribespeople as an aphrodisiac stimulant (Anderson 1993). The roots of this species have been used as an analgesic, antiinflammatory and antipyretic, activites which have also been demonstrated in animal studies (Narayanana et al. 1999). The leaves of C. trichotomum are used medicinally in China as an antihypertensive, sedative, analgesic and antinflammatory. They have been used to treat rheumatic arthritis, asthma and bronchitis (Zhu et al. 1996a). In S. Africa, C. glabrum is known to be soporific, and the leaf is used by the Lobedu to relieve convulsions in children (Watt 1967). The Fang of Guinea use C. splendens leaf in the form of nose drops, to treat cerebral malaria (Akendengué 1992). The Yoruba used C. polycephalum leaves as a 'virility medicine' (Verger 1995).

C. floribundum was chemically screened, but no alkaloids, essential oil or saponins were found in leaf or stem of the samples examined. The leaves contained 1% tannin, but no active principles were isolated (Aboriginal Communities 1988).

C. indicum and C. infortunatum leaves have yielded scutellarein-7-O-glucuronide and hispidulin-7-O-glucuronide (Subramanian & Nair 1973).

C. multiflorum leaves have yielded scutellarein [6-OH-*apigenin*; see **Scutellaria**], 4',6-dimethylscutellarein [pectolinarigenin] and (24S)ethylcholesta-5,22,25-trien-3β-ol (Rastogi & Mehrotra ed. 1990-1993).

C. tomentosum leaf from Rockhampton, Queensland [Australia], harvested in January, tested positive for alkaloids [HCl extract]; leaves harvested from Jandowae, Qld [harv. Jun.] gave negative tests [Prollius fluid extract] (Webb 1949).

C. trichotomum has yielded the indole alkaloid trichotomine from its fruits [bronchodilator, hypotensive, sedative], as well as diterpenoids and flavonoids. Extracts have shown binding to opiate, 5-HT1, *adenosine*-1, α-2-adrenergic, *histamine*-1 and *GABA* receptors (Harborne & Baxter ed. 1993; Kapadia et al. 1977; Zhu et al. 1996a, 1996b).

Extracts of C. bungei and C. mandarinorum root barks [from s.w. China] have been screened for receptor-site binding. Both extracts showed binding at α-1 and α-2 adrenergic, 5-HT1, 5-HT1a, 5-HT2, *dopamine*-1, *adenosine*-1, *GABA*a, *GABA*b, and opiate receptor sites; C. mandarinorum also exhibited β-adrenergic, *dopamine*-2 and *histamine*-1 binding (Zhu et al. 1996a, 1996b).

Clerodendrum floribundum is a small, sparse tree to 5m tall; bark light grey to brown, corky, fissured. Leaves opposite, broadly ovate-elliptic, widest near base, prominent central and lateral veins, 3-15 x 3-10cm; petioles 7cm long. Inflorescences many-flowered terminal or axillary cymes; calyx red, fleshy, 5-lobed, lobes 4-6mm long, persistent, spreading; corolla salverform, tube narrowly cylindric, straight or incurved, +- equal in diameter throughout, limb 5-parted, spreading or subreflexed; stamens 4, exserted, didynamous, alternate with corolla lobes, involute in bud; anthers opening by longitudinal slits. Ovary imperfectly 4-celled, 4-ovulate; pistil 2-carpellary; stigma shortly 2-fid. Fruit a drupe, shiny, black, 1cm diam., globose or ovoid, usually 4-sulcate, exocarp +- fleshy, endocarp bony, separating at maturity into 4 pyrenes, or sometimes cohering in pairs.

In a range of habitats, including monsoon vine thickets, open forest and woodland; all regions of Northern Territory [Australia] (Aboriginal Communities 1988; Gleason 1952 [for some genus detail]).

COFFEA

(Rubiaceae)

Coffea arabica *L.* – Arabian coffee, Abyssinian coffee, Brazilian coffee
Coffea brevipes *Hiern*
Coffea canephora *Pierre ex Froehner* **(C. arabica var. stuhlmannii** *Warb.***; C. canephora var. robusta** *(Linden) A. Chev.***; C. maclaudi** *A. Chev.***; C. robusta** *Lind.***)** – Congo coffee, robusta coffee, Rio Nunez coffee
Coffea canephora var. nganda *Haarer* **(C. kouilouensis** *Pierre***)** – Nganda coffee
Coffea dewevrei *De Wild. et Dur.* – rainforest coffee
Coffea kianjavatensis *Leroy*
Coffea liberica *Bull ex Hiern* **(C. abeokutae** *Cramer***; C. excelsa** *A. Chev.***)** – Liberian coffee, Monrovia coffee, Lagos coffee, abeokuta coffee, shari coffee, large-seeded coffee, bawfili, coocoon
Coffea mauritiana *Lam.* **(C. sylvestris** *Willd. ex Roem. et Schult.***)** – café marron, café pays, kafe pei
Coffea racemosa *Lour* – inhamban coffee
Coffea stenophylla *G. Don* – bush coffee, Sierra Leone mountain coffee, narrow-leaved coffee

Coffee may have been cultivated [and its berries chewed] in Ethiopia as early as c.500AD. Yemeni sufis were said to have discovered the technique of roasting the beans; they still value it to maintain concentration in long prayers or other rites, and to aid in entering 'ecstatic' states. Early on, coffee was often drunk with other herbs that added to its flavour and stimulating effect, such as 'cardamom' [Elettaria cardamomum], 'betel' [see **Areca**], 'cinnamon' [see **Cinnamomum**] and 'ginger' [see *Endnotes*]. Some Bantu-speaking peoples use it as a ritual drink, and it is often taken with **Cannabis**. In Ethiopia, C. arabica is taken by poor people as a leaf or seed-epidermis infusion, and in Tanganyika, the plant matter of C. canephora is chewed. C. arabica supplies c.80-90% of the world's coffee, and is cultivated in tropical regions all over the world; C. canephora and C. liberica supply much of the remainder. The cheaper C. canephora is usually used to make instant coffees, and C. liberica, which makes a bitter brew, is largely used as a filler in blends of different types of coffee. In Africa, many species are used locally as well to make coffee, including C. brevipes, C. canephora var. nganda, C. dewevrei, C. racemosa and C. stenophylla (Briandet et al. 1996; Burkill 1985-1997; Rätsch 1998). The beverage prepared from C. mauritiana is claimed to be bitter and intoxicating (Iricaf undated).

Coffee berries are harvested when deep red, and are initially put in water to separate the over-ripe berries [which float]. The remaining berries are gently 'pulped' to release the beans, which are soaked for 24 hours to remove the slimy coating; they are then rinsed thoroughly and dried to a water content of c.11%, and then dehusked before roasting. Sometimes

beans are stacked to ferment earlier in the process, and drying/fermenting may be carried out in the sun. Fermentation is said to improve the flavour of the resultant coffee; it also increases the *caffeine* content through metabolism of nucleic acids. Beans may be roasted at up to 200°C for c.15 minutes, then cooled rapidly, left to stand overnight, and packed for storage. In roasting, beans should be heated evenly; also, temperatures should be kept as low as possible, and roasting as brief as possible, so as not to burn or over-roast. Instant coffees are mostly made from low grade C. canephora beans; they are usually manufactured by drying a liquid concentrate of freshly brewed coffee (Dowell & Bailey 1980; Lehane 1977; Schapira et al. 1975; Suzuki et al. 1992). Coffee beans must be ground for use, and then they may be decocted or percolated; some finely ground coffees can simply be steeped to brew an inferior beverage ['plunger coffee']. Alternately, if you really love the taste of coffee, you can chew the beans. Chocolate-coated coffee beans [see **Theobroma**] are also widely available and very popular with students in Melbourne, Australia (pers. obs.).

Coffee is a CNS-stimulant, vasodilator, bronchodilator, respiratory and circulatory stimulant, local irritant [due to the volatile oil], diuretic and laxative. It interferes with digestion, but can allay nausea in moderate amounts; it also can increase the effects of some analgesics, possibly due to the enzyme P450-inhibiting capacity of *chlorogenic acid*, caffeic acid, and some related polyphenols. Recently inhibition of MAO-A and B has been noted. Excessive doses [more than several cups in one sitting] can cause nervous agitation, insomnia, hypertension, nausea, sweating, confusion, and even indistinct colour hallucinations. Heavy coffee users [5 or more cups a day] report less insomnia when drinking it at night than lighter users; they also experience greater withdrawal symptoms, such as irritability, nervousness, lethargy, headache and inability to concentrate (Bremness 1994; Goldstein & Kaizer 1969; Herraiz & Chaparro 2006; Lehane 1977; McManamy & Schube 1936; Morton 1977; Rätsch 1992; Teel & Huynh 1998; pers. obs.). Coffee is sometimes administered by enema – there are reported deaths from frequent coffee enemas in people undergoing special diets (Eisele & Reay 1980).

A cup of coffee brewed from ground beans may contain 39-190mg of *caffeine*; a cup of instant coffee 29-99mg; and a cup of decaffeinated coffee 0-75mg (Gilbert et al. 1976). Freeze-dried instant coffee has yielded 4.5-5.1% *caffeine* and 5.2-7.4% *chlorogenic acid* [NOT per cup] (Briandet et al. 1996). Brewed coffee of various kinds may contain up to 210µg/l β-carbolines, mostly *norharman* with smaller amounts of *harman*; these appear to be formed during roasting (Alves et al. 2007; Herraiz 2002, 2004; Herraiz & Chaparro 2006).

Roasted coffee beans of unspecified origin have yielded 0.8-1.5% *caffeine*, 2-4% *chlorogenic acid*, 1% trigonelline, 0.02% *choline*, and 2% essential oil (Lindner 1956). Green coffee beans may contain c.8% non-volatile acids, c.7% of which is *chlorogenic acid*, as well as citric, tartaric, malic and oxalic acids; roasting decomposes c.40% of this, and also gives c.5% caffeic acid, 0.5% quinic acid, 0.35% acetic acid, 0.1% propionic acid, 0.2% butyric acid and 0.2% valeric acid as by-products (Morton 1977). The green beans also contain 0.2-0.3% 'coffee wax' externally, which was found to contain Nβ-alkanoyl-*serotonin* [C-5-HT], which was in turn found to consist of C-5-HT homologues [Nβ-arachidoyl-*serotonin*, Nβ-behenoyl-*serotonin* and Nβ-lignoceroyl-*serotonin* in a ratio of 12:12:1]. A stearoyl-homologue was also mentioned as being found, but not included in this ratio calculation. The wax was also found to contain traces of Nβ-(20-OH-arachidoyl)-*serotonin*, Nβ-(22-OH-behenoyl)-*serotonin* and *caffeine* (Folstar et al. 1979, 1980). Sucrose and trigonelline are largely degraded during roasting, and nicotinic acid is formed. Severe roasting may result in a loss of c.5.4% of the *caffeine* present (Trugo & MacRae 1989).

Leaves of unspecified commercial Coffea sp. have yielded 0.087-0.86% *caffeine* (Power & Chesnut 1919a). Species which contain *caffeine* contain it throughout the plant – average concentrations have been given as 0.3% in leaf, 0.04% in twig, 0.01% in stem, and 0.01% in root (Burkill 1985-1997).

C. arabica beans have yielded 0.72-3% *caffeine*, *theobromine*, xanthine, *guanine*, trigonelline, mannitol, caffetannic acid, sitosterol, kahweol, tannin, sucrose and fats [also other compounds – see above and below]; pericarp has yielded 0.35% *caffeine*. Leaves and fruits contain xanthine, hypoxanthine, *guanine*, adenine, vernine, and small amounts of *caffeine* [0.8% has been found in leaves of Egyptian trees]; stalks and small branches have yielded 0.15% *caffeine*; flowers may contain up to 0.9% *caffeine* (Balbaa et al. 1976; Chopra et al. 1965; Morton 1977; Schermerhorn et al. ed. 1957-1974).

C. canephora beans have yielded 2-3.21% *caffeine* (Burkill 1985-1997; Morton 1977). They can be distinguished from C. arabica in commercial samples by the presence of 16-O-methylcafestol, which is not found in C. arabica; also, C. canephora roasted beans contain higher levels of *caffeine*, *chlorogenic acid* (Briandet et al. 1996) and β-carbolines (Alves et al. 2007).

C. kianjavatensis beans have yielded 0.55-0.81% *caffeine*, 5.9% caffeoylquinic acids and 0.69% dicaffeoylquinic acids (Clifford et al. 1991).

C. liberica beans have yielded 1.4-1.6% *caffeine* (Burkill 1985-1997; Gilbert 1986); they have an inferior taste (Dowell & Bailey 1980).

C. mauritiana beans have yielded 0.07% *caffeine* (Clifford et al. 1991).

Coffea arabica is a glabrous evergreen shrub or small tree to 5m; branchlets compressed. Leaves evergreen, opposite (rarely in threes), 10-20cm long, shining, with conspicuous lateral veins, oblong-elliptic, apex shortly acuminate; stipules broad, interpetiolar. Flowers clustered in leaf axils, or in condensed 1-2-nate axillary cymes, appearing with leaves, white, fragrant, tubular; bracteoles often connate; calyx-tube short, limb short, often glandular, persistent; corolla 85-130mm long, 5-lobed, lobes 10-15mm long, spreading, twisted in bud; anthers 4-7, sessile, often recurved or twisted. Ovary 2-celled; style slender, bifid at apex; ovules solitary in each cell, peltate on septum. Drupe oblong, 1.3-1.9cm long, red when ripe, skin smooth, glossy, tough, flesh soft, mucilaginous; containing 2 plano-convex or ventrally concave hard pyrenes, or beans, to 1.3cm long, flattened and grooved on inner side, grey-green or grey-blue, enclosed in silvery, membranous testa (Chopra et al. 1965; Morton 1977).

C. arabica requires moderate rainfall, and a temperature +- constant at around 30°C. Flowers open 3-4 years after planting, and berries ripen 6-9 months later. C. canephora is more adaptable, and more resistant to insects and diseases. It gives larger yields than C. arabica, but the berries take longer to ripen [2-3 months more], and do not drop from the tree even when over-ripe; the taste is said to be inferior, as stated above.

Coffee trees can be grown from cuttings, but seed propagation is the usual method. Seeds germinate in 4-8 weeks [up to 3 months according to other sources]; they may be sown where they are to grow, in prepared ground, or they are grown in nurseries and transplanted when 6-24 months old. Spacing is 1.5-3m apart. Unshaded trees give higher yields, and regular fertilisation and weeding are needed.

The soil around a coffee tree gradually becomes rich in *caffeine* from fallen plant matter; thus the soil is rendered +- toxic, and coffee plantations degenerate after 10-25 years or more for this reason (Gilbert 1986; Morton 1977).

COLA

(Sterculiaceae)

Cola acuminata *(P. Beauv.) Schott et Endl.* **(Sterculia acuminata** *P. Beauv.***)** – cola nut, kola nut, guru nut, bissy nut, obì, abata

Cola anomala *K. Schum.* – Bamenda kola

Cola ballayi *Cornu ex Heckel*

Cola cordifolia *(Cav.) R. Br.* **(Sterculia cordifolia** *Cav.***)** – ntaba, bambana taba

Cola nitida *(Ventenat) Schott et Endl.* **(C. acuminata var. latifolia** *K. Schum.***; C. vera** *K. Schum.***; Sterculia nitida** *Vent.***)** – cola nut, kola nut, guru nut, bissy nut, obì

Cola verticillata *(Thonn.) Stapf ex A. Chev.* **(Sterculia verticillata** *Thonn.***)**

The cola [also spelled 'kola'] nut, an important stimulant in w. Africa, was said to have been brought to earth long ago by the creator, who on one visit left behind a piece he had been chewing. This was noticed by a watching man who, despite the warnings of a woman, placed it in his mouth and began to enjoy it. The creator came back soon after to look for the missing cola nut, and forced the man to give it back by pressing his finger against the man's throat – this is said to be why men have a projecting larynx (Rätsch 1992).

In their natural range of tropical Africa the nuts [or rather, the embryo of the seeds] of C. acuminata or C. nitida are chewed fresh or boiled into a drink that acts as a tonic, stimulant, aphrodisiac and diuretic. They are known to relieve fatigue, depression and headaches, give stamina, improve digestion, stimulate the cariac and respiratory systems, and allay appetite and thirst. The nuts are often preferred over coffee [see **Coffea**] and tea [see **Camellia**] as a stimulant. Taken with alcohol, a single nut is reputed to prevent drunkenness. Sometimes they are used as divinatory objects, as currency, as gifts for the gods, or as simple gifts to friends. Exchange or splitting of nuts is usually seen as a special gesture of friendship. Amongst the Yoruba of w. Nigeria, priests of Ifà [god of divination] use the nut for divination by splitting it into its four cotyledons, then throwing them to the ground. The number of pieces falling hollow side up determines the reading – 4 signifying good luck, 3 signifying wealth, 2 signifying scattering, 1 signifying health and success, and 0 signifying impending opposition. The nuts also yield a red dye (Bremness 1994; Burkill 1985-1997; Christy 1883; De Smet 1998; Emboden 1979a; Rätsch 1992; Verger 1995). The Yoruba also use C. verticillata as a stimulant, though they prefer C. acuminata. In general, older nuts are held in higher esteem, as are white or pink nuts which are kept to give to special guests. The Nso of the highlands of Cameroon have reportedly made extensive use of C. anomala nuts, in the same manner as other cola nuts. It was often consumed in palm-wine [see *Methods of Ingestion*] drinking sessions (De Smet 1998). The introduction of cola trees to India has led to their use as a stimulant nervine tonic there, as well (Nadkarni 1976).

In Sierra Leone, C. nitida leaves are macerated with salt and infused to treat asthma and diarrhoea (Lebbie & Guries 1995). C. cordifolia is

used as a remedy for leprosy (Watt & Breyer-Brandwijk 1962). C. acuminata and C. nitida nuts are much used in flavouring throughout the world [though nowadays synthetic flavours are more often substituted], and flavour Coca-Cola™, along with coca-leaf extract [see **Erythroxylum**].

Cola nuts from C. acuminata or C. nitida may contain [1.5-]2.35-3[-3.5]% *caffeine* [2.2%, based on dry weight, in fresh seed; 2.24% in dry seed; 2.38% in lyophilised fresh seed], 0.2-0.9% *theobromine*, 5% 'kola red' [an anthocyanin pigment], d-catechol, l-epicatechol, d-gambir-catechol, dl-gambir-catechol, 0.25% betaine, dextrose, cycloartenol, 24-methylenecycloartenol, 1.28-3% fixed oil, a volatile oil, and tannins. Fresh seeds contain greater amounts of catechins, which alter the effects. When dried, a small portion of the *caffeine* becomes bound with catechin and tannins; when fresh seeds are lyophilised, most of the *caffeine* present becomes bound. Administration of a fresh seed extract to rats caused EEG frequencies to predominate in the 7-10Hz spectrum, whilst *caffeine* alone caused dominance in the higher frequencies (Lindner 1956; Maillard et al. 1985; Nadkarni 1976; Rastogi & Mehrotra ed. 1990-1993; Schermerhorn et al. ed. 1957-1974; Vaille et al. 1993; Watt & Breyer-Brandwijk 1962).

C. ballayi nuts contain *caffeine* (De Smet 1998). Due to their uses, it is likely that C. anomala and C. verticillata nuts also contain *caffeine* (pers. obs.).

C. cordifolia has been found to contain *caffeine* (Watt & Breyer-Brandwijk 1962).

Cola acuminata is a forest tree, very similar to C. nitida, up to 22m tall. Leaves alternate, entire, oblanceolate to narrowly oblong or elliptic, sometimes narrowly obovate, up to 22 x 8cm, apex gradually long-acuminate, acumen often twisted downwards, base cuneate or rounded. Indumentum on inflorescence often comparitively sparse and free; inflorescence puberulous, up to 9cm long; flowers hermaphrodite or unisexual, actinomorphic, up to 2(-3)cm long, whitish, in dense clusters; sepals valvate, mostly partly connate or rarely spathaceous; petals 5, or absent, contorted-imbricate, often hooded; stamens free or connate into a column, sometimes with staminodes; anthers 2-celled, in 2 whorls. Ovary superior, of 2-12 united carpels or of 1 carpel; ovules on axile placentas; style simple or rarely free to the base. Fruiting carpels russet-brown or olivaceous, rough to touch due to minute indumentum, not nobbly, up to 20 x 6cm, narrowed to apex, upper suture not conspicuously ridged, apex not deflexed; seeds up to 14 per carpel, each seed with (2-)3-4(-6) cotyledons.

Sometimes cultivated; native to Togo (Hutchinson & Dalziel 1954-1972).

COLEUS [including Plectranthus, Solenostemon]

(Labiatae/Lamiaceae)

Coleus aromaticus *Benth.* **(C. amboinicus** *Lour.***)** – asmantaka, patherchur, patharkuchi, amlakuchi, amroda, kurpurvalli, country borage, Indian borage

Coleus blumei *Benth.* **(C. atropurpureus** *Benth.***; C. scutellarioides** *(L.) Benth.***; Plectranthus blumei** *(Benth.) Lawnert***; Solenostemon blumei** *(Benth.) Maza***; S. scutellarioides** *(L.) Codd.***)** – el nene ['the child'], el ahijado ['the godson'], maconha, cimorilla, timorilla, painted nettle, many cultivar names incl. 'Flame dancer'

Coleus forskohlii *(Poir.) Briq.* **(C. barbatus** *Benth.***; Plectranthus barbatus** *Andr.***)** – gurmal, garmalu, mainmul, makandi, boldo, boldo falso

Coleus pumilus *Blanco* **(**often referred to as **C. pumila; C. acuminatus** *Benth.***; C. rehneltianus** *Berger***)** – el macho ['the male']

[Note – many, if not all, Coleus spp. have recently been transferred to Plectranthus and Solenostemon]

Introduced to the Americas at an early date, C. blumei and C. pumilus attracted attention during field investigations into the use of **Salvia** divinorum in Oaxaca, Mexico. A Mazatec informant reported that C. pumilus, and two varieties of C. blumei ['el nene' and 'el ahijado'], were used for the divinatory properties of their leaves, in the same manner as **Salvia** divinorum. Later field work failed to find confirmation for this use, and researchers were told the plants were only ornamental (Schultes & Hofmann 1980, 1992; Wasson 1962). It would not seem unlikely if Mazatec people who knew of the use of Coleus had since decided not to divulge any more information. It is to be remembered that in cases where the indigenous use of sacred plants has been reported [such as with **Psilocybe** and **Lophophora**, both prominent Mexican examples], an influx of drug-enthusiasts has often followed, creating unwelcome disruption of the small communities where such use is often based, as well as inviting police harassment.

Apparently, as 'maconha', C. blumei is smoked as a **Cannabis** substitute by the Macumba of Brazil in their ceremonies, the purpose of which is to enter a trance in order to open one's self up to their deity (Rätsch 1992). In n.e. Peru the leaves are used externally as an antiinflammatory, but are believed to be too toxic to take internally (De Feo 2003). It is also used in Samoa as a remedy for elephantiasis (Ott 1993), and it treats dysentery and digestive problems in Ayurvedic medicine, along with C. aromaticus and C. malabaricus. Coleus spp. are known collectively under Ayurveda as 'pashanabhedi', and may treat asthma, coughs, slow and painful urination, piles, convulsions, heart diseases and insomnia, amongst other uses. The tuberous roots of C. forskohlii are pickled and eaten as a condiment in India (Nadkarni 1976; Perry & Metzger 1980; Valdés et al. 1987b), as are the leaves. The plant is antispasmodic, dilates bronchioles and blood vessels, increases circulation to the brain, lowers blood pressure, and acts as a heart tonic. The leaves and roots are harvested in autumn (Ammon & Muller 1985; Bone 1996; Chevallier 1996). As C. barbatus, it has been used to procure abortion; this has also been demonstrated as effective in rats (Almeida & Lemonica 2000).

C. aromaticus is known to be intoxicating, stimulant and antispasmodic in India, and the leaves are also used there in a popular culinary dish called 'bajeh'. In China, the plant is used to treat epilepsy and convulsions (Kirtikar & Basu 1980; Nadkarni 1976; Perry & Metzger 1980). In Tanganyika, C. kilimandschari is used by the Shambala to treat convulsions in children (Watt 1967). In New Britain, Papua New Guinea, C. atropurpureus is used in rain magic (Paijmans ed. 1976). A closely related plant, tentatively identified as a Plectranthus sp., is used by the Nkopo of PNG in rituals to create harmony with natural forces (Schmid 1991). Sap from the closely-related Solenostemon latifolius is used in the Congo as a cardiac sedative, and to ensure nightmare-free sleep. In Tanganyika, the leaves are used for 'reviving' (Burkill 1985-1997), presumably for those who have fallen unconscious or stuporous.

Few people have tried ingesting Coleus spp. for psychonautic purposes, and of those who have, there are conflicting reports. Most people swear that Coleus spp. are inactive, some swear that they can be psychoactive. Most experiments have centred on C. blumei, which exists in many horticultural forms, and may be expected to exist in different chemical races. Also, the mode of administration may have been inappropriate in some instances, as the leaves do not seem to be noticeably active via the oral route. They may show activity with sublingual administration [keep 1 or more large, thoroughly chewed leaves under the tongue for 20-30min.], or with smoking. Myself, and some others, have had definite psychoactive results. My single experiment involved smoking a dried alcohol extract, which had been evaporated onto a small amount of the original leaf as a binder. The solution had been left for 3 days with occasional shaking; the amount of dried extract smoked was the size of a small pea. Effects were much milder than those of **Salvia** divinorum, though I felt strongly 'stoned' for at least 30 minutes (pers. comms.; pers. obs.).

C. aromaticus leaf has yielded 0.3% essential oil, consisting mostly of carvacrol [60.1%] and β-caryophyllene [20.6%], as well as 5.3% p-cymene, 4.3% γ-terpineol, 3.2% humulene and traces of other compounds; *eugenol* and *methyleugenol* have also been reported, but not from Javan plants (Bos et al. 1983). As C. amboinicus, the leaves yielded the flavonoids *apigenin*, salvigenin, luteolin, quercetin, taxifolin, 6-MeO-genkwanin, chrysoeriol and eriodyctiol (Brieskorn & Riedel 1977). The chewed fleshy leaves had a mild stimulating and euphoric effect in one psychonaut, which he compared to the effects of *borneol* (theobromus pers. comm.).

C. blumei has yielded rosmarinic acid (Buckingham et al. ed. 1994), 5,6,7-trihydroxyflavone, scutellarein [6-OH-*apigenin*], cyanidin-3,5-diglucoside, pelargonidin-3-glucoside, nonacosane, hentriacontane, dotriacontane, tritriacontane, pentatriacontane, β-sitosterol and stigmasterol (Rastogi & Mehrotra ed. 1990-1993). In the process of analysis for *salvinorin A*, the leaf extract was shown to be rich in components, but their identities were not pursued as none were similar to *salvinorin A* (Gruber 1997).

C. forskohlii tubers have yielded c.0.1-0.3% [c.0.05% in whole plant] of the diterpene forskolin [coleonol], which has spasmolytic, bronchodilating, cerebral-vasodilating, hypotensive, and cardiotonic activity. It lowers intraocular pressure, inhibits platelet aggregation, and activates the enzyme adenylate cyclase, causing increased thyroid secretion, adrenal steroid synthesis, and *adrenocorticotropin* release from pituitary (Ammon & Muller 1985; Bone 1996; Valdes et al. 1987b). Forskolin is reputed to be psychoactive, in a similar way to other diterpenoids found in **Salvia** and **Scutellaria** (friendly pers. comm.).

Coleus blumei (generally) is an annual herb or shrubby perennial, 30cm to 3m or more; stems and branches square, slightly succulent, often coloured (usually pale translucent green), angles generally obtuse, joints often hairy. Leaves rhomboid-ovate, deltoid-ovate, linear to lanceolate, 0.5-25cm wide, 1-30cm long, becoming smaller and cuspidate ascending upper flowering stems, margins incised or serrate, sometimes digitately lobed, sometimes entire, apex acuminate to acute, base attenuate to cordate, membranaceous, pubescent or subglabrous on both surfaces, green or yellow-green, frequently blotched, spotted or striate with purple, brown, red, pink, white, often uniform purple on underside; principal nerves partially raised on underside only; petioles usually pubescent at sides, 0.5-8cm long. Inflorescence terminal whorled racemes, panicles or cymes, sometimes branched, 10-60cm long, with bracts, shedding after

pollination; calyx 2-3mm long, oval, broader at base, bell-shaped, usually very pubescent outide, glabrous inside, upper lobe entire and oval with downturning edges, lower lip 3-parted, middle lobe parted into 2 triangular pointed teeth protruding beyond the other, side lobes shorter and oval-ended, closing inwards and retaining nutlets after pollination; corolla violet, very occasionally bluish-white, funnel-shaped, protruding downwards, curved or more often sharply bent and refracted, 4-6mm long, limb double lipped, upper lip short and broad, erect, 3-cleft, lower one extended, boat-shaped, bearing stamens and style; stamens 4, united into a tube for more than ½ their length, encompassing the style; style protruding beyond the anthers, bearing a 2-fid stigma. Nutlets 4, black or dark brown flattened spheres, c.1mm diam. (Pedley & Pedley 1974).

Native to Java; widely cultivated as an ornamental. Much variation exists in appearance due to the many different cultivars. This species itself is apparently a hybrid of other species – today, many people do not even consider C. blumei to be a valid species designation.

Grows best in strong, indirect light in warm, rich, loose, well-drained moist soil. Start seeds indoors in flats of fine soil covered with glass or plastic; sow thinly and cover with a thin soil layer. Transplant to pots or garden when large enough to handle. Can also be grown from cuttings. Frost- and shock-sensitive. Needs high-N fertilisation in spring and summer, though do not overfertilise. The combustion fumes of city life often contribute to excessive leaf-dropping (Pedley & Pedley 1974; pers. exp.).

CONIUM

(Umbelliferae/Apiaceae)

Conium maculatum *L.* **(C. cicuta** *Neck.***; C. maculosum** *Pall.***; Cicuta major** *Lam.***; Ci. officinalis** *Crantz***; Coriandrum cicuta** *Crantz***; Cor. maculatum** *Roth***; Selinum conium** *Krause***; Sium conium** *Vest***)** – koneion, hemlock, spotted sorobane, spotted hemlock, poison hemlock, poison parsley, winter fern, herb bonnet, beaver poison, Musquash root, kurdumana, wašia, kex [a name for all similar Umbelliferae in Lincolnshire, UK]

Hemlock is an ancient poisoner's herb, sacred to Hecate [Greek goddess of magic, who protects travellers at night]. It has been used since ancient times as a medicine, anaphrodisiac and incense. A decoction of the unripe seeds in wine or opium wine [see **Papaver**] was a means of execution [either official or illicit] with the ancient Greeks. Socrates was said to have chosen hemlock as his drink of death. Besides having been an ingredient in some witches flying ointments [see *Methods of Ingestion*], hemlock has been used magically to induce astral projection, and in spells to banish sexual desires. Its juice was also rubbed on ritual knives and swords to empower and purify them before use. A German folk tradition tells that hemlock was home to a toad [see **Bufo**], which lived under the plant and sucked its venomous properties from it. In the Middle Ages, the sedative action of hemlock was used to counter conditions such as epilepsy, mania, and 'St. Vitus' Dance' [an old term for the convulsive stage of ergot poisoning – see **Claviceps**; today it refers to the symptoms of chorea]. In India, the plant is considered aphrodisiac [in contrast to the anaphrodisiac properties the herb is usually known for – perhaps a matter of dose?], and is used to treat painful skin conditions. The root has been recommended for gout, but today is given only in homoeopathic doses for prostate problems and thickened arteries (Bremness 1994; Cunningham 1994; Jordan 1992; Nadkarni 1976; Rätsch 1992). The Tarahumara of n. Mexico know this introduced plant as 'wašia', and use a small portion of the root [from the flowering plant] to stun fish. They only use it in slowly moving water, never in pools (Pennington 1958).

C. maculatum is sedative, analgesic, antispasmodic, and often fatal (Bremness 1994). Animals including humans have suffered from hemlock poisoning, though animals are rarely stupid enough to eat it (Lamp & Collet 1989; McBarron 1983). Sometimes people mistake it for 'wild parsley' [see **Petroselinum**] or 'wild carrot' [see **Daucus**], or have consumed the tubers believing them to be 'wild parsnip', Pastinaca sativa [see *Endnotes*].

C. maculatum contains a mixture of 5 very toxic piperidine alkaloids [0.01-0.15% in stem; 0.03-0.6% in leaves; 0.09-0.24% in flowers; 0.73-0.98% in unripe fruit; up to 3.6% in ripe dried fruit; root low in alkaloids], which are *coniine*, γ-coniceine, N-methyl-*coniine*, conhydrine and pseudoconhydrine (Blackwell 1990; Henry 1939; Pammel 1911). γ-Coniceine is usually the major alkaloid, except in maturing fruits, where it is mostly converted to *coniine*. A mixture of unidentified compounds [several amino acids and two alkaloids] was found in leaf, fruit, and root, at all stages of development. Seedlings and young leaves contain predominantly γ-coniceine, with *coniine* levels increasing as the leaves mature. Seedlings harvested 2 weeks after the opening of the first 'true' leaves contained γ-coniceine and traces of conhydrine, but no *coniine* or N-methyl-*coniine*; seedlings harvested 1 week later contained only γ-coniceine [in addition to the unidentified mixture mentioned above]. In roots, alkaloids are +- absent when the plant is actively growing. In flowers, alkaloid levels are minimal in the first week. In the fruits, alkaloids are most concentrated in the endocarp ['*coniine* layer'] and the pericarp cells directly beneath ['beaker-cell layer']. Alkaloid levels peaked in the fruits after 4-5 weeks of development; the highest yield obtained was c.3%. γ-Coniceine was the major alkaloid, until 5-6 weeks of development, when it is largely replaced by *coniine*. Shortly after, there was again a small rise in γ-coniceine levels. Alkaloid yields, and relative proportions of *coniine*/γ-coniceine, were observed to fluctuate widely throughout the course of a day [samples taken 4-hourly], with highest overall levels at 4am, 4pm, and 12 midnight, and lowest at 8am and 12 midday, in weeks 4 and 5. In a study done of the next year's crop, fruits in week 5 [sampled 2-hourly over a 14 hr period] did not vary as widely, and gave lower yields per fruit; lowest levels were at midday, with slight peaks at 8am, and 4-6pm. Aborted fruits were shown to consistently bear higher alkaloid concentrations, compared to normal fruits. In rainy weather, γ-coniceine is the main fruit alkaloid. Sunny and dry weather seems to encourage development of larger fruits, with higher levels of alkaloid per fruit (Fairbairn & Challen 1959; Fairbairn & Suwal 1961).

All of the alkaloids in this plant are considered toxic, and some may cause birth defects. *Coniine* in small doses is similar to *nicotine* in overdose – paralysis of the motor nerves occurs, as well as stimulation then depression of the CNS; nausea and vomiting also occur. In higher doses, heart action is slowed, numbness and paralysis spread from the lower limbs to the arms and chest, and death usually occurs from paralysis of the diaphragm. Lower doses are said to produce a sensation of flying. *Coniine* may be toxic at doses as low as 60mg. *Coniine*, and perhaps the other alkaloids, lose their toxicity on drying or from heat (Blackwell 1990; Bremness 1994; Foster & Caras 1994; Harborne & Baxter ed. 1993; Henry 1939; Lamp & Collet 1989; Pammel 1911; Rätsch 1992; Wexter ed. 1998). The plant is said "to be nearly harmless in the spring but very dangerous afterwards" (Pennington 1958).

The related 'water hemlock' [Cicuta virosa] is also highly toxic, with ingestion of the root causing burning in the mouth, "prolonged vomiting and violent convulsions". It has yielded cicutoxin, cicutol, falcarindiol, and other similar compounds. 'Hemlock water dropwort' [Oenanthus crocata] causes similar symptoms from the consumption of the root; the main toxic principle in this case is oenanthotoxin, an unstable polyenyne (Bruneton 1995).

Conium maculatum is an erect annual or biennial herb to 3m tall; stems freely branched, glabrous, longitudinally grooved and spotted purple, hollow except at nodes. Leaves alternate, glabrous, 20-50cm long, broadly triangular-ovate in general outline, 3-4 times pinnately compound, ultimate divisions ovate-oblong, 4-10mm long, toothed or incised; petioles deeply cupped at base surrounding the stem, hollow. Flowers numerous in dense terminal umbels, white, 2-4mm diam.; petals 5. Fruits grey-brown, broadly ovoid, c.3mm long, consisting of 2 sections, humped with 5 prominent undulate ribs. Fl. late autumn to summer.

Native to Europe, w. Asia, n. Africa; a weed of waste areas, crops and other places worldwide. Prefers to grow in humid and subhumid temperate regions in shaded sites and near streams on moist, fertile loam soils; occurs as an introduced weed in all states of Australia except Northern Territory (Gleason 1952; Parsons & Cuthbertson 1992).

CONOCYBE

(Agaricaceae/Bolbitiaceae)

Conocybe cyanopus *(Atkinson) Kühner* **(Galerula cyanopus** *Atk.***; Pholiotina cyanopoda** *(Atk.) Sing.***)**
Conocybe kuehneriana *Singer*
Conocybe siligineoides *Heim* – ta'a'ya
Conocybe smithii *Watling* **(Galera cyanopes** *Kauffman***)**

The Mazatec of Oaxaca, Mexico, reportedly used C. siligineoides in their shamanic practices (Wasson 1961). It has also been claimed that a Conocybe sp. known as 'tamu' ['mushroom of knowledge'] is used in the Ivory Coast for its entheogenic effect (Samorini 1995b, quoting Yves Soubrillard).

C. cyanopus from Norway has yielded 0.33-0.55% *psilocybin* and 0.004-0.007% *psilocin*; a fresh Finnish collection yielded 0.45% *psilocybin* and 0.07% *psilocin*; a collection from the Pacific n.w. US yielded 0.93% *psilocybin*. Canadian specimens from Vancouver have yielded also 0.03-0.1% *baeocystin*, and 0.05% was found in samples from Washington (Benedict et al. 1962, 1967; Beug & Bigwood 1982; Christiansen et al. 1984; Ohenoja et al. 1987; Repke et al. 1977). German specimens have yielded 0.84-1.01% *psilocybin* and 0.12-0.2% *baeocystin*. Cultivated mycelium has yielded 0.25% *psilocybin*. It has been suggested that this species would not be practical to consume in c. Europe due to its relative rarity and small stature (Gartz 1991). With N. American specimens, 40-50 fresh fruiting bodies may constitute an effective dose (Allen 1997). This is the only Conocybe sp. in c. and n. Europe which has a bluing stem (Gartz 1991).

C. filaris [Pholiotina filaris] from Seattle has been shown to contain the cyclopeptide α-amanitin, a toxin found in some of the deadly

Amanita spp. (Brady et al. 1975). Obviously, caution is advised with unknown Conocybe spp. There is also the possibility that such toxins will show up in Conocybe spp. known to contain *psilocybin* and/or *psilocin*. See also *Producing Plant Drugs* for discussion of a spot test for amanitins.

C. kuehneriana has yielded 0.004% *psilocin* (Ohenoja et al. 1987).

C. siligineoides has not been chemically analysed, but is thought to contain *psilocybin* and/or *psilocin* due to its purported uses, and the alkaloid content of some of its cousins (Repke et al. 1977; Schultes & Hofmann 1980).

C. smithii from Michigan has yielded *psilocybin*, as well as up to 0.08% *baeocystin* and possibly also *norbaeocystin* (Benedict et al. 1967; Repke et al. 1977).

Conocybe siligineoides has a cap 1.3-2.3cm across, 0.9-1.9cm tall, at first subhemispherical, then conic-campanulate, never spread, fawn-orange-red, near centre slightly deeper orange, glabrous, dull becoming shiny, hygrophanous, margin regularly crenate, white with darker striations. Stem slender, rigid, cylindrical, hardly swollen towards base, up to 6cm tall, 1.5mm thick, white-farinaceous at top, pale orange in upper part, cream-citrine elsewhere, tinged with dull-pink near middle, at first darker, always white at base, fistulous; growth of stem continuing after growth of cap. Flesh thin, translucent in cap, white with a slight tinge of flesh colour. Gills +- distant, rather thick, adnexed, with 2 series of very unequal, saffron-coloured or brownish-orange lamellulae. Spores polymorphic, obovoid, very slightly cylindrical, often subtly hexagonal in profile, 11-15 x 7-10 x 6-12µ, with large germinative pore, bright ochraceous or chrome yellow. Fr. Jun.-Jul.

On rotting tree trunks; Oaxaca, s. Mexico (Schultes & Hofmann 1980).

C. cyanopus is very rare in Europe, and thus should not be harvested irresponsibly, or in the immature state.

The genus Conocybe is believed to be closely related to the genera Galerina and Pholiotina [see also **Gymnopilus**, **Psilocybe**], some of which are known to be deadly poisonous.

CONVOLVULUS

(Convolvulaceae)

Convolvulus arvensis *L.* **(C. minor** *Gilib.***)** – field bindweed, lesser bindweed, European bindweed, field morning glory, wild morning glory, small-flowered morning glory, cornbine, hiranpandi, hiranpag, naranji

Convolvulus mauritanicus *Boissier* **(C. sabiatus** *Viviani***)** – vilucchio della riviera

Convolvulus pluricaulis *Choisy* **(C. microphyllus** *Sieb. ex Spreng.***)** – sankhapuspi, sankpuspi, dodak, bephuli, gorakhpinaw, poprang, porprang

Convolvulus sepium *L.* **(Calystegia sepium** *(L.) R. Br.***)** – greater bindweed, Rutland beauty, villucione, campanelle, zaunwinde, grand liseron

Convolvulus tricolor *L.* **(C. minor** *Hort. ex Mill.***)** – dwarf morning glory, villucio tricolor, bunte ackerwinde, dreifarbige winde

Convolvulus spp. – bindweeds

Dioscorides wrote that ingesting the seeds of C. sepium could cause "many and troublesome dreams" (Gunther ed. 1934; Ott 1993). It is regarded as poisonous, and has cathartic properties (Hurst 1942). In n. India, C. pluricaulis [whole plant] is used "as a brain tonic, in the treatment of some forms of insanity and neurasthenia". The herb is harvested when in flower. In animal experiments, the alcohol extract has been shown to potentiate the hypnotic effects of barbiturates, potentiate *acetylcholine* response in skeletal and tracheal muscle, and exhibit a spasmolytic effect in smooth muscle other than the tracheal (Barar & Sharma 1965; Rastogi & Mehrotra ed. 1990-1993). The herb has proven very effective as a brain tonic taken with equal parts of **Bacopa** monnieri and Celastrus paniculatus seed-oil [see *Endnotes*] (friendly pers. comm.).

C. scammonia has been used as an abortifacient and to treat headaches (Ott 1993). The fresh root [gathered in June, in the northern hemisphere] is cut near the apex, and the milky sap collected and dried, to prepare the drug 'scammony'. One imitation scammony originating from s. France was made from the root sap of Cynanchum monspeliacum [Asclepiadaceae]. Scammony is mainly used as a powerful purgative [said to be safe even in large doses], and for such purposes it is sometimes mixed with unskimmed milk, sweet almonds, sugar, and/or ginger (Felter & Lloyd 1898). C. arvensis was said to quicken birth, and has been used as a topical haemostatic (Ott 1993). Resin obtained from the leaves of C. arvensis has been used as a gentle purgative (Chiej 1984), and the roots are also used as a purgative in India (Nadkarni 1976). This plant has caused purging in stock animals who have eaten the tuber, and is also suspected of causing photosensitisation in some animals (Parsons & Cuthbertson 1992). All parts of C. arvensis, C. sepium, and C. soldanella contain resins with purgative activity (Erspamer 1947). The tubers of C. erubescens may be eaten safely, though they are fibrous and have little flavour (Low 1989). In NSW, Australia, a decoction of the whole plant is used by some indigenous people to treat indigestion, stomach aches, and diarrhoea (Cribb & Cribb 1981).

C. arvensis aerial parts yielded 0.017% crude alkaloids [w/w], mostly pseudotropine, with traces of tropine, tropinone, meso-cuscohygrine and hygrine; α-amyrin, campesterol, stigmasterol, sitosterol, alkanes and alkanols were also found. The roots yielded cuscohygrine and calystegines [polyhydroxytropanes] (Todd et al. 1995), and calystegines are also found in the herb and flowers (Schimming et al. 1998) – calystegines have glycosidase-inhibitory activity (Drager et al. 1995). The plant has also been shown to contain *scopoletin*, umbelliferone and isoferulic acid (Rastogi & Mehrotra ed. 1990-1993).

C. erinaceus roots yielded c.2% alkaloids, consisting mostly of cuscohygrine (Aripova et al. 1972).

C. krauseanus aerial parts have yielded convolvine [3α-veratroyloxy-nortropane, or veratroyl-nortropine], convolamine [veratroyltropine], convolidine [3α-vanilloyloxy-nortropane], convolicine [3α-veratroyl-N-acetylnortropine] and phyllalbine (Aripova & Yunusov 1980).

C. lanatus roots have yielded c.0.11% alkaloids, consisting mostly of cuscohygrine; the roots have purgative activity (Hilal et al. 1986).

C. lineatus flowering aerial parts have yielded 0.03% alkaloids, including convolvine, convolamine, and 4 other unidentified alkaloids (Israilov et al. 1965), as well as umbelliferone and *scopoletin* (Festi & Samorini 1999b).

C. mauritanicus seeds were found to contain 0.009% ergoline alkaloids (Taber et al. 1963a); flowers contain 3 calystegines (Schimming et al. 1998).

C. pluricaulis has yielded an alkaloid, sankhpuspine (Basu & Dandiya 1948); two unidentfied bases were isolated, only one of which was pharmacologically-active, showing hypotensive actions in dogs (Rakhit & Basu 1959). Also found were 6-MeO-7-OH-coumarin, 0.76% chloride, 3,4-dihydroxycinnamic acid, kaempferol [MAOI, potential neuroprotectant (Sloley et al. 2000)], kaempferol-3-glucoside, sterols, sugars and starch (Deshpande & Srivastava 1970; Rastogi & Mehrotra ed. 1990-1993).

C. sepium has yielded calystegines from all parts (Drager et al. 1995; Schimming et al. 1998), though some specimens contained none; seeds did not contain ergoline alkaloids; roots yielded cuscohygrine, and 2-7% of a toxic glucoside (Festi & Samorini 1999b).

C. subhirsutus roots yielded 0.43% alkaloids, consisting mostly of convolvine (Aripova et al. 1972), as well as convolamine (Yunusov et al. 1959), convolidine, phyllabine, confoline [N-formyl-convolvine] and an unidentified alkaloid (Sharova et al. 1981); aerial parts have yielded up to 0.406% alkaloids, and seeds up to 0.5% alkaloids, consisting of convolvine, convolamine, convolvidine and convolicine. Aerial parts from young plants yielded up to 2.08% alkaloids (Yunusov et al. 1959). Young plants contain mainly convolvine in aerial parts [c.91% of alkaloids] and roots [c.0.68% of alkaloids]; as the plant matures, the convolvine content declines in the aerial parts, replaced by a large increase in convolamine levels (Aripova et al. 1983).

Seeds of one batch of Danish C. tricolor 'Fine Mix' were once found to yield 0.001% alkaloids and 6.1% lipids [w/w] (Genest & Sahasrabudhe 1966), though this was later doubted due to possible seed contamination by **Ipomoea** spp. (Ott 1993), as most C. tricolor seed has tested negative for alkaloids (Der Marderosian & Youngken 1966; Hahn 1990). However, others have detected lysergic acid and clavine alkaloids in seeds of C. tricolor [0.011% in 'Cambridge Blue'; 0.021% in 'Royal Marine'], C. 'Lavender Rosette' [0.014%] and C. 'Royal Blue' [0.018%] (Taber et al. 1963a).

Calystegines have also been found in the herbage of C. caput-medusae and roots of C. cneorum (Schimming et al. 1998), and in the closely related Calystegia soldanella and Calystegia sylvatica (Festi & Samorini 1999b).

Convolvulus tricolor is an annual herb, often branching from the base and spreading as a ground cover c.60cm across; stems trailing, ascending 15-30cm, angulate, brownish, villous. Leaves alternate, exstipulate, narrow-oblong or subspatulate, obtuse or rounded at apex, pubescent or sometimes glabrous, ciliate towards base. Peduncles 3-flowered, usually exceeding the leaves; calyx persistent, 5-parted, without bracts, sepals ovate, acute, villous; corolla campanulate or funnelform, c.3.75cm across, with azure-blue limb and yellow throat margined with white, limb plicate, 5-angled; stamens 5, inserted near base of corolla, included, filaments often dilated at base. Ovary 2-celled, 4-ovulate; stigmas 2, oblong or linear. Blooming continuously throughout summer, flowers remaining open all day in pleasant weather. Some varieties have striped or spotted flowers, or white only. Capsules globose, opening by 4 valves or bursting irregularly; seeds glabrous.

Southern Europe (Bailey 1968).

CORDYCEPS [including Elaphomyces]

(Ascomycetae/Clavicipitaceae)

Cordyceps barnesii *Thwaites ex. Berk. et Broome* – xiang bang chong cao
Cordyceps capitata *(Holmskjold ex Fries) Link* – tlakatsitsin ['little men'], hombrecitos, niños
Cordyceps hawkesii *(G.R. Gray) Cooke* **(Sphaeria hawkesii** *G.R. Gray***)** – huokesi chong cao, yaxiang bang chong cao
Cordyceps liangshanensis *Zang, Liu et Hu* – liang shan chong cao
Cordyceps militaris *(Fr.) Link* **(Sphaeria militaris** *Fr.***)**
Cordyceps ophioglossoides *(Ehrenberg ex Fries) Link* – tlakatsitsin, deer fungus parasite
Cordyceps sinensis *(Berk.) Sacc.* – yarsagumba, tung chung hsia tsao, dong chong xia cao, kurki, jivanbuti, thokre chyau, winter worm summer grass, cordyceps
Cordyceps shanxiensis *Liu, Rong et Jin* – jinbangbang chong cao
Cordyceps spp.

(Elaphomycetaceae)

Elaphomyces cervinus *(L. ex Gray) Schlechtendal* – hexenspitzel ['witch informer', hart's truffle, puffball]
Elaphomyces granulatus *Fr.* – false truffle, deer truffle, su mondo
Elaphomyces variegatus *Vittadini* – false truffle, su mondo

Cordyceps spp. are a group of ascomycetes that parasitise other species, ranging from subterranean truffles to insects, overcoming the host with their sclerotia and fruiting from the ground. C. capitata and C. ophioglossoides grow on the truffles Elaphomyces granulatus and E. variegatus, which are known as 'su mondo' ['its world']. In Tlanixco [Mexico], these 'little men' are ritually consumed paired with specimens of the 'little women', **Psilocybe** wassonii ['siwatsitsintli'], sometimes apparently for analgesic and anti-rheumatic effects, according to Heim (1963b). C. capitata is believed to possess visionary properties which augment the effect of the **Psilocybe** mushrooms, and might possibly also contribute a tonic effect, given the medicinal properties of some other Cordyceps spp. E. granulatus and E. variegatus are consumed in the Alta Mixteca of Oaxaca as rejuvenatives, and to treat serious wounds (Heim 1963b; Guzmán 1990; Tamm 1962; Wasson 1961). E. granulatus has been claimed to have aphrodisiac properties (Norland 1976), and Elaphomyces spp. are sold in British markets as aphrodisiacs (theobromus pers. comm.). Incidentally, E. cervinus has been known in Germany as hexenspitzel ['witch informer'], hinting at some kind of interesting past use (De Vries 1991). It has been observed to act as an aphrodisiac for stags, bulls and boars, but not humans (Rätsch 1990). See also Tuber spp. truffles in *Endnotes*.

C. sinensis is a highly prized tonic in TCM. In ancient China, it was very scarce [as it still is], and used only in the Emperor's palace. The fungus grows on moth larvae of the order Lepidoptera, especially on Hepialus armoricanus ['sphinx moth']. Himalayans compete with the local yaks for the fungus, harvesting it just before the yaks migrate into the steep ravines to eat it, which they do regularly in spring before returning to the lowlands for mating. Likewise, in Nepal, it is used as an aphrodisiac. C. sinensis is usually prepared by roasting or baking it inside a duck, the duck flesh then being endowed with the properties of the fungus and eaten over a week or so; it may also be decocted in water [in a dose of 3-9g], or infused in alcohol. The herb has an affinity for the lungs and kidneys, and is considered a tonic for these organs; it reinforces vital energy, stimulates the immune system, stimulates the endocrines, reduces stress, reduces excess phlegm, helps build bone marrow, replenishes sperm, treats impotence, spermatorrhoea, neuraesthenia and backache, and has sedative, antitumour, antibacterial, antifungal, antiasthmatic [by relaxing smooth muscle and dilating bronchii] and *epinephrine*-potentiating properties. C. ophioglossoides also stimulates the immune system, as well as stimulating circulation and regulating menstruation. C. cicadae has antitumour properties. C. barnesii, C. hawkesii, C. liangshanensis and C. militaris may have similar effects to C. sinensis, due to sharing similar chemistry [see below]. A new species, C. shanxiensis, is said to have greater medicinal virtues than any other Cordyceps sp. (Hobbs 1995; Hsu et al. 1986; Huang 1993; Pegler et al. 1994).

Recently, it was found that Nepalese shamans in the upper Kalinchok region use C. sinensis for shamanic travelling; it is ground and mixed with **Nicotiana** or **Cannabis**, then either smoked or added to 'rakshi' liquor and drunk (Müller-Ebeling et al. 2002). A Cordyceps sp. extract, as well as soup made from the whole fungus, has caused mild 'LSD-like' symptoms in some individuals when taken in large quantity [doses unspecified]. It is unknown whether the actual identity of the fungus was C. sinensis, or another related species (Trout pers. comm.). A commercially-available alcohol extract of C. sinensis mycelium [1:1], taken in a dose of 15ml, resulted in mild euphoria and closed-eye visuals in one psychonaut. The same person later consumed the same dose of the extract, in combination with c.330mg dried **Psilocybe** semilanceata. The effects of the **Psilocybe** were altered and intensified, with similarities to the combination of **Psilocybe** and **Peganum** harmala seeds, but more subjectively 'sensual' (theobromus pers. comm.).

C. barnesii contains alkaloids, sterols [including 1.18% ergosterol], 8.73% d-mannitol, proteins, organic acids, and amino acids, of similar composition to C. sinensis, which it has been proposed as a substitute for (Yang et al. 1985, 1987).

C. capitata has yielded 0.004% of an unidentified indole derivative, as well as c.1% fatty oil (Tamm 1962).

C. cicadae has yielded galactomannans [CI-P and CI-A], which have shown hypoglycaemic activity in mice (Hobbs 1995).

C. hawkesii contains d-mannitol, alkaloids, sterols [including ergosterol], amino acids, organic acids and vitamins, of similar composition to C. sinensis, except with lower d-mannitol content; it has been proposed as a substitute for C. sinensis (Guo et al. 1990; Huang, H.-T. et al. 1981; Huang, H.-Y. et al. 1981).

C. liangshanensis contains d-mannitol, ergosterol, organic acids [including stearic acid], amino acids, and alkaloids, of similar composition to C. sinensis, which it has been proposed as a substitute for (Tan, Z. et al. 1985, 1987).

C. militaris contains cordycepin, d-mannitol, ergosterol, β-sitosterol, adenine, *adenosine* (Liu et al. 1990), homocitrullylamino-*adenosine*, and 3'-amino-3'-deoxy-*adenosine* (Buckingham et al. ed. 1994).

C. ophioglossoides contains ophiocordin, and 3 protein-bound polysaccharides [CO-N, SN-C and CO-1] with antitumour activity (Hobbs 1995). In a screening of fungi, it tested weakly positive for the presence of unidentified alkaloids (Spilsbury & Wilkinson 1961).

C. sinensis contains cordycepin, cordycepin 3'-deoxy-*adenosine*, cordycepic acid, ophiocordin, uridine, uracil, d-mannitol [7.83% in one analysis], adenine, *adenosine*, *tryptophan* [and other amino acids], sterols [including ergosterol – 1.1% in one analysis], fatty acids and coarse protein. Many of these compounds have antifungal, antibacterial, antitumour and/or immunostimulating properties (Bok et al. 1999; Hobbs 1995; Hsu et al. 1986; Huang 1993; Huang, H.-T. et al. 1981; Yang et al. 1985). A commercial C. sinensis extract was shown to inhibit MAO degradation of *phenethylamine*, in rodent brains (Xu et al. 1988). It appears to be relatively non-toxic (Huang et al. 1988).

Cordyceps capitata fruiting body is divided into a spherical fertile head, and a spherical cylindrical stalk; head 6-10mm, yellow-brown, sometimes with olive tint, with fine dark punctation from the projecting ostioles of the perithecia, roughened by ostioles when dry; stalk offset sharply, 50-80 x 8-10mm, thick below but tapering upwards, deep to pale yellow, smooth, without yellow mycelial strands; perithecia immersed; asci cylindrical, c.15µ wide, 8-spored; spores filiform, breaking up when mature into many smooth, hyaline, rod-like spores with a few drops, 16-21(-25) x 2-3µm. Fr. Sep.-Oct.

Singly to clustered, in coniferous forests among mosses and needle litter, parasitic on Elaphomyces spp. growing underground, not common (Breitenbach & Kranzlin 1984; Dennis 1968) to common; N. America [common in n. California & Pacific n.w.], Asia, Europe (Hobbs 1995).

Cordyceps militaris grows on submerged caterpillars, and is found in N. America, Asia, England and Australia [NSW, Vic.] (Hobbs 1995; Phillips 1981; Young, T. 1994).

Cordyceps sinensis is found over Asia, especially on mountain tops above 3000m in cold and snowy grasslands in China (Hobbs 1995; Pegler et al. 1994).

Cordyceps hawkesii has been reported from eastern Australia, though there is some doubt regarding its true identity here. A number of other species grow in Australia – C. aphodii, C. bicephala, C. brittlebankii, C. coxii, C. cranstounii, C. dovei, C. aff. entomorrhiza, C. furcata, C. gunnii, C. meneristitis, C. robertsii, C. scottiana and C. taylori (Willis 1959).

CORIANDRUM

(Umbelliferae/Apiaceae)

Coriandrum sativum *L.* **(Selinum coriandrum** *Krause***)** – coriander, Chinese parsley, cilento, kottmir, kustumbari, kusbara, kushniz

Coriander, cultivated for at least 3,000 years, is mentioned in many ancient writings [such as the Egyptian Ebers papyrus from c.1500BC, and Sanskrit texts], and is compared to 'manna' ['food from heaven'] in the bible. Originating in North Africa and the Mediterranean, it was spread north through Europe by the Romans, who combined it with cumin and vinegar as a meat preservative. The Egyptians used it as an aphrodisiac, a trend continuing until the Middle Ages. The Greeks added it to their wine [see *Methods of Ingestion*]; added to warm wine, the powdered fruits are said to make an effective 'lust potion'. The Chinese believed coriander gave immortality. The fruits are used in TCM to treat stomach ache, nausea and measles, and in Ayurveda to treat indigestion, sore throat, burns, allergies and urinary tract infections. In India, it is said to reduce the effects of alcohol. In the Philippines, the aroma of the crushed fruit is inhaled to relieve dizziness. The fruits are also known to relieve flatulence and headaches, and have sedative-hypnotic properties. The essential oil of

the fruit is used in toothpaste, perfumes and massage oils, and the fresh leaves and crushed fruits are popular as a cooking herb/spice (Bremness 1994, 1998; Cunningham 1994; Mabey et al. ed. 1990; Nadkarni 1976; Perry & Metzger 1980; Polunin & Robbins 1992).

C. sativum fruits [sometimes referred to as the seeds] have yielded 20-25% fatty oils, and up to 2.17% essential oil, the latter containing 33-81.6% d-linalool [sedative, antiseptic, fungistatic], 1-7.3% limonene [sedative, expectorant, skin-irritant], 1.8-31.5% α-*pinene*, 0.1-1.2% β-*pinene*, 1.9-6.6% *camphor*, 0.4-6.1% camphene, 0.4-3.4% myrcene, 0.2-1.6% p-cymene, dipentene, 0-0.7% α-terpineol, 2.5-15.4% γ-terpinene, 0.2-10.2% geranyl acetate, 0-8.2% geraniol, 0-0.9% decanal, 0-1% decanol, 0-0.5% E-2-dodecenal, 0-1.2% sabinene and 0-0.7% undecanal [these last 2 both tentatively identified] (Harborne & Baxter ed. 1993; Karow 1969; Smallfield et al. 2001). Also present in the fruit are flavonoids [such as quercetin, kaempferol (MAOI (Sloley et al. 2000)) and *apigenin*], coumarins, and phenolic acids, such as caffeic acid [analgesic, antibacterial, antioxidant, antiinflammatory, antifungal, antiviral] and *chlorogenic acid* (Harborne & Baxter ed. 1993; Polunin & Robbins 1992).

Coriandrum sativum is a glabrous annual herb rising from a taproot, 20-70cm tall. Basal leaves forming a rosette, ternately or pinnately lobed to pinnately compound, ovate, 3-15 x 2-10cm; leaflets flabelliform-cuneate, 1-2 x 0.5-1cm, toothed or incised; upper cauline leaves pinnately dissected, the ultimate divisions linear to filiform, 2-15 x 0.5-1.5mm; petioles 1-15cm long. Flowers in lax, compound umbels; peduncles terminal and lateral, 3-10cm long or occasionally abortive, rays 2-8, 1-2.5cm long, pedicels 2-5mm long, involucel dimidiate, bractlets linear, 2-4mm long; calyx teeth ovate-lanceolate, 0.5-0.8mm long; petals white or rose, 5, bilobed, oblong with a narrower inflexed apex, outer petals radiant; styles slender, stylopodium conical; carpophore 2-parted. Fruit 1.5-5mm diam., globose, subterete, mericarps boat-shaped, glabrous, not readily separating at maturity, primary ribs 5, filiform, secondary ribs filiform or obscure, vittae absent; seed face concave. Fl. summer.

Native to Mediterranean region (Simonetti 1990; Wagner et al. 1990).

CORIARIA

(Coriariaceae)

Coriaria arborea *Lindsay* **(C. sarmentosa** *Forst. f.***; C. tutu** *Lindsay***)** – tutu

Coriaria atropurpurea *DC.*

Coriaria japonica *A. Gray*

Coriaria myrtifolia *L.* – dyer's bush, gerberstrauch, redoul

Coriaria sinica *Maxim.* **(C. nepalensis** *Wall.***)**

Coriaria thymifolia *Humb. et Bonp. ex Willd.* **(C. lurida** *Kirk***; C. microphylla** *Poir***; C. ruscifolia** *L.***)** – shanshi, tutu, tutu-papa, tutu-heu-heu, pohou, tupakihi, ink plant

'Shanshi', C. thymifolia, is used by sorcerers in the Ecuadorian Andes for its psychoactive berries, which are said to induce a sensation of flying. They are still collected in the mountain forests by the Sibundoy. The berries, known as 'piñan', have produced intoxications in children who have eaten them; human deaths have occurred with overdose, and the plant has also poisoned stock animals. C. atropurpurea has also been reported as being intoxicating, and has been suggested to have been the Aztec 'tlacopétatl' [this might be a spelling error]. It is known in Mexico as a toxic cardiac stimulant and convulsant (Diaz 1979; Montgomery 1997a, 1997b; Ott 1993; Schultes & Hofmann 1980, 1992; Usher 1974).

In parts of S. America, the juice of the flower petals of C. thymifolia has been used as an ink, known as 'chanchi'. Maoris of New Zealand are also known to use juice from Coriaria spp. as an ink for tattooing. In New Zealand, intoxications have occurred with Coriaria spp. ['tutu poisoning'], especially C. arborea, as well as C. thymifolia. Here, C. thymifolia and C. ruscifolia have sometimes been separated, on the basis of the former being a shrub, and the latter a bush or small tree [possibly a confusion with C. arborea]. Sometimes the intoxications result from consumption of the berries, though the Maoris are known to make a "non-intoxicating drink" from the fruits (Ford 1910/1911a). Another source reported the juice of the fleshy petals to be the part used for these beverages (Cheeseman 1906). In Spain, C. myrtifolia is known as 'emborracha cabras' ['inebriates goats'] (theobromus pers. comm.).

Intoxications occur from ingestion of honey made from the honeydew-secretion of the leaf-hopper Scolypopa australis, which feeds on these plants. The young shoots and berries are considered the most toxic parts (Palmer-Jones 1965). In animals, symptoms of poisoning include "stimulated and then impaired respiration, tetanic convulsions and coma", with death usually following within a few hours. In sublethal doses, animals recover completely from the intoxication with no lasting damage evident. In humans, however, there is usually complete recovery, though memory impairment has been reported. The toxins do not easily deteriorate from boiling. Lime [not the **Citrus** fruit] has been suggested as an antidote to tutu poisoning, as alkalis are known to destroy the toxins in vitro (Ford 1910/1911a), though I can not imagine how it would be feasible to consume adequate quantities of lime without painful burning of the alimentary tract, unless it were encapsulated.

C. arborea leaves and berries contain the picrotoxin-like sesquiterpene lactone *tutin* [causes extreme CNS-excitation, stimulates respiratory, vasomotor and cardioinhibitory systems]. The leaf-hopper insect Scolypopa australis metabolises *tutin* to hyenanchin [mellitoxin; 4-OH-*tutin*], which has similar effects.

C. japonica and C. myrtifolia have yielded *coriamyrtin*, which has similar effects to *tutin*; leaves of C. japonica also contain the tannin coriariin A, which has antitumour properties (Harborne & Baxter ed. 1993; Palmer-Jones 1965).

C. sinica has yielded *tutin*, *coriamyrtin*, corianin, and coriatin; a mistletoe [see *Endnotes*] that parasitises this species, Taxillus yadoriki, has been shown to accumulate up to 10 times the concentration of these compounds from the host plant (Chang & But ed. 1986).

C. thymifolia aerial parts [from Chile] yielded 0.042% *coriamyrtin*, 0.021% quercetin, 0.017% quercetin-3-O-galactoside, 0.01% quercitrin, 0.007% avicularin, 0.021% β-sitosterol and 0.035% ursolic acid; fruits also contained *coriamyrtin*, β-sitosterol, ursolic acid (Reyes et al. 1980), ellagic acid 3,3'-dimethylether, and corianin (Valencia et al. 2001).

Coriaria thymifolia is a small, glabrous, suffruticose or herbaceous plant 15-20cm or more tall; rootstock often stout, woody, much-branched; stems and branches slender, with winged angles, often flattened in one plane. Leaves frond-like, +- pinnate, opposite or rarely in whorls of 3, entire, exstipulate, variable in size, 3-26mm, oblong-ovate or lanceolate, acute or acuminate, sessile or very shortly petioled, glabrous or slightly pubescent. Axillary racemes 2.5-10.2cm long, slender, spreading, pubescent; flowers less than 3mm diam., often unisexual, strongly proterogynous; sepals 5, imbricate, persistent, broadly ovate, subacute; petals 5, hypogynous, smaller than sepals, keeled within, enlarged after flowering and becoming thick and fleshy and embracing the fruit; stamens 10, hypogynous; filaments short, elongating after fertilisation; anthers large; disc absent. Carpels 5-10, free, 1-celled, whorled on a short conical receptacle; styles as many as carpels, free, thick, elongated, covered for whole length with stigmatic papillae; ovules solitary, pendulous from top of cell. Fruit globose, purplish-black, of 5-8 cocci enveloped by persistent enlarged juicy petals, 1-celled, 1-seeded; seed with membranous testa.

North and south Islands of New Zealand, in mountainous districts from Taupo and the east Cape southwards, 300-1500m (Cheeseman 1906); also native to Peru and Ecuador (Bailey & Bailey 1976; Schultes & Hofmann 1980).

Cultivate from seed in early spring, or from cuttings or layers in midsummer. Grows well in well-drained soil in a sunny position (Grubber 1973).

CORNUS

(Cornaceae)

Cornus amomum *P. Mill.* – knob-styled dogwood, cawaruc ['deer feed']

Cornus racemosa *Lam.* **(C. paniculata** *L'Her***)** – panicled dogwood, northern swamp dogwood, masigusge ['arrow wood']

Cornus rugosa *Lam.* **(C. circinata** *L'Her.***)** – Alder leaved dogwood, rough leaved dogwood, broad leaved dogwood, round leaved cornel, silky cornel, rugisucje ['smoking bark']

Cornus stolonifera *Michaux* **(C. sericea ssp. stolonifera** *(Michx.) Fosberg***; Thelycrania sericea** *(L.) Dandy***)** – western red osier dogwood, red willow, rose willow, swamp dogwood, silky cornel

In Pacific northwest N. America, the inner bark of C. stolonifera is smoked as a 'kinnikinnick' [see **Arctostaphylos** and *Endnotes*] by Plains Indians; it is said to produce an opium-like effect [see **Papaver**]. The root bark is generally preferred over the stem bark. Conversely, the North Carrier Indians decoct the bark as a stimulant. Perhaps the discrepancy lies with differences in dosage and route of administration. The Winnebago smoke the bark of C. amomum, C. racemosa and C. rugosa as kinnikinnick; in British Columbia, leaves of Cornus spp. are smoked instead, by the Thompson Indians. C. racemosa is said to have a flavour similar to, but milder than, **Arctostaphylos** (Felter & Lloyd 1898; Kindscher & Hurlburt 1998; Ott 1993; Winter 1998). Bark of C. florida and other Cornus spp. have been used medicinally as quinine substitutes, and to relieve headache from quinine, also acting as a tonic and mild stimulant [dose c.1.3-3.9g]. The flowers have been used as a chamomile substitute [see **Anthemis**, **Matricaria**], and tinctures of the ripe fruit in brandy or whiskey have been a popular bitters with some rural folk (Felter & Lloyd 1898). The Cherokee use Cornus spp. for medicine – C. alternifolia and C. florida barks are used as a tonic, stimulant, antiseptic, astringent, antipyretic, anthelmintic, antidiarrhoetic and analgesic. These species, as well as C. stricta, are used to treat lost voice (Hamel & Chiltoskey 1975).

In Central America, C. excelsa [C. declinata, C. tolucensis; 'tepeacuilotl'] root bark is used as a tonic. C. mascula ['cornelian cherry'] fruits

are eaten for their sweet taste in Eurasia, and in France they are made into an alcohol called 'Vin de Cornoulle' (Usher 1974). In TCM, C. officinalis fruits ['shan-chu-yu' or 'shan zhu yu'] are used as a "long-life medicine" (theobromus pers. comm.), and in a dose of 3-10g as an astringent tonic, to treat impotence, spontaneous ejaculation, vertigo, night-sweats, infrequent urination, tinnitis, impaired hearing, and other disorders. The fruits are considered incompatible with **Asarum** sieboldii, **Siler** divaricatum, and Platycodon grandiflorus, and have shown anti-*histamine* activity (Hsu et al. 1986; Huang 1993; Keys 1976).

I have been unable to find any chemical studies of most of these plants, though C. alba ssp. tartarica and C. sanguinea have yielded *phenethylamine* (Lundstrom 1989). C. officinalis fruits have yielded cornin, loganin, morroniside, 7-O-methylmorroniside, and sweroside, and the leaves have yielded longiceroside (Hsu et al. 1986; Huang 1993).

Cornus stolonifera is a shrub 1-3m tall, often forming dense thickets; younger branches red; pith white and large. Leaves opposite, commonly 5-10cm long, 1/4-2/3 as wide, lanceolate to elliptic or ovate, gradually acuminate, acute to broadly rounded at base, distinctly whitened beneath, pubescence of lower leaf surface appressed to spreading, the hairs all or mostly 2-pointed, inserted near their middle, rarely as much as 0.5mm long; lateral veins on well-grown leaves 5-7 pairs. Inflorescences flat or slightly convex open cymes; sepals rarely as much as 1mm long; petals 4, small, white, purple or yellow, valvate in bud, spreading or revolute at anthesis; stamens 4; filaments long and slender; anthers versatile. Ovary 2-celled; ovule 1 in each cell; style elongate; stigma capitate. Fruit a white drupe, 7-9mm diam., the hard endocarp 2-celled but often only 1-seeded.

A complex and highly variable species.

C. stolonifera forma interior [west US, east to Michigan and Indiana] – the pubescence of the young stems and inflorescence is dense and tomentose.

Ranging from Newfoundland to Alaska, south to Pennsylvania, Indiana and Illinois, west to n. Mexico (Gleason 1952).

CORYNANTHE [including Pausinystalia]

(Rubiaceae)

Corynanthe johimbe *K. Schum.* **(Pausinystalia yohimbe** *(Schum.) Pierre ex Beille***)** – johimbe, yohimbe, idágbon

Corynanthe macroceras *K. Schum.* **(Pausinystalia brachythyrsa** *De Wild.***; P. macroceras** *(K. Schum.) Pierre ex Beille***)** – nikiba, eyamonet, abo idágbon ['female johimbe']

Corynanthe pachyceras *K. Schum.* **(C. africana** *R. Br.***; Pausinystalia pachyceras** *(K. Schum.) De Wild.***; Pseudocinchona africana** *A. Chev. ex E. Perrot***; Ps. pachyceras** *(K. Schum.) A. Chev.***)** – mbarakun, pramprama, gauhele, bopat, nkaka, kobri

Corynanthe paniculata *Welw.*

Pausinystalia angolensis *Wernham*

The inner bark shavings of C. johimbe are a famous aphrodisiac, perhaps the only one with a proven aphrodisiac action. Its use is well-established in Gabon, Nigeria and e. Cameroun, where it is chewed as a stimulant tonic and aphrodisiac. When taken too often, it is said to disturb one's sanity. It is used by the Bantu of tropical w. Africa in fertility orgies that may last up to 15 days, with the herb being consumed in ever greater quantities over this period. It may also be generally consumed as an aphrodisiac tonic. Some tribes are reported to consume it in combination with **Tabernanthe** iboga during initiation rites. In Gabon, the bark is cooked with meat or fish and fed to hunting dogs as a stimulant, and the plant is also used as a fish-poison. C. macroceras is used in Congo as a strong aphrodisiac stimulant, and anti-hypnotic; it is also used in Cameroun in the same way as C. johimbe. Bark of C. pachyceras is also considered aphrodisiac in this part of the world, and may be added to sorghum beer [see *Methods of Ingestion*] to increase its potency. In Congo, it is taken 'as a stimulant to prevent bad dreams'. In Ivory Coast, it is macerated or chewed as an antitussive, antipyretic, and to ease nausea. Near the Liberia/Ivory Coast border, the bark is used as an arrow-poison ingredient (Burkill 1985-1997; Miller 1985; Oliver-Bever 1986; Rätsch 1990, 1992).

Today in the west, quality 'yohimbe' has been at times difficult to obtain, yet it and its main active constituent *yohimbine* [an indole alkaloid] have attracted interest as male aphrodisiacs, and extracts are sometimes available in health shops and pharmacies. Commercial yohimbe may sometimes be adulterated with other Corynanthe spp., which may be low or deficient in *yohimbine*.

Dose suggestions for C. johimbe bark vary widely and it would be wise to establish individual tolerance before trying high doses. Some suggest using 2-4g (Torsten pers. comm.), though Miller (1985) suggested 30g! I suspect this latter figure may be due to the use of low-quality bark. Bark shavings are prepared non-traditionally by bringing 2 cups of water to a boil, reducing to a simmer, adding the juice from ¼ of a lemon or lime [see **Citrus**] or c.1g ascorbic acid, and then adding the powdered root bark and simmering for a further 10 minutes. This brew is then filtered through coffee-filter papers while still hot, then cooled to room temperature for consumption. The material may be more effectively extracted by soaking in alcohol for c.8 hours, before straining and evaporating the alcohol to leave a crude alkaloidal residue. The purpose of adding a source of vitamin C is to increase the absorption of *yohimbine* and other alkaloids, as well as reducing the time to onset of effects. The tea is quite bitter, and ascorbic acid also reduces the likelihood of nausea. It is reported to be best consumed as quickly as possible. Effects of plain tea may be felt in 30-60 minutes; the alcohol extract in 10-20 minutes. Effects include warm tingles up the spine, relaxation of limbs, hypertension, mental stimulation, mild perceptual alterations in higher doses, and often a spontaneous erection lasting several hours, due to stimulation of the spinal ganglia which control penile erectile tissue. Lower doses of *yohimbine* are more effective for sexual purposes than higher doses. When used as a sexual tonic, 250-500mg may be taken every morning after food. Due to *yohimbine*'s MAOI activity, it should not be taken with *amphetamine*s or *tyramine*-rich foods; also should not be taken by those with kidney, liver or heart problems, or by diabetics or hypoglycaemics. Combined with tricyclic antidepressants, dangerous hypertension may result (Crenshaw & Goldberg 1996; Fugh-Berman 2000; Miller 1985; Rätsch 1992; Torsten pers. comm.). Yohimbe can also interact dangerously with dextromethorphan [DXM] (pers. comm.).

It is suggested that blood-sugar levels be kept high when consuming yohimbe, to reduce the incidence of unpleasant reactions. Drinking a glass of milk immediately before consumption has also been suggested to minimise unwanted side-effects (Torsten pers. comm.). Chocolate [see **Theobroma**] should not be consumed, even with small doses of yohimbe. Ginseng [see **Panax**] also interacts with yohimbe so that only ¼ of the usual yohimbe dose may be needed for the same level of effect (theobromus pers. comm.).

C. johimbe bark has yielded tannins, and 1-15% alkaloids [with higher levels in 15-20 year-old trees], consisting mostly of *yohimbine*, α-*yohimbine*, and β-*yohimbine*, as well as pseudoyohimbine, alloyohimbine, yohimbiline, *ajmalicine*, corynantheine and dihydrocorynantheine (Bruneton 1995; Buckingham et al. ed. 1994; Burkill 1985-1997; Henry 1939; Meulen & Kerk 1964); corynanthine [rauhimbine] has also been reported from the plant, and is an α1-adrenoceptor antagonist (Buckingham et al. ed. 1994), mild local anaesthetic, and in dogs [0.1-0.2mg/kg i.v.], stimulated erection and ejaculation. Corynanthine is 4-5 times less toxic than *yohimbine*, and its sympatholytic activity is twice as strong (Oliver-Bever 1986). Concentration of *yohimbine* and related alkaloids in bark was found to increase from the base to the top of the tree; leaves and branches contained only small amounts of alkaloids (Paris & Letouzey 1960).

C. macroceras bark has yielded 4% alkaloids – 60-65% *yohimbine*, 8% α-*yohimbine*, 7% *ajmalicine*, 7% (-)-calycanthine [see **Calycanthus**], 5% corynantheine [AChEI] and 1.5% β-*yohimbine* (Leboeuf et al. 1981; Orgell 1963a); trunk bark has yielded up to 1% alkaloids, mostly *yohimbine*, as well as saponins and tannins (Burkill 1985-1997). Corynanthine has also been reported from the plant (Buckingham et al. ed. 1994).

C. pachyceras bark has yielded 5-6% alkaloids, including corynantheine, corynanthine, corynanthidine and corynantheidine (Burkill 1985-1997).

C. paniculata bark was found to contain *yohimbine*, β-*yohimbine*, alloyohimbine, pseudoyohimbine, and an unidentified alkaloid (Meulen & Kerk 1964).

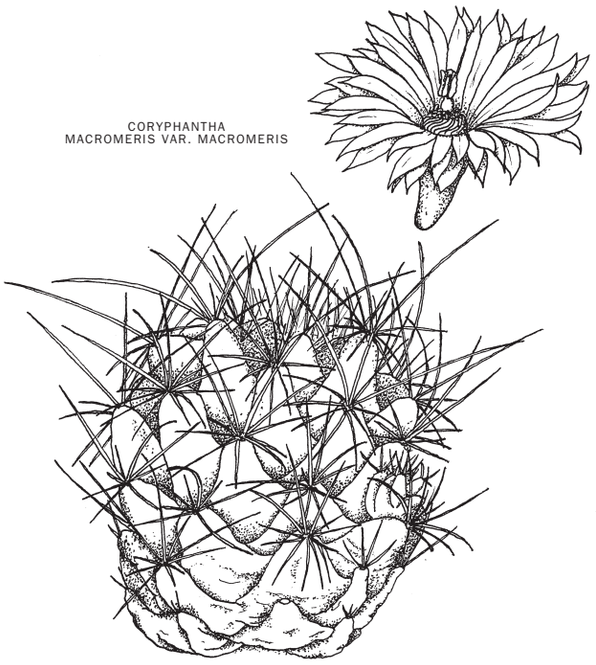
P. angolensis bark was found to contain *yohimbine*, α-*yohimbine*, β-*yohimbine*, alloyohimbine, pseudoyohimbine, corynantheine, and an unidentified alkaloid (Meulen & Kerk 1964).

Corynanthe johimbe is a forest tree 6-28m tall, trunk straight to the first main branches, without buttresses. Leaves opposite, elongate-obovate or oblanceolate, narrowed to the usually auriculate base, very shortly and obtusely acuminate, 13-35 x 5-11.5cm, with 10-16 main lateral nerves on each side of midrib, prominently venose-reticulate above, margins often undulate; petioles up to 7mm long. Inflorescences panicles up to 18cm long, glabrous, flowers in paniculate clusters; flowers 4-merous; calyx adnate to ovary; corolla epigynous, +- tubular, rarely campanulate, corolla-lobes valvate with filiform appendages c.1.5cm long; stamens epipetalous, as many as and alternate with the corolla-lobes. Ovary inferior; ovules 2 or more in each cell; anthers 2-celled; styles slender. Capsules 1-1.6cm long, dehiscent; seeds winged.

In west tropical Africa [s. Nigeria, Cameroun, Equatorial Guinea, Congo] (Hutchinson & Dalziel 1954-1972).

CORYPHANTHA

(Cactaceae)



Coryphantha bumamma *(Ehrenberg) Britton et Rose*
Coryphantha calipensis *Bravo*
Coryphantha compacta *(Engelmann) Br. et R.* – bakana, bakanawa, wichuri, Santa Poli
Coryphantha cornifera *(DC.) Lemaire* **var. echinus** *(Engelm.) L. Benson* **(C. echinus** *(Engelm.) Br. et R.***)**
Coryphantha elephantidens *(Lem.) Lemaire* **(Mammillaria elephantidens** *Lem.***)** – peyote
Coryphantha greenwoodii *H. Bravo*
Coryphantha macromeris *(Engelm.) Lem.* **(C. pirtlei** *Werder.***; Lepidocoryphantha macromeris** *(Engelm.) Backeb.***)** – doñana, doña ana
Coryphantha missouriensis *(Sweet) Br. et R.* **(Cactus mammillaris** *Nutt.***; Ca. missouriensis** *Kuntze***; Escobaria missouriensis** *(Sweet) Hunt* **ssp. missouriensis; Mammillaria missouriensis** *Sweet***; M. nuttallii** *Engelm.***; M. simplex** *Torrey et Gray non. Haworth***; Neobessya missouriensis** *(Sweet) Br. et R.***; N. notesteinii** *(Br.) Br. et R.***; N. rosiflora** *Lahman ex G. Turner***; N. similis** *(Engelm.) Br. et R.***; N. wissmannii** *(Hildmann ex Schumann) Br. et R.***)** – Missouri pincushion, Kansas pincushion
Coryphantha palmerii *Br. et R.*
Coryphantha pectinata *(Engelm.) Br. et R.* **(C. echinus** *(Engelm.) Orcutt***)**
Coryphantha ramillosa *Cutak*
Coryphantha rosea *Clokey* **(C. vivipara var. rosea** *(Clokey) L. Benson***; Escobaria vivipara** *(Nutt.) Buxbaum* **var. rosea** *(Clokey) D.R. Hunt***)**
Coryphantha runyonii *Br. et R.* **(C. macromeris var. runyonii** *(Br. et R.) L. Benson***; C. macromeris ssp. runyonii** *(Br. et R.) Taylor***; Lepidocoryphantha runyonii** *(Br. et R.) Backeb.***)**
Coryphantha scolymoides *(Scheidw.) Berg.* **(C. cornifera** *(DC.) Lem.* **var. scolymoides** *(Scheidw.) Börg.***)**

The Tarahumara respect and fear C. compacta as a kind of 'peyote' [see **Lophophora**], and it is used by their shamans as a "powerful medicinal plant" (Bye 1979b; Diaz 1979); sometimes it is made into a beer-like drink (Rätsch 1998). Its common names, 'bakana' and 'bakanawa', are shared with the **Scirpus** used by the Tarahumara. C. palmerii has also reportedly been used as a 'narcotic' plant in Mexico (Dominguez et al. 1970; Hornemann et al. 1972). C. rosea has also been hinted by reliable sources to be psychotropic. C. elephantidens has been observed to be sold as 'peyote' in a Mexico City market, though this may be only for medicinal purposes (Smith 2000).

C. macromeris, known as 'doñana' in n. Mexico, was reported by Schultes & Hofmann (1980) to possibly "still be used in this area as a ritual hallucinogen" (Schultes & Hofmann 1980), though this claim appears to be without foundation (Smith pers. comm.; Trout pers. comm.). C. macromeris is thought to have been used by N. American psychonauts since at least the early 1970's as an experimental intoxicant, as promoted by numerous underground publications still being reprinted and widely read (eg. Gottlieb 1992 and earlier editions). The promotion of its use appears to be based on assumptions gleaned from Hodgkins et al. (1967), who reported that *macromerine* [a major constituent of C. macromeris] showed what they regarded as "hallucinogenic reactions" in cats and squirrel monkeys (Hodgkins et al. 1967). C. macromeris has also reportedly "been declared as a sacrament" and cultivated for use by a Californian 'psychedelic church' (Schultes & Hofmann 1980).

The effects from one bioassay of C. macromeris [which used "several hundred grams fresh"] were described as "very mild and very strange, with many waves of intense nausea and extremely persistent after-effects, such as distorted vision and a very weird feeling of unreality lasting for weeks after its use" (Trout ed. 1997a; Trout pers. comm.). A dose of 8-12 de-spined cacti, eaten or decocted for 1hr and drunk on an empty stomach, has been suggested (Gottlieb 1992). However, it is likely that the comments by Gottlieb are not based on any personal experience, and it appears that few people have ever actually ingested this species (Trout pers. comm.).

The active chemicals in many Coryphantha spp. have been considered to be *macromerine* and *normacromerine*, which were claimed to be psychoactive in animals, but are less potent than *mescaline* by weight. The purported activity of *normacromerine* in rats was compared to *mescaline* and *psilocybin* (Bourn et al. 1978; Hodgkins et al. 1967). Of course, it would be better if the rats could tell us what they thought! Both alkaloids have also been reported to be non-psychoactive in rats (Vogel et al. 1973), but the tests used to reach this conclusion were inadequate (Bourn et al. 1978). If these alkaloids do indeed act as so-called 'hallucinogens', like *mescaline* and *psilocybin*, this would be unusual, as N-methylated *phenethylamines* usually lack such activity. However, this does not necessarily imply a lack of psychoactivity (Nichols & Glennon 1984). The β-OH-4-MeO-*phenethylamines* found in the genus inhibited the oxidation of *tyramine* [but not *tryptamine*] by MAO in vitro, whilst those lacking the β-OH group inhibited MAO oxidation for both (Keller & Ferguson 1976b). Such MAO-inhibition might possibly account for the psychoactivity of some of these cacti, given the low potency of *macromerine* and *normacromerine* alone. Also widespread in the genus are other *phenethylamine* [PEA] derivatives, including synephrines.

C. bumamma was found to contain 0.01-0.05% alkaloids [w/w], consisting of *hordenine* [>50%], N-methyl-4-MeO-*PEA*, and N-methyl-*DMPEA* (Bruhn et al. 1975); (-)-β-O-methyl-*normacromerine* [calipamine] has also been reported (Ranieri et al. 1976).

C. calipensis has yielded 0.14% alkaloids [w/w], including 0.0053% (-)-*normacromerine* [10-50% of total alkaloids, in one test], calipamine, 0.0016% N,N-dimethyl-3,4-trimethoxy-*PEA*, 0.0082% coryphanthine [β-MeO-dehydroxycandicine; β-MeO-N,N,N-trimethyl-*PEA*], N-methyl-3,4-dimethoxy-β-MeO-*PEA*, N,N-dimethyl-3,4-dimethoxy-β-MeO-*PEA*, and traces of N-methyl-*DMPEA*, N,N-dimethyl-*DMPEA*, N-methyl-*tyramine* and *hordenine* (Bruhn & Agurell 1974; Bruhn et al. 1975; Lundstrom 1989; Shulgin & Shulgin 1997).

C. compacta has reportedly yielded N-methyl-*DMPEA* (Diaz 1979), though this may have been in error. I have been unable to find any primary reference for the analysis of this species.

C. cornifera yielded N-methyl-*tyramine*, *hordenine*, synephrine, N-methyl-*DMPEA*, 4-MeO-*PEA* and β-OH-4-MeO-*PEA* (Hornemann et al. 1972).

C. cornifera var. echinus has yielded *macromerine*, 0.0002% N-methyl-*tyramine*, 0.0001% *hordenine*, synephrine, 0.0001% β-O-methyl-synephrine, 0.0002% N-methyl-4-MeO-*PEA*, β-OH-4-MeO-*PEA*, and 0.0007% N-methyl-*DMPEA*.

C. durangensis yielded N-methyl-*tyramine*, N-methyl-*DMPEA*, *hordenine* and synephrine.

C. elephantidens has yielded *macromerine*, N-methyl-*tyramine*, *hordenine*, synephrine, β-OH-4-MeO-*PEA*, and N-methyl-*DMPEA* (Hornemann et al. 1972; Shulgin & Shulgin 1997).

C. greenwoodii yielded 0.043% (-)-*normacromerine*, 0.034% calipamine, 0.0095% N-methyl-*DMPEA*, N,N-dimethyl-*DMPEA*, N-methyl-3,4-dimethoxy-β-MeO-*PEA*, N,N-dimethyl-3,4-dimethoxy-β-MeO-*PEA*, dl-synephrine, dl-β-O-methylsynephrine, *hordenine*, 0.022% [w/w] (+)-coryphanthine, and 0.0157% [w/w] O-methylcandicine [N,N,N-trimethyl-4-MeO-*PEA*] (Bruhn et al. 1975; Meyer et al. 1983; Ranieri et al. 1976).

C. macromeris has yielded 0.16% *macromerine* (Brown et al. 1968, 1972; Hodgkins et al. 1967); references to other alkaloids in this species by Buckingham et al. (1994), Keller et al. (1973a, 1973b), and Shulgin & Shulgin (1997) are in error and should refer to C. runyonii [C. macromeris var. runyonii]. Other unidentified alkaloids have, however, been observed in C. macromeris, and more detailed analysis is needed.

C. missouriensis yielded 0.39% *hordenine*, 0.013% N-methyl-*tyramine*, and traces of *tyramine* and N-methyl-*DMPEA* (Pummangura et al. 1981).

C. ottonis yielded N-methyl-*tyramine*, *hordenine*, synephrine and 4-MeO-*PEA* (Hornemann et al. 1972).

C. palmerii yielded a crude alkaloid, as well as 0.003% β-sitosterol, eicosanol and dotriacontane (Dominguez et al. 1970). An unclear remark

by Gennaro et al. (1996) suggested that this species may contain traces of *mescaline*.

C. pectinata has yielded *macromerine*, *tyramine*, N-methyl-*tyramine*, *hordenine*, synephrine, β-O-methylsynephrine, β-OH-4-MeO-*PEA*, N-methyl-4-MeO-*PEA*, and N-methyl-*DMPEA* (Hornemann et al. 1972; Shulgin & Shulgin 1997).

C. poselgeriana yielded N-methyl-*tyramine*, *hordenine*, synephrine and 4-MeO-*PEA* (Hornemann et al. 1972).

C. radians was found to contain 0.001-0.01% alkaloids [w/w], over 50% of which was N-methyl-*tyramine*, and 1-10% *hordenine* (Bruhn et al. 1975). An unclear remark by Gennaro et al. (1996) suggested that this species may contain traces of *mescaline*.

C. ramillosa has yielded 0.73% *hordenine*, 0.043% N-methyl-*tyramine*, 0.015% β-O-methylsynephrine, 0.0057% synephrine and 0.00092% N-methyl-4-MeO-*PEA* (Sato et al. 1973).

C. runyonii has yielded over 0.05% alkaloids [w/w] (Agurell 1969a); mostly *macromerine* [0.0021% w/w; 0.07% d/w] and *normacromerine* [0.071% w/w; 0.19% d/w], 0.0077% N-formyl-*normacromerine*, 0.0001% *tyramine*, 0.0019% N-methyl-*tyramine*, 0.0004% *hordenine*, 0.0006% N-methyl-*DMPEA*, 0.0005% N-methyl-4-MeO-*PEA*, 0.0001% synephrine, 0.0002% metanephrine, N-methylmetanephrine, *epinephrine* and *norepinephrine* (Agurell 1969a, 1969c; Below et al. 1968; Keller 1978; Keller & McLaughlin 1972; Keller et al. 1973a, 1973b; Lundstrom 1989).

C. scolymoides [fresh] has yielded 0.0004-0.0012% *mescaline* (Gennaro et al. 1996).

C. vivipara and C. vivipara var. arizonica yielded [w/w] 0.017% *hordenine*, as the only detectable alkaloid (Bruhn et al. 1975; Howe et al. 1977).

Coryphantha macromeris is a cactus branching at the base, often many-headed, up to 20cm long, clumping to 30cm across; larger stems green, cylindroid to elongate-ovoid, up to 10-15 x 5cm; tubercles large, soft, loosely arranged, elongated, 12-15mm long, c.6-9mm thick, protruding 1.5-2.5cm, grooved on upper side c.2/3 of their length; areoles c.3mm diam., usually c.12mm apart; spines 10-17, slender; radials dark to pale grey, lighter than centrals, 9-15 per areole, spreading parallel to stem surface, straight to slightly curving, the longer 20-25mm long, c.0.5mm wide at base, acicular or nearly so, nearly circular in cross-section; central spines 4-6, black or dark to pale grey or reddish-brown, lower one longer, 25-50mm long, base to 1mm thick, spreading irregularly, straight or somewhat curved or twisted, subulate, narrowly elliptic in cross-section. Flowers large, purple, 4.5-5cm long, (3-)6-8cm across; perianth segments with greenish midribs, reddish-purple margins, the larger narrowly oblanceolate, up to 25mm long, 6mm wide, apex fimbriate-ciliate; scales on tube ciliate; petals reddish-purple to rose, largest narrowly oblanceolate, to 30 x c.6-9mm, minutely fimbriate; filaments reddish-purple to rose, to 12mm long; anthers yellow, oblong, c.1mm long; style yellow, c.20mm long, up to 1.5mm thick; stigmas 7-8, c.4.5mm long, slender; ovary in anthesis c.7.5mm long, 4.5mm diam., bearing a few scales with hairy axils. Fruit 15-25 x 6-9mm, green at maturity, with fimbriate scales with wooly axils; seeds globose, brown to yellow, smooth, reticulate, c.1.25mm long, 2mm broad, 1mm thick.

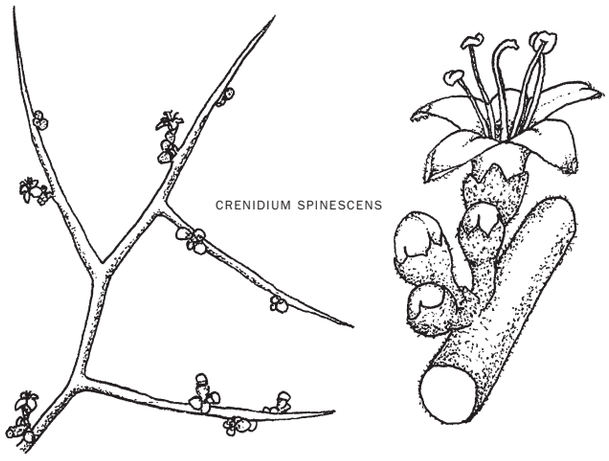
Yellow clay and gravelly soils of low hills in desert, mostly 750-1350m; s. New Mexico, w. Texas, Chihuahua south to Zacatecas, Mexico.

The groove on the upper tubercle is characteristic of the genus Coryphantha (Benson 1982; Britton & Rose 1963), and of the closely-related genera Escobaria and Neobesseya (Marshall & Bock 1941).

C. runyonii [C. macromeris var. runyonii] is similar in appearance to C. macromeris. It is distinguished by a smaller grey-green stem [to c.5-7.5cm long, 2.5-3.8cm diam.] growing in larger clumps [to 1m across], with longer tubercles [to 7.5mm long, c.4.5mm diam., protruding c.1.2cm], and different native habitat [Rio Grande Plain, Texas; near sea level] (Benson 1982).

CRENIDIUM

(Solanaceae)



Crenidium spinescens *Haegi*

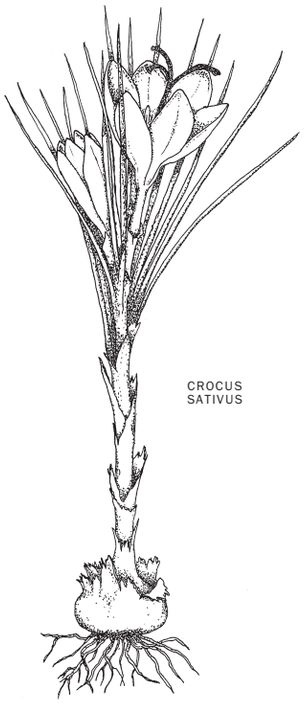
This Australian shrub has no recorded uses, yet it has been shown to be a source of hallucinogenic tropane-alkaloids and a *nicotine*-isomer. A mature, non-flowering specimen harvested in dry conditions in Western Australia [August] yielded 0.09% alkaloids from the aerial parts, consisting mostly of *hyoscyamine*, as well as *hyoscine*, tropine, 6-OH-*hyoscyamine* and *anabasine*. The roots yielded 0.21% alkaloids of similar composition, but without tropine or *anabasine* (El Imam & Evans 1984; Evans & Ramsey 1983).

Crenidium spinescens is a rounded, intricately branched shrub to 1.7m tall; branches spinescent, tomentose with non-glandular dendritic hairs, glabrescent. Leaves present only on immature parts, scattered, narrowly elliptic to linear, sessile, 3-10 x 0.5-1.5mm, tomentose, entire, margins slightly recurved. Flowers in cymose clusters at nodes, bisexual, slightly zygomorphic, each subtended by a pair of opposite bracts; pedicels 1-3mm long; calyx cupular, 5-lobed, 1.3-2mm long, tomentose, lobes minute; corolla 2.5-4mm long, tomentose outside, narrowly tubular with spreading limb, pale yellow, limb with 5 short, broad lobes, lobes ovate to broadly ovate, 1.5-2.5mm long, volutive in bud; stamens and style usually much exserted; stamens usually 4, didynamous, inserted at base of corolla tube; a staminode present or rarely fertile; anthers unilocular, not cohering, dehiscing by a semicircular slit. Ovary bilocular; stigma capitate, very shortly bilobed. Fruit a smooth ovoid capsule 4-4.5mm long, opening by 2 bifid valves, lower half enclosed by calyx; seeds subreniform, 3.5-4mm long.

In deep sand on margins of salt lakes; from Menzies to Lake Moore in s. Western Australia (Haegi et al. 1982).

CROCUS

(Iridaceae)



Crocus sativus *L.* – saffron crocus, saffran, saffer, karcom, kunkuma, kumkum pati, bhavarakta

Saffron, being the prized stigmas from C. sativus, has long been valued as a culinary and medicinal herb in the northern hemisphere, but particularly so in southern Europe and the middle east where it originated. In ancient Egypt and the Mediterranean, saffron was regarded as a powerful medicine. Greek shamans knew it as the 'blood of Hercules', and wore it as a protective amulet, as well as burning it in magical incense. The Phoenicians consumed saffron in crescent-shaped cakes, eaten in honour of the moon and Ashtoreth, their fertility goddess. It has long been associated in the east with fertility, sexual potency, strength, psychic powers and high-caste royalty. In parts of Asia, the privileged classes sometimes use it to dye their clothes a deep yellow. It may also be used to make a coloured paint for the 'third eye' spot worn on the forehead by devout Hindus. In Ayurvedic and Islamic medicine, it is used as a nerve tonic, stimulant, aphrodisiac and stomachic, and may be applied externally to treat headaches, bruises and rheumatism (Cunningham 1994; Nadkarni 1976; Rätsch 1990, 1992; Simonetti 1990). In Nepal, it is used in incenses, and the local variety has been observed to be more potently psychoactive than usual (Müller-Ebeling et al. 2002). It has been claimed that drinking an infusion of saffron can give the power "to foresee the future" (Cunningham 1994). In the Mediterranean region, saffron was once given as a tea to "put unruly children to sleep" (Emboden 1979a).

The stigmas of 1,700 flowers weigh only 25g dry (Bremness 1994), and are labour-intensive to harvest. This is the main reason why 'real' saffron is so expensive, and why false substitutes are so often encountered. 'Turmeric' [Curcuma longa] root powder is one of the more common substitutes, and in parts of Asia, turmeric is sometimes called saffron. Carthamus tinctorius ['bastard saffron', 'American saffron', 'safflower'] is also sometimes substituted for the real thing, in the form of shredded flower petals. Nowadays, saffron is mostly used to flavour saffron rice (Mabey et al. ed. 1990), though in some circles it is used as an expensive opium substitute [see **Papaver**], or as an exotic aphrodisiac, claimed to cause "long, distinctive orgasmic sensations" (Rätsch 1990).

Saffron is known to be capable of improving mood and even leading to euphoric, stimulant, 'narcotic', and perhaps mildly entheogenic effects. Besides this, it is known for its oestrogenic, analgesic, antiinflammatory, antipyretic, emmenagogic, carminative and digestive effects (Chiej 1984; Nadkarni 1976; Simonetti 1990; pers. comms.). For medicinal purposes, a standard dose may be 60-200mg. In overdose, it acts as a narcotic poison (Nadkarni 1976); 5-10g is considered sufficient to cause serious poisoning. One person who consumed 5g of saffron powder as an abortifacient collapsed, and suffered bleeding from the skin and kidney toxicity (Frohne & Pfänder 1983). Whilst 20g can kill, 1.5g may be +- safe for psychotropic use (Rätsch 1998). Saffron, in excess, can also cause headache and uterine bleeding. In small doses, however, saffron has been used to strengthen the uterus. Children have died from saffron overdose (Rätsch 1990, 1992). It has been claimed [by someone who probably never consumed toxic quantities] that eating too much saffron would cause one to "die of excessive joy" (Cunningham 1994)!

In animal studies, saffron has been shown to improve impairments in learning and memory induced by ethanol; these effects have been attributed largely to the crocin content of the stigmas. Also demonstrated are sedative, antitumour, and free-radical scavenging effects, which have been attributed largely to the crocetin content (Abe & Saito 2000; Zhang et al. 1994). Although early workers reported the isolation of crocetin in various forms from saffron (eg. Karrer & Helfenstein 1930), later analysis with more sophisticated equipment did not reveal crocetin itself (Tarantilis et al. 1995).

C. sativus stigmas contain mainly carotenoid glycosides, cis- and trans-derivatives of crocin, which are glycosides of crocetin; also present are safranal [a monoterpene aldehyde], picrocrocin [a glycoside, and precursor to safranal; the bitter component of saffron], picrocrocin aglycone, kaempferol diglycoside [kaempferol is an MAOI (Sloley et al. 2000)], isophorone, isophorone glycoside, 3,5,5-trimethyl-4-OH-1-cyclohexanon-2-ene, 3,5,5-trimethyl-1,4-cyclohexadione, 3,5,5-trimethyl-1,4-cyclohexadion-2-ene, 3,5,5-trimethyl-2-OH-1,4-cyclohexadion-2-ene, 2,6,6-trimethyl-4-OH-1-cyclohexene-1-carboxaldehyde, 2,4,4-trimethyl-3-formyl-6-OH-2,5-cyclohexadien-1-one (Karrer & Helfenstein 1930; Tarantilis et al. 1995; Zarghami & Heinz 1971a), *pinene*, cineole (Hilger 1900), naphthalene, 2-phenylethanol, 2-butenoic acid lactone, palmitic acid, stearic acid, oleic acid, linoleic acid and linolenic acid (Zarghami & Heinz 1971b). The essential oil has been claimed to contain *safrole* as a major constituent (Emboden 1979a), though this may be in error. The essential oil is obtained in a yield of 8-10% (Mabey et al. ed. 1990). Saffron is also rich in riboflavin [vitamin B2] (Rätsch 1992).

Crocus sativus grows from a usually symmetrical corm, enclosed by several tunics of variable texture and colour, tunics without rings, outer tunics fibrous in part, laciniate at base, fibres finely to coarsely reticulate, sometimes obscurely so; cataphylls up to 5, sheathing the aerial shoot. Leaves usually present at anthesis, appearing with or after flowers, all basal, flat or canaliculate on upper surface, lower surface usually strongly keeled, usually with 2 grooves; scape absent. Flowers 1-several, each on a short, subterranean pedicel which is sometimes subtended by a membranous, sheathing prophyll; bract membranous, bracteole similar or reduced, both white-membranous, rather flaccid, not closely sheathing at perianth tube; perianth regular, petaloid, 6-partite, deep lilac-purple with darker veins, white, or white with a purple base, segments 3.5-5cm, equal or subequal, tube long and narrow, glabrous, or with a ring of hairs in throat at insertion of filaments, throat glabrous or pubescent, white or lilac; anthers yellow, extrorse; stamens 3, opposite the outer perianth segments; stigmas 3. Ovary subterranean, inferior; style deeply divided into 3 simple branches, not at all subdivided at apex, style-branches 2.5-3.2cm. Capsule cylindrical or ellipsoid, maturing at or above ground-level by elongation of the pedicel. Fl. Sep.-Jan.

This plant is a sterile triploid, and is not known in a truly wild state; partially naturalised in some areas. It is very similar to the wild species C. cartwrightianus, which grows on rocky hillsides in the s. Aegean region (Tutin et al. ed. 1964-1980).

C. sativus also looks similar to the poisonous Colchicum autumnale ['meadow saffron', 'autumn crocus'], which does not have 3 stigmas (Bremness 1994).

Prepare harvested stigmas by sun-drying (Rätsch 1990).

CROTALARIA

(Leguminosae/Fabaceae)

Crotalaria juncea *L.* **(C. benghalensis** *Lam.***; C. fenestrata** *Sims***; C. porrecta** *Wall.***; C. sericea** *Willd.***; C. tenuifolia** *Roxb.***; C. viminea** *Wall.***)** – Bombay hemp, Sunn hemp, ghore-sun, pulivanji, mustanpat, shanabo

Crotalaria longirostrata *Hook. et Arn.* – long-beaked rattlepod, chipilin, chapilin, chiplino, chipil, tcap-in, chop, parrajachel, cascabell de vibora ['rattlesnake rattle'], tronador, garbancillo

Crotalaria mucronata *Desv.* – zhu zi tou

Crotalaria saggitalis *L.* **(C. belizensis** *Lundell***; C. fruticosa** *Mill.***; C. lunulata** *Raf.***; C. mathewsana** *Benth.***; C. parviflora** *Roth***; C. pilosa** *Raf.***; C. platycarpa** *Link***; C. pringlei** *A. Gray***; C. saggitatas** *Hill***; C. tuerckheimii** *H. Senn***)** – rattlebox, cascabelito, chinchin, chiplin de Montana, Chiplin de Monte, cohetillo, espadilla, guache, Trebol Silvestre

Crotalaria verrucosa *L.* **(C. acuminata** *(DC.) G. Don.***; C. angulosa** *Lam.***; C. arnottiana** *Benth.***; C. caerulea** *Jacq.***; C. coerulea** *Beddome***; C. coerulea** *Jacq.***; C. flexuosa** *Moench***; C. hastata** *Steud.***; C. mollis** *Weinm.***; C. paramariboensis** *Miq.***; C. semperflorens** *Vent.***; C. verrucosa var. acuminata** *DC.***; C. verrucosa var. genuina** *Stehle***; C. verrucosa var. obtusa** *DC.***; C. wallichiana** *Wight et Arn.***; Anisanthera hastata** *Raf.***; A. versicolor** *Raf.***; Phaseolus bulai** *Blanco***; Quirosia anceps** *Blanco***)**

Crotalaria spp. – rattlepod, rattlebox

In many parts of Central America [Guatemala, El Salvador, Honduras] young leaves and shoots of C. longirostrata are cooked in various forms and eaten with other food as a soporific. Raw leaves are emetic and purgative; in Guatemala, the root mixed with cornmeal is used as a bait to kill dangerous animals (Morton 1994). In North America, the Delaware-Okl use the root of C. saggitalis as a 'very strong narcotic' (Ott 1993). The Indian C. juncea, which is known as a type of 'hemp', has been said to be smoked as an inebriant (Nadkarni 1976), though this might be a confusion with the drug properties of **Cannabis** ['true' hemp]; C. juncea is primarily used for fibre. C. verrucosa is used by the Karen of n. Thailand as a tonic sedative (Anderson 1993). In Paraguay, C. incana pods [which, when ripe, rattle when shaken] are said to be blessed with the power of speech, and are used as a 'magic' plant to help children to speak properly. Facing the sun at sunset, the child's mother breaks one or more unripe pods in the child's mouth. The pods are then thrown towards the sunset, and the process repeated every day until it has proven effective (Hirschmann et al. 1987).

In TCM, the whole plant of C. mucronata is used to relieve insomnia [with **Ziziphus** spinosa], mental stress, and frequent urination (Huang 1993). In n. Western Australia, C. cunninghamii [C. sturtii] is used by indigenous peoples for fibre, and as a medicine. A leaf decoction relieves sore eyes and headache [externally]; sap from bruised leaves is used to treat earache; and a bark decoction is used as an external wash for swellings (Cribb & Cribb 1981; Lassak & McCarthy 1990). Many species are used as manure and fibre sources (Usher 1974).

Crotalaria spp. are known for their hepatotoxic alkaloids, particularly of the pyrrolizidine-type, and are known to cause stock poisonings (Keeler 1975). The major compound often responsible is the hepatotoxic carcinogen monocrotaline, found in 20% of the genus [which consists of c.600 species], though so far confirmed only in the section Calycinae and subsection Crotalaria, with one occurrence in section Dispermae (Pilbeam et al. 1983).

C. incana unripe pods yielded [w/w] 0.0034% pyrrolizidine bases, and 0.002% reduced N-oxides (Hirschmann et al. 1987).

C. juncea seed was found to produce HCN (Watt & Breyer-Brandwijk 1962); monocrotaline was not detected in seeds [detection limit 0.5%] (Pilbeam et al. 1983).

C. longirostrata has yielded γ-glutamyltyrosine, and traces of α-amino-α-oxalylaminopropionic acid (Morton 1994); monocrotaline was not detected in seeds [detection limit 0.5%] (Pilbeam et al. 1983).

C. mucronata has yielded the alkaloids mucronatine, mucronatinine, nilgirine, retrorsine and usaramine, and the flavonoids vitexin, vitexin-4-O-xyloside and *apigenin* (Huang 1993).

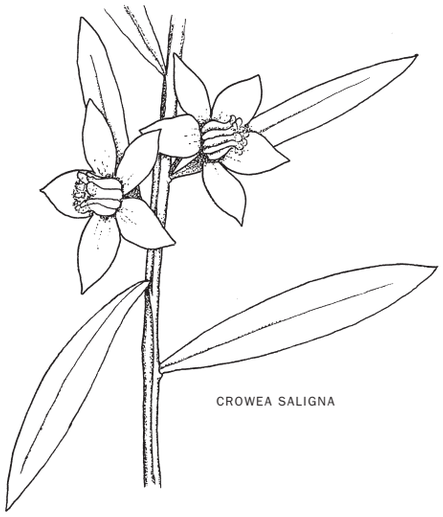
C. saggitalis pods have yielded monocrotaline and monocrotaline N-oxide (International... 1994); one study found no alkaloids in seeds [detection limit 0.5%] (Pilbeam et al. 1983).

Crotalaria saggitalis is an annual or short-lived perennial with a taproot; pubescence spreading-hirsute; stems ascending, 10-50cm tall. Leaves all simple, lanceolate or linear to elliptic, 3-8cm x 8-15mm; stipules usually present, triangular, very narrowly decurrent on stems for c.1/2 the length of the internode. Racemes 2-4-flowered; bracts ovate-lanceolate, slender-stalked; floral cup c.2mm long; calyx gamosepalous, tube often obliquely campanulate, lobes often free and often subequal, with spreading hairs, 1-2mm long, the unequal lobes lanceolate to linear; corolla +- as long as calyx, yellow; banner often with red diffused in the yellow, orbicular to ovate, longer than the wings or keel, external in bud; wings oblong; keel often scythe-shaped, sometimes beaked; stamens 10, monadelphous. Ovary nearly sessile, less commonly short-stiped. Pod oblong, glabrous, 20-35(-40)mm long, c.1cm thick. Fl. Apr.-Sep.

In sandy soils; east half of Texas, west to Parker, Bastrop & Wilson counties; e. & c. U.S. (Correll & Johnston 1970), Mexico, Caribbean, Belize, Costa Rica, El Salvador, Guatemala, Panama, Bolivia, Colombia, Peru and Venezuela (International... 1994).

CROWEA

(Rutaceae)



Crowea angustifolia *Smith* – swamp Crowea, narrowleaf Crowea, pink Crowea, pink stars
Crowea exalata *F. Muell.* – common Crowea
Crowea saligna *Andrews* **(Eriostemon crowei** *F. Muell.***)**

The essential oil from the leaves and terminal branchlets of the Australian shrub C. saligna was first analysed in 1922, after it was observed that the aroma of the crushed leaves suggested the presence of *safrole* (Penfold & Morrison 1922). Although the genus has since seen very little chemical analysis, Crowea spp. appear to be a rich source of interesting phenylpropenes.

C. angustifolia var. angustifolia has yielded an essential oil containing 68% γ-*asarone*, 13% *exalatacin* and 7% *croweacin* (Brophy et al. 1997).

C. exalata has yielded 0.3-1% essential oil. Five chemotypes were found within this species – one dominant in *safrole* [81.88%]; one rich in (E)-*carpacin* [47-51%] and (E)-*methylisoeugenol* [18-25%]; one rich in (E)-*methylisoeugenol* [29-46%], *safrole* [27-35%], and α-*pinene* [12-25%]; one rich in *asaricin* [57-74%] and *safrole* [6-29%]; and one rich in *exalatacin* [30-43%] and *croweacin* [10-20%] (Brophy et al. 1997).

C. saligna [originally analysed as Eriostemon crowei] yielded 0.4% essential oil, containing mostly the new compound *croweacin* [90%], as well as d-α-*pinene*, a sesquiterpene, a paraffin and an unidentified chemical; notably, *safrole* was absent (Penfold & Morrison 1922). However, later research found traces of *safrole* in the essential oil from C. saligna, along with *croweacin* [84-94%] and terpenoids (Brophy et al. 1997). The plant has also yielded croweacic acid (Buckingham et al. ed. 1994). To confuse matters a little, the plants originally analysed by Penfold & Morrison were said to be quite common throughout eastern NSW and some parts of Victoria (Penfold & Morrison 1922). However today, this does not correspond to the range of E. crowei [C. saligna], but does correspond to the range of C. exalata. Index Kewensis equates C. exalata with C. saligna, yet Harden (ed. 1990-1993) describes them as two obviously different members of the same genus!

C. exalata x saligna essential oil was similar in makeup to that from C. saligna, and was also rich in *croweacin* [82%] (Brophy et al. 1997).

Crowea exalata is a shrub to 1m tall; branchlets slender, scarcely angled, slightly hairy, obtusely angled or +- terete. Leaves alternate, oblong-cuneate to spathulate, 1.5-5cm x 1-6mm, apex rounded to obtuse and apiculate, base gradually attenuate, glabrous. Flowers bisexual, terminal or in upper axils on a short axillary shoot with few leaves; pedicel 2-4mm long, fleshy towards apex; sepals 5, free, 2-2.5mm long, slightly hairy to glabrous, finely ciliate; petals 5, imbricate, persistent in fruit, narrow- to broad-ovate, 5-12mm long, pink to pale mauve (sometimes green in fruit); stamens 10, slightly imbricate, sterile apices gradually spreading, free but with contiguous or imbricate filaments, pyramidally arranged and incurved over ovary; carpels 5, basally fused, lacking a sterile apex; styles fused, arising subterminally on carpels; stigma globose; ovules 2 in each carpel. Fruit of 1-5 cocci, cocci +- erect, c.7mm long, with rounded apices, not transversely ribbed; seeds released forcibly from dehiscing cocci, shiny, brown. Fl. sporadically throughout the year.

Widespread in dry sclerophyll forest on sandy soils, south from Deepwater, NSW, through much of eastern NSW, also eastern highlands of Vic. [such as Mt Howitt and Pine Mountain] and the Bendigo area (Costermans 1992; Harden ed. 1990-1993).

CUSCUTA

(Convolvulaceae/Cuscutaceae)

Cuscuta australis *R. Br.* **(C. cordofana** *(Engelm.) Yunck.***; C. hygrophilae** *Pearson***; C. kawakamii** *Hayata***; C. millettii** *Hook. et Arn.***; C. obtusiflora var. australis** *(R. Brown) Engelm.***; C. obtusiflora var. cordofana** *Engelm.***)** – tu szu tzu, tu si zi ['jade woman'], yeh hu sse ['wild fox silk'], Australian dodder

Cuscuta chilensis *Kerl-Gawl* – cabello de angel

Cuscuta chinensis *Lam.* **(C. chinensis** *C. Wright***)** – tu szu zu, tu si zi, yeh hu sse

Cuscuta japonica *Choisy* **(Monogynella japonica** *(Choisy) Hadacβ. et Chrtek.***)** – tu szu tzu, tu si zi, yu nu, yeh hu sse

Cuscuta micrantha *Choisy* – cabello de angel

Cuscuta monogyna *Vahl* **(C. astyla** *Engelm.***; Monogynella monogyna** *(Vahl) Hadacβ. et Chrtek.***)**

Cuscuta reflexa *Roxb.* **(C. gigantea** *Griff.***; Monogynella reflexa** *(Roxb.) Holub***)** – amaravela, akasbel, tukhm-i-kasusa

Cuscuta spp. – dodders, cabello de angel

The dodders are fairly common parasitic plants the world over, and have varied medicinal uses. C. australis, C. chinensis and C. japonica are all used in similar ways in TCM, and share the same Chinese names. The dried, ripe seeds are considered to have pungent, sweet, and neutral properties, with an affinity for the kidneys and liver. Decocted in doses of 7-15g, they are said to be a stimulant and nutritive sexual tonic, used to tonify the kidneys and liver, nourish semen, improve vision, retard ageing, strengthen the urinary tract, strengthen bone and sinew, control diarrhoea and prevent miscarriage. They have been shown to have cardiotonic, hypotensive and uterine-stimulant actions, and also decrease spleen size and inhibit intestinal activity. Prolonged use may retard the healing of open sores, though [especially when given with 'wild yam' – see **Dioscorea**] they are said to give longevity when used for extended periods (Hsu et al. 1986; Keys 1976; Reid 1995). A friend finds that when used regularly, they enhance "perceptions both of the physical and the nonphysical" (Trout pers. comm.). Interestingly, C. australis is reported to have been used as an arrow-poison in Australia (Pammel 1911).

In India, dodder seeds are considered to be purgative, and the plant juice is used to staunch bleeding and reduce inflammation. In Ayurvedic medicine, C. reflexa is said to be aphrodisiac, alterative, tonic, astringent to bowels, acrid and bitter; it is also useful in diseases of the eye and heart, and in treating biliousness (Kirtikar & Basu 1980; Nadkarni 1976). C. europea has strong cathartic properties (Pammel 1911). The Mapuche of Chile have used Cuscuta spp. ['cabello de angel'] as a 'love elixir', as well as to treat inflammatory tumours. Mixed with parsley seed [see **Petroselinum**], they have been used to procure abortion. The only species reported from this area are C. chilensis and C. micrantha (Ruben Garcia et al. 1995).

It is worth noting that in Germany, Cuscuta spp. have been known by various names denoting an association with witches – 'hexengarn' ['witch yarn'], 'hexenhaar' ['witch hair'], 'hexenseide' ['witch silk'] and 'hexenwirbel' ['witch tears']; C. epithymum is known as 'hexenklee' ['witch clover'] (De Vries 1991).

C. americana contains *GABA* (Durand et al. 1962).

C. australis has yielded β-carotene [vitamin A], α-carotene, 6-epoxide, taraxanthin, cuscutin and lutein (Hsu et al. 1986; Reid 1995).

C. chilensis [growing parasitically on **Sophora** macrocarpa] yielded quinolizidine alkaloids derived from its host plant; proportionally, they consisted of 78.61% matrine, 2.98% sophoranol and 1.32% methyl-*cytisine* (Ruben Garcia et al. 1995).

C. chinensis has yielded cuscutin, as well as sugars and a resin (Hsu et al. 1986; Reid 1995).

C. europaea tested positive for the presence of c.0.001% alkaloids (Hultin & Torssell 1965).

C. japonica has yielded vitamin A, cuscutin and sugars (Hsu et al. 1986; Keys 1976; Reid 1995).

C. micrantha [growing parasitically on **Convolvulus** arvensis] yielded 0.1% kaempferol [MAOI (Sloley et al. 2000)] and lesser amounts of kaempferol-3-O-β-glucoside (Ruben Garcia et al. 1995).

C. monogyna is of primary interest because its seeds yielded 0.015% (-)-*agroclavine* (Ikan et al. 1968). However, another investigation, examining seeds of a specimen grown on **Artemisia** maritima [selected due to supporting the most vigorous growth of hosts tested] in a greenhouse in London [it did not produce seed outdoors], found no ergoline or clavine alkaloids (Mantle 1972). It may be likely that the host plant influences the alkaloid content, as with C. chilensis. The host of the specimen analysed by Ikan et al. was not reported.

Alkaloids were detected in the stems of an unidentified Cuscuta sp. in Yarraman, Queensland [Australia], harvested in October (Webb 1949).

Cuscuta monogyna is a herbaceous parasite, usually annual; stems twining, with haustoria. Leaves reduced to minute scales. Flowers 3-4mm, (3-)4-5-merous, small, white, yellowish or reddish, sessile or shortly pedicellate, in spike-like inflorescences of 1-4-flowered cymules; calyx campanulate, 2/3 as long as corolla-tube or equalling it in length; lobes orbicular-ovate, obtuse, overlapping, somewhat carinate and with crenulate margins; corolla lobes ovate, obtuse, crenulate, erect, about ½ as long as tube; corolla tube cylindrical; stamens inserted in throat of corolla tube; hypostaminal scales attached at base of corolla tube, dentate, nearly reaching stamens. Ovary globose-conical, 2-celled, each cell containing 2 anatropous ovules; style 1, in fruit about as long as stigma, free or united; stigmas capitate or elongate. Fruit a circumsessile capsule dehiscing by a line near base, or remaining closed, capped by the detached corolla; seeds 4 or fewer, 3-3.5mm.

Mainly on shrubs and trees; s.e. Europe, extending locally westwards to Portugal (Tutin et al. ed. 1964-1980) and east to Afghanistan, also n. Africa (Mantle 1972).

CYMBOPETALUM

(Annonaceae)

Cymbopetalum penduliflorum *(Sessé et Moçiño ex Dunal) Baill.* **(Unona penduliflora** *Sessé et Moçiño ex Dunal***; Porcelia cinnamonema** *G. Don***)** – xochinacaztli ['flower ear'], teonacaztli ['divine ear'], hueynacaztli ['growing ear' or 'big ear'(?)]

This tree was apparently used by the Aztecs for its aromatic flowers, which were drunk in 'cacao' [see **Theobroma**, also Quararibea in *Endnotes*] or smoked with tobacco [see **Nicotiana**]. As 'teonacaztli' [see also Enterolobium cyclocarpum in *Endnotes*], it was written in the Florentine Codex that "one shouldn't drink much because it comes out in people; it inebriates like the mushrooms", referring to **Psilocybe** mushrooms. The flowers are still used today as a spice in cacao; the fruit has eupeptic and anti-asthmatic properties (Diaz 1979; Ott 1993).

I am not aware of any phytochemical studies of C. penduliflorum, but C. brasiliense bark has yielded quaternary alkaloids [0.572% magnoflorine (see **Magnolia**), 0.286% tembetarine, 0.286% N-methylisocorypalmine, 0.221% colletine], and a mixture of non-quaternary alkaloids [0.13%], including (+)-reticuline, asimilobine, and (-)-norushinsunine. The quaternary alkaloids acted synergistically [the mixture was 5 times more potent than any of the alkaloids alone] to increase contractile force of isolated rat heart, and decrease blood pressure and pulse rate (Cave et al. 1984).

I haven't been able to find the description for this plant, though here are the reference citations -

Cympopetalum penduliflorum – Baill. Adansonia, viii:268 (1868); or as

Unona penduliflora – Monog. Anon., 100, t.28.

CYMBOPOGON

(Gramineae)

Cymbopogon ambiguus *(Steudel) Camus* **(C. exaltatus var. ambiguus** *(Steudel.) Domin***)** – native lemon grass, scented oil grass, aher-aher, rrwengerrweng, herre-herre, yawula, ilintjii, kalpalpi, karrinyarra, minjinpa, ampwer, pajarnpajarnpa, yayirri-yayirri

Cymbopogon densiflorus *(Steud.) Stapf* **(C. stypticus** *(Welw.) Fritsch***; Andropogon densiflorus** *Steud.***; A. schoenanthus var. densiflorus** *(Steud.) Hack.***; A. stypticus** *Welw.***)** – esakuna

Cymbopogon procerus *(R. Br.) Domin.* – wurrunjinbung, kunbong, bu, gabulurr

C. densiflorus, closely related to the common lemon grass [C. citratus], is used in Tanganyika by shamans, who smoke the flowers of the herb either alone or with tobacco [see **Nicotiana**] to induce a dream-like state where divinations may take place. Its aromatic leaves and rhizomes are also used as a tonic, and to control bleeding (De Smet 1996; Schultes & Hofmann 1980, 1992). Macerated together with **Ocimum** americanum, it is used in Zaïre to treat epilepsy (Watt 1967). The Nkopo of Papua New Guinea chew a Cymbopogon sp. ['petaong'] as a stimulant for dancing (Schmid 1991). The Warlpiri of northern Australia have a legend that tells of a wallaby with human form, who is immortal and lives on C. ambiguus. This herb is rubbed on the body and inhaled [sometimes decocted] for colds, chest complaints and other ills. A leaf decoction taken in the evening provoked "an almost continuous stream of vivid nightmares throughout the night" in one ethnobotanist (Latz 1995).

C. ambiguus leaf yielded 1.3% essential oil, which consisted of 47% camphene, 24% *borneol*, 4.3% tricycline, 5.8% α-*pinene*, 8.3% limonene, 2.5% *camphor*, 1% iso-*borneol*, 2.8% α-terpineol, and traces of other constituents (Aboriginal Communities 1988).

C. citratus essential oil may contain 90-95% *citral* (Erickson 1976).

C. densiflorus essential oil has yielded buchu-*camphor*, isopiperitinol, p-mentha-1(7),8-dien-2-ol (Buckingham et al. ed. 1994), cineole,

diosphenol, limonene, ocimene and dihydrotagetone (De Smet 1998).

C. martini essential oil ['palmarosa oil'] is rich in geraniol.

C. nardus and C. winterianus essential oil ['citronella oil'] contains 30-45% geraniol, 40-50% *citronellal* and citronellol (Erickson 1976).

C. procerus leaf yielded 0.4% essential oil; samples from one location contained predominantly *elemicin* [66% of essential oil], as well as 11% trans β-ocimene, 3.6% cis β-ocimene, 6.6% trans caryophyllene, 2.9% *methyleugenol*, 1.5% citronellyl acetate, 1.5% γ-cadinene, and traces of other constituents. A sample from a different area contained 47% camphene and 18% *borneol* as the major constituents, with no *elemicin* or *methyleugenol* (Aboriginal Communities 1988).

Cymbopogon densiflorus is a grass, usually perennial; culms erect, stout, up to 5mm diam. below, up to 8 or more noded, simple below false panicle, terete, smooth, sometimes waxy below nodes, glabrous. Leaf sheaths terete, tight, glabrous, smooth; ligules very short, truncate, glabrous; blades linear to linear-lanceolate, base usually wider and sometimes rounded, apex long and tapering to a fine point, to over 30 x 1.2-2.5cm, glaucous, glabrous, smooth except on upper margins; midrib slender, primary lateral nerves 7-11 on each side, fine, slightly raised. Spatheate panicle very dense or compact, ovoid to oblong or subglobose, 9-15cm or more x 6.3-10.2cm; lowest internodes 2.5-6.4cm long, rapidly decreasing upwards; lowest primary branches undivided at base; rays finely filiform, c.3mm long, glabrous; subtending sheaths with normal but shorter blades; spathes lanceolate, acutely and often finely acuminate, thinly subherbaceous, 7-11mm long, green then turning reddish or brownish; spatheoles similar but scarious, narrower and shorter; peduncles c.3mm long, very slender; racemes 2-nate, slender, olive-green to brownish, 0.5-1cm long, obscurely hairy, one sessile or subsessile, the other with glabrous base; fertile spikelets oblong, subobtuse, c. 2mm long, glabrous; callus very small, obtuse, minutely bearded; glumes subchartaceous, equal, lower subtruncate, back flat, with fine median groove, keels acute or obscurely winged, oil streaks on each side of the groove; upper glumes narrow in profile, acutely keeled above, 1-nerved; lower floret reduced to an oblong obtuse sub-2-nerved sparingly ciliolate valve; upper floret, valve reduced to a subchartaceous very slender stipe, usually without lobes, passing gradually into a fine bristle, including it c.3.5mm long; anthers c.1mm long; pedicelled spikelets neuter, lanceolate to lanceolate-oblong, c.1.5mm long; lower glume subherbaceous with 3-5 intracarinal nerves; upper membranous, white, 1- to sub-3-nerved; florets usually quite suppressed.

Fairly common in meadows, thickets and dry savannahs; lower Guinea, Gabon, Congo, Angola, Mozambique, Malawi (Prain ed. 1934).

CYPERUS, including BALANSIA endophytes

(Cyperaceae)

Cyperus articulatus *L.* **(C. corymbosus** *Rottb.***; C. diphyllus** *Retz.***; C. niloticus** *Forssk.***; C. nodosus** *Humb. et Bonpl. ex Willd.***; C. subnodosus** *Nees et Meyen***)** – waiyo duri, intiash piripiri, napi piripiri, cu nuni, nuni, piripiri yaca, mandassi

Cyperus digitatus *Roxb.* **(C. bourgaei** *C.B. Clarke ex Lundell***; C. mexicanus** *Liebm.***)** – chicorro

Cyperus fastigiatus *Rottb.* – mothoto

Cyperus odoratus *L.* – piripiri

Cyperus prolixus *Kunth* **(C. amplissimus** *Steud.***; C. jubaeflorus** *Rudge***)** – nuni, ta-dexka pona manise-ko, huhu diri, huhu nuni, hududi, saida nyame dudi, na'nyame dudi, na'nyame nuni ['rainbow nuni'], uchi achitiai maikiua, chicorro, piripiri yaca

Cyperus rotundus *L.* **(C. bicolor** *Vahl***; C. maritimus** *Bojer***)** – nutgrass, suad, yelka, thiang fowtse, tsin, hsiang fu, so t'sao, mustaka, muthanga, bhadramustra, junica redunda

Cyperus sp. – shako shayari, shako shejeti, anubedsetetseperi, piripiri, piripiri de brujo ['piripiri of the witch'], napi piripiri ['snake piripiri'], nuni, chicuro, chondoy, chondur, huaste, pijipíg

Cyperus spp. – sedge grass, ivenkiki

(Clavicipitaceae)

Balansia claviceps *Spegazzini* – black crust, inflorescence blight

Balansia cyperi *Edgerton*

Balansia epichloë *(Weese) Diehl*

These sedges, related to the original 'paper plant' [C. papyrus], are often infected with Balansia spp. endophytic fungi, and as such are used ritually and medicinally in Amazonia, often collectively referred to as 'piripiri' in Ecuador. In some villages, the infected sedges are cultivated in communal gardens (Plowman et al. 1990). The Jivaro of e. Ecuador attribute 'hallucinogenic' properties to these plants (Lipp 1995). Their bulbous roots are prepared in water and drunk by the Yagua of Peru for shamanic intiation, and to contact the spirit of the plant (Luna & Amaringo 1991). Shuar and Aguaruna shamans also sometimes consume a root tea for the same purposes as ayahuasca [see **Banisteriopsis**], and recognise a variety of endophyte-infected strains of C. articulatus, C. odoratus and C. prolixus, as do other groups [see below] (Bennett 1992).

The Sharanahua of the Peruvian Amazon add powdered rhizomes of a Cyperus sp. known as 'shako shayari' [probably C. digitatus or C. prolixus] to their ayahuasca brews. The Culina use a similar species, as 'anubedsetetseperi', when hunting peccaries (Pinkley 1969; Rivier & Lindgren 1972; Schultes 1972). In Peru, leaves of C. prolixus infected with B. cyperi are added to ayahuasca, and the dried rhizomes are sometimes mixed with tobacco [see **Nicotiana**] and smoked for an entheogenic effect (Plowman et al. 1990). C. digitatus may be smoked in the same way [Trout ed. 1998 notes that this information was referenced by various authors to Luna 1984, though I could find no mention of this in Luna's paper]. In Venezuela, a rhizome infusion of C. articulatus is given to children to increase their intelligence. C. articulatus has been used there [and also in Africa] to treat headaches, epilepsy, stomach ache, constipation, respiratory infections, rheumatism, oedema, problems in ovulation, and as an aphrodisiac. In Africa, the root powder is applied externally for such purposes (Bum et al. 1996; Plowman et al. 1990). This species is said to have 'intoxicating' properties (Lipp 1995).

The Yanomamo of Venezuela recognise a large variety of endophyte-infected Cyperus spp., which they cultivate and use for specific purposes. Many are used as hunting charms, the tubers heated and attached to arrows to ensure accuracy. Different cultivars are used, depending on the type of animal that is being hunted. Others are used as aphrodisiacs, stimulants, and contraceptives, amongst other uses, but the Yanomamo also know a cultivar that can kill. Piripiri varieties are used to treat fright, anger, diarrhoea, snakebites, and to counter witchcraft; they generally act as stimulants. The most widespread use is to procure abortion, due to the uterotonic action of the endophytes; piripiri is also enlisted to treat postpartum haemorrhage [due to its vaso-constrictive effects], hasten impending birth, or as a contraceptive (Lizot 1985; Plowman et al. 1990).

In Peru, a Cyperus sp. known as 'caballo piripiri' ['horse piripiri'] is mixed with Genipa americana, and the preparation poured over the body to gain strength. For this purpose, the mixture must be left on the body for at least 8 days, and the user must avoid the sun, salt, sugar, garlic, alcohol, pig fat, sex, and association with those who have been having sexual activity (Luna & Amaringo 1991). Most commonly, piripiri is prepared by grating the rhizome and infusing it in cold water; the liquid is either drunk or applied to the body as a wash (Plowman et al. 1990).

The Machiguenga of Peru know Cyperus spp. as 'ivenkiki', and like the Yanomamo, they cultivate a large variety of endophyte-infected Cyperus spp. for specific purposes. Each type of game animal has a corresponding ivenkiki cultivar, the tuber of which is chewed by male hunters when that animal is to be hunted. In the case of fishing, some of the chewed tuber may also be spat into the water, "to mesmerise the fish and focus the hunter's attention." Machiguenga women also cultivate their own Cyperus spp., used "to improve their concentration and skill spinning and weaving". Other uses for particular cultivars include treating headaches, fevers, diarrhoea, cuts, haemorrhage in childbirth, insanity, and for inciting bravery, defending babies against harmful spirits and rubbing on the hands when planting certain crops ["to make them more hardy"]. In his time with the Machiguenga, Glen Shepard Jr (1997), normally clumsy by his own admission, was temporarily able to skilfully juggle grapefruits after consuming a Cyperus sp. intended to treat his headache [which it did, incidentally] (Russo undated; Shepard 1997)!

The Chinese consider the rhizome of C. rotundus to be a tonic stimulant, properties for which it is also esteemed in Ayurvedic medicine [as well as for being an anthelmintic, diuretic, demulcent, stomachic, astringent, and vermifuge]. In Ayurveda, it is regarded as a 'jeeyanya' ['life promoter'], and is an ingredient of the Ayurvedic herbal preparation 'brahmighritham', used to control epilepsy. In Indian Unani medicine, it is reputed to improve memory and treat chronic fever, palpitations and anorexia. Tubers of the Indian C. inundatus and C. iria are also used as tonic stimulants (Nadkarni 1976; Shanmugasundaram et al. 1991). In Nepal, C. esculentus seeds ['kaancho laae' - see also **Scirpus**] may be used in ritual incense, but not by the Kirati (Müller-Ebeling et al. 2002). In southern Africa, the Basuto have been reported to use C. fastigiatus ['mothoto'] as an ingredient of a compound drug ['sehoere'] consumed in intoxicating ritual feasts [see *Methods of Ingestion*] (Laydevant 1932).

The pharmacology of the Amazonian endophyte-infected Cyperus spp. appears to be largely due to the chemical compounds produced by the endophytes in question. As many of the cultivars in use appear to be similar or identical botanically, their individualised applications are probably related to selected strains of the endophytes, that have been shown over time to produce the desired effects. These chemicals are mostly indoles similar or identical to those found in **Claviceps** ['ergot'] and **Ipomoea** ['morning glory'], for example.

B. claviceps has yielded the ergot-alkaloids *ergonovine*, ergonovinine and *chanoclavine I* (Bacon 1985; Bacon et al. 1986; Porter et al. 1978). In liquid culture, one strain of B. claviceps [219] produced 170.25mg of alkaloids per litre, consisting of *ergonovine*, ergonovinine, and *chanoclavine I*, whilst another [266] did not produce alkaloids. Both strains were orig-

inally growing on the same host species, Chasmanthium laxum (Bacon et al. 1979).

B. cyperi has yielded the ergot-type petides ergobalansine and ergobalansinine, as well as unidentified ergot-alkaloids [see **Claviceps**] (Buckingham et al. ed. 1994; Plowman et al. 1990; Powell et al. 1990).

B. epichloë, which has been implicated in stock intoxications similar to those caused by **Claviceps**, has yielded the ergot-alkaloids *agroclavine*, *elymoclavine*, *ergonovine*, ergonovinine, *penniclavine*, *chanoclavine I*, isochanoclavine I, 6,7-seco-*agroclavine*; as well as other indoles – indoleacetamide, indoleethanol, indoleacetic acid, threo-1-(3-indolyl)propane-1,2,3-triol, erythro-1-(3-indolyl)propane-1,2,3-triol, 3-(3,3-diindolyl)propane-1,2-diol, 4-(3-indolyl)butane-1,2,3-triol and 3-(3-indolyl)propane-1,2,3-triol (Bacon 1985; Bacon et al. 1975, 1986; Buckingham et al. ed. 1994; Porter et al. 1977, 1978). 'Smutgrass' [Sporobolus poiretii] parasitised by this species yielded 0.0017% alkaloids, consisting mostly of *chanoclavine I*, followed by *ergonovine*. In liquid culture, this strain of B. epichloë produced 390mg of alkaloids per litre, consisting of *ergonovine*, ergonovinine, *agroclavine* and *chanoclavine I* (Bacon et al. 1979).

B. henningsiana and B. strangulans in liquid culture produced 6.95mg and 85-158mg of alkaloids per litre, respectively; both produced only *chanoclavine I* (Bacon et al. 1979). The former species has been found on Panicum anceps (Bacon et al. 1979), P. agrostoides (Mogen et al. 1991), Andropogon spp. and Eragrostis spp. as host grasses (Bacon et al. 1975).

C. articulatus has yielded α-corymbolol, mandassidione and muskatone (Buckingham et al. ed. 1994). Extracts from rhizomes collected in Cameroon inhibited binding to the NMDA and *glycine* receptors in rats (Bum et al. 1996); a rhizome decoction [which was shown to contain flavonoids, saponins, terpenes, tannins and sugars] showed sedative activity in mice (Rakotonirinaa et al. 2001).

C. rotundus [whole plant] has tested positive for HCN (Watt & Breyer-Brandwijk 1962); it has has yielded cyperol, isocyperol, α-cyperone, *pinene*, cineole, *camphor*, glucose, fructose, and a eudalene-group sesquiterpene (Schermerhorn et al. ed. 1957-1974), as well as [w/w] 0.0091% octopamine; octopamine [0.0017%] and *tyramine* [0.001%] are also found in C. papyrus (Wheaton & Stewart 1970).

Balansia spp. – sclerotium composite, formed of the affected parts of the host embedded in a well-developed mass of fungal tissue; stroma arising from, not growing from, the sclerotium (true sclerotia with thick rinds are not formed), erect, large, stipitate and capitate or sessile, pulvinate, obovate, discoid, or separated from the sclerotium as soon as the latter is mature, stroma with distinct sterile and fertile portions, the latter often knob-like, surface lightly papillate from the projecting ostiola of the immersed scattered perithecia; asci 8-spored; spores continuous; paraphyses none; conidia, when known, an ephelis and preceeding the stroma (Sprague 1950; Stevens 1913).

Balansia claviceps produces a soft stroma on the inflorescence of the host grass, and does not produce sclerotia; spikes and rachis somewhat stunted, rachis thickened; stromata white inside, dark to black outside, hemispherical or globose, arising from spikelets, 1.5-3mm diam., stipe 1.5-3mm long, 1-1.5mm thick; perithecia subcortical in cap of stromata, densely grouped, distinctly obovate, 200-220 x 120-140μ, perforate ostiole; asci cylindrical, apices rounded, truncate, bases moderately attenuate, briefly rounded, 150-160 x 5-6μ, without paraphyses, 8-spored; ascospores filiform, fascicled, 0.6-0.8μ across, transversely septate, hyaline; conidia an ephelis.

Also infects Cenchrus echinatus, Setaria spp., Pennisetum spp.; tropics (Sprague 1950; White et al. 1995).

Balansia cyperi occurs on the surface of meristematic rhizome tissue and meristems (not growing internally), on young leaves, in the gap between the leaves in the whorl, and on aborted inflorescences as stroma, bearing abundant conidial frutifications (and, more rarely, ascostromata). Some aborted inflorescences have been observed to themselves produce miniature plantlets, which themselves would flower and produce miniature aborted inflorescences. Mycelium particularly abundant on rhizomes. Hyphae tightly packed only at very base of gap between leaves, extending upwards in loosely woven net, hyaline, thin-walled, c.2μ diam.; widely scattered patches of disarticulated and apparently senescent mycelium on surface of older leaves; mycelium proliferates around young, developing inflorescences, abundant mycelium filling all spaces between different parts of young spikes – the spike may continue to develop until initial signs of ovules appear – finally the fungal stroma completely enclose the culm apex; on stroma surface, a continuous palisade of ephelis conidiophores is formed.

Infects Cyperus spp. such as C. articulatus, C. pseudovegetus, C. rotundus, C. surinamensis and C. virens. C. rotundus uninfected by B. cyperi is usually infected by Rhizoctonia solani on the leaves (Clay 1988; Leuchtmann & Clay 1988; Plowman et al. 1990; Stovall & Clay 1991).

Balansia epichloë produces stroma on the upper leaf surface; mycelium grows intercellularly in leaf and culm tissues, as well as in pith; hyphae grow between host cells; in leaf sheaths hyphae are relatively straight.

Infects 'smutgrass' [Sporobolus poiretii], Andropogon scoparius and other Andropogon spp. [see **Cymbopogon**], Agrostis alba, Calamagrostis spp., Chasmanthium laxam, Chloris spp., Ctenium aromaticum, Eragrostis spp., Gymnopogon ambiguus, Oryzopris asperifiloa, Panicum spp., Thrasya petrosa and Triodia flava (Bacon et al. 1986; Leuchtmann & Clay 1988).

Cyperus spp. infected with Balansia spp. seem to be more vigorous than uninfected plants. Also, the same species of Balansia may produce different chemicals, or none, on a different host species (Bacon et al. 1986).

Cyperus prolixus is a perennial herb; rhizome horizontal, thick and hard, knotty, thickly fibrillose. Culms 90-150cm high, robust, obtuse triangular, smooth, base porous-thickened, lower bearing many leaves. Leaves equalling or exceeding culms, glaucous, 8-20mm wide, quite long, acuminate, margin keeled, scabrous, strongly septate-nodulose, sheath brownish and lucid. Bracts 6-10, exceeding anthelae. Anthela loose, large, radiating in many directions, rays rigid compressed-triangular, suberect, strongly inequal continuously to 30cm high, arising from prophylls, long, tubulose, brownish-green, in front truncate, at back long-bicuspidate. Anthelulae arranged bracteoles 6-8, short, mostly equal length, to 4mm wide, shortly setaceous, subtended, setaceous, suberect, firm, compressed, to 12cm long. Spikes densly multispiculose, outline oblong-elliptic; spikelets suberect, linear or linear-lanceolate, acute, 15-20mm long, 1½-2mm wide, compressed, 10-14-flowered; rachilla tenerrima flexuose, high, wings lanceolate, soon deciduous; scales scattered, when fruiting apex spreading, oblong-elliptic, obtuse, often shortly mucronate, 4mm long, green-keeled, dingy straw-yellow, 5-7-nerved, secondary nerves rusty-lineolate, margin enveloping, soon falling; stamens 3; anthers linear, apex white-setose. Style long, slender, deeply trifid; stigma strongly exserted, nearly tufted. Nut nearly equalling scales, narrowly oblong, thickened at angles, dark brown, shiny, densely punctulate, shortly apiculate.

Mexico to tropical S. America (Engler 1936).

CYPHANTHERA

(Solanaceae)

Cyphanthera albicans *(Cunn.) Miers* **ssp. albicans (C. ovalifolia** *Miers***)** – grey ray flower
Cyphanthera albicans ssp. notabilis *Haegi* **(Anthocercis albicans** *Cunn. sensu Maiden et Betche***)**
Cyphanthera anthocercidea *(F. Muell.) Haegi* **(A. anthocercidea** *(F. Muell.) Druce***; Eadisia anthocercidea** *F. Muell.***)**
Cyphanthera microphylla *Miers* **(A. microphylla** *F. Muell.***)**
Cyphanthera myosotidea *(F. Muell.) Haegi* **(A. amblyantha** *F. Muell.***; A. myosotidea** *F. Muell.***)**
Cyphanthera odgersii *(F. Muell.) Haegi* **(Anthocercis odgersii** *F. Muell.***)**
Cyphanthera odgersii ssp. occidentalis *Haegi*
Cyphanthera racemosa *(F. Muell.) Haegi* **(A. racemosa** *F. Muell.***)**
Cyphanthera scabrella *(Benth.) Miers* **(A. scabrella** *Benth.***)**
Cyphanthera tasmanica *Miers*

These Australian plants are known to produce hallucinogenic tropane alkaloids, and have no known native use. Although C. myosotidea was claimed to be "the only likely candidate" for the botanical identity of "an intoxicating root [...] used by some South Australian Aborigines", there is no evidence that it was the plant used (Peterson 1979).

All parts tested from the species below were collected in September, except for C. odgersii ssp. odgersii [Aug.] and C. tasmanica [May].

C. albicans ssp. albicans aerial parts yielded 0.05% alkaloids, consisting of *hyoscyamine*, *hyoscine*, their apo-derivatives, valtropine, valeroidine, 3-α-acetoxytropane, 3-α-isobutyryloxytropane, 3-α-isobutyryloxytropan-6-β-ol and tigloyl esters; roots yielded similar constituents, as well as 6-OH-*hyoscyamine*.

C. albicans ssp. notabilis stem bark yielded 0.01% alkaloids, most of which was *hyoscine*, with lesser amounts of *hyoscyamine*, their apo-derivatives, and tropine; leaves yielded 0.02% alkaloids of similar constituency to C. albicans ssp. albicans; roots yielded 0.07% alkaloids.

C. anthocercidea stem bark yielded 0.025% alkaloids, mostly *hyoscine*, as well as apo-*hyoscine* and an unidentified base; leaves yielded 0.21% alkaloids, mostly *nicotine*, with lesser amounts of *hyoscyamine*, *hyoscine*, their nor-derivatives, *anabasine* and tropine; roots yielded 0.07% alkaloids, mostly *hyoscine*, with less *hyoscyamine*, their apo-derivatives, *nicotine* and an unidentified pyridine derivative.

C. microphylla aerial parts yielded less than 0.01% alkaloids, which consisted of *hyoscyamine*, apo-*hyoscyamine* and unidentified bases.

C. myosotidea aerial parts yielded 0.11% alkaloids, most of which was *hyoscine*, as well as *hyoscyamine*, their apo- and nor-derivatives, 6-OH-*hyoscyamine*, scopine, tigloyl esters, and possibly 6,7-dihydroxy-3-phenylacetoxynortropane (Evans & Ramsey 1983).

C. odgersii ssp. odgersii aerial parts yielded 0.08% alkaloids, mostly *hyoscine*, as well as *hyoscyamine*, nor-*hyoscyamine*, apo-*hyoscine*, apo-*atropine*, 6-β-OH-*hyoscyamine* and tropine (El Imam & Evans 1984; Evans & Ramsey 1983).

C. odgersii ssp. occidentalis aerial parts yielded 0.1% alkaloids, mostly *hyoscine*, as well as *hyoscyamine*, their apo-derivatives, 6-OH-*hyoscyamine* and tetramethylputrescine.

C. racemosa aerial parts yielded 0.01% alkaloids, consisting of *nornicotine*, *anabasine* and an unidentified base; roots were alkaloid free to the limits of detection.

C. scabrella aerial parts yielded 0.06% alkaloids, mostly *hyoscine*, as well as apo-*hyoscine*, and possibly *hyoscyamine* and valeroidine (Evans & Ramsey 1983).

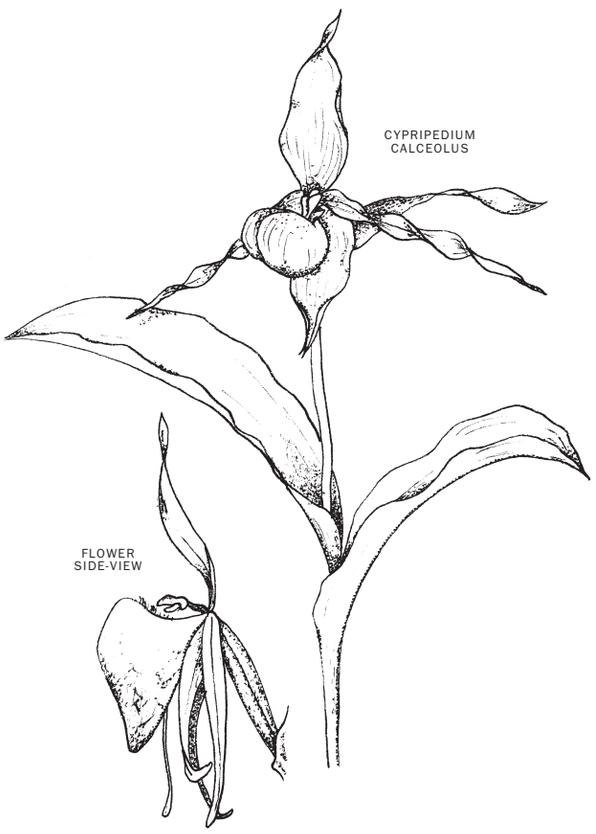
C. tasmanica aerial parts yielded 0.17% alkaloids, mostly *nicotine*, followed by *hyoscine*, as well as *hyoscyamine*/*atropine*, tropine, meteloidine and tigloidine; roots yielded 0.16% alkaloids, mostly *nicotine*, followed by *hyoscine*, as well as *hyoscyamine*/*atropine*, tropine, tigloidine and valeroidine (El Imam & Evans 1984)

Cyphanthera anthocercidea is an erect shrub to 2m tall; branches moderately tomentose. Leaves alternate, ovate to narrowly ovate, rarely ovate-elliptic, margins flat, sessile or almost so, 8-35 x 2-10mm, sparsely pubescent, midrib not indented above; young leaves up to 11 x 4cm, petioles to 15mm long. Inflorescence leafy, dense, and panicle-like, terminal or lateral; pedicels 2.5-6.5mm long, sparsely pubescent; calyx 3-4mm long, glabrous or almost so, campanulate to cupular, 5-lobed; corolla 10-14.5mm long, funnel-shaped to campanulate with spreading limb, almost glabrous, white, with purple striations in tube, limb 5-lobed, lobes ovate-truncate to linear, 4-5.5(-9)mm long, volutive in bud; stamens 4, inserted at base of corolla tube, 2-4mm long; staminode sometimes present; anthers unilocular, dehiscing by terminal, semicircular slit. Ovary bilocular; stigma capitate, very shortly bilobed. Fruit a smooth capsule, +- globose, 4-5mm diam., opening from apex by 4 valves, partially enclosed by calyx; seeds subreniform, 2.4-3.5mm long.

In rocky gullies of dry sclerophyll forest, also in sandstone-derived soil on exposed rocky spurs in shrubland; mainly in Wimmera region of Victoria (Haegi et al. 1982).

CYPRIPEDIUM

(Orchidaceae)



Cypripedium acaule *Aiton* **(C. humile** *Salisb.***; Fissipes acaulis** *(Aiton) Small***)** – stemless lady's slipper, low lady's slipper

Cypripedium arietinum *R. Br.* **(Criosanthes arietina** *(R. Br.) House***)** – ram's head lady's slipper

Cypripedium bulbosum *L.* **(Calypso borealis** *Salisb.***; C. bulbosa** *(L.) Oakes***)** – bulbous lady's slipper

Cypripedium calceolus *L.* **(C. parviflorum** *Salisb.***; C. pubescens** *Willd.***; Calceolus parviflorus** *(Salisb.) Nieuwl.***)** – yellow lady's slipper, moccasin flower, patridge moccasin, American valerian, nerve root, umbel

Cypripedium candidum *Muhl. ex Willd.* – small white lady's slipper, white-flowered lady's slipper

Cypripedium spectabile *Salisb.* – showy lady's slipper

The generic name and common name of these herbs are intertwined to some degree, with the 'lady' of the lady's slipper being Aphrodite, the Cypriot (theobromus pers. comm.). Some of these North American orchids are used by native groups as medicaments and intoxicants. The Meswaki used C. acaule root in love charms. The Menomini consume C. acaule as a nervine, and they use sacred bundles of C. calceolus to induce a shamanic dream-state. The Cherokee used C. calceolus and C. acaule in the form of a root tea to treat nerve problems, neuralgia, spasms, mania, pain, diabetes, colds, stomach ache and worms. In the 19th century, the dried rhizome of C. calceolus [and sometimes C. borealis] was used as an alcoholic tincture in Europe and N. America, primarily to treat menstrual disorders; the flower parts are thought by some to be representative of female genitalia, and the plant reputedly has aphrodisiac properties. The tincture was also used to treat nervous irritability, depression, insomnia and delirium. A syrup preparation was also given to restless children (Emboden 1979a; Felter & Lloyd 1898; Hamel & Chiltoskey 1975; Hutchens 1973; Lawler 1984; Ott 1993). Combined with equal parts of **Scutellaria** lateriflora and **Nepeta** cataria, C. calceolus roots have been decocted and used as an effective headache remedy (Felter & Lloyd 1898). The Indian C. elegans has been used for nervous disorders, as has C. luteum by native N. Americans. Leaves and roots of C. guttatum have been used to treat epilepsy in Siberia and e. Russia (Lawler 1984).

It is advisable to cultivate Cypripedium spp., as many species are rare in the wild. The roots, including rootlets, are harvested in autumn, cleaned free of dirt and carefully shade-dried. Although decoction in boiling water will extract some of the properties of the herb, extraction is best achieved with preparation of a simple alcoholic tincture, which is usually taken in a dose of c.6-20ml [concentration not noted]. The properties of all species are relatively mild, but synergise effectively with some other herbs, such as **Eupatorium** aromatica and **Scutellaria** lateriflora. All of the species listed above share similar properties, though C. acaule and C. spectabile are reputed to be more potent, particularly when found growing in dark swamps. Cypripedium spp. are said to give "a more calm and cheerful condition of the body and mind [...] consequently favouring mental tranquillity, or sleep" (Felter & Lloyd 1898; Hutchens 1973). However, handling the leaves of some species may result in 'poison ivy'-like dermatitis [see **Rhus**] (Lawler 1984).

C. calceolus has yielded the quinone cypripedin, which has been shown to cause allergic skin lesions in guinea pigs (Schmalle & Hausen 1979). A compound that has been referred to as 'cypripedin' [not the same as the aforementioned quinone] may be prepared by the addition of water to a strong alcoholic tincture of the roots, and collecting the precipitate (Grieve 1931). One psychonaut followed this procedure, drying out the precipitate to leave a powdery resinous residue. This 'cypripedin' acted as a strong sedative if eaten, but did not result in any noticeable effects when smoked, except that the psychonaut became immune to the effects of **Cannabis** for the next 3 days (theobromus pers. comm.)! Contact with the leaves and stems of Cypripedium spp. has been known to cause dermatitis, due to the glandular hairs that cover them (Felter & Lloyd 1898; theobromus pers. comm.).

In a screening for alkaloids in orchids, C. acaule, C. calceolus and C. macranthon gave negative results (Lüning 1967).

Cypripedium calceolus is a perennial herb growing from coarsely fibrous roots; stem erect, leafy, 20-80cm tall, bearing 2 or more ample leaves. Leaves +- sheathing, oval to ovate-lanceolate, 6-20cm long, about ½ as wide. Flowers 1-2, each subtended by an erect foliaceous bract; sepals (3) and petals (3) greenish-yellow to purplish-brown, ovate to linear, acute to acuminate, widely spreading; 2 lower sepals connate into 1, narrower than upper sepals, 2-toothed at apex; upper sepal ovate to ovate-lanceolate, 3-8cm long; lateral petals lanceolate, 3-8cm long, usually twisted; lip a large inflated pouch, margins +- inrolled around orifice, yellow, not cleft, usually +- veined with purple, 2-6cm long; column declined over orifice of the lip, bearing a fertile stamen on each side and a dilated staminode above; anthers 2. Ovary inferior, 1-celled; stamens 1-2, united with style and with prolongation of the central axis to form a central column bearing the stigma on its anterior face near base and anthers on its side, back or summit. Fruit a 3-valved capsule, containing many minute seeds.

In bogs and moist woods; widely distributed in Eurasia and N. America [Newfoundland to n.w. Canada, south to S. Carolina, Louisiana and New Mexico]. North American plants are represented by C. calceolus var. pubescens (Gleason 1952). Cultivate in soil with plenty of decayed leaves; can be propagated by division. Likes shade to full sun, winter min. 4°C, but doesn't grow in subtropical/tropical climates (Banks & Perkins 2005).

CYTISUS, GENISTA and SPARTIUM

(Leguminosae/Fabaceae)

Cytisus canariensis *(L.) Steud.* **(C. monspessulanus** *L.***; Genista canariensis** *L.***; G. monspessulana** *(L.) L.A.S. Johnson***; G. monspessulana** *(L.) Bolos et Vigo***; Teline monspessulana** *(L.) K. Koch***)** – Canary Island broom, canary broom, Cape broom, Montpellier broom, French broom, soft broom

Cytisus racemosus *Hort.-Cf. Marnock*

Cytisus scoparius *(L.) Link* **(Genista scoparia** *Lam.***; Sarothamnus scoparius** *(L.) W.D.J. Koch***; Spartium scoparium** *L.***)** – Scotch broom, common broom, yellow broom, giesta, retama de escobas

Cytisus spp. – brooms

Genista linifolia *L.* **(Cytisus linifolius** *Lam.***; Teline linifolia** *(L.) Webb et Berth.***)** – flax-leaved broom

Genista tinctoria *L.* – dyer's broom, dyer's greenweed

Spartium junceum *L.* **(Genista juncea** *Scop.***; G. odorata** *Moench***; Spartianthus junceus** *Link.***)** – Spanish broom, weaver's broom, retama, ginestra

The complex group of 'brooms', which are common weeds and garden plants in many parts of the world, attracted attention from people like ourselves when it was discovered that C. canariensis, an introduced plant to Mexico, was being smoked by at least one Yaqui shaman as a shamanic inebriant. The shaman interviewed in the original study claimed that he was instructed to smoke the flowers by a 'plant teacher' whilst in a trance. The flowers were prepared by ageing them for 10 days packed in a sterile, sealed glass jar, before being dried and smoked. During this ageing process, the flowers were not allowed to ferment or become mouldy, yet I have found it difficult to prevent such decompositions. Yaqui shamans may also prepare a drink from the seed capsules to facilitate divination, healing and time travel (Emboden 1979a; Fadiman 1965; Rätsch 1992; Schultes 1966). In Ecuador, dried flowers of S. junceum are smoked to treat asthma, and the root is infused to procure abortion (Schultes & Raffauf 1990). In Tuscany, Italy, stems of the wild plant are burned on Christmas eve to prevent the 'evil eye' and bring good omens (Pieroni & Giusti 2002).

Brooms get their collective name from the fact that they have been used to make brooms, due to their strong and flexible branches. In mediaeval times, the flowering plants were sometimes featured in heraldry. At one time, broom seeds were used as a coffee substitute [see **Coffea**], and the flowers pickled in wine. Perhaps more important was the widespread European use of young, green flowering tops [or occasionally the seeds] in beer brewing [see *Methods of Ingestion*], to render the drink more bitter and intoxicating. In European folk medicine, the flowers have been decocted as an aphrodisiac, and used to make a dye. The herbage was utilised in tanning leather, due to its tannin content. Medicinally, the plants have been used to treat heart, kidney and bladder problems, as well as rheumatism. The actions of the herb on the body in low doses are diuretic, purgative and weakly cardioactive; in moderate doses, they are 'narcotic', causing 'inebriation, staggering gait, and impaired vision', first with excitation, and later stupefaction; higher doses cause GI pain, diarrhoea, vomiting, sweating, and if unlucky, death by asphyxiation (Bremness 1988, 1994; Buhner 1998; Chopra et al. 1965; Rätsch 1992; Turner & Szczawinski 1991). C. proliferus is intoxicating to horses when fruiting, and C. scoparius has been toxic to sheep (Watt & Breyer-Brandwijk 1962).

Experiments have been carried out to examine the effects of the prepared, dried flowers when smoked. Subjective effects noted consisted of relaxation and a feeling of well-being; when more than one cigarette was smoked by subjects, a greater level of arousal was experienced, accompanied by mental clarity, and in some cases, greater appreciation of colour and contrast; some subjects also noted closed-eye imagery. C. canariensis was said to be the most pleasant and effective, with C. scoparius and S. junceum being less effective (Fadiman 1965). In my own experience, C. canariensis [as C. monspessulanus], C. racemosus and G. linifolia were +- equal in their mild effects.

The activity of the brooms is usually thought to be solely attributable to their *cytisine* content. However, as well as the other alkaloids, non-alkaloidal constituents such as flavonoids may also possibly contribute to overall activity.

In general, brooms contain quinolizidine alkaloids, such as *cytisine*, N-methylcytisine, sparteine, lupanine, anagyrine and many others. They should only be taken internally with caution due to their toxic nature. Sparteine, for example, has a similar action to *coniine* [see **Conium**], but is less toxic, and has little psychotropic activity, apart from CNS depression; it can paralyse motor nerves and sympathetic ganglia, as well as depressing the heart in large doses. Smaller doses stimulate heart action [see also **Lupinus**, **Sophora**] (Buhner 1998; Henry 1939; Nucifora & Malone 1971; Schmeller et al. 1994). Genistein, a flavonoid commonly found in Fabaceous legumes, has shown MAOI properties (Hatano et al. 1991), and is oestrogenic (Harborne & Baxter ed. 1993).

C. canariensis has been found to contain *cytisine*, N-methylcytisine, sparteine, lupanine, anagyrine, and other alkaloids (Harborne et al. ed. 1971; International... 1994).

C. proliferus seeds yielded 0.55% alkaloids, containing c.10% dl-calycotomine [6,7-dimethoxy-1-OH-methyl-THIQ], as well as other alkaloids, including sparteine (White 1957).

C. scoparius seeds yielded 0.5-0.6% alkaloids, including lupanine as a major component, as well as hydroxylupanine and traces of sparteine (White 1957). Flowers have yielded 2% amines, such as L-*DOPA*, *dopamine*, *tyramine* and epinine; branches have yielded 0.5-1% alkaloids, c.60% of which was sparteine, as well as 17-oxo-sparteine and lupanine; the plant has also been shown to yield the tetrahydroisoquinoline salsolidine [6,7-dimethoxy-1-methyl-THIQ; MAOI (Bembenek et al. 1990)]. Terpenoids, and flavonoids such as chrysin [MAOI (Sloley et al. 2000); see **Passiflora**], genistein, quercetin and vitexin are also found, particularly in the flowers. Alkaloid concentration reaches a maximum in winter (Bruneton 1995; Harborne et al. ed. 1971; Henry 1939; International… 1994; Smith 1975; Watt & Breyer-Brandwijk 1962). Seed alkaloid content was found to be highest [over 1%] in March; the seeds are generally the most concentrated in alkaloids (Chopra et al. 1965).

G. linifolia seeds have yielded c.1% *cytisine*; pods yielded 0.08% *cytisine*. Stems and leaves yielded 1.2-1.3% alkaloids in Feb., 0.64% alkaloids in May, 0.99% in Jul.; stems and leaves separately [harv. May] yielded 0.81% and 1.24% alkaloids, respectively. This consisted of c.70% anagyrine (White 1944b).

S. junceum has been reported to contain sparteine in flowers [c.0.22%] and the rest of the plant [c.0.02%]. However, plants growing in New Zealand were found to contain no sparteine above the detection limit [0.02%] in tops, young shoots, petals, stamens, and seeds; instead, *cytisine* was found in stems and leaves [0.09%], petals [0.29%], other flower parts combined [0.36%], and seeds [1.24%]. This species is regarded as being more potent than C. scoparius; "serious poisoning" has been reported from an ingestion of as little as 6g dry plant material (White 1943a).

Cytisus canariensis is an erect, evergreen shrub 1-2(-3)m tall; stems erect, woody, ridged, softly hairy, usually one main stem with numerous branches. Leaves alternate, shortly stalked, trifoliate; leaflets entire, obovate, hairy on lower surface, less so on upper, middle leaflet 5-30mm long (can be to 40mm on young growth), the others shorter. Flowers bright yellow, pea-like, c.1.2cm long, shortly stalked, occurring singly or in clusters of up to 9 in leaf axils and terminally; calyx bilabiate; corolla lobes short, upper 2 free or slightly connate, lower 3 connate into a 3-lobed lip, standard ovate, wings oblong, keel petals oblong, slightly incurved, swollen at sides, claws of wings and keel petals usually adnate to the staminal tube; stamens 10, monadelphous; anthers alternately short and versatile, long and basifixed. Ovary sessile, 2-many-ovuled; style apex incurved; stigma capitate, terminal. Fruit a brown or black silky pod, linear-oblong, 2-valved, non-septate, 2.5 x 0.5cm, coiled after release of seeds; seeds 5-8, dark brown to black, rounded and flattened, 2mm diameter, smooth, shiny. Fl. late winter-spring, sometimes in late summer.

Native to Mediterranean region; a weed in west coast N. America, Hawaii, New Zealand, Australia, Chile and forests of S. Africa.

Hardy and drought-resistant, brooms may be cultivated by seed or cutting; seeds should be nicked and soaked until swollen before planting. Do not transplant until older; or, plant seeds where they are to grow. Grow in well-drained soil with full sun; often does not flower until 2 years old (Allen & Allen 1981; Parsons & Cuthbertson 1992). Should not be cultivated in many places due to its great invasive potential (pers. obs.).

For medicine, aerial parts are usually gathered before flowering; for psychotropic use, the flower buds are gathered.

DATURA

(Solanaceae)

Datura ceratocaula *Ortega* **(D. macrocaulis** *Roth.***; D. sinuata** *Sessé et Moc.***; Apemon crassecaule** *Raf.***)** – tlápatl, nexehuac, tornaloco, atlinan, 'sister of ololuiqui' [see **Turbina**]

Datura discolor *Bernh.*

Datura ferox *L.* **(Stramonium ferox** *Boccone***)** – fierce thornapple, long-spine thornapple

Datura inoxia *Miller* **(D. guayaquilensis** *H.B.K.***; D. lanosa** *Barcley ex Bye***; D. metel** *Dunal non L. (Sims non L.)***; D. meteloides** *DC ex Dunal***)** – downy thornapple, a'neglakya, toloache, tolohuaxihuatl, dekuba, wichuri, peyote, tikúwari, tokhu

Datura leichhardtii *F. Muell. ex Benth.* **(D. pruinosa** *Greenman***)** – native thornapple [Australia]

Datura metel *L.* **(D. alba** *Nees ex Eisenb.***; D. cornucopaea** *Hort. ex W.W.***; D. fastuosa** *L.***)** – tatorah, datora, jous-matehl, dhustura, unmata, dhatura, dutra, chocho wah, bhakli wah, chosen asago ['Korean morning beauty'], man t'o-lo, mehen-x-tokhu, mondzo

Datura quercifolia *H.B.K.* **(D. stramonium ssp. quercifolia** *(H.B.K.) Bye***; D. villosa** *Fernald***)**

Datura stramonium *L.* **(D. bertolonii** *Parl. ex Guss.***; D. inermis** *Jacq.***; D. laevis** *L. f.***; D. tatula** *L.***)** – common thornapple, jimsonweed, Jamestown weed, toloache, toloatzin, nacazul, wichuri, uchiri, dekuba, kieli-sa, chamico, hierba del diablo, miayu, miyaya, ?ama'y mushtak, mehen-x-tokhu, hexenkraut, hexenkümmel, sekle wah

Datura wrightii *Regel ex Bye* **(D. meteloides** *Dunal***)** – hairy thornapple

Datura spp. – thornapple, dhaturo

Few plants have acquired such a fearsome reputation as those grouped under the genus Datura, which bear a huge testimony of written lore. Given the enormity of the literature regarding this genus, the following can only be seen as a general summary. Overall, it could be said that Datura spp. are known largely for their reputed use in European witches potions and 'flying ointments' (Rudgley 1995; Schultes & Hofmann 1992).

The ancient Sao culture of Chad have been hypothesised to have smoked D. metel in pipes, though there is no conclusive evidence to support this (De Smet 1998). D. metel was recorded to have been used as a narcotic inebriant by the Arabs by c.1000AD; it was also acknowledged that the plant could be deadly in higher doses. In Morocco, D. stramonium is used as an inebriant alone, or as 6 flowers added to coffee [see **Coffea**]. Datura has long been commonly used in India and Nepal [generally as D. metel], where it is sacred to Shiva – as such, it is smoked by saddhus and others with **Cannabis** as a sacramental aphrodisiac and an aid to raising the kundalini-energy [see *Influencing Endogenous Chemistry*], particularly in tantric yoga. It has a long history of use in tantric sorcery, and has also been added to alcoholic beverages to make them more potent. It is sometimes used to fortify 'bhang' [see **Cannabis**]. Nepalese shamans use Datura spp. seeds for shamanic travel, and to treat insanity; for the latter, the Kirati prescribe 1 seed each of D. metel, D. stramonium and D. metel var. fastuosa, with the dose of each increased to 2-3 seeds for the next day or two. Its Sanskrit names, 'dhustura' or 'unmata', mean 'divine craziness'. The seeds have been used by Kali-devotees for criminal purposes, presumably homicidal poisoning. Others use the seeds to stupefy a victim in order to rob them or otherwise take advantage. D. stramonium has been used in Indian medicine to treat mental disorders, fevers, headache, rheumatism, epilepsy, asthma, diarrhoea, inflammation and opium poisoning [see **Papaver**] (Mehra 1979; Müller-Ebeling et al. 2002; Nadkarni 1976; Ott 1993; Rätsch 1990, 1992; Schultes & Hofmann 1980, 1992; Siklós 1993).

Although indigenous Australians have not been reported to use their native Datura spp. as drugs, some refer to D. leichhardtii as a 'cheeky bugger' [meaning that it has toxic properties], indicating some knowledge of its effects. In the 19th century, inhabitants of Norfolk Island were reported to eat D. stramonium seeds "to invoke temporary or permanent insanity" (Low 1990).

In China, flowers ['yang-jin-hua'] and seeds of D. metel have been taken internally to treat nervous disorders and colds, and externally for skin eruptions and infections. Combined with **Cannabis** in wine, D. metel was used as an anaesthetic for minor operations; the inebriating properties of the plant were also well-known (Li 1978). In Haiti and Jamaica, Datura spp. are known as 'concombre zombi' ['zombi cucumber'], and are used as an aphrodisiac and medicine by healers. In Haiti, the plant is sometimes an ingredient in the 'antidote' administered to new zombis when they are dug up from their fresh graves, and also afterwards to keep them enslaved [see *Methods of Ingestion*] (Davis 1988a; Rätsch 1992). This may explain why zombis are traditionally said to die when given salt, as sweating is reduced in Datura poisoning (theobromus pers. comm.).

Datura spp. leaves are smoked in gourd pipes in e. Africa to produce inebriation, and in tropical w. Africa the plants are used to strengthen native beers and palm wines [see *Methods of Ingestion*]. Leaves of D. metel are used for this purpose in Tanzania. Amongst the Fulani, a D. metel seed decoction is given to boys "to incite them in the Sharo contest or ordeal of manhood" (De Smet 1998). Datura spp. may also be used as sacred inebriants by Kunama women of north-east Africa. D. metel is known to be consumed in the final stages of female puberty initiation rites, by the Shagana-Tsonga of n. Transvaal, to induce contact with ancestral fertility spirits so that sexual fertility is ensured. In west and central Africa, D. metel is also used as an inebriant, and for divination on criminal matters. In some parts of Africa, schoolboys initiate one another with the administration of an inebriating dose of Datura sp. seeds ['langboontije'] (Johnston 1972; Watt & Breyer-Brandwijk 1932, 1962).

In S. America, the use of Datura spp. seems to be largely replaced by **Brugmansia** [once classified under the genus Datura], though D. stramonium has been claimed to be an ingredient of the mysterious 'cimora' potion based on **Trichocereus** pachanoi [see **Trichocereus** for further discussion] in Peru (Schultes 1967a). Even though 'cimora' may not actually exist as the name for such a beverage, rather being a term used for a variety of plants (Davis 1983), D. stramonium [as 'chamico'] might still be added to T. pachanoi brews in Peru (Rätsch 1998). Also, the Mapuche of Chile use D. stramonium and/or another Datura sp. as a 'narcotic', and administer the seeds to 'unruly children' (Plowman et al. 1971). D. stramonium has been reported as one of the 4 major visionary plants of the Mapuche [see also **Latua**, **Lobelia** and Ovidia pillopillo in *Endnotes*] (Rätsch 2001).

The Aztecs used Datura spp. as analgesics, and called D. ceratocaula 'tlapatl'. Species such as D. ceratocaula, D. inoxia, D. metel and D. stramonium are still used in Mexico as local analgesics and stupefacients. D. inoxia is also used in sorcery and as an anaphrodisiac, and is known in some areas of Mexico as 'peyote' [see **Lophophora**]. D. stramonium is also used in sorcery and as an anaphrodisiac, antiasthmatic, expectorant, antipyretic, and poultice for wounds and skin conditions. D. inoxia root has been used by Zuñi shamans of New Mexico to 'render the patient unconscious' for performing operations; they may also put the powdered root into their eyes or chew the root for shamanic purposes. The plant may be decocted and drunk, or made into an ointment and rubbed on the body. Datura spp. have long been used for divination and healing by Mexican shamans, and the Maya, Tarahumara and Mixe still practice their use. The Mixe administer 27 seeds for a man, and 21 for a woman, for divination at night. Mayan shamans in the Yucatan eat 10-30 Datura seeds and concentrate on a crystal to divine; they also smoke the flowers as an aphrodisiac, and offer them to the gods. Still, shamans prefer to use these plants only in difficult cases. Most Yucateo and Lacandon Maya will not handle the plants [usually D. stramonium or the introduced D. inoxia] unless necessary, and then only for medicinal use. Such use is external, except in the case of nightmares, where a leaf or root tea may be given. The Naja Lacandon know Datura spp. as 'ts'ak tsimin' ['medicine of the wind/thunder beasts']; they are regarded as only being used by 'evil' shamans, and many Maya say the plants emit the 'smell of death', referring to their noxious odour. On a more casual note, Datura spp. are sometimes added to the fermented maize drink 'tesguino' [see also 'chicha', in *Methods of Ingestion*], and to mezcal [see also 'pulqué', in *Methods of Ingestion*], to increase their potency (Bye 1979b; Diaz 1979; Furst 1976; Lipp 1990; Litzinger 1994; Ott 1993; Rätsch 1990, 1992, 1999a; Schultes 1937a, 1937b, 1979).

N. American natives north of Mexico have also made widespread use of the available Datura spp. The Luiseño and other tribal groups of southern California used the infused root of D. inoxia ['toloache'] in male puberty initiation rites; every male in their group must consume it once in his lifetime, to establish life-long bonds with the spirit-realms. The experience is known to last up to 3 nights, and has on occasion caused fatalities. The original inhabitants of Virginia also used a Datura sp. in boys initiation; root decoctions of it ['wysoccan'] were administered after a lengthy period of fasting and instruction from elders. The experience was said to last 18-20 days [probably due to a very high sub-lethal dose], and was intended to erase memory of youth, in order to begin manhood. To the Chumash, Datura is considered a powerful spirit teacher. Many tribes used it in a similar context, or as a ritual shamanic inebriant (Furst 1976; Ott 1993; Schultes 1979; Wellmann 1978).

In the US, D. stramonium acquired the name 'jimsonweed' as a corruption of 'Jamestown weed', referring to an incident in the 17th century, involving English soldiers on their way to stop a rebellion at Jamestown, Virginia. The soldiers picked, cooked and ate D. stramonium leaves, mistaking them for an edible plant, resulting in a mass delirious intoxication lasting several days (Furst 1976).

It is also noteworthy that hawk-moths of the genus Manduca, pollinators of D. wrightii [as D. meteloides], appear to experience intoxication when visiting the flowers of the plant (Grant & Grant 1983).

Occasionally, Datura spp. have caused accidental poisonings [as with the Jamestown incident mentioned above], which have sometimes been fatal, though full recovery usually occurs within several days. A child [3 years, 9 months of age] was taken to hospital after eating the seeds from 3 D. stramonium fruits, and although he suffered hallucinations and other characteristic effects, "twelve hours after his admission to hospital he was alert and rational, but his gait was still ataxic; after a further period of 12 hours he was normal in all respects, except for occasional episodes of head-rocking over the next two days" (Schumacher 1965).

Modern-day use of Datura spp. amongst non-traditional peoples has largely been conducted by young, ill-informed people in search of a free 'trip' – indeed, what are claimed by experimenters to have been 'Datura trips' are often in reality based on consumption of the closely related **Brugmansia**. It must be said, however, that these plants do have their adherents amongst responsible experimenters. Many of the consequent experiences are extremely frightening, disorienting, and sometimes life-threatening; few repeat the experience, it being notoriously difficult to work with. Smoking the leaves or seeds provides a relatively safer means of ingestion, as the dosage is easier to gauge, effects are usually less drastic, and the duration of the effects is shorter [see **Brugmansia** for more discussion on consumption and effects]. Some people do manage to ingest Datura-preparations and direct a useful experience. Such people usually accomplish this with the aid of ritual, 'magic', and experience; some just have a personal affinity with these plants and their effects, that is lacking in most other people. It is not an easy journey to extract positive results from if you are not a shaman already acquainted with it. Regular use is widely reputed, even amongst shamans, to cause insanity (Gowdy 1972;

Siegel 1976; Weil 1977a; pers. comms.; pers. obs.).

Use of D. stramonium in asthma preparations as an orally-consumed psychoactive drug occurred frequently when such preparations were still widely available. Such preparations were intended as smokable mixtures, consisting mainly of c. 50% D. stramonium and 25% potassium nitrate [to facilitate burning], as well as **Atropa** belladonna, a Grindelia sp. and a **Nicotiana** sp. to add bulk and adjust the average tropane alkaloid concentration to 0.3%, or 220µg *hyoscine* and 250µg *atropine* per cigarette. D. stramonium is also found in some brands of 'bidis', small hand-rolled cigarettes from India; one type was shown to contain 65µg *hyoscine* and 16µg *atropine* per cigarette (Gowdy 1972; Siegel 1976).

Datura spp. have been shown to contain predominantly anticholinergic tropane alkaloids, as well as an array of other tropines [including cuscohygrines; see **Erythroxylum**], and withanolides [see **Withania**]. The anticholinergic effects of these plants may be reversed by the administration of physostigmine [i.v.], an AChE-inhibitor. In one case, 6mg given in 2mg increments over 10min. was sufficient to counteract the majority of CNS effects, but not the pupil dilation (Orr 1975). Other treatments that have been used for Datura-poisoning include the administration of charcoal [slows absorption], magnesium citrate [speeds passage through intestines], and ipecac [as an emetic; see **Psychotria**] (Friedman & Levin 1989). The Mixe of s. Mexico say that 'bad effects' of Datura may be relieved by drinking "a broth of very hot chili peppers" [see **Capsicum**] (Lipp 1990).

D. discolor [cultivated in Mexico] aerial parts yielded 0.17% alkaloids, including *hyoscine* [0.08%], *hyoscyamine* [0.01%], apohyoscine, norhyoscine, meteloidine, tropine and ψ-tropine; roots yielded 0.31% alkaloids, including 0.02% *hyoscine*, norhyoscine, *atropine* [0.01%], littorine, meteloidine, tropine, ψ-tropine, 3α,6β-ditigloyloxytropane, 3α,6β-ditigloyloxytropan-7β-ol, and cuscohygrine [0.06%]. Both contained traces of tropanes which were not positively identified (Evans & Somanabandhu 1974).

D. ferox aerial parts yielded 0.06-0.4% *hyoscine*, 0.1% meteloidine, and an unknown alkaloid; roots yielded *hyoscine*, *hyoscyamine*, cuscohygrine, littorine, meteloidine, 3α-tigloyloxytropane, 3,6-ditigloyloxytropan-7-ol, and 3,6-ditigloyloxytropane; seeds [fresh] yielded 0.07% alkaloids, mostly *hyoscine*, with no meteloidine. Apoatropine is found predominantly in seedlings, later decreasing in proportion to *hyoscine*, and remaining at its highest level in leaves and pericarps (Evans & Partridge 1949; Evans et al. 1972c; Everist 1974; Saber et al. 1962b). The plant also contain withanolides called daturolactones (Veleiro et al. 1999).

D. inoxia leaves have yielded 0.3-1.8% alkaloids, mostly *hyoscine* [0.17-1.65%], as well as *hyoscyamine* [0.047-0.15%] and meteloidine [0.05%]; stems yielded 0.3-2.52% *hyoscine* and 0.54% *hyoscyamine*; seeds yielded 0.436% *hyoscine*; fruits yielded 0.668-0.77% *hyoscine*; green calyx yielded 1.12% *hyoscine*; whole roots yielded 0.055-0.394% *hyoscine*, 0.27% *hyoscyamine*, and 0.09% meteloidine; tap roots yielded 0.81-1.65% *hyoscine* and 0.05-0.1% *hyoscyamine*; and fine roots yielded 1.69% *hyoscine* and 0.34% *hyoscyamine* (Everist 1974; Gerlach 1948; James 1953; Shibata 1956). Roots have also been shown to contain norhyoscine, apoatropine, littorine, tigloidine, cuscohygrine, tropine, ψ-tropine, 3,6-ditigloyloxytropan-7-ol and 3,6-ditigloyloxytropane (Evans et al. 1972c). The leaves also yielded 0.00036% [w/w] *scopoletin* and aesculetin (Kala 1958).

D. leichhardtii leaves yielded 0.33% alkaloids, and stems yielded 0.07% alkaloids [combined aerial parts yielded 0.16% alkaloids], consisting mostly of *atropine* [0.06%], with lesser amounts of *hyoscine* [0.02%], apoatropine, noratropine, norhyoscine, apohyoscine, littorine, tigloidine, meteloidine, tropine, ψ-tropine and 3-α-tigloyloxytropane; roots yielded 0.31-0.46% alkaloids, consisting mostly of *atropine* [0.18%], with lesser amounts of *hyoscine* [0.01%], norhyoscyamine, littorine, tigloidine, meteloidine, tropine, ψ-tropine, cuscohygrine, 3-α-tigloyloxytropane, 3,6-ditigloyloxytropane and 3,6-ditigloyloxytropan-7-ol (Evans & Treagust 1973a; Evans et al. 1972c; Everist 1974).

D. metel combined aerial parts yielded 0.1% *hyoscine*, 0.02-0.04% *hyoscyamine* [disappears after flowering; none in seeds or root] and 0.01% norhyoscyamine; leaves yielded 0.264-0.52% alkaloids [0.113% *hyoscine*, 0.076% *hyoscyamine* in one test]; calyces yielded 1.08% alkaloids; stems yielded 0.3% alkaloids; roots yielded 0.39-0.66% alkaloids, mostly *atropine* or *hyoscyamine*, as well as 0.054% *hyoscine* and cuscohygrine; fruit yielded 0.2% [as D. fastuosa var. niger] to 0.77% alkaloids; capsules yielded 0.334% alkaloids; seeds yielded 0.23-0.5% alkaloids. Leaves also yielded the withanolides withametelin [0.0015-0.1%], withametelin B [0.00175%], 12-deoxy-withastramonolide [0.016%] and physalindicanol A [0.00375%]. Roots had highest alkaloid content [up to 0.77%] in cold and rainy seasons, and when flowering and fruiting; stems bear the highest content [up to 0.41%] when in flower and fruit; leaf is highest in alkaloids [up to 0.55%] when young and at the start of flowering; flowers are highest in content [up to 0.98%] near the end of flowering and fruiting; fruit has highest content [up to 0.089%] when ripe; and seeds also have highest content [up to 0.17%] when ripe. Plants grown at higher altitudes had higher alkaloid content in all parts than plants grown at lower altitudes. Tetraploid plants had higher alkaloid levels than haploid [lowest levels] and diploid plants (Afsharypuor et al. 1995; Gerlach 1948; Gupta, M. et al. 1991; Henry 1939; Karnick & Saxena 1970; Shibata 1956).

D. quercifolia leaves yielded 0.42% alkaloids, consisting of *hyoscine* and *hyoscyamine*; seeds yielded 0.29% alkaloids, of similar constituency (Henry 1939). The plant also contains withanolides called daturolactones (Veleiro et al. 1999).

D. stramonium aerial parts have yielded up to 0.54% alkaloids – 0.07-0.2% *hyoscine* [lower before flowering, higher after] and 0.04-0.15% *hyoscyamine* [lower before flowering, higher after]. Leaves have yielded 0.4% *hyoscyamine* and 0.01% *hyoscine*; stems yielded 0.2% *hyoscyamine* and 0.05% *hyoscine*; roots have yielded 0.1% *hyoscyamine*, 0.1% *hyoscine*, apoatropine, 0.01% 3,6-ditiglolyteloidine, cuscohygrine, littorine, meteloidine, tropine, ψ-tropine, 3,6-ditigloyloxytropan-7-ol, and 3,6-ditigloyloxytropane. Seeds yielded 0.2-0.48% alkaloids, mostly *hyoscyamine* [though one recent study (Friedman & Levin 1989) found *atropine* and *hyoscine* as the major alkaloids, with yields of 0.16-0.28% and 0.033-0.079%, respectively], as well as 0.017% *GABA*, 0.012% arginine, 0.008% histidine, and 0.16-0.56% tannins. Tetraploid plants had higher alkaloid content than haploid [lowest content] and diploid plants (Anon. 1916a; Evans et al. 1972c; Friedman & Levin 1989; Henry 1939; Karnick & Saxena 1970; Leete 1959). As D. tatula, leaves yielded 0.36% alkaloids [0.27% *hyoscyamine*, 0.09% *hyoscine*]; roots yielded up to 2.28% *hyoscyamine*, 0.012% *hyoscine* (Shibata 1956; Spurná et al. 1981) and the coumarin *scopoletin* [0.0002% w/w] (Kala 1958). Leaf tested positive for HCN (Watt & Breyer-Brandwijk 1962).

D. wrightii roots contain large quantities of *hyoscine* and *hyoscyamine*, whilst leaves contain only small quantities of *hyoscine* (Spurná et al. 1981). Root [as D. meteloides] has been shown to contain *hyoscine*, *hyoscyamine*, norhyoscine, norhyoscyamine, cuscohygrine, littorine, meteloidine, tropine, ψ-tropine, 3,6-dihydroxytropane, 3α-tigloyloxytropane, 3,6-ditigloyloxytropan-7-ol, and 3,6-ditigloyloxytropane (Evans et al. 1972c); leaves [as D. meteloides] from Australian plants yielded 0.18-0.45% alkaloids, mostly *hyoscine*, as well as *hyoscyamine* and norhyoscyamine; seeds yielded 0.17-0.47% alkaloids (Everist 1974). Whole plant [again, as D. meteloides] yielded 0.4% alkaloids, including 0.13% *hyoscine*, 0.03% *atropine* and 0.07% meteloidine (Henry 1939).

In tests on the Datura alkaloids in animals, very high doses [ie. too high to be of significance in human pharmacology] of *atropine*, *hyoscine* and total alkaloid mixture caused 9, 14.7 and 15.2% inhibition of MAO and 8, 9.3 and 8.9% inhibition of *5-hydroxytryptophan*-decarboxylase, respectively (Rastogi & Mehrotra ed. 1990-1993). D. stramonium inhibited human plasma AChE (Orgell 1963b).

Datura stramonium is a stout annual herb, glabrous or sparsely pubescent with non-glandular hairs; stems to 0.5-2m tall, purplish or green. Leaves 5-15(-36)cm long, rhomboid to angularly-ovate, deeply lobed, lobes few, usually coarsely toothed or sinuate. Flowers perfect, gamopetalous, solitary and pedicelled, erect; calyx 3-4(-5.5)cm long, tubular, 5-lobed, lobes 6-8mm long; corolla funnel-shaped, 5-lobed, lobes ending in a slender point c.10mm long, white or lavender, 6-10cm long, 3-4cm wide at apex; stamens 5, not exserted, alternating with corolla-lobes, attached to inner surface of tube near base; anthers 3-6mm long, purple in lavender-flowered types, white in white-flowered. Ovary superior, 2-celled at apex, often 4-celled below; style 4-6cm long, filiform; stigma below, level with or above anthers, 2-lobed. Capsule ovoid, to 4.5-5(-7)cm long, 3-5cm wide, erect, shiny green, spiny, spines c.100-200, slender, conical, sharp, variable in length, the longest less than ½ the length of capsule, dehiscing apically by (usually) 4 slits; persistent base of calyx to 10mm long; seeds many, 2.5-4.5mm long, black or grey when ripe.

Origin uncertain – widely naturalised around the world, also a weed of waste ground and disturbed areas (Haegi et al. ed.1982; Satina & Avery 1959; pers. obs.).

Sow seed in spring; freezing and subsequent thawing of the seed [notably in the case of D. inoxia] may aid in germination (Gerlach 1948).

Seeds of Datura spp. are a frequent contaminant of harvested soy beans, wheat, and other commercial grain crops, in one analysis comprising c.79% of organic contaminant material. As the alkaloids largely survive being baked in bread as a flour contaminant, there is an obvious risk of poisoning if post-harvest cleaning is insufficient (Friedman & Levin 1989).

DATURICARPA

(Apocynaceae)

Daturicarpa elliptica *Stapf.* **(Tabernanthe elliptica** *(Stapf.) Leeuwenb.***)**

This shrub from Zaïre [previously Belgian Congo] has no ethnobotanical uses to my knowledge, though it has yielded some indole alkaloids of great interest. The genus has been named in reference to the **Datura**-like appearance of the 'spiky' fruits.

D. elliptica root bark yielded 5.6% alkaloids, and stem bark yielded 2.4% alkaloids; in both samples, *ibogaine* was the major alkaloid [c.80% of total alkaloids], with lesser amounts of *iboxygaine*, *ibogaline*, (+)-ibophylli-

dine and *voacangine* (Bruneton et al. 1976).

Daturicarpa elliptica is a shrub or small tree; branches on previous year's growth closely striate-wrinkled and lenticellate-verrucose. Leaves opposite, broadly elliptic or elliptic-oblong, abruptly caudate-acuminate, acumine linear obtuse, 10-18cm long, 5.5-7cm wide, quite slender, upper side green or dark brown when dried, under side pallid, lateral nerves 6-7 on both sides; petiole 3-6mm long, bases opposite, laterally mostly sub-acutely angulate. Inflorescence a panicle, 3cm long including peduncle; peduncule c.5mm long; calyx very small, herbaceous, glandless within; sepals 5, imbricate, ovate-rotundate, obtuse or subobtuse; corolla hypocrateriform, 6-7mm long, 7-8mm diam., pale greenish-yellow, red-striate, tube widened at base, narrowing gradually from the middle to the apex, with a pilose line within for each anther, corolla lobes obtuse, contorted to the left, not inflexed in bud; stamens inserted at middle of corolla tube; anthers converging to a cone, included in tube. Disc indistinct; ovary adnate, 2-carpellate, slightly fleshy; ovules 3-5-seriate; style becoming abruptly filiform; stigma linear-sagittate, capitate, shortly apiculate-acuminate, not or scarcely adhering, base narrowly manicate, lightly 5-furrowed, subviscose. Mericarp peduncule 1-2cm long, mericarp spreading or erect, subtended, globose, to 3.5cm diam., indehiscent, ochre-reddish or orange, spines flexible and soft, 7-10mm long, closely scattered covering each other, outer layer 3mm thick; seeds to 20, 7-9mm long, ellipsoid.

Zaïre – Kwango District, Kikwit, Mondombe, Province Orientale, in virgin forest near Lubutu-Kirundu, Kasai District, Batempa, Kondue (Stapf 1921).

DAUCUS

(Umbelliferae/Apiaceae)

Daucus carota *L.* **(Carota sativa** *Rupr.***; Caucalis carota** *Crantz***; Cau. daucus** *Crantz***)** – wild carrot, Queen Anne's Lace, bird's nest, philtron, nanheshi, gajar

Daucus glochidiatus *(Labill.) Fischer et C.A. Meyer* – Australian carrot

Wild carrot [D. carota ssp. carota] is the original wild counterpart of the cultivated carrot [D. carota ssp. sativus], the root of which is fleshier, more colourful, more flavoursome and more nutritious. The wild plant is not without its virtues, however, as it is rich in medicinal compounds, some of which may be psychoactive.

There are only a few vague references to psychotropic usage of D. carota that I could find (Schultes & Hofmann 1980). A brief aside in the Bulletin on Narcotics (Phillips et al. 1968) stated that "It is reported that teenagers in the United States of America are smoking the leaves of Daucus carota [wild carrot], called the 'Queen Anne's Lace'." Another paper reported the 'dried tops' to "have been smoked with the intention of 'tripping'" (Krikorian 1968). The only other source I have located is an underground comic book (Sheridan 1969), where it is said that the herb of Queen Anne's lace may be smoked, with psychoactive effects alluded to. In neither case were any further details given. Rätsch (1998) reported that the aerial parts give **Cannabis**-like effects when smoked, with the wild variety giving best results, though the comparison to **Cannabis** seems dubious.

The root is sometimes ground into an edible flour, and has also been roasted and used as a coffee substitute [see **Coffea**] similar to dandelion or chicory. The root also lowers blood pressure, and acts as an antibacterial, anthelmintic, antacid, diuretic and ophthalmic. It has been used as a poultice for skin itches, though some people experience photosensitisation after contact with the foliage. The root may be useful in treating cancer. In TCM, the dried ripe seeds, known as 'nanheshi', are used as a galactogogue, emmenagogue, antispasmodic, and antiseptic, as well as to prevent formation of urinary stones. The herbage is used for similar reasons in Ayurvedic medicine, and in India the seeds are used as a stimulant, aphrodisiac and nervine tonic (Bremness 1994; Chiej 1984; Huang 1993; Mabey et al. ed. 1990; Nadkarni 1976; Polunin & Robbins 1992). The seeds have apparently also been used as a hangover remedy (Chevallier 1996). Wild D. carota has been suspected of causing mild intoxications in horses and cattle (Crosby & Aharonson 1967).

D. carota seed oil acts as a CNS-depressant and hypotensive in animals at higher doses; in smaller doses it is a stimulant, excitatant, vasodilator and a smooth muscle relaxant. The seeds also have a cholinergic action on GI smooth muscle (Chopra et al. 1965; Lawless 1995; Rastogi & Mehrotra ed. 1990-1993), and should probably be avoided in pregnancy, due to their potential abortifacient action (Chevallier 1996). An article I have been unable to locate suggests that D. carota may act as an MAOI (Gupta, L. et al. 1973. "Monoamine oxidase inhibiting activity of Daucus carota". Indian J. Exp. Biol. 11(4):342-3). Another elusive article (Vashist, M.G. et al. 1997. "Screwing a carrot out of the rectum." Indian J. Gastroenterology 16(3):120) suggests another use which the carrot may be put to!

D. carota seed has yielded 0.6-2.1% essential oil [from cultivated varieties], containing mostly carotol [(9-)65.85-67.2%; wild varieties contained almost none], as well as daucol [8.8-9.6%], β-bisabolene [5.6-6.2%], epoxydihydrocaryophyllene [2.5-20%], geranyl acetate [0-48%], geraniol, *asarone*, *elemicin*, α- and β-*pinene*, (+)-daucene, limonene, sabinene, dipentene, p-thymol, linalool, β-elemene, bergamotene, α-curcumene and farnesene; the fixed oil of the seed contains oleic acid, linoleic acid, linolenic acid and palmitic acid; the seed has also yielded *choline* (El Gendhi 1990a, 1990b; Rastogi & Mehrotra ed. 1990-1993; Stahl 1964). The leaf-wax has been found to contain *methylisoeugenol* (Berueter & Staedler 1971; Shulgin & Shulgin 1991) and the leaves contain compounds called porphyrins which stimulate release of sex hormones from pituitary gland (Chevallier 1996). Also, 0-0.023% *tyramine* been found in the plant (Lundstrom 1989). D. carota ssp. sativus root has yielded an essential oil containing β-caryophyllene, terpinolene, *pinene*, β-myrcene, γ-terpinene, p-cymene, α-humulene, and (E)-γ-bisabolene as major components, with lesser amounts of many other compounds, including traces of *myristicin*, *elemicin*, and *camphor* (Harborne et al. 1969; Kjeldsen et al. 2001); the root has also yielded carotatoxin [trans-1,10-heptadecadiene-5,7-diyn-3-ol], a compound which was neurotoxic in mice [LD50 100mg/kg] (Crosby & Aharonson 1967). Under some storage conditions, the roots have been shown to produce abnormal metabolites, such as the coumarins *scopoletin*, 6-MeO-mellein, and 6-OH-mellein, and the chromones eugenin and 5,7-dihydroxy-2-methylchromone (Coxon et al. 1973).

D. glochidiatus seed yielded *myristicin* (Harborne et al. 1969).

Daucus carota is a biennial pubescent herb with a stout taproot; stems 50-100cm tall, glabrous, scabrous, or commonly rough-hairy. Leaves pinnately decompound, oblong in general outline, the ultimate divisions linear, lanceolate or oblong. Inflorescence a terminal compound umbel, erect, long-peduncled, commonly 7-15cm wide, 20 rays or more, the lateral ones usually smaller; involucre of numerous large, pinnately dissected bracts; bracts divided into elongate filiform-attenuate segments 5-20mm long; umbellets several to many-flowered; bractlets linear or rarely pinnate; flowers white or rarely pinkish, the central one of each umbellet often purple; calyx greatly reduced; sepals minute or obsolete; petals 5, usually prolonged at tip to an inflexed appendage; stamens 5, inserted on disk; filaments elongate. Ovary inferior, 2-celled; 1 ovule in each cell; styles 2, usually swollen at base into stylopodium. Fruit 3-4mm long, oblong or ovoid, flattened dorsally, primary ribs low and inconspicuous, bearing a row of short inconspicuous bristles, the 4 secondary ribs prominently winged, divided into a row of flattened-subulate, hooked or straight spines; oil tubes 1 under each secondary wing, 2 on the commisure. Fl. Jun.-Sep. (northern hemisphere).

Native to Eurasia; established as a weed in fields, roadsides, waste ground and open woods throughout US, Canada and many other parts of the world (Gleason 1952), including Australia (Hnatiuk 1990).

DELOSPERMA

(Aizoaceae/Mesembryanthemaceae)

Delosperma acuminatum *L. Bolus*
Delosperma bosseranum *Marais*
Delosperma britteniae *L. Bolus*
Delosperma cooperi *(Hook.) L. Bolus* **(Mesembryanthemum cooperi** *Hook.***)**
Delosperma ecklonis *(Salm.) Schwant.* **(Mesembryanthemum ecklonis** *Salm.***)**
Delosperma esterhuyseniae *L. Bolus*
Delosperma hallii *L. Bolus*
Delosperma harasianum *(Delfers) Poppendieck et Ihlenf.*
Delosperma herbeum *N.E. Br.*
Delosperma hirtum *(N.E.Br.) Schwant*
Delosperma klinghardtianum *(Dtr.) Schwant* **(Mesembryanthemum klinghardtianum** *Dtr.***)**
Delosperma lebombense *(L. Bol.) Lavis*
Delosperma aff. litorale *(Kensit) L. Bolus*
Delosperma lydenbergense *L. Bolus*
Delosperma mahonii *(N.E. Br.) N.E. Br.* **(Mesembryanthemum mahonii** *N.E. Br.***)**
Delosperma minimum *Lavis*
Delosperma nubigenum *(Schltr.) L. Bolus*
Delosperma obtusum *L. Bol.*
Delosperma pageanum *(L. Bol.) L. Bolus*
Delosperma pergamentaceum *L. Bolus*
Delosperma pottsii *(L. Bol.) L. Bol.*
Delosperma pruinosum *(Thunb.) J. Ingram*
Delosperma rogersii *(Schoenl. et Berger) L. Bol.* **var. rogersii**
Delosperma tradescanthioides *(Berger) L. Bolus*
Delosperma and some related **spp.** – ice plants

Delosperma spp. are used for various purposes in parts of southern and eastern Africa. The Tswana consume a root decoction of D. herbeum to treat loss of male fertility. They also powder the plant and rub it into scarifications on the vertebral joints, to make one "strong and resist-

ant to witchcraft". The Bantu use the root of D. mahonii [which contains up to 3% oxalates] to brew an intoxicating beer or mead, often known as 'khadi', which is said to be poisonous when these plants are used in large amounts [see *Methods of Ingestion*]. The root has been shown to sometimes be infected by a Torula sp. yeast and the mould **Aspergillus** niger, as well as possibly A. oryzae and Mucor erectus, which are thought to possess fermenting properties. One of the moulds has been shown to form oxalic acid in sugar solution. Europeans have used the root for yeast in bread-making (Anon. 1916b; Steyn 1934; Watt & Breyer-Brandwijk 1962). D. cooperi leaves have also been used for khadi, and this species has been shown to host similar yeasts and moulds (Hargreaves 1999). Curiously, in his excellent discussion on khadi, Hargreaves did not refer to D. mahonii, unless he used a synonym not known to me. These symbiotic organisms may also possess psychotropic properties of their own, as some **Aspergillus** spp. have yielded psychoactive ergot-alkaloids, and Mucor heimalis has yielded the ergot-alkaloid [see **Claviceps**] ergosine (El-Refai et al. 1970), a *serotonin*-antagonist and uterotonic (Cerletti & Doepfner 1958).

D. bosseranum leaf has been obscurely used by some western psychoanuts in the same manner as **Sceletium** tortuosum and other **Sceletium** spp.; the effects are reportedly similar but more pleasant. The root reputedly has mild stimulant properties (t st tantra pers. comm. 2003).

Unidentified Delosperma spp. have been reported to contain *DMT* and *N-methyltryptamine* [*NMT*] (Smith 1977b); they have remained unidentified until recently, with independent researchers taking the initiative using thin-layer chromatography and colour-reaction tests. However, the results (in Heffter 1996; Trout ed. 1997a) should be considered tentative; it should also be noted that the tryptamines were often present in low amounts, if at all, and were usually accompanied by many unidentified compounds in larger amounts.

D. acuminatum contained *DMT*, *5-methoxy-DMT* [*5-MeO-DMT*] and *NMT*.

D. britteniae contained *5-MeO-DMT* [high in late autumn, absent in spring] and *NMT*.

D. cooperi contained *DMT* [more in autumn], *5-MeO-DMT* [more in late spring/summer] and *NMT* (Heffter 1996; Trout ed. 1997a). Earlier tests for alkaloid presence indicated a strong reaction (Jeffs 1981), and the alkaloidal material present was presumed to have been *mesembrine* (Steyn 1934). D. cooperi fo. cooperi has also been shown to contain small amounts of mesembrenone, 4'-O-demethylmesembranol [see **Sceletium**], and larger amounts [c. 8% of extract] of an unidentified, possibly indolic, compound (Smith, M.T. et al. 1998).

D. ecklonis was found to contain traces of alkaloids in an early assay (Jeffs 1981), presumed to be *mesembrine* (Steyn 1934); *DMT* was later tentatively detected (Trout ed. 1997a).

D. esterhuyseniae contained *DMT* in small amounts in autumn, as well as *NMT*.

D. hallii contained high amounts of *5-MeO-DMT* in autumn, as well as *NMT*.

D. harasianum contained *5-MeO-DMT* and *DMT* in small amounts in autumn, as well as *NMT*.

D. hirtum contained small amounts of *DMT* in late autumn/winter, as well as *NMT*.

D. klinghardtianum tested positive for other unidentified tryptamines (Heffter 1996; Trout ed. 1997a).

D. lebombense has been shown to contain small quantities of mesembrenone, as well as two unidentified peaks, believed to contain indole constituents (Smith, M.T. et al. 1998).

D. aff. litorale contained *5-MeO-DMT* in autumn, none in spring, as well as *NMT*.

D. lydenbergense contained *DMT* in autumn, none in spring.

D. nubigenum contained small amounts of *5-MeO-DMT* (Trout ed. 1997a).

D. obtusum has been shown to contain small quantities of 4'-O-demethylmesembrenol (Smith, M.T. et al. 1998).

D. pageanum contained *5-MeO-DMT* in larger amounts in late spring, as well as *DMT* and *NMT*.

D. pergamentaceum contained traces of *DMT* in autumn (Trout ed. 1997a).

D. pottsii has been shown to contain moderate quantities [c.39% of extract] of unidentified compounds, some of which appear to be indoles.

D. pruinosum has been shown to contain small amounts of *mesembrine*, mesembrenone and 4'-O-demethylmesembrenol, as well as unidentified compounds.

D. rogersii var. rogersii has been shown to contain small quantities of 4'-O-demethylmesembrenol, as well as at least two unidentified compounds which appear to be indoles (Smith, M.T. et al. 1998).

D. tradescanthioides contained small amounts of *DMT* in autumn, as well as *NMT*.

In general, no alkaloids were found in spring harvests of Delosperma spp.; late autumn and early winter harvests gave the highest alkaloid levels (Heffter 1996; Trout ed. 1997a).

D. lehmannii and D. subincanum have tested alkaloid-positive, the latter only in trace amounts (Jeffs 1981; Steyn 1934; Watt & Breyer-Brandwijk 1962). D. luteum contains humilixanthin (Buckingham et al. ed. 1994). Like Mesembryanthemum and other related plants [see **Sceletium**], most Delosperma spp. may be expected to contain considerable quantities of oxalates.

Delosperma cooperi is a small, soft, hairless perennial, with numerous small papillae; rootstock woody or tuberous; stems often prostrate, with distinct internodes. Leaves opposite, sessile, narrow, slightly connate, succulent, soft and fleshy, +- finely papillose, broadly triangular to cylindrical in cross-section, lowest up to 4cm x 5mm, most leaves much shorter and only c.2mm wide. Flowers axillary, singly or in small groups, shortly stalked, c.1.5cm diam., with leaf-like bracts; perianth-segments 5, the longer ones sometimes horn-shaped or caudate; longer calyx lobes long-tailed; sepals 5, long and narrow; petals magenta, narrow, numerous; staminodes in few series, +- linear; stamens whitish, sometimes hairy towards base. Ovary 5-locular, +- convex; glands separated, partly crenulated; placentas parietal; stigmas 5, acute, papillose. Fruit soft in texture, 5-locular, keels with membranous marginal wings; seeds suborbicular, pale brown.

In rock crevices; Sicanusa, Swaziland (Compton 1976; Launert et al. ed. 1978); common horticultural succulent.

DESFONTAINIA

(Desfontainiaceae/Loganiaceae)

Desfontainia spinosa *Ruiz et Pav.* **(D. acutangula** *Dunal***; D. chilensis** *Gay***; D. costaricensis** *Woodson***; D. fulgens** *D. Don***; D. hookeri** *Dunal***; D. ilicifolia** *Phil.***; D. novemdentata** *Gand.***; D. obovata** *Kraenzl.***; D. parvifolia** *D. Don***; D. pulchra** *Moldenke***; D. spinosa var. chilensis** *(Gay) Reiche***; D. spinosa var. hookeri** *(Dunal) Reiche***; D. spinosa var. parvifolia** *(D. Don.) Hook.***; D. splendens** *Bonpl.***; D. steyermarkii** *Moldenke***; Linkia peruviana** *Pers.***; L. splendens** *(Bonpl.) Poir.***)** – taique, borrachero de paramo, chapico, michai blanco, trau-trau, latué, latuy

Kamsa and Ingano shamans of the Sibundoy Valley area of Colombia are known to make a tea of D. spinosa leaves to diagnose illnesses and enter a visionary state; it is said to make them 'go crazy'. People with knowledge of the plant are reluctant to discuss it with outsiders. In Chile, leaves of D. spinosa are taken as a narcotic and stomachic. The local Mapuche use the plant to make a yellow fabric dye (Schultes 1977a), as well as using it obscurely "in a similar way" to **Latua** pubiflora (Rätsch 1998, 2001).

This species has screened negative for alkaloid content (Schultes 1977a), though D. spinosa leaves and stems have yielded the iridoids loganin [0.026%], loganetin [0.055%], loganic acid [0.06%] and 7-O-(p-coumaroyl)-loganin; the seco-iridoids sweroside, secoxyloganin and dimethyl secologanoside; the glucoside iridoid-triterpenoid congeners desfontainoside [in stems only] and desfontainic acid; the cytostatic triterpene 11-deoxycucurbitacin I [0.003%]; and the furofuran lignans (+)-syringaresinol, (+)-syringaresinol O-β-D-glucopyranoside and liriodendrin (Amonkar et al. 1985; Houghton & Ming 1985, 1986); nigaichigoside F1, hyptatic acid, 7α-OH-tormentic acid and 7α-23-dihydroxytormentic acid were also reported from the plant (Buckingham et al. ed. 1994).

Desfontainia spinosa is an evergreen shrub 1.5-3m tall, branched, with pale brownish shiny bark, the twigs greyish. Leaves opposite, simple, coriaceous, spiny, 2-4 x 1-2.3cm, elliptical to ovate or obovate, acute and pungent, cuneate at base, with 2-8 pairs of spiny, broadly triangular teeth, the spines 2-2.5mm; petiole 8-10mm; stipules absent. Peduncles 9-10mm, with 2 basal bracts c.6 x 1-1.2mm, +- linear; flowers solitary, terminal; sepals 5, united at base; calyx segments 7-8 x 3-3.5mm, elliptic-oblong, obtuse, ciliate, sparsely pubescent; corolla infundibuliform, shallowly 5-lobed, 4.5-6cm, with rotund lobes, the tube red, the lobes yellow-orange; stamens 5, inserted at base of corolla lobes. Ovary superior, (3-)5-celled; style 1; stigma subcapitate, included or slightly exserted; anthers subsessile. Fruit a many-seeded berry, 12-15 x 9-11mm, oblong-subglobose, greenish-purple; seeds 2-2.5 x 1-1.2mm, oblong-obovoid, smooth. Fl. Dec.-Feb.

Coastal forest, 0-30m; w. Argentina 42-40°S, Chile from 40°S, north along Andes to 25°S (Moore 1983).

DESMANTHUS

(Leguminosae/Mimosaceae)

Desmanthus cooleyi *(Eat.) Trel.* **(Acuan [Acuania] cooleyi** *(Eat.) Brit. et Rose***)** – bundleflower

Desmanthus illinoensis *(Michx.) MacM. ex Robinson et Fern.* **(D. brachylobus** *(Willd.) Benth.***; Acuan illinoensis** *(Michx.) Kuntze***; Mimosa illinoensis** *Michx.***)** – Illinois bundleflower, atikatsatsiks ['spider bean'], kitsitsaris ['bad plant'], pezhe gasatho ['rattle plant']

Desmanthus leptolobus *T. et G.* **(Acuan leptolobum** *(T. et G.) O. Ktze.***)** – prairie bundleflower, prairie mimosa, slenderlobed bundleflower, dragon's root

Desmanthus velutinus *Scheele.* **(Acuan velutinum** *(Scheele) Kuntze***)** – bundleflower

Children of the Omaha and Ponca use the dried pods of D. illinoensis [still containing seeds] as rattles, when imitating the ritual dances of the adults. Adults use the boiled leaves as a wash for itches. The Moapa Paiutes were said to have placed the [presumably ground] seeds in the eyes at night, washing them out the next morning, to relieve trachoma. D. illinoensis is now considered an important food crop for livestock animals, and is used in revegetation (Kindscher 1992).

Today, these Desmanthus spp. are of interest because the root bark of D. illinoensis has been used for around two decades as a *tryptamine*-component in ayahuasca analogues, mostly within the US. However, the plant is not an ideal source for these alkaloids, and many report dissapointingly low yields, requiring large amounts of plant material [c.60g for threshold effects]. More recently, D. leptolobus extracts have been bioassayed, both in the form of ayahuasca analogues, and vapourised freebase extracts. This plant seems preferable to D. illinoensis for practical use; some Texan users have dubbed it 'dragon's root' (DeKorne 1994, ed. 1996; Ott 1994; Van Heiden 1998; pers. comms.).

D. cooleyi has yielded c.0.07% *DMT* from roots (Appleseed 1993; Van Heiden 1998).

D. illinoensis aerial parts [flowering and fruiting] tested negative for alkaloids in a broad screening (Fong et al. 1972); root bark yielded 0.34% *DMT*, 0.11% *N-methyltryptamine* [*NMT*], and small amounts of *gramine*, indole-3-acetic acid, N-OH-N-methyl-1H-indole-3-ethanamine, 2-OH-*NMT* and tryptophol; root wood yielded only 0.01% *DMT* and 0.0016% *NMT* (Thompson et al. 1987). Rootbark of this species has sometimes been low or deficient in *DMT*; faulty identification could be responsible in some instances, chemical variation in others (pers. comms.). Seeds have been shown to contain djenkolic acid, N-acetyldjenkolic acid, dichrostachic acid, and smaller amounts of 4-OH-pipecolic acid, S-(β-carboxyisopropyl)-cysteine, and S-(β-carboxyethyl)-cysteine (Krauss & Reinbothe 1973).

D. leptolobus root bark has yielded 0.14% *DMT*, though it has often yielded larger quantities in practice; *gramine* and *NMT* may also be present.

D. velutinus yielded *DMT* in some root collections, but others contained none (Appleseed 1993; Van Heiden 1998).

Desmanthus illinoensis is a perennial shrub with a herbaceous stem, to 2m tall, several stems from the crown, strongly angled, glabrous to hirsute. Leaves bipinnate, 5-10cm long; pinnae 6-14 pairs, 2-4cm long with a small oblong or suborbicular gland between them or between the lower pair of pinnae only; leaflets 20-30 pairs, oblong, linear, acute, 2-5mm long, glabrous or often ciliate; stipules threadlike, 6-10mm long. Flowers perfect, white or whitish, in several-flowered heads; peduncles axillary, in fruit 2-7cm long, ascending; sepals 5, free to the top of the floral cup; calyx united, campanulate, 5-toothed; petals c.2mm long, 5, separate or slightly united at very base; stamens 5, separate to top of floral cup. Pods strongly curved or somewhat twisted together in a dense subglobose head, thin, flat, 1-2.5cm x 4-7mm; seeds 3-5mm long, nearly as wide. Fl. summer.

In moist or dry soil or clay soil in river banks, prairies, pastures, waste ground; from Minnesota across Colorado, south to Florida, Texas and New Mexico (Correll & Johnston 1970; Gleason 1952).

Seed should be soaked overnight before germination [after optional scarification]. Plant c.5-15cm apart, and cover with a sprinkling of soil; water well, but do not saturate. Germination may be staggered over a year or more. Enjoys full sun for part of the day; tolerates poor soil; drought-tolerant once established. Feed regularly, but do not saturate. Plants cultivated in rich soils seem to suffer a higher mortality rate than others. In areas with frosts, prune severely before winter. Root-bark growth can be encouraged by pruning back stems several times a year. Harvest roots late summer-autumn; witholding water at the end of summer, then watering heavily 4-6 weeks before harvest, is reputedly advantageous to alkaloid levels. Cleaned roots are processed more easily when still fresh; lightly beating with a hammer splits the bark, which can then be easily removed (Case 1995; see this and its updates for more in-depth discussion).

DESMODIUM

(Leguminosae/Fabaceae)

Desmodium adscendens *(Sw.) DC.* **(D. caespitosum** *(Poir.) DC.***; D. strangulatum** *Thw.***; Hedysarum adscendens** *Swartz.***; H. caespitosum** *Poir.***)** – beggar-lice, tick clover, margarita, amor seco ['dry love'], amores do campo, carrapichinho, acoumengate, pega-pega, lo a guo, tombolombo, koli-niki ['leopard's groundnut'], ndogbo-nikili ['bush groundnut'], hardstick, hard man, strong back

Desmodium caudatum *DC.* **(D. laburnifolium** *(Poir.) DC.***; Catenaria caudata** *(Thunb.) Schindl.***; C. laburnifolia** *(Poir.) Benth.***; Hedysarum caudatum** *Thunb.***; H. laburnifolium** *Poir.***)** – moh-t'sao, misonaoshi, qing jiu gang

Desmodium cephalotes *(Roxb.) Wall.* **(D. triangulare** *(Retz.) Merr.***; Hedysarum cephalotes** *(Roxb.) Wall. ex Wight et Arn.***; H. triangulare** *Retz.***; H. umbellatum** *Roxb.***)** – karabija

Desmodium gangeticum *DC.* **(D. maculatum** *(L.) DC.***; Aeschinomene gangetica** *(L.) Poir.***; A. maculata** *(L.) Poir.***; Hedysarum collinum** *Roxb.***; H. gangeticum** *L.***; H. maculatum** *L.***)** – saumya, amsúmat ['rich in soma juice'], shalaparni, salpani, salvan, sarivan, pullaadi, gitanaram, kolapanna

Desmodium gyrans *DC.* **(D. motorium** *(Houtt.) Merr.***; D. roylei** *Wight et Arn.***; Codariocalyx gyrans** *(L.f.) Hassk.***; C. motorius** *(Houtt.) Ohashi***; Hedysarum gyrans** *L.f.***; H. motorium** *Houtt.***)** – moving plant, telegraph plant, whirling plant, gyred cock's head, bhunakra, ote-atil

Desmodium lasiocarpum *(Beauv.) DC.* **(D. latifolium** *DC.***)** – anguchabadi, abashoka, chinanduri, chimbattai, damgere, ewe omo, kohemi koko, otokataka, simmathasura

Desmodium paniculatum *(L.) DC.* **(D. dillenii** *Darl.***; D. glabellum** *(Michx.) DC.***; D. perplexum** *Schub.***; Meibomia pubens** *(T. et G.) Rydb.***)** – panicled tick clover

Desmodium pulchellum *Benth. ex Baker* **(Dicerma pulchellum** *(L.) DC.***; Hedysarum pulchellum** *L.***; Phyllodium pulchellum** *(L.) Desv.***)** – birkapi, caliacay, jatasalpara, kadumuduru, krishnopornii, takamala, pai chien cao, p'ai-chien-t'sao ['string of coins']

Desmodium racemosum *(Thunb.) DC.* **(D. oxyphyllum** *DC.***)** – Chinese Desmodium, shan-ma-huang, nusubitonasi

Desmodium ramosissimum *G. Don.* **(D. mauritianum** *(Willd.) DC.***)**

Desmodium tiliifolium *(D. Don.) G. Don.* **(D. cinerascens** *Franch.***; D. elegans** *DC.***; D. esquirolii** *H. Lév.***; D. forrestii** *Schindl.***; D. franchetii** *Rehder***; D. glaucophyllum** *Pamp.***; D. rhabdocladum** *Franch.***; D. spicatum** *Rehder***; Hedysarum tiliifolium** *D. Don.***)**

Desmodium triflorum *(L.) DC.* **(Hedysarum triflorum** *L.***; Nicholsonia triflora** *(L.) Griseb.***)** – sweethearts, hinundupiya, jaharipana, jajaladbihir, kodalia, kolante, koli-niki, marlomin, muntamandu, outoupilli, pacpaclangao, pookarisa, ranmethi, sirupullady, trefle noir

Various Desmodium spp. have uses in folk medicine, particularly in Indian districts. Uses are generally to treat dysentery, liver diseases, catarrh, eye diseases and as a poultice for acne, abscesses and ulcers. Stems of some spp. are used to weave baskets and prawn traps, and flowers of some yield dyes. The leaves of D. oldhami are used as a tea in Japan (Allen & Allen 1981; Uphof 1968), and the Houma of N. America consume a root infusion of D. paniculatum as a stimulant. D. lasiocarpum is smoked by the Bontoc of the Philippines (Ott 1993), and the Bimin-Kuskusmin of Papua New Guinea use the leaves of a Desmodium sp. known as 'khaandisiim' as a wrapper for their ritual tobacco [see **Nicotiana**], smoked in the 7th stage of initiation (Poole 1987). In n. Thailand, the Mien use D. laxiflorum roots and leaves as a tonic and to treat high blood pressure; it has also been used to relieve unconsciousness. The Akha use D. longipes roots as a tonic, and to treat convulsions and epilepsy (Anderson 1993; Trout ed. 1997f). In Malaya, the roots of a Desmodium sp. ['kachang hantu'] are used in the manufacture of dart-poisons; the roots tested alkaloid-positive (Bisset & Woods 1966). The Asian D. cephalotes has been used as a CNS stimulant, as well as to treat bronchial spasms, coughs and dysentery (Ghosal & Mehta 1974).

In India, D. heterocarpon [D. polycarpum] has been used to relieve fainting and convulsions (Nadkarni 1976). In Ayurvedic medicine, D. gyrans leaves are considered to act as a tonic, aphrodisiac, diuretic and febrifuge; roots treat coughs and asthma, and are emollient, laxative and antidysenteric (Ghosal et al. 1972a). D. gangeticum aerial parts are used as an aphrodisiac and uterine stimulant; root extracts are used to treat diarrhoea, asthma and chronic fever. In Ayurvedic medicine, it has been used in compound medicines [with 10 or more other herbal drugs] to treat fever and a variety of other complaints, including "affections of the brain" and delirium in fever. The plant is known as 'saumya' or 'amsumat' ['rich in soma juice'], hinting at knowledge of its chemical properties (Ghosal & Bhattacharya 1972; Nadkarni 1976; Ott 1993). The Indian D. latifolium is used for its roots, to treat insanity, amongst other complaints. Leaves of D. triflorum are given as an anticonvulsant, galactagogue and diuretic (Nadkarni 1976). Also in Ayurveda, D. pulchellum bark is decocted to treat haemorrhage, poisoning, diarrhoea and eye diseases; flowers treat biliousness (Ghosal & Mukherjee 1964; Ghosal et al. 1972c; Nadkarni 1976). In TCM, the aerial parts of the same plant are used as an antipyretic and cold remedy (Huang 1993). In China, D. caudatum [as whole plant, which is collected in May] is used as an analgesic, antiseptic, antipyretic, detoxifier and insecticide. D. racemosum is also used there as a diaphoretic and respiratory stimulant (Perry & Metzger 1980; Trout ed. 1997f).

In central Africa, D. adscendens leaves are used to treat asthma, fever, pain, epilepsy (N'gouemo et al. 1996), convulsions and vertigo. The plant has been used magically when aid of some kind is needed. For this purpose, a 'heap' of leaves is mixed with earth and spread over the body; secretly, the person goes out into the sun. No other details were available (Trout ed. 1997f, citing Motte, E. 1980. Les Plantes Chez Les Pygmées Aka et Les Monzombo (Centrafrique), p.376). D. adscendens is considered to have 'magical powers' in the Amazon. The plant is taken as an infusion to treat nervousness, and is also believed to have the power to "reattract a mate whose affection has strayed" (Duke & Vasquez 1994). Mestizo shamans in Peru sometimes use it as a love charm. For this purpose, the roots from 5-6 plants are pulverised and dried to a powder, which is infused with perfume, dried again, and 'given strength' in an ayahuasca ceremony [see **Banisteriopsis**]. To be used, a small amount of the powder is "placed discretely on the body of a lady to make her fall in love with the owner of the preparation" (Luna & Amaringo 1991). The Cuna use D. intortum to prepare a love potion (Trout ed. 1997f). In Liberia, a leaf infusion of D. ramosissimum is used as a wash for children suffering convulsions (Watt 1967); in some parts of tropical Africa, the plant has been used as an excitant (Uphof 1968).

Fresh aerial parts of Desmodium spp. contained more than 3-5 times the amount of alkaloids than dried material, though little difference was noted with roots (Ghosal & Bhattacharya 1972; Ghosal et al. 1972a) – the alkaloids generally consisting of tryptamines, β-carbolines, phenethylamines, and tetrahydroisoquinolines [THIQs].

D. adscendens leaves contain indole-3-alkylamines, phenethylamines, THIQs and triterpenoid saponins [mostly dehydrosoyasaponin]. A plant extract acted as a CNS-depressant, hypothermic and analgesic, as well as inhibiting synthesis and release of *histamine*, prostaglandins and arachidonic acid (N'gouemo et al. 1996).

D. caudatum [harv. May, Japan] root has yielded 0.087% *DMT*, 0.03% *bufotenine* N-oxide, and the flavonoid desmodol; stems yielded 0.0035% *DMT*, 0.04% *bufotenine* [5-OH-DMT], 0.004% *bufotenine* N-oxide, and desmodol (Ueno et al. 1978); canavanine [see **Canavalia**] was also detected in the plant (Bell et al. 1978).

D. cephalotes stems and roots [combined] yielded 0.011% alkaloids – 0.00375% *hordenine*, 0.0027% *tyramine*, 0.00075% *phenethylamine*, 0.0014% candicine [4-OH-N,N,N-trimethyl-*phenethylamine*], 0.00088% salsolidine [6,7-dimethoxy-1-methyl-THIQ – see **Pachycereus**], 0.0018% *choline* and 0.0007% of an unidentified base; leaves yielded 0.0048% alkaloids, consisting mostly of *phenethylamine*, with smaller amounts of *tyramine* and traces of salsolidine (Ghosal & Mehta 1974).

D. gangeticum roots yielded 0.02% *DMT*, 0.0075% *DMT* N-oxide, *5-MeO-DMT* N-oxide, 0.0175% *phenethylamine*, 0.03% N-methyl-*tyramine*, 0.05% *hordenine*, 2-(N,N-dimethylamino)-*acetophenone*, candicine, *choline* and hypaphorine [see **Erythrina**]. Stems and leaves yielded 0.01-0.03% alkaloids [much higher in fresh samples]; the following yields are given as w/w – 0.041% *DMT*, 0.033% *DMT* N-oxide, 0.057% *5-MeO-DMT* [*5-methoxy-DMT*], 0.018% *5-MeO-DMT* N-oxide, 0.003% N-methyl-*tetrahydroharman*, leptocladine [1,2-dimethyl-THβC], 6-MeO-2-methyl-THβC [2-methyl-*pinoline*] and 0.004% 6-MeO-2-methyl-β-carbolinium salt [has AChEI activity]. In dry aerial parts, *5-MeO-DMT* is a dominant alkaloid. Seeds yielded 0.015% alkaloids – *DMT*, *DMT* N-oxide, 6-MeO-2-methyl-β-carbolinium salt and *norharman* (Banerjee & Ghosal 1969; Ghosal 1972; Ghosal & Banerjee 1969; Ghosal & Bhattacharya 1972; Ghosal et al. 1970b); the plant has also yielded 2-methyl-THβC, 2-methyl-β-carbolinium quaternary salt, 6-MeO-2-methyl-THβC quaternary salt, and 1,2-dimethyl-β-carbolinium salt [melinonine F] (Shulgin & Shulgin 1997). Alkaloids reached highest levels in red leaves from late autumn to winter (Trout pers. comm.). Alkaloids from aerial parts have CNS-stimulant, depressor, anticholinesterase and smooth muscle stimulant actions in animals (Ghosal & Bhattacharya 1972; Rastogi & Mehrotra ed. 1990-1993).

D. gyrans leaves from India have yielded 0.036% alkaloids [11.1% *DMT*, 25% *DMT* N-oxide, 5.55% *5-MeO-DMT*, traces *5-MeO-DMT* N-oxide, 8.3% *bufotenine*, 13.9% 5-MeO-*N-methyltryptamine* [5-MeO-*NMT*], 13.9% *phenethylamine*, 2.8% of an unidentified β-carboline, 13.9% *choline*, and uncharacterised indole-3-alkylamines]; roots yielded 0.33% alkaloids [3% a combination of *DMT*, *DMT* N-oxide and 2 unidentified indole-3-alkylamines, as well as 24.24% *choline*, 72.7% hypaphorine and traces of unidentified phenethylamines] (Ghosal et al. 1970b, 1972a). Canavanine has also been found in the plant (Bell et al. 1978).

D. pulchellum whole plant from India has yielded 0.3% alkaloids in one test [including, as % of plant, 0.2-0.25% *5-MeO-DMT*, and 0.0018% of combined *DMT*, *DMT* N-oxide and *bufotenine*] (Ghosal & Mukherjee 1964); another test also found 0.0004% *5-MeO-DMT* N-oxide, 5-MeO-*NMT* and *gramine* (Ghosal & Mukherjee 1966). The root of the young seedling has yielded c.0.27% *DMT*, 0.011% *DMT* N-oxide, 0.041% *DMT* N-methylcation, 0.022% N-methyl-*serotonin*, traces of 5-MeO-*NMT*, 0.026% *adrenoglomerulotropin* and traces of 6-MeO-N-methyl-β-carbolinium salt; root of mature plants yielded 0.067-0.451% *DMT*, 0.012-0.121% *DMT* N-oxide, 0.022-0.132% *5-MeO-DMT*, 0.013% N-methyl-*serotonin*, 0.0015% 3-alkylindole, 0.001% 5-OH-3-alkylindole, and traces of *bufotenine*, *bufotenine* N-oxide and 2-methyl-*pinoline*. Stem and leaf of mature plants yielded 0.294% *DMT*, 0.07% *DMT* N-oxide, 0.476% *5-MeO-DMT*, 0.154% *5-MeO-tryptamine*, 0.112% *bufotenine* and traces of *bufotenine* N-oxide. Green fruits and ripe seeds yielded 0.001% *DMT*, up to 0.007% *DMT* N-oxide and c.0.002% each of *5-MeO-DMT* and *5-MeO-tryptamine*; *harman*, *tetrahydroharman* and *pinoline* were also found in seeds, *harman* also in fruits (Ghosal 1972; Ghosal et al. 1972c). The plant has also yielded *hordenine*, *norharman*, 2-methyl-THβC, 2-methyl-β-carbolinium quaternary salt, 1,2-dimethyl-6-MeO-THβC, melinonine F, and canavanine. In dogs, the stem-leaf alkaloids [0.1mg/kg i.v.] caused initial respiratory stimulation, followed by hypotension and severe bronchoconstriction, which resulted in death in some cases; cardiac depression was also observed. Alkaloids of the green fruits and seeds inhibited cholinesterase (Bell et al. 1978; Ghosal 1972; Ghosal & Mukherjee 1966; Ghosal et al. 1970b, 1972c; Harborne et al. ed. 1971; Shulgin & Shulgin 1997).

D. racemosum was found to contain *5-MeO-DMT* in the whole plant (Hsu et al. 1986); canavanine has also been found (Bell et al. 1978).

D. tiliifolium root has yielded 0.00073% *tryptamine*, 0.0021% *tyramine*, 0.0006% *DMPEA*, 0.0022% N,N-dimethyl-*DMPEA*, 0.0012% *normacromerine*, 0.0005% *hordenine*, 0.0031% salsolidine, 0.0014% salsoline, 0.0036% *choline*, 0.0003% abrine [N-methyl-*tryptophan*], 0.0029% hypaphorine and 0.0003% betaine; homovanillylamine [3-MeO-*tyramine*] and N,N-dimethylhomovanillylamine have also been found in the plant. Alkaloid content is highest in roots, and lowest in leaves, with the stems being intermediate in concentration (Ghosal 1972; Ghosal & Srivastava 1973b; Lundstrom 1989).

D. triflorum from India yielded 0.01-0.015% alkaloids from the leaf [traces of *DMT* N-oxide, 17% *phenethylamine*, 12% indole-3-acetic acid, 9% *tyramine*, 8% hypaphorine, 5% N,N-dimethyltryptophan, 5% S-(+)-N,N-dimethyltryptophan methyl ester, 2% S-(-)-stachydrine, traces of trigonelline, *hordenine*, and hypaphorine methyl ester, and 39% *choline*, betaine and other bases]. Stems yielded 0.008% alkaloids [3% *DMT* N-oxide, 15% *phenethylamine*, 7% *tyramine*, 2% hypaphorine, 2% S-(+)-N,N-dimethyltryptophan methyl ester, traces of hypaphorine methyl es-

ter, N,N-dimethyltryptophan, *hordenine*, and indole-3-acetic acid, 3% S-(-)-stachydrine, 1% trigonelline, and 62% *choline*, betaine and other bases]. Stem and leaf have also yielded *tryptamine*. Roots yielded 0.01-0.018% alkaloids [4% *DMT* N-oxide, 5% hypaphorine, 2% hypaphorine methyl ester, traces of N,N-dimethyltryptophan, 3% S-(+)-N,N-dimethyltryptophan methyl ester, 11% *tyramine*, 6% *phenethylamine*, 3% *hordenine*, 3% 3,4-dihydroxyphenethyl-trimethylammonium cation, 2% S-(-)-stachydrine, 1% trigonelline, 58% combined betaine, *choline*, and other bases, traces of indole-3-acetic acid, and an unidentified *phenethylamine* with strong *nicotine*-like activity] (Ghosal 1972; Ghosal et al. 1971b, 1973); this species has also yielded coryneine [3,4-dimethoxy-N,N,N-trimethyl-*phenethylamine*] (Lundstrom 1989). The total alkaloids from the root [50mg/kg i.p.] "produced excitation, piloerection, tremors, salivation, and increased motor activity in albino rats and mice" (Ghosal et al. 1973).

D. brachypodum [leaf and stem] and D. uncinatum [whole plant] from Queensland [Australia] gave negative tests for the presence of alkaloids (CSIRO 1990). Others have found canavanine in D. uncinatum (Bell et al. 1978).

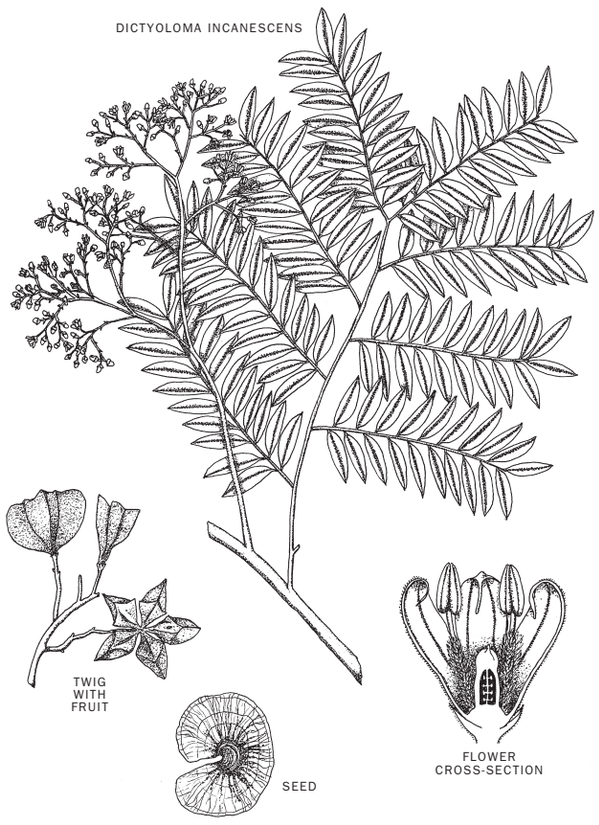
Desmodium gangeticum is a small shrub 0.6-1.2m tall; stems irregularly angled, glabrous; branches angled, covered with appressed white hairs. Leaves 1-foliate; petioles 1-2cm long; stipules dry, thin and membranous, 6-8mm long, linear subulate, striate at base; leaflets membranous, 9-12.5 x 3.5-6.3cm, ovate-oblong, acute or slightly acuminate, margins somewhat waved, glabrous and green above, paler and clothed with dense white appressed hairs beneath, reticulately veined, base rounded, truncate or subcordate; main nerves 8-12 pairs; petiolules 1.5mm long, hairy; stipels 3mm long, subulate. Flowers in copious ascending terminal and axillary racemes 15-30cm long, arranged in few-flowered clusters along a slender pubescent angular rachis; pedicels 4-6mm long, filiform, pubescent; bracts subulate, 1.5-3mm long; bracteoles minute; calyx 2mm long, hairy, teeth triangular, longer than the campanulate tube; corolla 4mm long, violet or white, standard 3mm broad, cuneate at base. Pods subfalcate, 12-20 x 2mm, deeply indented on the lower, slightly indented on the upper edge, joints 6-8, longer than broad, not opening, sparsely clothed with minute hooked hairs, lower edge rounded, upper edge straight.

Outer Himalaya up to 1530m, throughout India to Ceylon and Burma, Malay, China, Philippines and tropical Africa (Kirtikar & Basu 1980).

Plant in sandy loam, potting soil, or good garden dirt, not too rich; grows best in the ground, rather than potted; drought-tolerant, can handle full sun. Plants do not seem to produce *5-MeO-DMT* or *DMT* until 2-3 years old, at least in cultivated material (Trout ed. 1997f).

DICTYOLOMA

(Rutaceae)



Dictyoloma incanescens *DC.* **(D. vandellianum** *Adr. Juss.***)** – tinaqui

I have found no ethnobotanical information regarding this South American tree. D. peruviana [the only other member of the genus], known as 'shiksi huama', is used in Peru with **Ocimum** micranthum ['albahaca'] to reduce sexual desire in over-amorous women (Luna & Amaringo 1991).

D. incanescens is the plant from which *5-methoxy-DMT* was first isolated, in a yield of 0.04% from the bark, as the picrate salt (Pachter et al. 1959); stems have yielded the alkaloids casimiroine [see **Casimiroa**] and 4,7,8-trimethoxy-1-methyl-2-quinolone, as well as the limonoid deacetylspathelin [and its 21- and 23-γ-OH-butenolide derivatives]; fruits yielded the above limonoids, as well as triglycerides and sitosterol (Vieira et al. 1988). Although yields for the above stem components are given by Vieira et al., it is unclear whether the weight given in the data refers to the stems or the crude extract. The plant has also yielded 6-(3-methyl-2-butenyl)-allopteroxylin (Buckingham et al. ed. 1994).

D. peruviana stem bark has yielded 0.126% crude alkaloids, including dictyolomide A and dictyolomide B (Lavaud et al. 1995).

Dictyoloma incanescens is a tree 2-6m tall; branchlets 2-3mm thick, leafy, internodes 5-6cm long, branchlets terete, shortly and densely rusty-pilose. Leaves to 10-20cm long, erect-spreading, subcoriaceous, upper-side sparingly pilose, under-side very shortly tomentose and sericeous-pilose, 6-12-paired, petiole shortly rusty-pilose, internodes usually with alternate narrow wings; leaflets 3-5cm long, barely 1.5cm wide, oblique-oblong, unequal, obtuse, lateral nerves distinct on under-side, margin densely glandulose, revolute, base +- oblique, sessile, apex +- attenuate. Inflorescence a panicle to 33-66cm long, in upper axils, multi-branched, branchlets 10-15cm long, extremities cymose-corymbose, +- shortly rusty-tomentose; pedicels 2-3mm long; calyx laciniate, acute-ovate; sepals appressed sericeous-pilose, 1.5mm long, 1mm wide; corolla 6-lobed, petals 6 x 2mm, apex long, linear, inflexed; in females petals short, purplish, appendicule half equal, bifid, externally and internally glabrous, margin densely pallid-villose; anthers oblong-ovate, 1mm long, purplish; disc ashy-pilose, 2mm long. Ovary carpel 3mm long, laterally compressed, densely villose; style usually 2mm long, ashy-puberulous; stigma thick, deeply 5-lobed, lobes 0.5mm long, rotundate. Fruit a capsule, shortly rusty-pilose, up to 15 x 8mm; seed 2.5mm long, 2mm wide, wing 3.5mm wide, shiny, purplish, parenchyma lacking.

In Brazil (Fridericus & DeMartius ed. 1965-1975).

DICTYONEMA

(Dictyonemataceae)

DICTYONEMA SP.
'NENENDAPE' ON WOOD

Dictyonema sp. – nememdape, nenendape

The Waorani of eastern Ecuador used this lichenised tree fungus in the past, up until early last century. Their name for it is not specific, as they apply the same name to many other fungi. It was said to have been used by "bad shamans", who "ate it to send a curse to cause other Waorani to die". To place things into context, it is worth noting that the Waorani consider the use of psychoactive flora to be an "aggressive, anti-social act" practiced only by those who intend to project harm onto others. Any existing Waorani shamans obviously practice their craft in secret to avoid persecution from their fellow community members. The fungus was infused in water, along with an unidentified Bryophyte [the group containing mosses and liverworts] known as 'kigiwai' – when drunk, the infusion was said to cause severe headaches and confusion (Davis & Yost 1983). The Waorani also believe it to cause sterility, and may put it in children's drinks to cause future barrenness (Schultes & Raffauf 1990).

Chemistry of this rare Dictyonema sp. is unknown, though the related D. glabratum has yielded 3 galactosyldiacylglycerides [glycolipids] (Sassaki et al. 1999).

Dictyonema genus – basidiocarps sessile or resupinate, single or united in rosettes, soft or paper-like, small or up to 20cm or more diam. Upper surface glabrous, villous, hispid or radially fibrillose, sometimes sulcate or zonate, greyish or greenish, olivaceous or blue. Lower surface even, granulose, reticulate or with low concentrical bands of hymenophore. Hyphal system monomitic; generative hyphae thin- or thick-walled, with septa, with clamps or without, hyaline or yellowish, 3-11(-13)µm diam.; hymenium thickening, consisting of abundant basidioles and basidia, organised into a definite palisade layer; cystidia and gloeocystidia absent. Basidia in fascicles, clavate or subcylindrical, not constricted, 15-30 x 5-9µm, with 4 slightly curved slender sterigmata. Spores subcylindrical, narrowly ellipsoid or subnavicular, 6-10 x 2.8-5µm, thin-walled, hyaline, non-amyloid. Algal layer usually well-developed [algal component: Chroococcus or Scytonema] (Parmasto 1978).

The Waorani Dictyonema sp. has not yet been formally described, but it is known to possess a white hymenial layer, and a bright green-blue upper surface (Davis & Yost 1983).

DIMORPHANDRA

(Leguminosae/Caesalpiniaceae)

Dimorphandra mollis *Benth.* – faveira, faveiro-do-cerrado, fava-de-anta ['broadbean of the tapir'], farinha, jacaranda, barbatimão

Dimorphandra parviflora *Spruce ex Benth.* – holótipo, faveira, faveira-vermelha, sucupira amarela, fava-uim

According to the legendary ethnobotanist Richard Spruce, who collected D. parviflora in 1851 at Barra, Brazil, its seeds were used to manufacture an inebriating 'paricá' snuff [see **Anadenanthera** and **Virola**] (De Silva 1986; Ott 1993). It was not noted whether the seeds were mixed with these other snuff plants, or used alone – further studies are needed to verify this report. The related D. mollis is known to cause cattle intoxications in Brazil, with symptoms including intestinal disturbance, colic, blood in excrement, tremor, and cardiac depression. Later the animals lie down and moan until they die, if a fatal dose has been consumed [c.2.5kg/100kg] (Pott & Alfonso 2000).

D. mollis contains unidentified alkaloids [0.58% from bark, 0.7% from leaflets] and rutin (Murad & Gazinelli 1973) [c.8% in pods] (Mors & Rizzini 1966); the seeds contain protein compounds which inhibit the enzyme trypsin (Macedo et al. 2000).

D. parviflora has not been chemically studied to my knowledge.

Dimorphandra parviflora is a medium to large tree, 8-20(-23)m tall, 20-30(-60)cm thick; bark bitter; branches lenticellose; petioles, rachis and inflorescence rusty-puberulent. Leaves petiolate, with 8-12 pairs of primary opposing pinnae, subopposite or alternating, short-petiolate; petiole commonly subcylindric, deep and narrowly canaliculate, 3.5-5.5cm; primary petiole 3mm; secondary petiole thin, 1-1.5mm; pinnules oblique, ovate-elliptic, inequal, 1.25-1.5(-2)cm long, 6-9(-12)mm wide, subchartaceous, glabrous on upper side, finely puberulent beneath, base asymmetric, truncate on one side, the other cuneate, apex obtuse, margin entire, slightly revolute, primary nerves immersed in upper face, prominent beneath, secondary nerves immersed in both sides, or visible beneath under a hand lens. Inflorescence corymbose-paniculate, to 20cm, erect, consisting of densely flowered spikes, mostly reaching the same height as the upper leaves; peduncle thick, densely lenticellose; flowers foetid-creamy, 2-2.5mm; calyx glabrous, 1-1.5mm, 5-lobed at apex, lobes rounded, glabrous within and without; corolla with 5 petals double the size of the calyx, 2-3mm, glabrous; stamens 5, epipetalous, same size as petals; filaments glabrous; anthers rimose, introrse; staminodes 5, apex clavate-spatulate. Fruit a stipitate legume, thick, erect, 9-10 x 2-2.5cm, glabrous and wrinkled on the upper face.

In bush and capoeiras of firm land; Brazilian Amazonia (De Silva 1986).

DIOSCOREA

(Dioscoreaceae)

Dioscorea alata *L.* **(D. atropurpurea** *Roxb.***; D. colocasiifolia** *Pax***; D. globosa** *Roxb.***; D. purpurea** *Roxb.***; D. rubella** *Roxb.***; D. sapinii** *De Wildemann***; D. sativa** *Munro***)** – common yam, humped yam, winged yam, white yam, water yam, greater Asiatic yam, large leaf yam, chupri alu, pindalu

Dioscorea balcanica *Košanin*

Dioscorea batatas *Dcne.* – Chinese yam, cinnamon vine

Dioscorea deltoidea *Wall.* – kins, kniss, kildri, krit

Dioscorea dregeana *(Kunth) Dur. et Schinz* **(Helmia dregeana** *Kunth***)** – isidakwa

Dioscorea dumetorum *(Kunth) Pax.* **(D. buchholziana** *Engl.***; Helmia dumetorum** *Kunth***)**

Dioscorea hirsuta *M. Martens et Galeotti*

Dioscorea hispida *Dennstedt* **(D. daemona** *Roxb.***; D. mollissima** *Blume***)** – choo-ay-go, pashpoli ['strangle cake'], darakanda, kashalu, manda, tsiagri-nuren

Dioscorea mexicana *Scheidw.* **(D. deamii** *Matuda***; D. macrostachya var. sessiflora** *Uline***; D. tuerckheimii** *R. Knuth***)**

Dioscorea opposita *Thunb.* **(D. japonica** *Thunb.***)** – shan yao ['mountain medicine'], Chinese yam

Dioscorea villosa *L.* – China root, colic root, rheumatism root, devil's bones

Dioscorea spp. – wild yam, cabeza de negro

'Yams', Dioscorea spp., are much used today to yield precursors for manufacture of human steroid hormones, while some species exhibit narcotic and other medicinal properties. Yams are also cultivated for their edible tubers in tropical and subtropical zones of the world [though some are hardy in temperate regions]. The cultivation of enormous yam tubers is important in magical belief systems amongst many indigenous peoples of Papua New Guinea (Burkill 1985-1997; Paijmans ed. 1976).

Amongst some yam species cultivated or found wild in Africa, sever-

al are known to have tubers which may be narcotic or toxic in their fresh state. This toxicity is removed by a combination of cooking and leaching, the exact procedures differing in different areas. The fresh tuber of D. alata is considered narcotic, though some varieties are edible. The tuber of D. dregeana has narcotic and paralytic effects, and has been used to stun monkeys. It is sometimes used in S. African traditional medicine as a sedative anlgesic, and to treat epilepsy, hysteria, psychosis and insomnia. It is sometimes consumed with **Boophane** disticha for divination. The wild variety of D. dumetorum shows narcotic and convulsant properties, and has also been used to capture monkeys. D. sansibarensis is sometimes used as a homicidal poison. Tubers of D. diversifolia and D. dregeana are used by the Zulu as a remedy for 'hysteria', and an infusion of the latter is sometimes taken in 1 tsp doses as a soporific. Ingestion of these tubers, improperly cooked, causes paralysis of the lower limbs, and a 'drunken' state (Burkill 1985-1997; Van Wyk & Gericke 2000; Van Wyk et al. 1997; Watt 1967; Watt & Breyer-Brandwijk 1932).

These toxic properties of Dioscorea spp. are also known in Mexico, where they have been used obscurely in witchcraft (Heffern 1974). In Peru, a Dioscorea sp. known as 'papas-trueno' is said to enable one to control the rain if ingested (Luna & Amaringo 1991). In India, tubers of D. purpurea are used as an acrid aphrodisiac. In Burma, D. hispida tubers are eaten after slicing, repeated leaching, and steaming. Without this preparation, ingestion can cause "irritation in the mouth and throat, vomiting of blood, a sense of suffocation, drowsiness and exhaustion; and a piece of the tuber the size of an apple is sufficient to cause death in 6 hours". Though sometimes used as a poison, the tubers can be applied as a poultice to relieve swellings (Nadkarni 1976). Dioscorea spp. have also been used in Malaya, along with Antiaris spp. [curare-poison plants – see also **Strychnos**], to prepare arrow poisons for hunting (Bisset & Woods 1966).

In Arnhem Land, northern Australia, D. bulbifera [sometimes known as D. bulbifera var. rotunda] is eaten by local indigenous people. Considered 'cheeky' [referring to the undesirable bitterness] when fresh or improperly prepared, the tubers are usually baked and leached in running water overnight to render them edible; or, they are at least chopped and cooked (Smith et al. 1993; Webster et al. 1984). In some parts of Africa, D. bulbifera [D. latifolia] tuber is used as a suicidal poison and tubers of D. smilacifolia have been used as homicidal poisons. In Gabon, the tuber of D. latifolia var. sylvestris is sometimes used to strengthen palm wine [see *Methods of Ingestion*] (De Smet 1998).

The tuber of D. opposita is used in TCM – it is considered sweet, and has an affinity for the spleen and lungs. The dried, sliced tuber is used as a kidney, lung and stomach tonic, and applied as a poultice for abscesses, boils, bruises, carbuncles, swellings and other skin sores. It relieves diarrhoea, moistens skin and hair, strengthens kidneys, stimulates appetite, nourishes the semen, stimulates endocrine glands and tones the immune system. In decoction, it is usually given in doses of 10-30g (Bremness 1994; Hsu et al. 1986; Keys 1976; Reid 1995).

D. villosa tuber has been used to relieve muscle tension and spasm, leg and menstrual pains, inflamed colon, rheumatism and colic. It also dilates blood vessels and increases bile flow. In India, Dioscorea spp. are considered detergent, cardiotonic, expectorant, diaphoretic and antispasmodic (Kirtikar & Basu 1980; Polunin & Robbins 1992).

Until 1970, D. mexicana was the only yam species used as a commercial source of hormones for female contraceptive pills, made from the steroid sapogenin *diosgenin*, which can be transformed to a wide range of steroid hormones including cortisone and progesterone. *Diosgenin* had been isolated from other species earlier [such as from D. tokoro in 1936], but such species had not been put to much use. However, now many other species, particularly D. villosa [and also D. deltoidea and D. prazeri, in India], are used for these and other products (Abrol et al. 1963; Coppen 1980; Marker et al. 1940). A number of wild yam extracts are being sold in health supplement stores as 'pre-DHEA', containing precursors to *dehydroepiandrosterone*, which is difficult to obtain in Australia.

D. alata tuber contains c.88% carbohydrates, 7% protein, a saponin, alatanin 2, and the pyrrolidine alkaloid *dioscorine* [causes extreme excitation of CNS, and may paralyse it] (Buckingham et al. ed. 1994; Harborne & Baxter ed. 1993; Henry 1939; Watt 1967).

D. balcanica tuber has yielded up to c.2% *diosgenin* (Bisha & Pisha 1968).

D. batatas aerial tubers have yielded [w/w] 0.0103-0.0164% *diosgenin* (Edwards et al. 2002).

D. bulbifera tuber has reportedly yielded *dioscorine* (Willaman & Li 1970), and 0.08% *diosgenin* (Quigley 1978). However, more detailed analysis [using wild-harvested Australian varieties selected for their bitterness] could detect no *dioscorine* or other alkaloids, no *diosgenin*, and no saponins or cyanide. The presence of the furanoid nor-diterpene diosbulbin D [0.007%] was confirmed; diosbulbin D was determined to be the main compound responsible for the bitterness of the tubers. Bitter Japanese D. bulbifera tubers have yielded [w/w] up to 0.015% combined diosbulbins (Webster et al. 1984). Boiling, baking, and leaching were tested separately for their ability to remove bitterness from the Arnhem Land varieties, as measured by both taste and diosbulbin D content. Leaching was shown to be the only procedure that was effective alone; baking or boiling was thought to contribute to the process by softening tissue structure, allowing for greater leaching efficiency. However, an extract of the bitter yams was shown to be non-toxic in mice, at up to 4.5g/kg [the highest dose tested] (Webster et al. 1984).

D. burkilliana tuber has yielded 0.42-0.92% *diosgenin* (Quigley 1978).

D. deltoidea, from n.w. Himalayas, yielded [traces-]0.8-8% *diosgenin* from the tubers. Yields were highest when tubers were dormant in the winter (Abrol et al. 1963).

D. dregeana tubers have yielded 0.03% *dioscorine* and 0.02% crinamine [hypnotic sedative (Koorbanally et al. 2000); respiratory depressant and powerful transient hypotensive in dogs – LD50 10mg/kg (Buckingham et al. ed. 1994)], though the extraction was not exhaustive; sitosterol, stigmasterol, 3-(4'-OH,3'-MeO-phenyl)propenoate [0.024%], and 3,4',5-trihydroxybibenzyl [0.016%] were also isolated (Mulholland et al. 2002).

D. dumetorum tuber has yielded *dioscorine*, dihydro-*dioscorine* and dioscine (Watt 1967; Willaman & Li 1970).

D. hirsuta tuber has yielded *dioscorine* (Henry 1939).

D. hispida tuber has yielded [w/w] 0.017-0.12% *dioscorine*; no sapogenins, *diosgenin*, or cyanide have been found (Pinder 1953; Webster et al. 1984).

D. opposita tuber contains starch, mucilage, fat, sugar, the enzyme amylase, and the amino acids arginine, leucine and tyrosine (Reid 1994).

D. pentaphylla tuber has yielded *dioscorine* (Willaman & Li 1970).

D. prazeri rhizome tuber has yielded 2.1% *diosgenin* (Abrol et al. 1963).

D. sansibarensis tuber has yielded *dioscorine*, dihydro-*dioscorine* (Willaman & Li 1970), and 0.05% *diosgenin* (Quigley 1978).

D. villosa tubers have yielded [w/w] 0.00022-0.0519% *diosgenin* (Edwards et al. 2002; Marker et al. 1940).

Dioscorea dregeana is a climber; stems stout, very twining, pubescent. Leaves alternate; fully developed petiole 7.6-10.2cm long; leaf blade digitately trifoliate; leaflets 7.6-20.3cm long, thin but firm in texture, green, pubescent beneath, the end one obovate-cuspidate, triplinerved from base to apex, the side ones obliquely ovate, much-produced on the lower side. Male flowers in ample panicles, in sessile globose clusters spaced out on the slender, spreading pubescent branches; perianth campanulate, 16mm long, with short tube and 6 subequal spreading lobes; segments ovate; bracts ovate, very hairy, about as long as clusters; fertile stamens 6; filaments short, incurved; anthers small, oblong or globose; style rudimentary. Female flowers in ample panicles, with spreading spicate branches; perianth segments 6, free, very small, ovate; staminodes minute, 0-6; ovary inferior, linear-oblong, acutely triquetrous, 3-celled, densely pubescent; ovules 2 in each cell, laterally attached near apex; styles 3, short; stigmas 3, terminal, bifid or entire, reflexed above style. Capsule oblong, deflexed, 3.8-5.1cm long, loculicidal; seeds compressed, with semiorbicular apical wing about the breadth of the nucleus.

Eastern S. Africa and Cape region (Harvey & Sonder 1984; Kirtikar & Basu 1980).

DIPLOPTERYS

(Malpighiaceae)

Diplopterys cabrerana *(Cuatrecasas) B. Gates* **(Banisteriopsis cabrerana** *Cuatr.***; B. rusbyana** *sensu non (Niedenzu) Morton***)** – oco-yajé, yajé-oko, yajé oco, cajé uco, yaji, chagropanga, pucuhuasca, chalipanga, ka-hee-ko, mene kahi ma, nyoko-buku guda hubea ma

Diplopterys involuta *(Turcz.) Niedenzu* **(Mezia includens** *(Benth.) Cuatr.***)** – ayahuasca negro, ee'-taw-gaw

D. cabrerana, closely related to the yajé vine itself [see **Banisteriopsis**], is a common additive to ayahuasca potions in parts of the Amazon. It is documented to have been used by the Shuar, Kofan, Mocoa, Siona, Secoya, Taiwano, Tukano, Inga, and possibly the Barasana and Karapana. The common name 'oco-yajé' means 'water yajé', as the wild form grows near river banks, and its fruits are well-suited to water-dispersal. It is often cultivated inland by shamans, grown from cuttings, and it rarely flowers. Leaves and young shoots are the parts added to ayahuasca (Bennett 1992; Bristol 1966; Der Marderosian et al. 1968; Gates 1982; Pinkley 1969; Schultes 1957, 1969c; Schultes & Raffauf 1990; Uscategui 1959). Some shamans consider it unfit for human consumption, and seem to fear it at the same time as deriding it (McKenna 1990) – this might be due to the exceptionally high *DMT* content of some specimens [and possibly also due to any *5-methoxy-DMT* and *bufotenine* present].

D. involuta is not known to have use as an ayahuasca additive, but its colloquial name gives the impression that it may have once been used in such a capacity (Ott 1994). The Makuna use the bark as a diuretic, and the leaves as an emetic. D. martiusii was once used by the Kubeo of Colombia, who burned the leaves and added the ash to their coca [see **Erythroxylum**] (Schultes 1950; Schultes & Raffauf 1990).

D. cabrerana leaf has yielded 0.17-1.75% *DMT*, as well as traces of *N*-

methyltryptamine, *5-methoxy-DMT* [5-MeO-DMT], *bufotenine* and 2-methyl-THβC. Stems yielded 0.177% alkaloids, consisting of 94% *DMT*, 2% *5-MeO-DMT* and 2% 2-methyl-THβC (Agurell et al. 1968a, 1968b; Der Marderosian et al. 1968; McKenna et al. 1984a). It should be noted that the higher range of *DMT* content in leaves was an estimated quantity, which was not actually isolated (Trout pers. comm.).

Diplopterys cabrerana is a liana, young branches golden-appressed-sericeous; old branches glabrate, sometimes appearing flattish; stipules minute, triangular, sparsely sericeous, often joined by an interpetiolar line. Petiole (4-)8-15(-22)mm long, appressed-sericeous to glabrate, channeled adaxially, apex biglandular, glands convex then prominent. Leaf coriaceous, falcate, (8.5-)10-21(-25.9) x (2.9-)4.1-9cm, elliptic to broadly elliptic, base truncate, apex long-acuminate, acumen up to 3cm long, margin with minute glands, plane to slightly revolute, upper side glabrous, underside sparsely appressed-sericeous, the hairs with trabecula 0.2-0.3(-0.6)mm, reticulation prominulous to prominent adaxially and 6-8(-10) pairs of lateral veins prominent on underside. Inflorescence axillary, of 4-flowered umbels, borne singly or in short racemes or condensed panicles, appressed-sericeous; bracts and bracteoles (1.5-)2-3mm long, ligulate, sparsely sericeous abaxially, glabrous adaxially, spreading, persistent; pedicels sessile, 5-12 x 0.4-0.5mm, up to 1mm diam. in fruit, sparsely appressed-sericeous to glabrate; sepals 1.5-2.2mm long, anterior sepal 0.7-0.8mm wide, narrowly elliptic, eglandular (rarely 1-glanded), 4 lateral sepals up to 1.4mm wide at base, 0.7-0.8mm at apex, deltate, inpressed, apex reflexed, biglandular, projecting 1-1.3mm beyond glands, glands 1-1.8 x 0.5-1mm; petals yellow, sparsely sericeous in middle of limb externally, long-fimbriate, eglandular, 4 lateral petals reflexed between sepals, antero-lateral petals with claw 1-1.5mm long, limb 7-8mm long and wide, concave, postero-lateral petals with claw 0.5-1mm long, limb 5-7mm long, 4-5.5mm wide, broadly elliptic, plane, posterior petal with claw erect, 2.5-3.5mm long, up to 0.6mm wide, apex constricted, limb 4.5-5.5 x 3-4.5mm, obovate; stamens glabrous, with filaments connate at base for 0.4-1mm, those opposite sepals 2-2.8mm long, those opposite petals 1.6-1.8mm long; anthers with locules 0.8-1mm long, sparsely hairy to glabrate. Ovary densely hairy, 1mm tall; styles 1.4-1.6mm long, posterior styles slightly longer than anterior style, with stiff straight hairs at base; stigmas strongly capitate. Fruit of 3 mericarps, without carpophore, nut orbicular, up to 15mm long and wide, bearing crest-like dorsal wing 1-5mm high, usually 4 ridges or winglets on each side 1-10mm high, irregular or dissected along margin, interconnected with ridges so that the surface of the nut between winglets is irregularly foveolate, surface of nut between areole and proximal winglet smooth, appressed-sericeous throughout, hairs and trabecula 0.1-0.2mm long. Fl. Sep.; fr. Oct.-Dec. (fruit once found in April).

Often on river margins; Colombia, Ecuador, Brazil, Peru, Venezuela. Due to having often been incorrectly referred to as **Banisteriopsis** rusbyana [a name that is now regarded as synonymous with B. longialata] by ethnobotanists, it is unclear whether some reports of use of B. rusbyana actually refer to B. longialata or D. cabrerana, though the uses of the latter are confirmed (Gates 1982).

DODONAEA

(Sapindaceae)

Dodonaea viscosa *Jacq.* **ssp. viscosa** – hops bush, giant hops bush, wild hops, wase, watchupga, kirni, tecan

Dodonaea viscosa ssp. angustifolia *(L. f.) J.G. West* **(D. angustifolia** *L. f.***; D. salicifolia** *DC.***; D. viscosa var. angustifolia** *(L. f.) Benth.***; D. viscosa var. linearis** *(Harv. et Sond.) Sherff***)**

Dodonaea viscosa ssp. angustissima *(DC.) J.G. West* **(D. angustissima** *DC.***; D. attenuata** *A. Cunn.***; D. denticulata** *F. Muell.***)** – slender hop bush, narrow-leaf hop bush

Dodonaea viscosa ssp. burmanniana *(DC.) J.G. West* **(D. burmanniana** *DC.***)**

Dodonaea viscosa ssp. cuneata *(Sm.) J.G. West* **(D. cuneata** *Sm.***)** – wedge-leaf hop bush

Dodonaea viscosa ssp. mucronata *J.G. West*

Dodonaea viscosa ssp. spatulata *(Sm.) J.G. West* **(D. asplenifolia** *Rudge***; D. spatulata** *Sm.***; D. viscosa var. spatulata** *(Sm.) Benth.***)** – sticky hop bush

Dodonaea spp. – wild hops, hop bush

Leaves of D. viscosa [possibly D. viscosa ssp. angustifolia?] are sometimes chewed as a stimulating 'coca' substitute [see **Erythroxylum**] in Peru, or used to adulterate real coca. The bitterness of Dodonaea spp., combined with the superficial resemblance of the fruits to true 'hops' [see **Humulus**], meant that some Australian species [especially D. viscosa ssp. angustissima] gained use as hops substitutes for brewing beer [see *Methods of Ingestion*] in Australia's early white pioneer days. D. viscosa was used by some indigenous Australians as a painkiller. The leaves were chewed without swallowing the juice to treat toothache; the chewed leaves and juice also treated stonefish and stingray [see **Urolophus**] wounds. A root decoction or root juice of D. viscosa is also used for toothache, and is externally applied for healing cuts and open wounds (Cribb & Cribb 1981; Lassak & McCarthy 1990). D. viscosa is also used in Baliem, Papua New Guinea in rituals concerning the dead, and is burned as an incense in funeral pyres (Paijmans ed. 1976). In the Ashburton region of Western Australia, leaves of D. lanceolata are boiled and mashed; this mixture is applied externally as an analgesic, or diluted to drink (Reid & Betts 1979).

D. viscosa leaves contain up to 18% tannin, pinocembrin [anaesthetic, antiseptic, fungicidal, antileukaemic], quebrachitol, aliarin, barringtogenol, viscosol, eriodictyol, *chlorogenic acid*, caffeic acid, isorhamnetin, 5,7-dihydroxy-3'-(4-OH-3-methylbutyl)-3,4',6-trimethoxyflavone, 5-OH-3,4',6,7-tetramethoxyflavone, 15,16-epoxy-13(16),14-labdadiene-3,8-diol and hautriwaic acid; they are slightly cyanogenic. Bark has yielded shikimic acid, *chlorogenic acid*, glucose and a leucocyanidin. Seeds have yielded dodonic acid, dodonin, dodonosides A and B, β-sitosterol and stigmasterol (Brooker et al. 1987; Buckingham et al. ed. 1994; Cambie & Ash 1994; Duke 1998; Lassak & McCarthy 1990; Sachdeu & Kulshreshtha 1984; Watt & Breyer-Brandwijk 1962). Leaf from Queensland tested weakly positive for alkaloids (Webb 1949).

Dodonaea viscosa is a spreading or erect shrub or tree to 5(-8)m tall, often resinous; branchlets angled to flattened, usually slightly ribbed, puberulent to glabrous. Leaves alternate, simple, linear to obovate or spatulate, 1-15.5cm x 1-25(-40)mm, apex obtuse to acuminate, sometimes rounded and mucronate, base attenuate to cuneate, glabrous, viscid, sessile or petiolate; petiole to 18mm long. Inflorescence a cymose terminal panicle; pedicels 3-9mm long; sepals 3-4, lanceolate to ovate, 1.3-3mm long, free, not persistent, viscid; petals absent; stamens (6-)8-10(-16), usually longer than sepals, in female flowers absent or rudimentary. Disc small; ovary 2-6-carpellate, glabrous to pubescent. Fruit a capsule, usually prominently 3-4-winged, 8.5-28 x 11-28mm, glabrous, membranous or leathery, sometimes coriaceous, dehiscence usually by valves breaking away from septa, wings 2-10mm wide; seed lenticular, 2-3.1mm long, black, dull, aril mostly absent, testa covered with hyaline membrane. Fl. (mostly) spring-summer.

Mainly in open forests, woodlands, mallee scrub; all states of Australia, pantropics, extending to S. Africa, Pacific Islands, s.e. Asia and the Americas.

The subspecies may be distinguished by these differences -

D. viscosa ssp. angustifolia grows to 5m; leaves linear-lanceolate, mostly 6-13cm x 5-10mm, apex narrow-acute to acuminate, base narrowly-attenuate; petiole (2-)6.5-18mm. In dry sclerophyll forest and woodland.

D. viscosa ssp. angustissima grows to 4m; leaves sessile, linear to narrow-oblong, rarely oblanceolate, 3-9.5cm x 1-6mm, apex acute to obtuse, margins irregularly sinuate or toothed. In woodland, mostly in arid or semi-arid regions.

D. viscosa ssp. burmanniana grows to 6m; leaves lanceolate to narrowly-elliptic, mostly 7-12cm x 14-23mm, apex acute; petiole 6-18mm; capsule 8.5-20(-28)mm long, 11-22(-28)mm wide, wings 3-6(-10)mm wide. In wet sclerophyll forest, sometimes on rocky slopes, coastal areas.

D. viscosa ssp. cuneata grows to 3m; leaves cuneate to angular- or narrow-obovate, margins entire to irregularly sinuate, apex truncate or obtuse, shortly apiculate or occasionally irregularly 2-3-toothed, rarely emarginate, (0.8-)1.2-3(-3.8)cm x 4-9mm; sessile or petiole short. In sandy loams in open forest, and mallee scrub in semi-arid regions.

D. viscosa ssp. mucronata grows to 4m; leaves obovate to spatulate, 2.5-6cm x 10-25mm, apex mucronate, base broad-attenuate, margins entire to irregularly sinuate; petiole 3.5-20mm. On rocky hills and ranges, sometimes near creeks in arid regions.

D. viscosa ssp. spatulata grows 1.5-4m; leaves obovate to spatulate or oblanceolate, 2.3-7.5(-9)cm x 6-16(-18)mm, apex broad-acute to obtuse, sometimes short-apiculate, margins entire to toothed or irregularly sinuate, leaf morphology highly variable; petiole 0-10mm. Open forest and mallee shrubland in high-rainfall regions.

D. viscosa ssp. viscosa – grows to 2m; leaves elliptic, 7-13cm x 20-40mm, apex broad-acute to obtuse; petiole 2.5-6mm; capsule 15-23mm long, 20-25mm wide, 2(-3)-winged, wings 4-4.5mm wide. In sandy coastal areas.

Many of the subspecies are known to intergrade in the wild, and some [such as D. viscosa ssp. spatulata] can also be very variable in appearance. There is also a horticultural variety, D. viscosa 'purpurea', which is becoming more widespread due to escaping cultivation. It has attractive deep-purplish foliage (Albrecht et al. 1999; Harden ed. 1990-1993).

DUBOISIA

(Solanaceae)

DUBOISIA HOPWOODII

Duboisia hopwoodii *(F. Muell.) F. Muell.* **(Anthocercis hopwoodii** *F. Muell.***)** – pituri, pitcheri, pitchiri, pitjiri, bedgery, pedgery, petcherie, murulunga, mononga, mo-da, ne-em-pa, ta-rem-bo-la, ti-rum-bo-la, tjilla, undakora, ungulpa, unkulpa, walgul, walgulba, walkal, emu plant, camel poison, poison bush, spinifex poison, narrow leaf

Duboisia leichhardtii *(F. Muell.) F. Muell.* **(Anthocercis leichhardtii** *F. Muell.***)** – Leichhardt corkwood, corkwood

Duboisia myoporoides *R. Br.* **(Entrecasteauxia elliptica** *Montr.***)** – corkwood, cork tree, elm, eye plant, ngmoo, onungunabie, orungurabie

'Pituri' [the prepared terminal leaves and stems of D. hopwoodii] was once widely used as a 'narcotic' by the indigenous inhabitants of parts of central Australia; it was said by Wills [of Burke and Wills fame] to have "a highly intoxicating effect when chewed, even in small quantities". The term pituri [and its variants] has been applied by both 'black' and 'white' men to other plants used as tobacco substitutes, many of which are actual **Nicotiana** spp. Earlier, the name had only been used by a small group of indigenous clans [such as the Ulaolinya], living in arid s.w. Queensland, near the Northern Territory border, but the use of the term appears to have spread primarily from white people. Today, use of the drug is uncommon, and may have even died out. One indigenous healer from s.w. Queensland, George Quartpot, reported to Tim Low (1990) that it was once chewed by all older people, but that the practice was stamped out by local police.

Pituri was often only used by the older men of the tribe, who reserved it for themselves, though sometimes it was used by all males, for social or ceremonial purposes, or to relieve physical stress. The leaves have also reportedly been burned, to provide an anaesthetic smoke "for such crude operations as they performed." The drug has also been alleged [by A.S. Vogan] to "enable old men to act as seers, and thus obtain power and perquisites." Amongst pituri-clans, the correct methods of preparation were only revealed to men when their beards had turned grey. Although younger men and women were allowed to come close to the collection and preparation area, they were not allowed to witness the process, instead remaining to prepare the bags to hold the pituri, and to collect food for the older men. The elders would build a fire near the plants, and let it die down, before harvesting branch-tips up to 30cm long. The remains of the fire were raked out to form a pit, in which the fresh pituri was placed, and covered with sand for 2hrs or more. The exact length of 'steaming' is a matter of expertise. When ready, the sand was raked away, and the pituri left to cool and dry out, after which it was broken up with the edge of a boomerang, and large twigs removed. This pituri was now ready for storage in specially made string bags [made from a type of **Verbena** or a broom species (see **Cytisus**)]. For use, a tablespoon or more of the dried, semi-pulverised herb is powdered, moistened, rolled with plant-derived alkaline ashes [the preferred donor being **Acacia** salicina, high in calcium sulphate] to aid in alkaloid release, and sometimes mixed with fibrous matter such as kangaroo hair or native flax [Psoralea spp.]. This is rolled into a quid c.6cm long and 1.5cm thick, ready for chewing [as with **Areca** and other drugs taken as a quid, this is more accurately described as sucking]. The quid may be passed from person to person, or enjoyed by one's self. It is stored in or behind the ear when not being used; this also allows passage of the alkaloids through the skin in those places. Pituri has occasionally been observed to be smoked, though this is believed to be a 'post-contact' phenomenon (Aiston 1937; Cox 1880; Cribb & Cribb 1981; Johnston & Cleland 1933; Lassak & McCarthy 1990; Low 1990; Peterson 1979; Thomson 1939; Watson et al. 1983; Webb 1948). The taste of the fresh leaves has been described as burning and 'chilli-like' [see **Capsicum**] (Letnic 2000).

Intricate trade-routes called 'pituri roads' network through parts of Australia's arid interior, and were once more widely used in inter-tribal pituri trading. This was necessitated because the highly-prized plant does not grow in many regions, and even where it does, it is not always recognised by locals; today there are reported to be very few indigenous people who still know what the plant looks like. Also, it is said that only strains from a select few localities are suitable for use, particlularly those of the Mulligan-Georgina Rivers [south-west Qld]. This may have been due to chemical differences, or may have even been a simple but effective rumour, spread to maintain the monopoly over pituri preparation. Some people would travel great distances to this area to obtain it, and there was use of "message sticks requesting the sending of pituri". In much of central Australia, the local plants have only been used to trap emus or other animals, by placing a maceration of the herbage in waterholes, to stun the prey and make them easier to catch. D. myoporoides branches have similarly been used to stun eels, though such use for this species is not widespread. Around 1860, it was reported that indigenous people in the areas near Illawarra, Kurrajong and Shoalhaven, made a practice of cutting a hole in the trunk of D. myoporoides, putting water in the hole to soak overnight, and drinking the potently stupefying beverage the next day (Aiston 1937; Bailey 1880; Johnston & Cleland 1933; Letnic 2000; Low 1990). This latter report remains unconfirmed, though it may well have been an accurate observation.

Intoxications have reportedly occurred even from D. myoporoides branches hung in a closed room! An extract of the leaves and fruits has been used medicinally to produce pupil dilation for eye examination, as well as to treat 'maniacal delirium' [a condition that this plant could cause in large enough doses], goitre, night sweats, painful tenesmus caused by urethra and bladder inflammation, and as a sedative for an inflamed cornea. Along with D. leichhardtii, it was used in WWII as a source of *hyoscine* [scopolamine] and *atropine* derived from *hyoscyamine*, to treat motion sickness and shock. They are still used as sources for these chemicals. D. myoporoides is also used in New Caledonia to treat ciguatera fish poisoning (Cribb & Cribb 1981; Lassak & McCarthy 1990; Low 1990; Morton 1977; Peterson 1979; Watson et al. 1983; Webb 1948).

In Australia, D. myoporoides, D. leichhardtii, and hybrids between these two species are cultivated commercially for their alkaloid content. In the course of harvesting and processing the material, it has been inevitable that unintended intoxications have occurred. This is primarily due to contact with small leaf fragments and 'dust' from the harvested plant, or from extensive handling during harvest. The tropane alkaloids contained in these plants are potent, and easily absorbed through the skin or mucous membranes. It would seem, due to the lack of precautions taken, that the people involved in the Duboisia industry were unaware of this. The initial symptoms of low-level intoxication have been dubbed 'cork-eye' by those involved in the trade – this includes strong pupil dilation and reddish eyes. Mid-level exposure also causes flushing of the face and dry throat. Someone suffering from strong intoxication is referred to as being 'corked up', and symptoms are consistent with *hyoscine* and *hyoscyamine* inebriation. One worker who had been sieving and baling D. myoporoides leaves in a shed was observed to become inebriated after 3hrs [probably to the amusement of his friends] – "he became withdrawn and quiet, and wandered away from the shed. He was found making a crank-handle from thin case-wire, which he then used irrationally and inappropriately to try to start a large diesel tractor" (Pearn 1981).

The only instance of recreational use coming to mainstream media attention, that I am aware of, occurred in Queensland in 1974. "Four male teenagers prepared an intoxicant by boiling leaves of Duboisia sp. with coffee granules [see **Coffea**], which they subsequently imbibed. Thirty minutes after they had drunk the coffee and corkwood infusant, hallucinations and drunken behaviour ensued, and disturbed neighbours called the police. One teenager was found unconscious and naked, and another was lying in eight centimetres of water in the bath, claiming he could see butterflies. Early symptoms had included drowsiness, a feeling of weightlessness, and difficulty focussing on objects in the room. All four patients were admitted to hospital but were discharged 48 hours later without specific treatment" (Pearn 1981). One person reported being unable to walk properly and experiencing strong drying of the mouth after smoking 'a couple of the leaves' of D. myoporoides. There is also one human death on record, of a Wollongong man who ate some D. myoporoides leaves and suffered a cardiac arrest. However, this is not a characteristic effect of this plant, and it was suspected that the unfortunate deceased already had heart problems (Low 1990).

Aiston (1937) observed the effects of pituri on some indigenous people at Mungeranie – "[it] had very little apparent effect on the old people who had been in the habit of using it for years, but it gave the young peo-

ple a swollen bestial look; one young woman I remember at Mungeranie had the appearance of being heavily drugged with opium; her eyes were swollen, her mouth loose and sloppy and she spoke as if in a drunken daze. The effect wore off and the next morning she was apparently normal."

In 1995 I conducted a bioassay using a small handful of whole, dried leaves from an unidentified Duboisia sp. These were given to me by a friend who had wild-harvested them, believing them to be 'pituri' [ie. D. hopwoodii]. Although I did not, unfortunately, attempt to identify them properly at the time, memory allows that the leaves were most likely from D. myoporoides x leichhardtii, due to their morphology and the high possibility that my friend had inadvertently encountered the outskirts of a commercial plantation, or escaped plants from one. The leaves were chewed, several at a time, over c.2hrs. The saliva was swallowed; leaves were chewed and sucked until leached of flavour, at which time they were spat out and replaced with new leaves. Initially, only a mild stimulation was noted. However, after 2hrs of chewing, sudden waves of nausea were felt, accompanied by dry mouth and throat ['cottonmouth'], 'gagging' sensation in the throat, dizziness, sedation, and impaired concentration. I was compelled to lie on my bed, looking up at the sky-light in the ceiling, and had a repeated hallucination of the sky-light swinging down as though hinged on one side. When I would look again directly at it, however, the sky-light would appear as normal. This strange but simple scenario continued for c.20min., after which the symptoms subsided enough for me to sleep. There was no interference with sleep – on the contrary, sleep seemed to be improved (pers. exp.).

D. hopwoodii may generally yield 1-2% alkaloids from the aerial parts, though up to 5% has been reported; this is mostly *nicotine* or *nornicotine* [plants from west Qld and WA seem to be *nicotine*-dominant; plants from SA and central Australia seem to be *nornicotine*-dominant], as well as 0.1% ursolic acid. Plants from the Mulligan-Georgina Rivers area yielded 0.5% *nicotine*, 0.2% metanicotine, and traces of *nornicotine*, N-formylnornicotine, anatabine, cotinine and bipyridyl in the aerial parts. Plants from Alice Springs contained *nornicotine* [major alkaloid; 0.5% in root, 0.3% in stem wood, 0.5% in stem bark, 1.6% in young leaf, 2.4% in middle leaf, 2.2% in old leaf], *nicotine* [0.2% in young leaf, none found in other parts by Kennedy (1971)], N-formylnornicotine, N-acetylnornicotine, *anabasine* [none found by Kennedy (1971)], anatabine, anatalline, hygrine [0.1-0.2% in roots, 0.1% in stems, 0.2% in young leaf, 0.1% in middle and old leaf], isopelletierine [0.2% in medium root, 0.1% in young and old leaf, none in other parts], myosmine and bipyridyl in leaves; roots and stems also contained cuscohygrine [0.2-0.3% in root only], *hyoscyamine* [0.8% in roots, 0.4% in stems] and *hyoscine* [0.1% in coarse root, 0.8% in medium root, 0.1% in stem wood, 0.6% in stem bark]. Plants from WA contained *nicotine* [major alkaloid], *nornicotine* [major alkaloid at 1.8%, in Kalgoorlie plants studied by Kennedy (1971)], hygrine [0.2%], isopelletierine [0.2%], metanicotine and *hyoscyamine* [0.1%] in leaves; roots contained *nornicotine* [0.6%], N-formylnicotine, N-acetylnicotine, *hyoscine* [0.2%], *hyoscyamine* [0.4%], cuscohygrine [0.1%], cotinine and myosmine. Plants from Kimba, SA, yielded *nornicotine* [3.2% in middle leaf, 0.3-0.4% in roots], *nicotine* [0.2% in middle leaf, 0.1% in roots], *anabasine* [0.1% in roots], cuscohygrine [0.1-0.2% in roots], hygrine [0.1% in medium root only], isopelletierine [0.1% in roots], *hyoscine* [0.1% in middle leaf, 0.1-0.2% in roots] and *hyoscyamine* [0.5% in medium root, 0.3% in coarse root, none in leaf]. Pituri prepared from the plant contains lower levels of *nicotine* than the material it is made from (Cribb & Cribb 1981; Evans 1979; James 1950; Kennedy 1971; Lassak & McCarthy 1990; Peterson 1979; Watson et al. 1983). Young regrowth may generally contain higher alkaloid levels than mature shrubs (Webb 1948).

D. leichhardtii leaves have yielded up to 5% alkaloids, and are very variable in content – the alkaloids may consist of 10-80% *hyoscyamine*, 6-46% *hyoscine*, 3-42% norhyoscyamine, apoatropine, apohyoscine, *atropine*, noratropine, tigloidine, isobutyroyl tropine, and traces of calystegines B1, B2, C1 & C2 [see **Convolvulus**]. Atroscine, scopadonnine, tetramethylputrescine and valtropine have also been found in the plant (Buckingham et al. ed. 1994; Kato et al. 1997; Lassak & McCarthy 1990; Morton 1977).

D. myoporoides is also very variable, and may exist in different chemical races. Leaves may yield up to 3% alkaloids. In cooler areas, *hyoscyamine* and norhyoscyamine are dominant; hotter regions may produce *hyoscine*-dominant plants [eg. north of Gosford, NSW]. Plants around Yarraman, Qld, were dominant in norhyoscyamine. However, tests on a plant cultivated in Nambour, Qld, showed 3% *hyoscine* in April, but 2% *hyoscyamine* in October [as the dominant alkaloid in each case]. Plants on the **Acacia** Plateau [near Killarney, Qld] are dominant in *anabasine*; New Guinea plants are *nicotine*-dominant. Sometimes, plants cultivated in different locations will continue the alkaloid patterns usual to their place of origin, but sometimes the chemistry will be altered. The leaves also yield *nornicotine* [in seedlings], *atropine*, 6-methyldotriacontane, hentriacontanyltetratriacontanoate, 3-OH-dotricontan-28-one and 4-pentatriacontanone. Fresh roots of plants from Beenleigh, Qld, were assayed – young root wood yielded 0.0049% tropine, 0.0038% *hyoscyamine*, 0.0012% valtropine, and traces of valeroidine; old root wood yielded 0.0068% *hyoscyamine*, 0.0031% *hyoscine*, 0.0023% apohyoscine, 0.0021% tropine, and 0.0005% tetramethylputrescine; young root bark yielded 0.13% *atropine*, 0.025% *hyoscine*, 0.02% tropine, and 0.007% apohyoscine; old root bark yielded 0.031% *hyoscyamine*, 0.027% tetramethylputrescine, 0.018% tropine, 0.017% *hyoscine*, 0.007% valtropine and 0.006% apohyoscine. The plant has also yielded neonicotine, pelletierine, isoporoidine, poroidine, and tigloidine (Buckingham et al. ed. 1994; Coulsen & Griffin 1968; Evans 1979; James 1950; Lassak & McCarthy 1990; Morton 1977; Rastogi & Mehrotra ed. 1990-1993). Leaf alkaloids have been observed to vary greatly over the course of a day. The best yields were obtained in the morning (Lee & Chiu 1989). Seedlings have yielded c.1% *hyoscine*, with *hyoscyamine* not appearing until plants are 5-6 months old; alkaloid levels similar to those from adult plants are reached at about 9 months of age. Alkaloid levels decline in stems as the plant matures (Hills & Rodwell 1947).

A Loranthus sp. 'mistletoe' [see *Endnotes*] growing on D. myoporoides yielded c.0.4% alkaloids, 80% of which was *hyoscine* (Bock unpubl.; Trautner 1952).

All of the above Duboisia spp. may yield up to c.1-2% ursolic acid from their dry leaves (Trautner & Neufeld 1947).

Experiments with a hybrid strain between D. leichhardtii and D. myoporoides showed an accumulation in the lower leaves. Alkaloids increased over the morning to reach a peak at midday, tapering off to a low in the afternoon. *Hyoscine* and *hyoscyamine* were in a roughly equal proportion in the early months after planting, until *hyoscine* became dominant in late spring, and decreased to a minimum in late autumn. Treatment with a weak dilution of Maxicrop™ fertiliser boosted alkaloid levels dramatically; greater amounts of K increased *hyoscine*; increased N actually decreased *hyoscine* and *hyoscyamine* content (Luanratana & Griffin 1980a, 1980b).

Duboisia hopwoodii is a rounded shrub to 4m tall, 3m wide. Leaves alternate, narrowly elliptic or ovate-elliptic to linear, sessile (rarely with petiole to 3mm long), 2-12cm x 1-13mm, concolorous. Inflorescence narrow, panicle-like, terminal, leafy; flowers bisexual, slightly zygomorphic, subtended by pairs of opposite bracts 0.5-4mm long; pedicels 1.5-5mm long; calyx campanulate, 1.5-4.5mm long, 5-lobed, the lobes usually about 1/3 as long as tube; corolla campanulate, white with purple striations in throat, 7-15mm long, tube funnel-shaped to campanulate, 4.5-8mm diam. at apex, limb 5-lobed, the lobes 2.5-5.5mm long, volutive in bud; stamens 4, 3-8mm long, inserted at base of corolla tube; anthers unilocular, dehiscing by a terminal, semicircular slit. Ovary bilocular; stigma capitate, very shortly bilobed; style 3.5-6.5mm long, equal to or shorter than upper stamens. Succulent berry usually globose or subglobose, rarely ellipsoid, 2-5mm diam., purple-black; fruiting pedicels 3-5mm long; seeds 2-2.5mm long.

Widespread, in red or yellow sand or sandy loam, on plains, low dunes or rises; arid regions of Western Australia, s. Northern Territory, South Australia, to c.w. Queensland and w. New South Wales.

May hybridise with **Grammosolen** dixonii (Haegi et al. 1982).

DUTAILLYEA

(Rutaceae)

Dutaillyea drupacea *(Baillon) Hartley*
Dutaillyea oreophila *(Baillon) Sevenet-Pusset*

These two New Caledonian plants seem to have very elusive descriptions, and I can find no reference to them outside of their chemical analysis. They both contain a number of alkaloids, including indoles of interest.

D. drupacea leaves yielded 0.04% alkaloids, of which 98% was *5-methoxy-DMT*. Stem bark yielded 0.2% alkaloids, of which 30% was evolitrine [7-MeO-dictamnine], 25% pteleine [6-MeO-dictamnine], 15% (-)-edulinine, 10% dictamnine [4-MeO-furo-[2,3-b]quinoline; shows antibacterial, antifungal, strong smooth muscle contracting and DNA-binding effects], 10% kokusaginine [6,7-dimethoxydictamnine; enhances *norepinephrine* and *dopamine* levels in mouse brain, 5-HT2 receptor agonist] and 2% dutadrupine (Baudouin et al. 1981; Cheng et al. 1994; Harborne & Baxter ed. 1993).

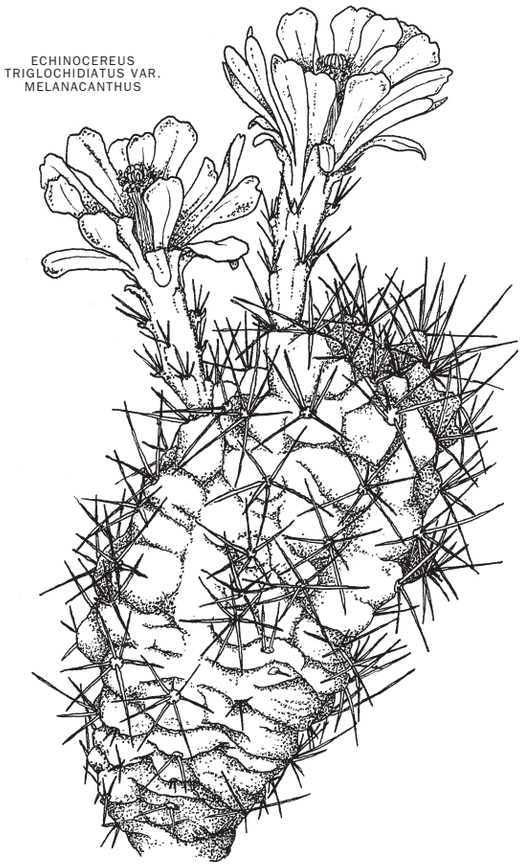
D. oreophila leaves yielded 0.05% alkaloids, of which 40% was *5-methoxy-DMT*, 25% kokusaginine, 25% *hordenine* and 10% 2-methyl-*pinoline*. Stem bark yielded 0.03% alkaloids, of which 40% was dictamnine, 20% kokusaginine, 20% pteleine and 20% evolitrine (Baudouin et al. 1981).

Dutaillyea spp. are shrubs or bushes. Leaves large, digitately trifoliolate, opposite; leaflets entire, petiolulate. Flowers mostly hermaphroditic, in axillary composite-cymose racemes; receptacle shortly conical; sepals 4, free, moderately thick, at first mildly decussate, becoming subvalvate; petals longer than calyx, imbricate or tortuose, rarely alternately imbricate; stamens 4, alternating with petals; filaments free, subulate, germ in disc glandulose near base, obscurely lobed, thickened, inserted; anthers oblong, 2-locular, filament somewhat longer, introrsely 2-rimose. Ovary su-

perior, conoid, 4-locular, locules opposite petals; ovules 2 in each locule, descending; micropyle above, extrorse; style apically erect, slender, entire, apex simple; stigma not at all thickened (Baillon 1871-1873).

ECHINOCEREUS

(Cactaceae)



ECHINOCEREUS TRIGLOCHIDIATUS VAR. MELANACANTHUS

Echinocereus berlandieri *(Engelmann) Hort. F.A. Haage* **(E. blanckii** *(Pos.) Palmer* [misapplied]**)**
Echinocereus cinerascens *(DC.) Lemaire*
Echinocereus merkeri *Hildmann ex Schumann* **(E. dubius** *(Engelm.) Rümpler***; E. enneacanthus** *Engelm.* **ssp. enneacanthus; E. sarissophorus** *Britton et Rose***; E. uspenskii** *Hort. A. Blanc ex Haage***)**
Echinocereus salm-dyckianus *Scheer* – hikuri, peyotl, wichuri, pitallita
Echinocereus triglochidiatus *Engelm.* **(E. gonacanthus** *(Engelm. et Bigelow) Lemaire***)** – hikuri, peyotl, wichuri, pitallita
Echinocereus triglochidiatus var. neomexicanus *(Stand.) Stand. ex W.T. Marshall* – hikuli, pitallito
Echinocereus triglochidiatus var. paucispinus *Engelm. ex W.T. Marshall*
Echinocereus spp. – hedgehog cactus, pitaya, tjeenayookisih

The Tarahumara of n. Mexico consider E. salm-dyckianus and E. triglochidiatus to have similar properties to **Coryphantha** compacta, but less effective, and collect them from mountainous areas (Bye 1979b; Diaz 1979; Schultes & Hofmann 1980). The Navajo eat Echinocereus spp. as cardiac stimulants; they know them as 'twisted heart plant' or 'tjeenayookisih'. The Isleta roast the stems and apply them as a poultice to reduce swelling (Winter 1998). E. cinerascens has been used for its edible fruit, and the dry plant used as fuel (Bruhn & Sánchez-Mejorada 1977).

E. berlandieri has yielded [w/w] 0.0013% *DMPEA* and 0.0033% N,N-dimethyl-*histamine* (Wagner & Grevel 1982).

E. cinerascens has yielded [w/w] 0.014% alkaloids, most of which was N,N-dimethyl-*DMPEA*, with lesser amounts of N-methyl-*DMPEA* (Bruhn & Sánchez-Mejorada 1977).

E. merkeri has yielded 0.016% alkaloids, of which 20% was N-methyl-*DMPEA*, and 60% N,N-dimethyl-*DMPEA*, as well as *DMPEA*, 3-MeO-*tyramine*, *hordenine* and salsoline [6-OH-7-MeO-1-methyl-THIQ] (Agurell et al. 1969b).

E. salm-dyckianus is rumoured to contain entheogenic tryptamines; this appears to be without foundation.

E. triglochidiatus has long been thought to contain *5-methoxy-DMT* (Bye 1979b; Schultes & Hofmann 1980), but this is now known to have been in error, stemming from tentative preliminary data which showed the possible presence of this alkaloid. However, it seems that this species does contain small amounts of indole compounds which researchers have not succeeded in isolating. This cactus, represented as two of its varieties [var. neomexicanus and var. paucispinus], has yielded N,N-dimethyl-*histamine*, detected chromatographically in the former variety, and isolated in 0.11% yield from the latter (Ferrigni et al. 1982). Based on the assumption that *5-MeO-DMT* was present in useful amounts, one person performed an acid-base extraction on E. triglochidiatus and obtained a good yield of crystalline material. This material was vapourised and inhaled, and the psychonaut perceived some kind of vague effect which was not described further. This material was probably mostly, or entirely, N,N-dimethyl-*histamine* (Trout pers. comm.), which has hypotensive activity in animals (Rizvi et al. 1985). The human pharmacology of this alkaloid is unknown, and caution is advised in experimentation due to possible toxicity in doses larger than were bioassayed by the subject just mentioned (Trout pers. comm.).

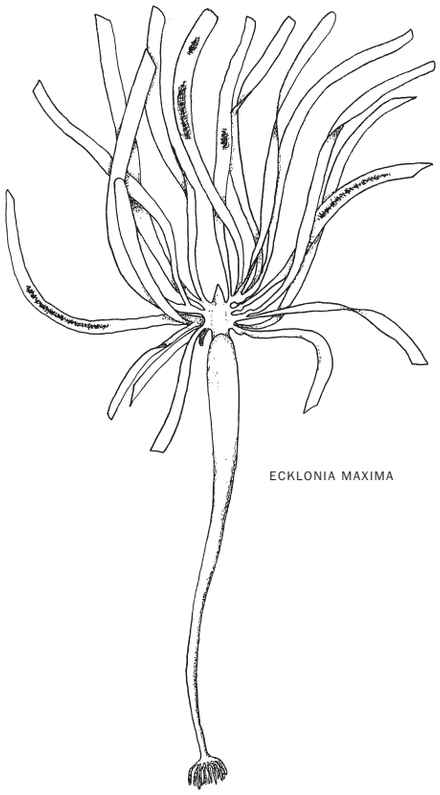
Echinocereus triglochidiatus is a caespitose cactus, with few or many simple stems (5-)20-40(-60)cm long, (2.5-)5-8(-15)cm diam., branching from base, erect or spreading, frequently forming dense mounds to 30cm high and 30-120cm across, deep green, larger terminal joints green or bluish-green, cylindroid to ovoid-cylindroid; 5-8(-12) ribbed, slightly tuberculate; areoles nearly circular, 3-4.5mm diam., usually 6-12mm apart, areoles of mature parts of stems with white felt or cobwebby hairs; spines from sparse to dense on joint, (2-)3-8(-16) per areole, variable amongst varieties, nearly terete to strongly angled, when young reddish/pinkish to yellow, grey in age, usually spreading, often all radial, 3cm long or less. Flowers scarlet, (2.5-)5-7cm long, 2.5-5(-6.4)cm diam.; perianth segments with greenish midribs, red entire margins, oblong to narrowly elliptic, obtuse to rounded apically, mucronulate, (1.5-)3cm long, 6-9mm across; petals red or red and yellow, largest broadly cuneate-obovate, 2-2.5cm x 6-12mm, apex rounded, outer petals slightly mucronulate, entire; areoles on flower tube and ovary few, white-felted, subtending scales small and red; spines on ovary and flower tube few, red and white; filaments white or pale green, 9-12mm long; anthers pale yellow, c.0.5-0.75mm long, up to 1-1.5mm diam.; style greenish, 12-20 x 1-2mm; stigmas c.10, 3-4.5mm long, slender; ovary in anthesis 9-12mm diam. Fruit at first spiny, in age smooth, bright red, 12-25 x 10-15mm, obovoid to cylindroid; seeds 1.5-2mm long, 1.2-1.5mm broad, 0.8-1mm thick, strongly papillate. Flowers do not close at night, and remain open for 2-3 days.

Very variable in habit and number and kind of spines; has at least 8 varieties.

W. Texas, New Mexico, Colorado (Benson 1982; Britton & Rose 1963), Arizona, Missouri.

ECKLONIA

(Alariaceae)



Ecklonia maxima *Osbeck* **(E. buccinalis** *L.***)** – brown algae, kelp

This marine plant is marketed in the form of a seaweed extract [Kelpak™] to promote rooting of cuttings in the horticultural industry (Crouch et al. 1992). It is related to Ecklonia kurome, a popular edible seaweed known as 'kun bu', which is used in TCM interchangeably with Laminaria japonica ['hai dai'] to lower blood pressure, and correct thyroid function and iodine deficiency. L. japonica is a natural source of monosodium glutamate [MSG] (Huang 1993).

Recently, the aforementioned extract of E. maxima was found to contain various indoles, such as *DMT*, indole-3-acetic acid, indole-3-carboxylic acid, indole-3-aldehyde and isoindole-1,3-dione [N-OH-ethylphthalimide] (Crouch et al. 1992; thanks to Michael Bock for this reference); the kelp itself has yielded 35-38% alginic acid, a variety of phenols called phlorotannins (Glombitza & Vogels 1985), and a high level of iodine [0.25% w/w] (Chapman & Chapman 1980) – hence, caution should be exercised by those with acute tuberculosis or chronic bronchitis, as their symptoms may be exacerbated (Huang 1993). Other studies have failed to identify *DMT*, suggesting great variation in chemical content of wild harvested kelp.

Ecklonia maxima has three basic parts – the blades, the stipe and the holdfast with which it keeps its grip on the ocean floor. Thalli brown, coriaceous, to 10m or more long. Blade flat, multiple divided frond, branching off bilaterally into flat, linear marginal portions. Stipe hollow, becoming inflated towards apex. Holdfast composed of dichotomously branched robust rhizoids. Cannot survive over 25°C. Usually carries the 'red alga' Suhria vittata as an epiphyte on its stipes.

On intertidal and subtidal rocks to depth of 8m; 0-4m deep, it makes up ⅔ of total kelp biomass, falling to ½ from 4-8m deep. Off west coast of S. Africa; prominent kelp in the cool Benguela upwelling region on the west coast of S. Africa, occurring from Swakopmund, Namibia, to Aasfontein, 15km west of Cape Agulhas (Chapman & Chapman 1980; Luning 1990; Tseng ed. 1983).

ELAEAGNUS [Eleagnus]

(Elaeagnaceae)

Elaeagnus angustifolia *L.* **(E. hortensis** *M.B.***; E. orientalis** *L.***)** – Russian olive, Trebizond date
Elaeagnus commutata *Bernh. ex Rydb.* – silverberry, wolf willow
Elaeagnus pungens *T.* – hu tin yie
Elaeagnus spinosa *L.*
Elaeagnus triflora *Roxb.* **(E. latifolia** *L.***)** – millaa vaine, millaa millaa, malay malay

The Gimi of the New Guinea highlands sometimes smoke the leaves of an unidentified Elaeagnus sp. with tobacco [see **Nicotiana**] and an Amaracarpus sp. [see *Endnotes*] to enter trance for divination (Glick 1967). This may be E. triflora, which is the only Elaeagnus sp. recorded in New Guinea (Bock unpubl.). E. angustifolia is used in India for lung problems and malignant fevers; the seed oil is also taken in syrup to treat catarrh and bronchial problems. In Spain, its flower juice is used as a cure for malignant fevers (Kirtikar & Basu 1980). In TCM, E. pungens leaf has been used as an antitussive (Huang 1993). The fruits of some Elaeagnus spp. are eaten as food – such as E. argentea ['silver berry'] in N. America, E. triflora in Nepal and Hindustan and E. multiflora ['cherry Elaeagnus', 'goumi'] in Japan, where they are also made into an alcoholic beverage (Usher 1974). In parts of India, the mealy covering of E. angustifolia fruits has been used as a binding adulterant in 'hashish' manufacture [see **Cannabis**] (Clarke 1998).

Some species contain β-carboline alkaloids of interest. Leaf extract, bark and seeds from E. angustifolia have been smoked for the effects of these alkaloids, and simply handling the herb seems to result in some absorption through the skin (Gerbil pers. comm.).

E. angustifolia aerial parts were shown to contain *tetrahydroharman* [eleagnine] and traces of *harman* (Lutomski & Nowicka 1969; Lutomski et al. 1968b; Men'shikov et al. 1951); root bark and bark from aerial parts was richest in *harman*; *harmol* and *tetrahydroharman* were also detected in these organs. As the plant matures, *harman* levels increase, and *tetrahydroharman* levels decrease (Gill & Raszeja 1971; Massagetov 1947; Nikolaeva et al. 1971a, 1971b). Stem bark has also yielded *tetrahydroharmol* and N-methyl-*tetrahydroharmol* (Platonova et al. 1957). *Harmalan* [dihydro-*harman*] and 2-methyl-THβC have also been isolated from the plant (Nikolaeva 1971). The presence of *harmine* has been reported (Shulgin & Shulgin 1997), but this may be a mis-reading of Gill & Raszeja (1971), which referred to the presence of *harmine* in **Peganum** harmala, in an ambiguous passage. Bark also yielded (+)-catechin, (-)-epicatechin, and 2 other catechin-derivatives; leaf has yielded *chlorogenic acid*s, neo-*chlorogenic acid*s, caffeic acids (Nikolaeva et al. 1971c), quebrachitol, kaempferol-7-p-coumaryl-3-D-glucoside, isorhamnetin-3-D-gluco-D-galactoside, isorhamnetin-3-D-gluco-D-feruloylgalactoside and isorhamnetin-3-rhamno-glucorhamnoside (Plouvier 1951; Rastogi & Mehrotra ed. 1990-1993). An aqueous extract of the fruit had analgesic and antiinflammatory effects in rats, and contained flavonoids, terpenoids and cardioactive glycosides (Ahmadiania et al. 2000).

E. commutata root bark has yielded 1-isobutyl-THβC (Slywka & Locock 1969); the plant inhibits human plasma AChE (Orgell 1963b).

E. pungens leaf has yielded *harman* and *tetrahydroharman* (Huang 1993). Quebrachitol has been found in leaves of E. pungens var. simonii and E. pungens var. reflexa (Smith 1975).

E. spinosa bark has yielded *tetrahydroharman* and another alkaloid which was not identified (Massagetov 1946).

E. triflora [as E. latifolius] leaf from Innisfail, Queensland [Australia], harvested in June, tested positive for alkaloids (Webb 1949).

Unspecified members of the genus Elaeagnus were also reported to have yielded *leptaflorine* [tetrahydroharmine] and 2-methyl-*tetrahydroharmol* (Shulgin & Shulgin 1997). Quebrachitol has also been found in the leaves of E. argentea, E. macrophylla [0.15%], E. multiflora and E. umbellata (Plouvier 1951), the latter of which also contains *serotonin* in the leaf, stem bark and cotyledons (Regula 1973b), as well as *eugenol* and many other compounds in the flower essential oil (Potter 1995).

Elaeagnus angustifolia is a shrub or small tree, of somewhat scraggly habit, to 3-9m tall; the older bark grey and shreddy; branches often thorny, dark brown. Leaves deciduous, alternate, simple, 2.5-8cm long, obtuse, lanceolate or oblong-lanceolate, bright green on upper surface, densely silvery-lepidote beneath, nerves faint; petiole 6mm. Flowers small, yellow, perfect or polyamodioecious, very fragrant, apetalous, solitary or in axillary clusters; perianth 4-6mm long, silvery, campanulate above, teeth triangular-ovate; calyx 4-lobed, pale yellow; stamens 4-8, on mouth of perianth; hypanthium closely surrounding but not uniting with the ovary; filaments short. Ovary 1-celled, superior; stigma lateral. Fruit ovoid, drupe-like, mealy, red or yellow, silvery-lepidote, 1-2cm long, enclosed in persistent accrescent berried or rarely dry perianth base, endocarp thick, bony, pericarp thinly membranaceous; seed with hard, shining testa. Fl. May-Jun.

W. Himalaya, Baluchistan, west to Spain, west and central Asia to China, often between 1220-3200m; introduced to US, where it is frequently cultivated, and a frequent roadside escape; New Mexico chiefly along streams, valleys and roadsides, usually in waste ground, widespread (Kirtikar & Basu 1980; Martin & Hutchins 1980).

ELAEOPHORBIA

(Euphorbiaceae)

Elaeophorbia drupifera *(Thonn.) Stapf.* **(E. grandifolia** *(Haw.) Croizat***; E. leonensis** *N.E. Br.***; E. neriifolia** *A. Chevalier***; Euphorbia drupifera** *(Thonn.) Stapf.***)** – kankan, ayang beyem, mbisa, ongitsimbi, getsimbi, mbego, amataisongo, dolo, douo, turo, toro, dodo, do, baga, tene

The latex of this w. African tree has gained interesting uses in its natural range. The crushed leaves and fruit are used as a fish poison, and a decoction of these parts is used in some areas as an ordeal poison (Usher 1974). The latex has also been applied to the eyes as an ordeal poison, with ocular damage signifying guilt (De Smet 1998). The latex was reportedly once applied to the eyes of slaves and prisoners to make them easier to deal with (De Smet 1998). The latex is used to treat ringworm, warts, scorpion stings, and as a purgative. It has sometimes been used as an additive to preparations made from 'iboga' [see **Tabernanthe**] and/or 'niando' [see **Alchornea**] root barks, to enhance their effects. The Byeri Fang of Gabon reportedly used the latex, mixed with vegetable and animal oils, by dipping a feather into the mixture ['ibama'] and brushing it across the eyes of initiates. Other groups carefully pour drops of it into the eyes. The highly caustic latex may normally cause blindness if brought into contact with the eyes, but diluted with oil it is said to produce brilliantly coloured visions; others say it causes 'odd visual states' and a 'general sensation of dulling' (De Smet 1998; Emboden 1979a; Samorini 1996c, 1997a).

The latex of E. drupifera has yielded the proteases euphorbain d1 [11%] and euphorbain d2 [7%] (Lynn & Clevette-Radford 1985), and the diterpene ingenol [0.47%]. The latex is highly irritating (Kinghorn & Evans 1974) and can act as a co-carcinogen (De Smet 1998). A crude extract of the leaves appears to stimulate muscarinic *acetylcholine* receptors (Eno & Itam 1998).

Elaeophorbia drupifera is a tree with a woody stem and fleshy, angular branches containing abundant caustic white latex; branchlets fleshy, armed with pairs of broad-based prickles c.5mm long; branched low down in open situations but with a clear bole in forest, 3-15m or more tall. Leaves oblanceolate to obovate, sometimes widely emarginate at apex, up to 25 x 9cm, fleshy, entire. Peduncles forked, with a sessile involucre in the fork, sometimes with lateral branches forked again; common peduncles 2.5-4.5cm long, axillary in threes, lateral branches of inflorescence 1-2cm long; involucre with 5 transversely oblong, denticulate lobes and 5 fleshy similar shaped glands; male flowers numerous, male and female flowers much reduced and enclosed in the same involucre as the stamens or in a separate involucre, the latter cupular or 4-angled; stamens 1. Fruits indehiscent drupes, thick and fleshy, ellipsoid, yellow when ripe, with very short stipe, usually c.2-3 x 1.5-1.8cm.

Common in forests and coastal plains; Guinea, Sierra Leone (Hutchinson & Dalziel 1954-1972), Gabon.

ELEUTHEROCOCCUS [including Acanthopanax]

(Araliaceae)

Eleutherococcus senticosus *(Rupr. et Maxim.) Maxim.* **(Acanthopanax senticosus** *(Rupr. et Maxim.) Harms***)** – shigoka, Siberian ginseng, ci wu jia, chi wu cha, wu jia pia, north wu pie pi, wa cha seng, touch-me-not, devil's bush, eleutherococc

Acanthopanax gracilistylus *W.W. Smith* – wu jia pi, south wu jia pi

Acanthopanax japonicus *Franch et Savart* **(A. nipponicus** *Makino***)**

Acanthopanax sciadophylloides *Franch. et Sav.* - gonzetsunoki, gonzetsu, koshiabura

Acanthopanax sessiliflorus *Seem.* – short stem wu jia

Acanthopanax sieboldianum *Makino* - ukogi, himeukogi

E. senticosus, a common plant of east Russia, is valued today as a potent tonic, which may rival even the 'true ginseng' [see **Panax**] in its efficacy – it is often used today as a cheaper, effective ginseng substitute. Its virtues were only revealed to the west last century [1958] after testing of the adaptogenic properties of Russian Araliaceae, by the Soviet scientist Itskovity Brekhman. Leaves and roots of E. senticosus share the major effects of **Panax** ginseng, but are less heating; the stimulant and tonic actions, during periods of high-intensity work, are stronger and longer-lasting than from ginseng. Extracts have been shown to increase stamina, improve immune function, improve alertness and clear mental functioning, reduce reaction-time, antagonise narcosis, increase visual and auditory acuity, increase weight and RNA-content of seminal vesicles and prostate glands, lessen X-ray toxicity, and act as an adaptogen and hypoglycaemic, as well as showing some antitumour properties. After the Chernobyl disaster in 1986, E. senticosus was given to treat radiation sickness. In Russia, extracts of the plant are commonly used by factory workers, Olympic athletes, soldiers and astronauts. The root and rhizome have been much longer used in TCM as a ginseng-substitute, male sexual tonic, and digestive. However, due both to confusion in ancient herbals with similar plants, and to a decrease in its use over history [probably partly in turn due to confusion with Periplocea sepium ('xiang jian pi'; see *Endnotes*), which is quite toxic], this historic useage was only rediscovered relatively recently by herbal scholars. On at least one occasion, P. sepium has been sold as E. senticosus (Fugh-Berman 2000). The closely related E. sieboldianus is used as a hedging plant in horticulture, but has not been tested for medicinal properties (Brekhman & Dardymov 1969a, 1969b; Bremness 1994; Farnsworth & Cordell 1976; Fulder 1993; Halstead & Hood 1984; Hikino et al. 1986; Huang 1993).

Plants from the closely related genus Acanthopanax have been used in similar ways in China. In TCM, A. gracilistylus and A. sessiliflorus roots are used as a ginseng-like tonic and aphrodisiac, the latter also with analgesic and antiinflammatory effects (Halstead & Hood 1984; Huang 1993). Extracts of leaves and roots from the Japanese A. japonicus are used as a tonic health supplement in Korea (Park et al. 2002). In rural Japan, A. sciadophylloides and A. sieboldianum leaves are used as an energising tonic tea; the roots treat rheumatism and stomach complaints. All parts of the latter species also treat hypotension (Brussell 2004).

E. senticosus contains predominantly the glycans eleutherans A-G (Hikino et al. 1986) and the eleutherosides [a diverse array of compounds, many of which are triterpenoid saponins], as well as lignans, sterols and coumarins. Some of these are known by previous synonyms, such as eleutheroside A [daucosterol], eleutheroside B [syringin], eleutheroside B1 [β-calychanthoside; isofraxidin-7-O-α-L-glucoside], eleutheroside B4 [(-)-sesamin], eleutheroside C [methyl-α-D-galactoside], eleutheroside D [(-)-syringaresinol-ol-di-O-β-D-glucoside], eleutheroside E [acanthoside D], eleutheroside I [mussenin B], eleutheroside K [β-hederin] and eleutheroside M [hederasaponin B]. Eleutheroside H is a mixture of I & K. The triterpenes known as senticosides, which are also found, may be identical to some of the eleutherosides. Also found are sinapyl alcohol glycoside, polysaccharides, sucrose, glucose, vitamin A, vitamin C, vitamin E, and an essential oil (Brekhman & Dardymov 1969a, 1969b; Bruneton 1995; Farnsworth & Cordell 1976; Halstead & Hood 1984; Segiet-Kujawa & Kaloga 1991). Roots yielded eleutherosides B4, C, D and E; leaves yielded eleutherosides I, K, L and M (Halstead & Hood 1984; Huang 1993). Eleutheroside B was found mainly in stem bark and root bark, whilst eleutherosides A, C, D and E were found mainly in stem bark and stem pulp (Lapchik & Ovodov 1971).

The herb should not be taken with digoxin, as it can increase the levels of that compound (Fugh-Berman 2000). The bark is tasteless, which may aid in detection of substitutes (pers. obs.). A synergy between the actions of E. senticosus and **Schisandra** has been noted (Halstead & Hood 1984). The herb is very non-toxic, with an oral LD50 of the root [using a 33% ethanolic extract] being 14.5g/kg (Huang 1993). Its effects are best realised with daily consumption as a tonic (Halstead & Hood 1984).

A. japonicus leaves yielded triterpene glycosides named acanjaposides (Park et al. 2002).

A. sessiliflorus root has yielded acanthosides A-D, 1-savinin, and 1-sesamen (Huang 1993).

Eleutherococcus senticosus is a shrub to 2(-5)m tall, with light-grey bark; shoots light brown, usually densely covered with thin brittle prickles curved below, sometimes prickles wanting. Leaves palmately compound of 5 leaflets; leaflets obovate-oval to elliptic, base cuneate, apex short-acuminate or tapering to +- long mucro, thin, adult leaves glabrous or +- densely covered with short bristly hairs, with rufous hairs below along nerves, upper leaflets larger than lower ones, 7-12.5 x 3-7cm, margins acutely bidentate; petioles to 10cm, glabrous or with sparse rufous hairs, with or without solitary prickles; petiolules 1-2cm, covered with dense rufous hairs. Umbels on long stalks, single, terminal but usually 3-4, the distal commonly solitary, fertile, larger and more multiflorous; peduncles to 8cm; pedicels (6-)10-20mm, glabrous or hairy only at base, not jointed, thin; flowers polygamous-dioecious; calyx of (4-)5(-6) small teeth; corolla of (4-)5(-6) petals, valvate in bud, soon deciduous, yellowish in pistillate flowers, light violet in bisexual and staminate flowers; stamens 5. Ovary (3-)5(-7)-locular; styles (3-)5(-7), adnate to tube for entire length, connate; stigmas 5, free, short. Fruit a subglobular berry-like double-drupe, black, pentapartite, strongly flattened, 7-10cm long. Fl. Jul.-Aug.

In mixed and coniferous mountain forests forming small undergrowths or groups in thickets and edges – a common undergrowth component – rarely in oak groves at the foot of cliffs and ravines, more rarely in high-forest riparian woodland; far-east Russia, Manchuria, n. China, Korea, Japan (Shishkin ed. 1986a).

Seed can be tricky to germinate. Harvest root in autumn (Chevallier 1996).

EPHEDRA

(Ephedraceae/Gnetaceae)

Ephedra americana *Humb. et Bonpl. ex Willd.* **(E. andina** *Poepp.***)**

Ephedra californica *S. Watson* – California joint fir
Ephedra distachya *L.* – shrubby horsetail, ma huang ['yellow hemp']
Ephedra equisetina *Bunge* **(E. shennungiana** *Tang***)** – mu-ts'è ma huang ['horsetail ephedra'], shan ma huang ['mountain ephedra'], mu ma huang ['wood ephedra'], ma huang, codati-mao
Ephedra fragilis *Desf.* – encarnaillo, carnaillo, canutillo, apalain fino
Ephedra gerardiana *Wall. ex C.A. Mey.* **(E. vulgaris** *Rich.***)** – amsania, butshur, chewa, tse, tseh, tseput, teapat, trano, rachi, khanda, huma, somalata, sang kaba
Ephedra intermedia *Schrenk ex C.A. Mey.* **(E. ferganensis** *Nikitin***; E. glauca** *Regel***; E. microsperma** *Nikitin***; E. pachyclada** *Boiss.***; E. persica** *(Stapf.) Nikitin***; E. tesquorum** *Nikitin***; E. valida** *Nikitin***)** – chung ma huang, ma huang
Ephedra intermedia var. tibetica *Stapf.* **(E. tibetica** *(Stapf.) Nikitin***)** – hum
Ephedra major *Host* **(E. nebrodensis** *Tineo.***)**
Ephedra monosperma *C.A. Mey.* **(E. minima** *K.S. Hao***)**
Ephedra nevadensis *S. Watson* **(E. antisyphilitica** *S. Watson***)** – Nevada joint fir, Mormon tea, desert tea
Ephedra sinica *Stapf.* **(E. flava** *Smith***; E. ma-huang** *Liu***)** – tien ma huang ['field ephedra'], ts'ao ma huang, chuan ma huang, ma huang
Ephedra viridis *Coville* **(E. nevadensis subvar. pluribracteata** *Palmer ex Stapf.***; E. nevadensis var. viridis** *(Coville) M.E. Jones***)** – mountain joint fir, squaw tea
Ephedra spp. – joint fir, tepopote

As 'ma huang' ['yellow hemp'], several species of Ephedra [E. distachya, E. equisetina, E. intermedia, E. sinica] have been used for at least 5,000 years by the Chinese in the form of the dried stems and scale-leaves to treat asthma, bronchitis, fluid retention, chills, fever, allergies and excessive appetite (Hu 1969; Huang 1993; Liu et al. 1993; Morton 1977; Reid 1995). The roots, as 'ma huang gen' [China] or 'mao kon' [Japan], are used in doses of 6-9g to relieve night-sweats associated with ch'i-deficiency or yin-deficiency (Hikino et al. 1984; Hsu et al. 1986). From c.2000-1700BC, for some 2,000 years, the Qäwrighul of far-west China buried their mummies with bundles of Ephedra twigs tied into their shrouds (Mallory & Mair 2000).

Ephedra spp. were thought to have been used ritually by the Neanderthals of Shanidar 60,000 years ago (Rätsch 1992); however, this claim was based merely on the finding of high concentrations of pollen from an Ephedra sp. [closely related to E. distachya, E. fragilis, and E. altissima], as well as pollen from 28 other species of medicinal plants, at the Shanidar cave burial site [in what is today n. Iraq/Kurdistan]. One theory was that the dead had been buried with medicinal flowers by their colleagues. However, bones of rodents [mostly of the 'Persian jird', Meriones persicus] also found at the site, once thought to have been attracted to the cave by the human carcasses, offer a different explanation, as the Persian jird is known to collect and hoard many of the same flowers (Leroi-Gourhan 1975, 1999; Sommer 1999).

In India, E. vulgaris has been used as a 'soma' substitute [see **Amanita**], and [as well as E. intermedia and E. pachyclada] has even been proposed by some to have been the original soma (Flattery & Schwartz 1989; Nadkarni 1976; Ott 1993, 1998b; Tyler 1966). In Nepal, E. gerardiana is "only used as an incense by powerful shamans and high lamas for burial ceremonies" (Müller-Ebeling et al. 2002). Some findings in the Kara Kum Desert [in what is now Turkmenistan] indicate that Ephedra spp. may have been important as an ingredient of the related [or perhaps synonymous] 'haoma' [see also **Peganum**], if haoma was a composite drug rather than a single-plant preparation. Ritual vessels from the temple of the fire-religion at s. Gonur [c.2000BC] were shown to contain traces of Ephedra and **Cannabis**; traces of Ephedra and poppy pollen [see **Papaver**] were found in bowls from the shrine at Togolok 21, and bone tubes with faces engraved on the side contained high concentrations of poppy pollen [to c.1750BC]. The Ephedra may have served as a stimulant to counteract the sedative effects of **Cannabis** and/or **Papaver** (Sarianidi 1993, 1994; theobromus pers. comm.). Modern-day Iranian Zoroastrians use Ephedra spp., with 'pomegranate' [Punica granatum – see *Endnotes*] and milk, as a haoma substitute (Flattery & Schwartz 1989).

E. gerardiana, E. intermedia, and E. distachya, amongst others, are used medicinally in India to treat rheumatism, and digestive and respiratory disorders (Chopra et al. 1958; Nadkarni 1976). In Ladakh, India, fruits of E. gerardiana are dried and powdered with tobacco [see **Nicotiana**], to make a kind of 'chewing tobacco' preparation [called 'tsotuck']; for use, a pinch of the powder is placed under the tongue (Bhattacharyya 1991). The Turkis of the Gobi Desert grind an Ephedra sp. with tobacco and lime in a mortar, to prepare a mixture known as 'naz', which "they chew with the most evident enjoyment" (Cable & French 1942). Zen monks are said to have used Ephedra spp. to "promote calm concentration during meditation" (Chevallier 1996).

The ancient Greeks, Romans and Egyptians knew of the properties of E. distachya and E. fragilis, which were considered to be 'foods of Saturn', and were ritually consumed in wines during Saturnalian rites, along with other intoxicating plants. E. americana was used by the Aztecs, and is today smoked with tobacco by some indigenous Mexicans to treat headache. Some native N. American groups use E. californica as a stimulant to prepare for their vision quests. The early Mormons drank a beverage made from E. nevadensis (Emboden 1979a; Heffern 1974; Rätsch 1992), which filled the gap left by their non-consumption of caffeinated products. E. fragilis is used in Spain decocted with water and honey, to treat coughs and colds (Martinez-Lirola et al. 1996).

Ephedra spp. contain *phenethylamine*-related alkaloids based on *ephedrine*; these give the herbage its CNS-stimulant, astringent, bronchodilating, vasoconstricting, diuretic, antispasmodic [for bronchi], hypertensive, appetite-suppressant and antiallergenic effects (Bruneton 1995; Chopra et al. 1965; Morton 1977). Ephedroxane, which is found in some Ephedra spp., has antiinflammatory activity (Bruneton 1995) and is structurally related to aminorex and 4-methylaminorex ['ice', 'euphoria'], synthetic CNS-stimulants. Like *ephedrine* and *amphetamines*, aminorex has been shown to stimulate release of *norepinephrine* and *dopamine* (Rothman et al. 2001). In *ephedrine*-containing Ephedra spp., *ephedrine* is almost always the major alkaloid, followed by pseudoephedrine, which is less potent than *ephedrine* as a CNS-stimulant by c.10-50 times. European Ephedra spp., like E. distachya, are generally low in alkaloids, and American species generally do not contain appreciable levels of *ephedrine*. The thin, green stems are the most potent parts; the roots are the least potent, and may contain the hypotensive imidazole alkaloid feruloylhistamine. Alkaloid content decreases with greater rainfall over the year. Alkaloids are most abundant when the plants are blooming in autumn. Exposure to heat or humidity whilst drying decreases the alkaloid levels, though once dry, they are very stable (Bruneton 1995; Chopra et al. 1965; Hikino et al. 1984; Huang 1993; Liu et al. 1993; Morton 1977; Nadkarni 1976).

The herbage can be prepared dry or fresh. Either way, the chopped and/or shredded herb may be decocted in dosages of 10-30g or more for stimulant effects [some use only a heaped tablespoon or less; I find I need a little more], though wide variation in alkaloid content should be expected, depending on species, strain and ecological conditions. At higher does, side-effects may occur, such as dry mouth and throat, heart palpitations, sweating, dizziness, headache, nausea, flushed skin and numbed extremities. It should not be consumed by persons with cardiovascular problems, or those taking an MAOI (pers. obs.; pers. comms). Ephedra has been reported to intensify the effects of psychedelics such as **Psilocybe** mushrooms (pers. comms.). In recent years, Ephedra spp. and extracts thereof have been banned in some countries, following adverse cardiovascular reactions in some consumers, many of whom probably had existing heart conditions and had been taking the drugs for an extended period. It does not seem unreasonable to suspect that a hidden agenda for this banning is related to the use of Ephedra spp. and its alkaloids in *methamphetamine* manufacture.

E. americana contains *ephedrine*.

E. californica contains *ephedrine* and pseudoephedrine (Lundstrom 1989).

E. compacta [from Mexico] tested positive for alkaloids (Fong et al. 1972).

E. distachya has yielded *ephedrine*, pseudoephedrine, norephedrine, and *norpseudoephedrine* [cathine] (Lundstrom 1989), as well as the flavonoid vicenin 2 (Porter & Wallace 1988).

E. equisetina has yielded 0.61-2.2% alkaloids, of which 85-90% was *ephedrine*, and 10-15% pseudoephedrine (Bruneton 1995; Henry 1939; Liu et al. 1993; Morton 1977), as well as the flavonoids vitexin, vicenin-1, vicenin-2 and vicenin-3 (Porter & Wallace 1988).

E. fragilis has yielded *ephedrine* and pseudoephedrine (Lundstrom 1989); E. fragilis ssp. campylopoda also yielded the flavonoids violanthin and vicenin-3 (Porter & Wallace 1988).

E. gerardiana has yielded 0.28-2.79% alkaloids, of which 50-90% was *ephedrine*, with lesser amounts of pseudoephedrine (Chopra et al. 1958; Henry 1939; Liu et al. 1993). E. vulgaris var. helvetica has yielded 0.018-0.305% *ephedrine* from Chinese plants; European plants seem to contain predominantly pseudoephedrine instead (Chen & Hao 1926; Masucci & Suto 1926).

E. intermedia yielded 0.42-2.33% alkaloids, of which 4.1-53.3% was *ephedrine*, 30-78% pseudoephedrine, 0.8-5% methylephedrine, 0.7-4.3% methylpseudoephedrine, 0.5-4.3% norephedrine and 1.4-15.1% *norpseusoephedrine*, as well as ephedroxane (Buckingham et al. ed. 1994; Chopra et al. 1958; Henry 1939; Liu et al. 1993; Lundstrom 1989); the flavonoids vicenin-1 and vicenin-3 are also found in the species (Porter & Wallace 1988).

E. intermedia var. tibetica has yielded 0.2-1% alkaloids, mostly pseudoephedrine, as well as *ephedrine* [0.025-0.056%] (Chopra et al. 1958).

E. major has yielded 1.31-2.56% alkaloids, 62-75% being *ephedrine* (Chopra et al. 1958; Henry 1939; Morton 1977), as well as the flavonoids violanthin, vicenin-1, vicenin-2 and vicenin-3 (Porter & Wallace 1988).

E. monosperma has yielded 2.8% alkaloids (Bruneton 1995).

E. nevadensis contains predominantly *norpseudoephedrine* (Emboden 1979a), though others have found no alkaloids, only large amounts of gallotannic acid (Terry 1927); the flavonoids vicenin-2 and lucenin-2 are also found (Porter & Wallace 1988).

E. sinica has yielded 0.44-2.31% alkaloids, of which 18-85% was *ephedrine*, 7.6-35% pseudoephedrine, 2.6-20.4% methylephedrine, 0.26-2% methylpseudoephedrine, 0.9-5.9% norephedrine and 1.2-9.9% *norpseudoephedrine* (Henry 1939; Liu et al. 1993).

E. tweediana [from Uruguay] tested positive for alkaloids (Fong et al. 1972).

Ephedra spp. roots, as used in TCM [usually from E. equisetina or E. sinica; see above], have yielded ephedradines A-D [spermidine alkaloids with hypotensive activity], feruloyl-*histamine*, and maokonine [betaine] (Hikino et al. 1983; Hsu et al. 1986).

Other chemicals have been reported from the genus – benzylamine, ephedralone, ephedrannin A, 5-phenyloxazolidines, nilcitin, sexangularetin, lucenin, mahuannins A-D, proanthocyanidin A5, herbacetin 7-(6-quinoylglucoside), 5,11,14,17-eicosatetranoic acid, and catechins (Bruneton 1995; Buckingham et al. ed. 1994).

Ephedra sinica is an erect, irregularly shaped perennial shrub 6-45cm high, monoecious or rarely dioecious; woody stem creeping in soil; aerial stems erect; braches irregular, radical, 1.5mm diameter, slender, stiff, articulate, furrowed, cylindrical, slightly flattened, slightly fibrous, pith form elliptical to circular; internodes slender, 2.5-5cm x 1-1.5mm, broken surface showing brownish-red pith. Non-functional scale-leaves sheath-like, in whorls around the nodes, 2 per whorl, basal ones half connate, surrounding nodes, apical ones half divided, free portion triangular, apex acuminate, with 2 nerves in middle, all generally acute-triangular, membranous, 2-4mm long, subulate, connate and reddish at base, apex recurved, base united into a cylindrical form. Inflorescences cone-like spikes; male cones broad-ovoid, 4-5mm long, terminal or axillary, 3-5 together, rarely solitary, individual cone consisting of 3-5 pairs of bracts; bracts connate, coriaceous with membranous margin, each subtending 1 male flower with a hyaline obovate scale and 6-8 exserted stamens; perianth 2-lobed; anthers exserted, stalked, rectangular or ovoid, crowded, dehiscent by apical slit; filaments connate, separated near anthers; female inflorescences usually solitary, terminal, ovoid spikes, consisting of 4-5 bracts; bracts green, coriaceous, connate, with narrow hyaline margin, upper 2 each subtending 1 female flower with shell-like perianth below ovule; apical end of integument extending, forming an erect tube 1-1.5mm long. Fruit a small, globular fleshy red cone; seeds 1-2, usually oblong to ovoid, plano-convex, 4.5-5.5 x 4mm. Fl. May; fr. Jul.

At c.1515m; n. China from Sinkian to Hopeh Province, north to outer Mongolia (Borrell 1996; Hu 1969; Liu et al. 1993; Morton 1977).

These plants may be cultivated from seed, layers, or dividing the rootstock in spring. Seed should be sown where they are to grow in early spring, spaced at least 75cm apart, and 1.25cm deep. Seedlings should be watered regularly in the first year, but will later tolerate much dryness and full sun, preferring less than 50cm of rainfall a year. Prefers loose, rocky, loamy soil. Harvest after 4 years old (Chopra et al. 1958; Grubber 1973; Morton 1977).

Ephedra spp. are more closely related to conifers than to true flowering plants.

EPIPHYLLUM

(Cactaceae)

Epiphyllum sp. – pokere, pukara, wama panako

Epiphyllum oxypetalum *(DC.) Haw.* **(E. acuminatum** *Schumann***; E. grande** *Br. et R.***; E. latifrons** *(Link) Zucc.***; Cereus latifrons** *Pfeiffer***; C. oxypetalus** *DC.***; Phyllocactus acuminatus** *Schumann***; P. grandis** *Lemaire***; P. guyanensis** *Brongnart***; P. latifrons** *Link***; P. oxypetalus** *Link***; P. purpusii** *Weingart***)** – flor de baile, belle de nuit, queen of the night, Dutchman's pipe, strap cactus, orchid cactus, night-blooming cereus, tarn hua

The Sharanahua and Culina of Amazonian Peru use an unidentified Epiphyllum sp. as an ayahuasca additive [see **Banisteriopsis**]. They either add only one 'leaf' to the brew, or drink its unboiled juice with the ayahuasca (McKenna et al. 1995; Pinkley 1969; Rivier & Lindgren 1972; Schultes 1972). It is not reported how the plant contributes to the effects of ayahuasca. E. oxypetalum has been claimed to cause "hallucinations" when taken in high doses (Trout ed. 1998; Trout & Friends 1999), but this may be a confusion with Selenicereus grandiflorus [see below], which has had similar claims made for it. E. oxypetalum is popular in horticulture for its large, fragrant, nocturnal flowers. Two of its common names, 'queen of the night' and 'night-blooming cereus', usually refer instead to the [equally popular] cactus species Selenicereus grandiflorus [see *Endnotes*].

E. oxypetalum is reportedly used in Malaya for longevity (http://squid2.laughingsquid.net/hosts/herbweb.com/). The flowers [as 'tarn hua'] are claimed to be used in Chinese medicine to "replenish the vital essence" and "strengthen the lungs". To prepare a medicine for this effect, a dose of 8 flowers is collected at night, and gently decocted for 30min., before being cooled, strained and consumed (http://www.massherb.com/Merchant/herbs/commonherb40.htm). However, this might also be a confusion with S. grandiflorus or another plant. I have not been able to find further reference to either of these American plants being adopted into TCM, and the internet reference quoted above gave no supporting reference for the claim.

The Javanese goddess Ratu Kidul was said to have stolen the 'night flower' wijayakusuma from Arjuna, in order to gain immortality. This flower has tenuously been proposed to be represented by a number of different plants, including E. oxypetalum (Jordaan 1997), which would seem unlikely, because of its disparate geographical origin [see below].

I conducted an experiment with an Epiphyllum sp. which had been labelled as E. oxypetalum [confirmation of species identity pending]. Branches were harvested shortly after midday from a greenhouse in Sydney, Australia, in early August. They were washed with cold water to remove possible contaminants, and due to necessity of circumstance, they were stored in a cool position for 20 days. A branch which had undergone minimum water-loss was selected for the experiment [44cm long, up to 9.5cm wide; c.22g]. This was rinsed again, then crushed in water with a pestle, before being frozen in the same water, in a sealed container. Two days later, the mixture was thawed and homogenised in an electric kitchen blender, then strained through fine cloth. The procedure resulted in c.200mls dark, brownish water with a smell of chlorophyll. The brew was consumed in several mouthfuls, and tasted quite tolerable. I did not expect much, if anything, to happen. After 1 hour, no obvious 'hallucinogenic' symptoms had been noted, though some vague alteration of consciousness seemed to be occurring. My head and body felt as though 'tightly packed', and a slightly altered sense of my surrounding space was felt; these effects were quite mild, and not unpleasant, and persisted for several hours. This may have been a 'placebo effect', a product of my imagination, but the experiment demonstrated a lack of toxicity, and further experiments at higher doses may be warranted.

E. angulifer contains traces of kaempferol [MAOI (Sloley et al. 2000)] and several organic acids.

E. truncatum [Zygocactus truncata] contains betacyanins, betaxanthins and caffeic acid (Schultes & Raffauf 1990), as well as unidentified alkaloids (Wheaton & Stewart 1970). Unidentified alkaloids have also been observed in E. ackermannii and E. phyllanthus (Trout & Friends 1999).

Epiphyllum oxypetalum is a stout epiphytic plant, up to 3m long or more, much branched, main stems terete and woody; branches flat, thin, leaf-like, to 10-12cm wide, long-acuminate, deeply crenate or 'feather-like'; areoles small, on margins of flattened branches. Flowers fragrant, tube 13-15cm long, c.1cm thick, stout, +- curved, red, bearing distant narrow scales c.10mm long; outer perianth segments narrow, acute, reddish to amber, 8-10cm long, inner perianth segments oblong-lanceolate, white, c.9.5cm long; stamens numerous, white; ovary green, slightly angular; style thick, 20cm long, white; stigma-lobes numerous, entire, cream-coloured. Flowers open in the evening; after anthesis, they are drooping and limp.

Mexico, Guatemala, Venezuela, Brazil; widely cultivated in tropics (Borg 1951; Britton & Rose 1963).

Sow from seed in spring or summer; treat as for typical cactus-seed germination. Propagate from cuttings by taking stem cuttings 15-20cm long, in the spring; allow to callus over, then plant in pots of sand or very sandy soil, in a gentle light situation. Only water when fairly dry. Once established, drench with water, and let the top 1/3 dry out before watering again. Feed monthly with a low-N fertiliser, except in winter; keep only slightly moist in winter. Prefers good air circulation, but dislikes strong winds; prefers c.50% humidity. Min. temp. 10°C, prefers warmer. Frost-sensitive (pers. comms.).

EPITHELANTHA

(Cactaceae)

Epithelantha bokei *L. Benson* **(E. micromeris var. bokei** *(L. Benson) Glass et Foster***)** – hikuli rosapari?

Epithelantha micromeris *(Engelmann) Weber* **(E. micromeris ssp. micromeris; Mammillaria micromeris** *Engelm.***)** – hikuli mulato, button cactus

Epithelantha micromeris var. greggii *(Engelm.) Borg.* **(E. micromeris ssp. greggii** *(Engelm.) Taylor***; E. densispina** *Bravo***; E. greggii** *(Engelm.) Orcutt***; E. rufispina** *Bravo***; Mammillaria micromeris var. greggii** *Engelm.***)** – hikuli rosapari?

Epithelantha micromeris ssp. pachyrhiza *(W.T. Marshall) Taylor* **(E. pachyrhiza** *(W.T. Marsh.) Backeberg***)**

Epithelantha micromeris ssp. polycephala *(Backbg.) Glass* **(E. polycephala** *Backbg.***)**

Epithelantha micromeris ssp. unguispina *(Bödeker) Taylor*

The Tarahumara of Mexico know E. micromeris as a type of peyote [see **Lophophora**], 'híkuli mulato'. It was reported early last century, by Carl Lumholtz, to "make the eyes large and clear to see sorcerers, to prolong life and to give speed to the runners." The fruits were also claimed to

be used, but to be less potent. 'Hikuli rosapari' or 'rosapara' was said to refer to older specimens [according to some botanists a distinct and different species, possibly **Mammillaria** senilis], which are believed to cause insanity in 'bad people' and cause them to throw themselves from cliffs (Bravo 1937; Bye 1979b; Schultes 1967a). E. micromeris fruits are edible, and are known as 'chilitos' (Bravo 1937; Britton & Rose 1963).

A bioassay of a single de-spined specimen of E. micromeris [c.2.5cm diam.] was conducted by one psychonaut. Approximately 30min. after eating the plant, the subject "entered a pleasant state of lucid mind. There was a distinct enhancement of perceptions and my energy level was incredibly high all day. That night I fell easily to sleep and experienced lots of hypnagogic imagery in my dreams. There were no noticeable negative side-effects". Smoking the plant "seems to produce some central nervous system stimulation and mild perceptual change for several hours" (Anon. 1998).

E. micromeris has yielded [w/w] 0.006% 3-MeO-*tyramine*, 0.0042% *DMPEA*, 0.001% N-methyl-*DMPEA*, 0.0003% *tyramine*, 0.0004% N-methyl-*tyramine* and 0.0026% *hordenine*; as well as triterpenes – 0.00008% epithelanthic acid, 0.004% methylepithelanthate, 0.0003% methylmachaerinate, methyloleanolate, 0.58% oleanolic acid, and 0.0002% of an unidentified triterpene lactone; and 0.001% β-sitosterol (Štarha 1994; Štarha 1995b; West & McLaughlin 1977; West et al. 1978).

Epithelantha micromeris is solitary, or offsetting and mat-forming, clumps to 6cm high, 15cm across; +- globose, 1.5-4(-12.5)cm high, 2.5-6(-7.5)cm diam., green, completely covered with chalk-white spines, slightly depressed at apex; tubercles small, barely 1mm or more high, conic-cylindroid, close-set in spirals (20-35 rows); areoles c.1mm diam., usually c.2mm apart; spines white, numerous and very dense, obscuring stem, arranged in 2-3 series, 20-30 per areole, with wooly hairs, 2-6mm long, c.0.1mm diam. at base, acicular, with numerous forward-directed minute barbs; spines of upper areoles (before disarticulating) c.twice as long as in lower areoles at flowering. Flowers funnel-shaped, from apical areoles, usually obscured by spines, c.3-4.5mm diam., 6mm long, whitish to rose-red; perianth segments 3-5, with pink midribs and pale pink margins, the larger elongate-semicircular, 1mm long and wide, apex rounded, irregularly denticulate; petals pale pink, largest approaching obdeltoid, upper sides somewhat curving, 1mm long and wide, acute, entire; stamens c.10-15; filaments tinged with red, c.0.5-0.7mm long; anthers white or pale yellow, 0.25mm long and wide; style yellowish, c.4.5 x 0.25mm; stigmas 3, 0.5mm long and wide; ovary in anthesis c.1mm long. Fruit club-shaped, red, sometimes colourless, fleshy at maturity, clavate, the lower portion not producing seed, 3-12 x 1.5-6mm; seeds (1-)4-11, large, 1mm long or more, rather cap-shaped, with recessed-elongate basal hilum, seedcoat red-brown or black, verrucose.

Limestone or igneous soils of rocky hills and ridges in desert and grassland, 1020-1500m; w. Texas, Arizona, New Mexico, to n. Mexico (Benson 1982; Haustein 1991).

'Híkuli rosapari' may represent a different species or subspecies. Lumholtz noted that compared to 'híkuli mulato', "it looks quite different, being white and spiny" (Schultes 1967a). Some consider this plant to be represented by **Mammillaria** senilis (Bye 1979b). This might also fit the description of E. bokei, which is often regarded as a subspecies or variant of E. micromeris, and has far more dense spination, making the plant appear white. Intermediate in appearance is E. micromeris var. greggii, which grows to a larger size, and has larger spines. It does not appear to be as white as E. bokei (Benson 1982; Innes & Glass 1991).

EREMOPHILA

(Myoporaceae)

Eremophila alternifolia *R. Br.* – taritjanpa, irmangka-irmangka, narrow-leaved fuchsia bush, magenta emu bush

Eremophila bignoniiflora *(Benth.) F. Muell.* – bignonia emu bush, fuchsia bush, dogwood, eurah

Eremophila longifolia *(R. Br.) F. Muell.* – amuna, utnirringa, tulypurpa, otenerrenge, julpur, berrigan, emu bush, weeping emu bush, long-leaf emu bush, native plum tree

These shrubs, the fruits of which emus are quite fond, have an esteemed position in the pharmacopoeia of aboriginal cultures in north and central Australia. Many Eremophila spp. are used medicinally. The Walbirri of the Northern Territory drink the flower nectar of E. freelingii and E. latrobei as a delicacy. E. freelingii leaves are also infused as a tonic and tea substitute [see **Camellia**]. E. gilesii and E. neglecta are also used as tonics. E. alternifolia is considered by many tribal elders to be 'number 1 medicine', and it was one of the few herbs to be actually dried and carried around, so that a supply was always at hand. The foliage is sun-dried, stripped from the twigs, broken up, and wrapped in a soft piece of bark for storage. A small handful is generally used for a medicinal dose, infused or decocted in water. It acts as a decongestant, expectorant, and analgesic, and is said to promote a feeling of well-being. For internal pains, a drink of it is both consumed and rubbed on the body, and the essential-oil vapours may be inhaled to relieve congestion. The plant is also used to treat insomnia or fitful sleep, colds, flu, headache, fever and septic wounds. E. longifolia is one of the most sacred of plants to central Australians. It is smouldered to 'smoke' new-born babies [to strengthen the child, and stop the mother's bleeding], as well as in other sacred ceremonies. Leaves and branches may be placed in head- and arm-bands during circumcision rites; the leaves are also used to brush men and sacred objects during some rituals. The branches are used to shroud dead bodies and line their graves. Some groups say preparations of E. longifolia are only safe for external use, and are not to be brought into contact with the eyes. However, some tribes are reported as applying a wash of it to sore eyes, as well as drinking a decoction for colds. A decoction of it is usually used as a wash for sores, wounds, pain and fever; a leaf infusion is also used for insomnia (Aboriginal Communities 1988; O'Connell et al. 1983; Richmond & Ghisalberti 1994). A decoction of E. bignoniiflora leaves is also reputed to be an excellent insomnia remedy, analgesic, and general medicinal tonic. George Quartpot, an indigenous healer in s.w. Queensland, stated that "When a haunted place is annoying you, you can't sleep, or dream bad thoughts, this will fix you right up" (Low 1990).

E. alternifolia leaves yielded 3.6-4% essential oil, of which 44% was fenchone, 15% limonene, 0.4% *camphor*, and lesser amounts of other compounds (Aboriginal Communities 1988).

E. longifolia seems to be quite variable in chemical makeup. One study found the leaves to yield 5.8% essential oil, which contained 37-93% *safrole* and 6-63% *eugenol* (Della & Jefferies 1961). An un-vouchered specimen of leaves, thought to belong to E. longifolia, gave only 0.025% essential oil, of which 55% was α-*pinene*, with no interesting phenylpropenes at all (Aboriginal Communities 1988). Furthermore, it has been documented that in different areas, this species has been deficient in oil glands (Della & Jefferies 1961).

Eremophila longifolia is a root-suckering shrub or small tree to 8m tall; branches drooping, +- tuberculate, grey, pubescent, hairs appressed or spreading, usually non-glandular, or rarely with glandular ones or a mixture of both; bark dark grey, rough. Leaves alternate, linear to linear-lanceolate, apex acuminate or attenuate, (3-)6-14(-20)cm x 2-7(-14)mm, margins entire, sparsely to densely pubescent or tomentose, often glabrescent. Flowers axillary, 1-3(-5) per axil; pedicels pubescent, 4-10.5mm long; sepals 5, green, valvate or imbricate, triangular or +- ovate, 2-8mm long, 1.5-2.5mm wide, apex acute to attenuate, pubescent; corolla zygomorphic, 5-lobed, unequal, 2-3cm long, lobes obtuse, pubescent externally, pinkish to reddish-brown, spotted inside; stamens 4, exserted; anthers reniform, rarely sagittate when dehisced, dehiscing by slits. Ovary superior, with nectariferous base, of 2 fused carpels, 2-locular or 4-locular with intruding septa; ovules 1-3(-4) per locule; style slender. Fruit a drupe, ovoid-oblong to subglobose, 5-12mm diam., dry, fleshy, indehiscent, endocarp woody, glabrous or rarely with scattered hairs. Fl. most of the year.

On deep sand or rocky plains and gravelly watercourses, in NT, otherwise adapted to a wide variety of plant communities and soil types; inland in all mainland states of Australia (Aboriginal Communities 1988; Harden ed. 1990-1993).

ERIOGONUM

(Polygonaceae)

Eriogonum annuum *Nutt.*

Eriogonum campanulatum *Nutt.* **(E. brevicaule ssp. campanulatum** *(Nutt.) S. Stokes***)**

Eriogonum inflatum *Torr. et Frém.* – desert trumpet

Eriogonum jamesii *Benth.* – James buckwheat, big snake's tobacco, horned worm's tobacco, antelope sage, yellow flower, bil nat'oh, bilatah lico, ta'loo

Eriogonum ovalifolium *Nutt.* **(E. nivale** *Canby***; E. ochroleucum** *Small***; E. roseiflorum** *Gandg.***; E. rubidum** *Gandg.***; E. vineum** *Small***)**

Eriogonum umbellatum *Torr.* **(E. ellipticum** *Nutt.***; E. hausknechtii** *Dammer***; E. polyanthum** *Benth.***; E. stellatum** *Benth.***; E. subalpinum** *Greene***; E. tolmieanum** *Hook.***; E. torreyanum** *Gray***)** – mountain tobacco

Eriogonum spp. – umbrella plants, wild buckwheat

This large genus of herbs is widespread in North America; many species are used medicinally or as food by native Americans. The medicine pipe used by the Shoshone is filled with a mixture of tobacco [see **Nicotiana**] and E. inflatum. The young stems of this species are also eaten raw as food, harvested before flowering. The Navajo use all parts of E. jamesii medicinally, applying it to wounds, as well as to ease the pains of childbirth. E. umbellatum, 'mountain tobacco', is used with other herbs as a ritual fumigant and emetic. The Navajo smoke the leaves of Eriogonum spp., such as E. jamesii and E. umbellatum, mixed with other herbs to relieve 'disturbing dreams' [see *Endnotes*] (Siegel et al. 1977; Usher 1974; Winter 1998).

E. alatum roots have yielded *hordenine*.

E. annuum [whole plant] has yielded *hordenine* and N-methyl-4-MeO-*phenethylamine*.

E. campanulatum yielded these compounds from the aerial parts, but only contained *hordenine* in the roots.

E. inflatum [whole plant] yielded *hordenine* (Schroeder & Stermitz 1984).

Unidentified Eriogonum spp. have been reported to yield *DMT* (Ott 1994, quoting Schroeder 1986), but this was a misreading of Schroeder (1986), who discussed the finding of *hordenine* and N,O-dimethyl-*tyramine* [N-methyl-4-MeO-*phenethylamine*] in four species, most likely those reported above.

E. ovalifolium tested positive for the presence of *DMT* in small amounts, by TLC; another unidentified compound was observed under UV light, in higher concentrations. An unidentified Rocky Mountain Eriogonum sp. with narrow leaves also contained traces of *DMT* (Trout pers. comm., citing Appleseed unpublished work).

The subgenus Flava does not seem to contain alkaloids (Schroeder & Stermitz 1984).

Eriogonum ovalifolium is a caespitose perennial herb, forming mats up to 30-40cm across; with closely branched, woody caudices thickly beset with leaves; densely white-tomentose; flowering stems scapose, slender, tomentose, (1-)3-20(-30)cm tall. Leaves basal, roundish to elliptic or oblanceolate, 5-20(-30)mm long x 3-15mm wide, from greenish on upper surface and tomentose, to nearly white on both sides and pannose-lanate, spatulate to slenderly petiolate; petioles 1-3 times as long as blades. Inflorescence a capitate cluster of several involucres, 1-2.5(-3.5)cm diam., +- umbellate, subtended by 3 or more linear-lanceolate bracts, very rarely with 1 foliaceous bract; involucres several, white-wooly, mostly (2.5-)4-5(-6)mm long, narrowly campanulate-turbinate to nearly cylindric, with 5 lanceolate, erect [rarely recurved] teeth 0.5-1.5mm long, rarely short-pedunculate; perianth cream-white to ochraceous, often tinged yellow, or pinkish to purplish in age, glabrous externally, (2.5-)3-4(-5)mm long, not stipitate, segments free almost to the swollen base, outer ones oblong-obovate to elliptic, often slightly cordate at base, inner ones narrower, oblong-spatulate, exserted; filaments basally pilose; stamens 9, inserted near base of perianth. Pistil 3-carpellary; ovary glabrous, 1-celled; ovule 1; styles 3; stigmas mostly capitate. Achenes glabrous, 2-2.5mm long, 3-angled. Fl. May-Aug.

Dry slopes and flats, sagebrush scrub [see **Artemisia**], alpine ridges, **Juniperus** or ponderosa pine woodland, mostly between 1600-2400m; from British Colombia [Canada] s. through Cascades and Olympic Mts. [Washington], w. Oregon, n. California, to mts. of s. California, to east slope of Sierra Nevada, n. and e. to Alta., Rocky Mountains.

Varies greatly under different ecological conditions. Plants at higher altitudes tend to be smaller. Intermediate forms between the similar E. ovalifolium and E. strictum have been observed. The two species are usually differentiated by the latter having a foliate-bracteate inflorescence, and/or pedunculate involucres (Hitchcock et al. 1959; Munz et al. 1968).

ERYTHRINA

(Leguminosae/Fabaceae)

Erythrina americana *Miller*

Erythrina berteroana *Urb.* **(E. neglecta** *Krukoff et Moldenke***)** – pito, coral bean, coralilla, tzinte, mata caiman

Erythrina coralloides *DC.* **(Corallodendron coralloides** *(DC.) Kuntze***)** – colorín, coral bean

Erythrina flabelliformis *Kearney* **(E. purpusii** *Brandegee***)** – coral bean, coralina, chilicote, kaposi, aposi, aposhi

Erythrina fusca *Lour.* **(E. atrosanguinea** *Ridl.***; E. caffra** *Blanco***; E. glauca** *Willd.***; E. moelebei** *Vieill. ex Guill. et Beauv.***; E. ovalifolia** *Roxb.***; E. patens** *DC.***; E. picta** *Blanco***; Corallodendron fuscum** *(Lour.) Kuntze***; C. glaucum** *(Willd.) Kuntze***; C. patens** *(Moc. et Sessé ex DC.) Kuntze***; Duchassaingia glauca** *Walp.***; D. ovalifolia** *Walp.***; Gelala aquatica** *Rumph.***)** – amasisa, assacú-rana, gachico, moté manso, moté bravo

Erythrina indica *Lamk.* **(E. indica** *Zoll.***; E. variegata var. orientalis** *(L.) Merr.***)** – Indian coral tree, parijataka, parijata, pangra, mandar, palita-madar, moochy wood tree

Erythrina mulungu *Mart. ex Benth.* **(E. corallodendron** *L.***; E. crista-galli** *L.***; E. verna** *Vell.***; Corallodendron crista-galli** *(L.) Kuntze***; C. mulungu** *(Mart. ex Benth.) Kuntze***)** – cockspur coral tree, mulungú, murungú, murungo, muchoc, flor-de-coral, pau imortal, suina-suina

Erythrina poeppigiana *(Walp.) O.F. Cook* – amaciza, amasisa, oropel, mulungú

Erythrina vespertilio *Benth.* **(E. biloba** *F. Muell.***; Corallodendron vespertilio** *(Benth.) Kuntze***)** – grey corkwood, cork tree, bat's wing coral tree, heilaman tree, goomurrie, aranyi

Erythrina spp. – coral tree, colorín, colorines, moté, patol, sompantle, zumpantle, xoyo, chakmol-che, parencsuni, te'batai

These plants, particularly their seeds and bark, have medicinal, magical and psychoactive uses. E. coralloides may have been the 'tzompanquahuitl' of the Aztecs, a tree associated with sacrificial death. Figurines of Aztec gods were carved from its wood; such amulets are still carved today, and are used to protect the home from evil. Its seeds are said to cause 'madness and impotence'. The stem and bark have been claimed to represent another kind of 'sinicuichi' [see **Heimia**]. Guatemalan shamans from the Ixil and Mam groups use seeds of E. flabelliformis in divination [not consumed], as well as for calendar markers. The Tarahumara say that these seeds induce erotic dreams, though they generally only use them with caution to treat toothache and intestinal disorders. The Maya of Yucatan attribute magical medicinal powers to a local Erythrina sp. Modern Lacandon Maya women wear the seeds beaded onto strings for ornamentation, and they may have once been used as a female aphrodisiac (Bye 1979b; Diaz 1979; Malone & Rother 1994; Rätsch 1992; Schultes & Hofmann 1980, 1992); it has been reputed that after eating only 2-3 seeds, a woman would turn into a raging nymphomaniac (Rätsch 1990)! 'Accidental poisonings' have been reported from such necklaces (García-Mateos et al. 2001), presumably from prolonged skin contact, or perhaps from absent-mindedly chewing or sucking on the seeds.

E. berteroana is used as a soporific in C. America. For this, the flowers are picked before the corolla has opened and turned red, though if they have opened, only the calyx is used. Other parts of the plant, ie. young leaves and twigs may be used, but are less prized. They are taken either cooked with food or made into a tea, as a sedative, nerve tonic and soporific, said to bring deep, relaxed sleep in 30 minutes. In Guatemala, E. fusca flowers are taken in a similar way. Crushed branches of Erythrina spp. have been used to stun fish (Hastings 1990; Morton 1994). Flowers of E. americana and E. flabelliformis are also a popular food in Mexico, and unripe green flowers of E. americana are infused or decocted for insomnia by the Huastec Maya (García-Mateos et al. 2001; Hastings 1990; Ott 1993). The seeds, bark and leaves of E. americana have also been reported to act as sedatives. The wood of this and other species is too soft for use in construction, and is rarely used as firewood, though it is widely used in the manufacture of carved figurines, and sometimes masks for religious ceremonies. E. americana, E. fusca and other species are commonly grown as shade trees for coffee [see **Coffea**] and cacao [see **Theobroma**] plantations, as well as for living fences and green manure (García-Mateos et al. 2001). E. fusca and E. poeppigiana are sometimes used as ayahuasca-additives in Iquitos [see **Banisteriopsis**] (Luna 1984; McKenna et al. 1995). E. poeppigiana wood is used for the floors of houses of worship in Candomblé (Voeks 1997).

E. mulungu is used in Brazil as a hypnotic sedative and nerve-tonic; it also treats asthma, bronchitis, constipation, hepatitis, water retention, skin diseases and intermittent fevers. The bark, leaves and/or flowers may be used, though it is most often the bark (Anon. 1881a; http://www.rain-tree.com). 'Mulungú' is used in the form of bark scrapings as a strong soporific in small amounts [several tsp.], and it is very effective, promoting a deep, uninterrupted sleep without fogginess upon waking (pers. obs.). However, as E. mulungu shares the common name 'mulungú' with E. poeppigiana, there may be some confusion regarding the specific origin of bark obtained commercially under this name.

Australian aboriginal peoples of some regions make shields from E. vespertilio. A leaf decoction is sometimes used as a sedative. A water maceration of the bark is applied externally for headache and sore eyes (Lassak & McCarthy 1990; Usher 1974). In India, E. indica [bark, juice and leaves] is said to "act on the central nervous system so as to diminish or abolish its functions" (Nadkarni 1976); the leaves are sometimes eaten as a soporific, and as well as the seeds, are considered narcotic (Perry & Metzger 1980). This species is usually regarded as being 'parijata', a 'celestial wishing tree', which in myth was created from the churning of the milky ocean, along with the divine intoxicants 'soma' and 'amrit' [see **Amanita**], Sri Lakshmi [goddess of luck and beauty], and Varuni [also called Amrtsvari – 'lady of amrit'; goddess of wine]. Varuni also wears the flowers of parijata in her hair (Liebert 1976).

Hypaphorine [N,N,N-trimethyl-*tryptophan*] is often encountered in this genus. It is a convulsive poison in frogs, but also a potential precursor to *tryptamine*s such as *DMT*. Although such a synthesis returns a low yield, some species contain very high levels of hypaphorine in the seeds [eg. 5.8% in E. acanthocarpa, 6.7% in E. pallida] which may make the process more practical. Many of the isoquinoline alkaloids found in this genus, eg. α- and β-erythroidine, are neuromuscular blocking agents and peripheral paralytics with some curare-like actions. β-Erythroidine is also a hypnotic, hypotensive and respiratory depressant [LD50 in rats – 27mg/kg]; dihydro-β-erythroidine binds as an antagonist at nicotinic *acetylcholine*-receptors, and is more potent than β-erythroidine, with similar effects [LD50 in rats – 6.55mg/kg]. Their activity as neuromuscular-blockers is antagonised by AChEI's. The erythroidines also synergise with some anaesthetics and hypnotics. Many of the other 'Erythrina alkaloids' have also shown CNS-depressant, neuromuscular blocking, and/or convulsant effects in animal studies (Boekelhede 1960; García-Mateos et al. 2001; Harborne & Baxter ed. 1993; Henry 1939; Marion 1952b; Sloan et al. 1988; Trout ed. 1997c).

Eating ¼-½ a seed of an Erythrina sp. has been claimed to result in a stuporous inebriation (Gottlieb 1992). Seeds of Erythrina spp. are generally believed to be highly toxic (García-Mateos et al. 2001). However, I know of several cases where they have been ground and taken internally, in doses ranging up to 6 seeds, with no apparent effects other than sedation, and occasionally nausea, with some reporting no effects at all (pers. comms.). Although it would seem from this that the toxic activity of hypaphorine injected into frogs does not tranfer to oral consumption by mammals, caution should still be exercised (pers. obs.) as other alkaloids in the seeds [such as β-erythroidine] are known to be orally active. 'Detoxified' seed flour is sometimes used as a stock feed fairly rich in proteins and lipids (García-Mateos et al. 2001).

E. americana seeds have yielded hypaphorine, erythrine, erysodine, erysopine, erysovine [erysocine; isolated as a complex with erysodine], erysothiovine, α-erythroidine, β-erythroidine, erythrocoraloidine, erythratine, erythraline, erythramine, erysothiopine, coraloidine and hexadecanoic, octadecanoic and tetradecanoic acids; lectins and trypsin inhibitors have also been reported from the seeds, as toxic constituents. Flowers have yielded α- and β-erythroidine, erythristemine N-oxide and erythrartine N-oxide (García-Mateos et al. 2001; Hastings 1990; International... 1994; Marion 1952b). In final stages of seed maturation, protein amino acid content increases and free amino acid content decreases (García-Mateos et al. 2001). Alkaloid extracts from the seeds diminished agressive behaviour in rats, proposed to be due to interaction with *acetylcholine* and *GABA* neurotransmission (Garín-Aguilara et al. 2000).

E. berteroana seeds contain erysodine, erysopine, erysothiopine, erysothiovine, erysovine, α- and β-erythroidine and hypaphorine; leaves contain erythroidine and 8-oxo-erythidine. Wood contains α- and β-erythroidine. The plant has also yielded erysoline, erysonine, 8-oxo-α-erythroidine, its β- counterpart, 11-OH-erythratidine, 11-OH-erysosalvine and 11-OH-erysotine (Hastings 1990; Jackson & Chawla 1983; Morton 1994).

E. coralloides seeds have yielded erythraline, erysonine and erysotramidine (García-Mateos et al. 2001).

E. flabelliformis seeds contain hypaphorine, erysodine, erysopine, (+)-erysotrine, erysoline, erysovine, erysothiovine and erysothiopine. Flowers contain callistephin, cyanidin-3-sophoroside and pelargonidin-3-sophoroside (Hastings 1990; International... 1994; Marion 1952b).

E. fusca contains hypaphorine, erysodine, erysovine, erythraline, erythramine and erythratine (Hastings 1990; Marion 1952b).

E. indica seeds contain hypaphorine and erythraline; leaves, stems, roots and fruit produce HCN (Perry & Metzger 1980).

E. mulungu seeds have yielded 1.25-1.87% hypaphorine, 0.04% erythraline, 0.00036% erythramine, 0.012% erythratine, 0.124% erysodine, 0.34% erysopine and 0.0074% erysovine (Deulofeu et al. 1939, 1947; Gentile & Labriola 1942). Leaves, trunks, and roots of the 'Maruba Deiko' cultivar were examined – leaves yielded erythraline, erybidine and N-nororientaline [a benzyltetrahydroisoquinoline]; bark, heartwood, and roots yielded erythraline, erythratine, and erythrinine (Ito et al. 1973). Leaves have also yielded [w/w] 0.0037% *tyramine* (Wheaton & Stewart 1970). Flowers yielded 1.91% erythrinine, 0.11% erythraline, 0.64% 11-β-MeO-erythraline, 0.2% 8-oxo-erythrinine, 0.09% erysopine, 0.05% 11-β-MeO-erythraline-N-oxide, 0.04% 11-MeO-erythratine, hypaphorine, betaine and *choline* (Chawla et al. 1987). An extract of the bark showed sedative properties (Anon. 1881a).

E. poeppigiana leaf has yielded erythroidine, dehydro-α-erythroidine, erythratidine, 11-OH-erythratidine, erysodine, erysopine, erysovine, erybidine, erythratidinone, erysothiovine and isoboldine (Jackson & Chawla 1983; Marion 1952b).

E. vespertilio leaf and stem [plants from Queensland, Australia] yielded 0.025% alkaloids (CSIRO 1990).

Hypaphorine and N,N-dimethyltryptophan are also found in seeds of E. arborescens, E. lithosperma [as well as N,N-dimethyltryptophan methyl ester] and E. variegata (Ghosal 1972; Ghosal et al. 1970b).

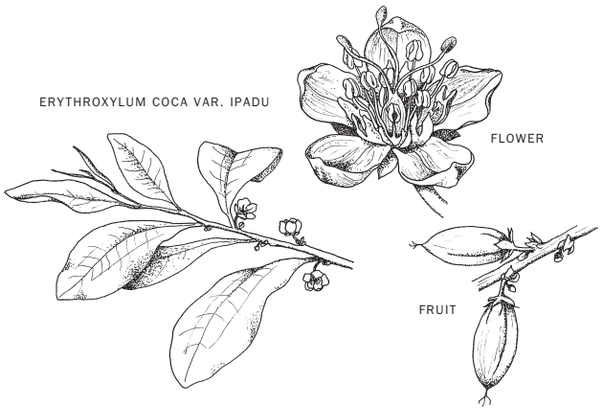
Erythrina flabelliformis is a shrub or small tree to 8m tall, armed with short spines 2-10mm long on branches and petioles; petioles 5-24cm long, tomentulose with fine hairs when young, eventually glabrate. Leaves pinnately trifoliolate; leaflets broadly ovate to suborbicular-deltoid, 3.5-11cm wide, 2.5-7.5cm long, obtuse, rounded or shallowly retuse at apex, base truncate to broadly cuneate, pubescent when young, finally glabrous or nearly so, pinnately-veined; stipules large, stipels of conical glands only. Flowers large and showy, in axillary or terminal racemes to 35cm long; calyx tube nearly truncate, slightly 2-lipped, c.1cm long, reddish, sparsely puberulent to subglabrate; banner red, 4-7cm long, to 18mm wide, much larger than other petals; wings 9-16mm long; keel petals slightly shorter than wings; stamens diadelphous, tube usually longer than free filaments. Ovary short-stipitate or sessile, densely strigose-pubescent, several-ovuled. Pods large, torulose, dehiscent, subwoody, 10-35 x 1.5-2.5cm, constricted between seeds, 1-several-seeded. Seeds 12-18mm long, 2/3 as broad, dark red, with a black line near hilum. Fl. Mar.-May.

Hillsides, along arroyos and rocky canyons; Sonoran Desert, Arizona, n. Mexico (Shreeve & Wiggins 1964).

Propagate from seeds, which must be nicked and soaked first in warm water to enhance germination; or from wood cuttings 0.6-10cm in diameter. Frost-sensitive. Likes well-drained soil, full sun and frequent-watering, though it is said to be drought-resistant (García-Mateos et al. 2001; Grubber 1973). Seedlings, however, require regular water when becoming established, to prevent death from dehydration, which can occur fairly rapidly (pers. obs.).

ERYTHROXYLUM [Erythroxylon]

(Erythroxylaceae)



Erythroxylum acuminatum *Ruiz et Pav.* – coca de mono
Erythroxylum cataractarum *Spruce ex Peyr.* **(E. zuluense** *Schoenland***)** – coca de pescado, ajicito
Erythroxylum catuaba *Martius* – catuaba, tatuaba, caramuru, chuchuhuasha, piratancara, pau de reposta
Erythroxylum coca var. coca *Lam.* **(E. bolivianum** *Burck***; E. chilpei** *E. Machado***; E. peruvianum** *Mitchell et Pascal., ex Steud.***)** – Bolivian coca, mamox-coca
Erythroxylum coca *Lam.* **var. ipadu** *Plowman* – Amazonian coca, ipadu, ipatu, huangana-coca, pato, pa-too, ka-hee, iga-tua
Erythroxylum fimbriatum *Peyr.* – coca brava
Erythroxylum gracilipes *Peyr.* **(E. cuatrecasasii** *W.A. Gentner***; E. novogranatense var. macrophyllum** *O.E. Schulz***; E. recurrens** *Huber***)**
Erythroxylum macrophyllum *Cav.* **(E. costaricense** *Donn. Sm.***; E. filipes** *Huber***; E. floribundum** *Mart.***; E. laurinum** *Planch. et Lind. ex Triana et Planch.***; E. lucidum** *Kunth***; E. multiflorum** *Lundell***; E. skutchii** *Standl.***; E. tabascense** *Britton***)** – coca brava
Erythroxylum novogranatense var. novogranatense *(Morris) Hieron.* **(E. coca var. novogranatense** *Morris***)** – Colombian coca, hayo
Erythroxylum novogranatense *(Morr.) Hieron.* **var. truxillense** *(Rusby) Machado* **(E. hardinii** *Machado***; E. truxillense** *Rusby***)** – Trujillo coca, tupa coca ['noble coca']
Erythroxylum steyermarkii *Plowman* – cerecito, hayo, jaillito
Erythroxylum vacciniifolium *Martius* – catuaba
Erythroxylum (Erythroxylon) spp.

Cultivation and chewing of 'coca' [often E. coca var. coca] supposedly began in Bolivia in the region of Machu Yunga. Its use and cultivation spread from there, to become a central part of Incan culture. Incan royalty chewed 'tupa coca', a flavourful coca probably referable to E. novogranatense var. truxillense. Coca use has been traced back to 2500-1800BC, and the herb is still used today by native peoples, mostly in highland areas of the Andes. The species most used are E. coca, E. novogranatense and their variants, where they occur. The coca plant is considered sacred, and is used as an offering to gods. It is chewed during religious rituals and worship, and ceremonies accompany its planting and harvesting. The leaves were also used by Inca shamans or priests in divination, by interpreting the leaf-venation, their pattern when thrown on the ground, or from the flow of green saliva over the fingers [from chewing the leaf]. Some shamans would also smoke the leaf in large amounts to travel to the spirit world, and Kogi shamans of the Sierra Nevada of Colombia chew it mixed with concentrated tobacco paste [see **Nicotiana**]. In the Andes, exchange of coca leaves is considered the most polite way to greet someone, and is a gesture of contact and friendship. Although it has been made into a tea or applied as a poultice, usually for medicinal reasons [such as to treat stomach and tooth aches], coca is otherwise generally chewed and sucked as a quid. Leaves that are curling, turning a darker colour, and just beginning to become brittle are picked for use. They are collected and left in a bag overnight to ferment slightly, before being dried [either toasted over a fire, or sun-dried], losing about 60% of their original weight. The leaves are then stacked to sweat and moisten enough for chewing. They are then usually pressed into bales or sacks for storage, with care to keep them dry.

Leaves are chewed briefly to moisten and break them up, before the

addition of lime [see *Methods of Ingestion* for more on lime reagents], which serves to make the alkaloids more available to the user through the mucous membranes [though breaking down some of the alkaloids to *ecgonine* – see below]. A small pinch or two of lime is carefully added at the beginning, another perhaps 5 mins later, and more every 10-15 mins afterwards. The wad is kept in the mouth [between the teeth and the cheek] and slowly sucked for at least an hour. The correct amount of lime to use is often a process of trial and error to the non-native novice chewer. Sometimes fresh leaves are occasionally added, and after lime has been added, the juice is swallowed in small amounts rather than spat out. Limestone is often used as the source for the lime; those with access to the coast may use seashells (Antonil 1978; Cobo 1990; Davis 1996; Emboden 1979a; Kennedy 1985; Martin 1970; Plowman 1979; Rätsch 1992; Smith 1981; Uscategui 1959; Von Bibra 1865). Today, the readily-available sodium bicarbonate is often used instead, mostly in urban areas. Otherwise, alkaline ashes prepared from plants are still used for the lime reagent, as in Amazonian limes [see below]. For example, in n. Argentina, stems of Chamissoa altissima, Iresine diffusa [see *Endnotes*], **Senecio** bomanii, and S. hieronymii have all been used, with substances such as ground raw potato [see **Solanum**], boiled corn grains, **Citrus** aurantium juice, sugar, salt, and water used as binders (Hilgert 2001).

E. coca var. ipadu is cultivated in parts of the western Amazon, and is no longer known in a truly wild state. It is cultivated by the men, in plots usually removed from those for vegetables. Some tribes make an infusion of the leaves for chest pains. For chewing, the leaves are prepared by toasting on a flat clay oven, turning the leaves often until dry and crisp. They are finely powdered in a large mortar, and finally mixed in equal proportions with the alkaline ashes of another plant [often **Cecropia** spp., sometimes **Musa** spp. leaf]. The Tanimuka of Colombia blow smoke from Protium heptaphyllum resin [see *Endnotes*] over the powder, to improve the taste. This mixture is finely sifted, by beating through the fibres of a bark-bag, in the mortar. Now ready, it is stored in a special container. The Makú prepare it fresh each evening, and thus have less need to store the drug. The preparation is usually used throughout the day [but sometimes only in the evening], and during small ceremonial events. 1-2 spoons of the powder are inserted into the mouth, with an improvised spatula, which is moistened and kept as a quid to be sucked in the sides of the mouth. This dose may be topped up as the old powder is swallowed (Martin 1970; Prance 1972; Schultes & Raffauf 1990; Uscategui 1959).

There are also other, lesser-known cocas used. E. cataractarum is said by the Barasanas to be a very strong wild coca, used by their forefathers – another report states that the leaves are less psychoactive than those of E. coca. E. acuminatum, E. fimbriatum and E. macrophyllum have been used as substitutes for E. coca var. ipadu [or probably E. novogranatense, in the case of E. acuminatum]. E. gracilipes is considered a stimulant in lowland Ecuador. An unidentified Erythroxylum sp., known as 'coca de Monte' or 'ita-jipie' ['coca of the tapir'], is a wild species used by Andoke shamans, and it is stronger than cultivated coca (Rätsch 1998; Schultes & Raffauf 1990). Barks and leaves of E. catuaba and E. vacciniifolium are used in Brazil as aphrodisiacs (Graf & Lude 1977; Mors & Rizzini 1966). Leaf of E. coca is occasionally used in TCM as an anaesthetic and vasoconstrictor (Huang 1993). In India, the bark of E. monogynum ['bastard sandal', 'red cedar'] is considered toxic, though the aromatic heartwood is used as a sandalwood-substitute [see **Santalum**]. Poor people have also been known to eat the leaves as food (Chopra et al. 1965; Watt & Breyer-Brandwijk 1962).

The effect of coca-chewing is that of a mild stimulant, local anaesthetic and appetite-suppressant. It is considered ideal for adjusting to high altitudes and strenuous work, as coca reduces the body's oxygen requirements, stimulates respiration and sustains stamina. The leaves themselves also constitute a highly nutritious food [see below] (Kennedy 1985; Martin 1970; pers. obs.).

Coca-containing wines were popular in Italy and France in the 1860's, and later in the US – the best known was 'Vin Tonique Mariani', a coca-extract in red Bordeaux wine, containing 6mg/oz *cocaine*. It was used and endorsed by Pope Leo XIII, the Prince of Wales, Thomas Edison, Robert Louis Stevenson, H.G. Wells, Jules Verne and other prestigous persons. Its maker also produced a stronger version ['Elixir Mariani'], a coca-extract by itself ['The Mariani'], and throat lozenges containing pure *cocaine* ['Pastilles Mariani']. However, *cocaine* and alcohol interact in the body to produce a substance called cocaethylene, which affects *dopamine* receptors in the same manner as *cocaine*, but has a longer half-life, making such combinations potentially dangerous in excess. Coca-cola™ was developed as competition to Vin Mariani, and the original 'coke' did indeed contain *cocaine* as well as *caffeine*. Now, due to legal restrictions, coca leaves are still used in Coca-cola™, but only in the form of residue, after *cocaine* has been extracted for the pharmaceutical industry. The species used is E. novogranatense var. truxillense (Davis 1996; Karch 1996; Kennedy 1985), desirable due to its flavour. E. novogranatense was briefly cultivated in Java by the Dutch to provide *cocaine* for the pharmaceutical industry, though these plantations lost their financial viability in the 1920's due to a large decline in the price of coca leaves (Plowman 1979).

In the mid-1980s, 'Health Inca Tea' and 'Maté de Coca' imported from Peru were briefly available on the US market, advertised as "decocainized" herbal tea blends. There were several varieties, containing E. coca var. coca and E. novogranatense var. truxillense; they contained 4.8-5.7mg *cocaine* per teabag, and were popular with pensioners for rheumatism relief (Siegel et al. 1986). On a related note, there has recently been a 'trend' in England amongst pensioners – that of smoking 'crack' *cocaine*, apparently both for enjoyment and rheumatic relief.

Although coca is illegal in Colombia [since 1947], the law is selectively enforced; the plant is commonly used as a medicine and tonic by native people, and is commonly grown in household gardens – it is a popular ornamental in the best neighbourhoods of Cali (Davis 1996). The politics of the international *cocaine* trade, and especially the US-headed war against it [including careless aerial spraying of toxic chemicals], have had drastic impact on the well-being and livelihoods of the indigenous people who cultivate coca traditionally, as well as those who simply live in the same areas as coca plantations. Although the chewed leaf is nowhere near as potent or as dangerous as pure *cocaine*, it is treated with the same disdain by the prohibition forces, being the source of *cocaine*. The only problems that have arisen from its native use are through the smoking of coca-paste (Jeri et al. 1978) and use of pure or near-pure *cocaine*, as obtained cheaply from stages of the *cocaine* extraction process used for the illicit trade [see *Producing Plant Drugs*], and not from the use of the herb itself.

This issue is too complex to enter into fully here. However, regardless of the pros and cons of *cocaine* itself, I believe that it is highly unethical to purchase illicit *cocaine*. Such purchases are supporting a trade that ruins the lives of many hard-working peasant folk, who have been left with no practical means to support their families but to grow coca, and attracts destruction and pollution of the environment, whilst reaping enormous profits for a corrupt few.

Coca paste is a crude mixture containing *cocaine* sulphate, *ecgonine*, other coca alkaloids [such as benzoyltropine and *tropacocaine*], and impurities such as kerosene, benzoic acid, methanol and sulphuric acid. It is derived from the early stages of *cocaine* extraction, and sold cheaply to local users. It is often smoked in cigarettes together with tobacco [see **Nicotiana**] and/or **Cannabis**, and has effects similar to smoked crack [free-base *cocaine*] – causing intense euphoria and stimulation, sometimes with simple or even realistic visual, auditory and tactile hallucinations, followed by insomnia, depression, emotional instability, paranoia and other negative personality changes, as well as overwhelming compulsion to continue paste-smoking (Jeri et al. 1978).

Extended or excessive use of 'street' *cocaine* may also lead to psychotic behaviour and hallucinations. Visual hallucinations take the form of fleeting movements in the periphery of the visual field [becoming flashes of light in darkness or dim light, called 'snow lights'], visions of dots, lines, grids and other simple forms [often in black and white], movement or pulsing of objects and surfaces, and occasionally realistic hallucinations [eg. one person saw "…an ashtray change into a frying pan and then into a chicken"]. Tactile hallucinations include the sensation of insects crawling under the skin ['cocaine bugs']; auditory hallucinations include hearing voices or whispers (Siegel 1978). Besides the chronic effects of *cocaine* itself, these effects may also be partially explained by other tropane alkaloids present in 'street' *cocaine*. It is well known that such *cocaine* is never truly pure; at the level of illicit manufacture, '*cocaine*' is a mixture of alkaloids which is by far mostly *cocaine*, as well as trace impurities from the extraction procedure. Each time the drug changes hands in the distribution chain, it is 'cut' or diluted with any number of adulterants, some relatively harmless [mannitol, lactose, dextrose] and some potentially dangerous [quinine, heroin, unknowns] (Lee 1976). Some alkaloids present in 'street' *cocaine* [*tropacocaine*, found at less than 1% of total alkaloid; benzoyltropine, found at up to 15% of total alkaloid] inhibit *acetylcholine* synthesis and *choline* uptake (Meyer et al. 1990), contributing to central anticholinergic symptoms.

Cocaine is usually snuffed intranasally [in 'lines' c.20-30mg per dose] in illicit use, and via this route takes effect in 30-120 seconds, peaking after about 15 minutes, and lasting 1 hour or less. It causes euphoria, local anaesthesia, CNS-excitation and stimulation, followed by a subsequent depression (Platt 1997; pers. comms.). If the drug is readily available, its use can be extremely habituating, often leading to physical and psychological health problems.

Acid hydrolysis of many coca-alkaloids breaks them down to yield *ecgonine*. In the *cocaine* extraction process, this conversion is deliberately used – the *ecgonine* is then converted back to *cocaine* [yielding more than would otherwise be obtainable, due to the conversion of all of the *ecgonine*-derived alkaloids into *cocaine*] (Henry 1939; theobromus pers. comm.). The lime chewed with coca acts to degrade *cocaine* to *ecgonine* (Kennedy 1985).

Note – the following paragraph refers generally to coca including E. coca and E. novogranatense, and their varieties, due to failure to properly distinguish between these in much literature. The work of Timothy Plowman [r.i.p.] was important in showing that 'coca' was represented by a variety of different plants.

Young, rolled leaves of coca are known to contain a higher level of the major alkaloids than fully expanded leaves. Leaf harvesting triggers the

plant to go into a reproductive phase. Alkaloid contents measured at this time may be as follows [for E. coca var. coca] – *cocaine* [0.23-0.96% young leaves; 0.39% unopened flower buds], methyl *ecgonine* [0.24%; 0.13%], hygrine [0.49%; 0.18%], tropinone [0.01%; 0.02%], cinnamoylcocaine [0.27%; 0.17%], cis-cinnamoylcocaine [0.03%; 0.02%], *tropacocaine* [0.02%; 0.06%] and cuscohygrine [only in leaves – 0.03%]. Alkaloids are present in other plant tissues, but at much lower concentrations (Griffin & Lin 2000; Johnson 1996). Seeds from mature fruits have been shown to contain *cocaine* in the endosperm [0.001%] and embryo [0.005%]. Light was necessary for further *cocaine* biosynthesis in developing embryos (Johnson & Elsohly 1991). Other studies found 0.13-0.96% *cocaine* and 0.001-0.53% cinnamoylcocaine in the leaf (Holmstedt et al. 1977; Plowman & Rivier 1983). Coca grown in China has also yielded trevilline, *ecgonine*, benzoylecgonine, ecgonidine methyl ester, hygroline and norecgonine (Huang 1993); coca has also been shown to yield benzoyltropine, dihydrocuscohygrine, truxilline (Duke et al. 1975; Henry 1939), *arecoline* and *nicotine* (Fikenscher 1959; Kennedy 1985). Leaf yields an essential oil [c.0.025% w/w] consisting of 38.9% combined of 2 unidentified dihydrobenzaldehydes, 13.6% methyl salicylate, 16.1% cis-3-hexen-1-ol, 10.4% trans-2-hexenal, 5.2% 1-hexanol, 3.7% N-methylpyrrole, 0.5% N,N-dimethylbenzylamine, and small amounts of unidentifed compounds (Novák & Salemink 1987). Coca is also very nutritious – typical daily consumption [c.100g] more than satisfies the recommended dietary allowance for calcium, phosphorous, iron, vitamin A, vitamin E and riboflavin, and coca leaves are also higher in carbohydrates, protein and fibre than most vegetable foods (Duke et al. 1975). Average *cocaine* levels in the dry season are double those of the wet season (Sauvain et al. 1997). Best *cocaine* production was noted with an average daily temp. of 24°C for the first harvest, and 19°C for the second harvest (Acock et al. 1996). Dried leaves lose all their potency after about 7 months of storage (Chopra et al. 1958). Incidentally, a moth which feeds on E. coca leaves, Eloria noyesi, accumulates *cocaine* from the plant (Groark 1996).

E. argentinum [growing in Sydney Bot. Gardens] yielded 0.2% alkaloids, mostly *tropacocaine*, as well as hygrine and cuscohygrine (El-Imam et al. 1985); another study found an unidentified alkaloid as the major component, followed by *tropacocaine*, 4-OH-hygrinic acid, methylecgonidine, and 3β,6β-ditigloyloxynortropane (Zuanazzi et al. 2001).

E. australe leaves contain variable amounts of alkaloids [0.8% in one report], mostly meteloidine, as well as other tropanes, 6β-hydroxytropan-3α-yl tiglate, 3α-hydroxynortropan-6β-yl tiglate and an unknown base [0.014%, 0.001%, 0.002% and 0.003% yields, respectively, from a different study]; roots yielded 0.001% (+-)-6β,7β-dihydroxytropan-3α-yl benzoate (Griffin 1978; Johns & Lamberton 1967). Leaf, bark, and mature fruits have given positive tests for alkaloids, from Queensland plants. Strongest positives were in leaf from Wandoan [harv. Jun.]. Negative results were obtained in some tests of these plant parts; absence of alkaloids was observed in branches from Rockhampton [harv. Dec.] (Webb 1949). Several leaves, chewed, produced strong throat constriction in one psychonaut, which was felt all the way down to the stomach; the leaves also caused 'gagging' without the urge to vomit. No anaesthesia or other effects were noted (Torsten pers. comm.). The plant grows in n.e. NSW and s.e. Qld, Australia.

E. cataractum yielded 0.2% alkaloids, mostly cuscohygrine and dihydrocuscohygrine – due to the strength ascribed to this species, perhaps cuscohygrine is psychoactive (El-Imam et al. 1985; Ott 1995a).

E. coca var. ipadu has yielded 0.11-0.41% *cocaine* and 0-0.0084% cinnamoylcocaine (Plowman & Rivier 1983).

E. dekindtii leaves from Angola yielded 0.018% alkaloids, consisting of *tropacocaine*, pseudotropine, *ecgonine* and methylecgonine; rhamnose, galactose and sucrose were also detected (Campos Neves & Campos Neves 1968).

E. ecarinatum bark and leaf gave positive reactions for the presence of alkaloids, in some tests; plants were from Danbullah, Queensland [harv. Jul.] (Webb 1949).

E. ellipticum [another north Australian species] stem bark yielded 0.32% crude alkaloids, containing mostly tropine 3,4,5-trimethoxycinnamate, as well as tropine benzoate (Johns et al. 1970). The stems have been used to make pipes (Brock 1988; Levitt 1981), and the Ngarinyman eat the raw gummy exudate from the bark, as a sweet (Smith et al. 1993).

E. gracilipes leaves have yielded 0.0015-0.3% *cocaine*, and 0.0049-0.031% cinnamoylcocaine (Plowman & Rivier 1983).

E. lucidum stem bark yielded hygrine, cuscohygrine, tropinone, tropine, 3-α-acetoxytropane, pseudopelletierine, *nicotine*, littorine and other hygrine derivatives. Leaves yielded traces of *cocaine* [0.0003%] (Brachet et al. 1997; Plowman & Rivier 1983).

E. mamacoca leaves have yielded 0.11% alkaloids, including *tropacocaine* and nortropacocaine (El-Imam et al. 1985); no *cocaine* or cinnamoylcocaine has been found. Although once thought to be a wild ancestor of E. coca, it is defined as a distinct and separate species (Plowman & Rivier 1983).

E. monogynum [an Indian species] is known to contain small amounts of alkaloids in the leaves, mainly cinnamoylcocaine, as well as *ecgonine*, a flavone and essential oil (Agar et al. 1974; Chopra et al. 1965); others found no cinnamoylcocaine (Plowman & Rivier 1983). The root bark has yielded 0.85% tropine derivatives, including tropine, ψ-tropine, 1αH,5αH-tropan-3α-yl 3,4,5-trimethoxycinnamate, 1αH,5αH-tropan-3α-yl 3,4,5-trimethoxybenzoate, 1αH,5αH-tropane-3α,6β-diol 3-(3,4,5-trimethoxycinnamate) 6-benzoate and 1αH,5αH-tropane-3α,6β,7β-triol-3-(3,4,5-trimethoxybenzoate) (Agar & Evans 1976; Agar et al. 1974); the root has been reported to have yielded 0.04% *cocaine*. The wood has yielded 0.085-16.6% essential oil [by steam distillation], consisting of 40% α-*pinene*, 50% diterpene, 1.8% of a diterpene alcohol, and traces of a sesquiterpene (Watt & Breyer-Brandwijk 1962).

E. novogranatense var. novogranatense may contain 1-2.5% alkaloids, consisting of up to 0.47% *cocaine*, 0.04-0.07% 1-OH-*tropacocaine* and 0.107-0.65% cinnamoylcocaine, as well as large amounts of methyl salicylate in the essential oil (Griffin & Lin 2000; Karch 1996; Plowman & Rivier 1983). The higher yields were obtained from the previously mentioned Dutch cultivated herb in Java (Plowman 1979). Twigs yielded 0.13% *cocaine* (Aynilian et al. 1974; Holmstedt et al. 1977). Best *cocaine* production was noted with an average daily temp. of 25°C for the first harvest, with no effect of temp. on the second harvest (Acock et al. 1996).

E. novogranatense var. truxillense has an essential oil containing methyl salicylate, flavonoids and tannins; leaf yields 0.5-1.5% alkaloids, 30-50% of which may be *cocaine* [studies have found 0.42-1.02%], as well as 0.3-0.5% 1-OH-*tropacocaine* and 0-0.93% cinnamoylcocaine (Bruneton 1995; Griffin & Lin 2000; Holmstedt et al. 1977; Plowman & Rivier 1983).

E. pelleterianum was shown to contain 0.00123% *cocaine*, in a 45-year-old herbarium sample (Aynilian et al. 1974), though later analysis found no *cocaine* in this species; *tropacocaine*, 4-OH-hygrinic acid, an unidentified major alkaloid, and another unknown with the same retention time as *cocaine* were found (Zuanazzi et al. 2001).

E. steyermarkii leaves have yielded 0.11% *cocaine*, and 0.0026% cinnamoylcocaine (Plowman & Rivier 1983).

E. vacciniifolium leaves and bark have been found to contain up to 11 alkaloids [c.0.032% alkaloids in leaf], consisting mostly of the tropanes catuabin A [0.01%], catuabin B [0.0005%] and catuabin C [0.00057-0.00064%] (Graf & Lude 1977, 1978).

Traces of *cocaine* have been found in E. areolatum [0.0014%], E. campestre [0.00014%], E. deciduum [0-0.0008%], E. fimbriatum [0-0.0011%, as well as tropine and other bases], E. glaucum [0.0003%; also 0.1% *tropacocaine*, 6-β-benzoyloxytropan-3-α-ol and dihydrocuscohygrine], E. aff. impressum [0.007%], E incrassatum [0.0007%], E. macrocnemium [0.0012-0.0022%], E. panamense [0.0012-0.0014%], E. pulchrum [0.00008-0.0004%, and 0.0001% cinnamoylcocaine], E. rotundifolium [0.025%, and 0.0001% cinnamoylcocaine], and E. shatoma [0.0004-0.0005%, and 0.1% *tropacocaine*]. E. macrophyllum yielded 6 bases which were not identified. E. ulei yielded 0.01% *tropacocaine* and several other alkaloids (Aynilian et al. 1974; El-Imam et al. 1985; Holmstedt et al. 1977; Ott 1995a; Plowman & Rivier 1983).

Erythroxylum coca is a small shrub or tree to 2.5m high, with a woody root; stems branching, twiggy; bark liberally scattered with prominent warty lenticels. Leaves dark green above, paler and glaucous below, alternate, simple, broadly elliptical, 3-8cm long, 2-4cm wide, tapering or somewhat rounded and pointed at apex, wedge-shaped at base, prominent midrib below, often deciduous after current season's growth; petiole short, subtended at axil by a pair of persistent triangular stipules. Flowers fragrant, yellow or yellowish-green, bell-shaped, in clusters of 6-12 in leaf axils, each on a thickened pedicel subtended by a pair of triangular bracteoles. Flowers of 2 kinds – one with stamens of equal length and 3 free styles 2mm long; the other with unequal stamens and 3 free styles 4mm long. Sepals 5, basally-fused into a tube about halfway; petals 5, free, usually with a strap-shaped appendage towards base on inner surface; stamens 10 in 2 series, filaments fused in lower half; anthers 2-locular, dehiscing by longitudinal slits. Ovary superior; carpels usually 3, fused, 3-locular with only 1 fertile; fertile loculus with 1 ovule; styles fused to nearly free. Fruit a red, oblong-ovoid, pointed succulent drupe, 7-10 x 3-4.5mm, furrowed when dry; 1-seeded. Seed distinctly 3-ridged, 6 x 1.5mm (Harden ed. 1990-1993; Parsons & Cuthbertson 1992; Plowman 1979).

Grows wild and cultivated in Peruvian and Bolivian Andes.

E. coca var. ipadu is cultivated in the western lowlands of the Amazon Basin and is generally short-lived, weak, less productive of leaf and *cocaine*, and prone to disease.

E. novogranatense var. novogranatense has smaller, narrower and thinner leaves, with a bright yellowish-green hue; they are elliptic and elongated, with a rounded apex. Stem bark is smooth. Grows in hot, seasonally dry habitat of river valleys in Colombia and n. coast of S. America.

E. novogranatense var. truxillense has small, elliptic, very narrow, rich [at maturity] light green leaves slightly thicker than those of var. novogranatense, and with the scent and taste of 'wintergreen' [see **Gaultheria**]. Leaf midrib ridge is flattened. It grows in dry areas of n. Peru, and although very drought-tolerant, requires irrigation to be cultivated in such areas. A form of E. novogranatense also occurs and is used

to a small degree in n.w. Ecuador, though elsewhere in Ecuador coca use seems to have died out (Bruneton 1995; Davis 1996; Plowman 1979).

E. coca can be grown from cuttings [E. coca var. ipadu is almost always grown from cuttings], and prefers the moist, steamy montana climate. It needs well-drained soils and moderate temperatures, with a constant humidity. E. novogranatense is always grown from seed, and prefers hot, seasonally dry locales; it is highly drought-resistant and tolerates wider temperature variation. The best altitudes for alkaloid yield are generally considered to be 1500-2000m, with temperatures of 18-28°C. Soils should be preferably clayey, rich in humus and iron, and well-drained [rocky]. Cuttings should be about 45cm long, planted 15cm deep. Seeds do not remain viable for long [1-2 weeks] and are enclosed in a hard endocarp; the embryos are killed if the seed is allowed to dry out. Seeds have been germinated successfully in a greenhouse at 20-30°C; if soaked for 5 days initially, they should germinate under shade in about 10 days, and should be watered generously during germination. Seeds should be sown in Dec.-Jan. in shade. When about 60cm high, seedlings are transplanted to clearings in valleys, or terraces on mountainsides. High humidity can bring problems with fungal diseases. Plants are not harvested until they are about 2 years old. Harvesting may take place up to 3 times a year – in April, June and November. New shoots are left to ensure luxurious new growth (Antonil 1978; Davis 1996; Morton 1977; Plowman 1979; Smith 1981).

ESCHSCHOLTZIA

(Papaveraceae)

Eschscholtzia californica *Cham.* – California poppy, cup of gold, gold thimble, railway weed, amapola amarilla, amapola de los indios, amapola de California

The California poppy is the state flower of California, and pickers of the wild flower are subject to stiff fines under state law; it is apparently in need of protection, becoming rapidly wiped out in the wild by land developers. Native Americans ate the leaves boiled or roasted on hot stones, and used the flowers and capsules as a tranquilliser, especially to ease toothache. In Mexico, the petals are used as a mild narcotic, taken smoked, decocted, or in other ways. The herb is now popular in Europe, where it is used to treat insomnia, as well as coughs and hyperactivity in children. It is also one of the Bach flower remedies, used to assist emotional cleansing. The whole plant oxygenates the blood, and aids in absorption of vitamin A (Bremness 1994; Chevallier 1996; Heffern 1974).

All parts of the plant can be dried and smoked for a mild, short-acting euphoria, with no side-effects of note. A concentrated extract is a more potent means of consumption, but does not burn well and requires vapourisation. Internal use via decoction is another option, though experimentation with dosage is required to avoid the potential toxicity of higher amounts (Siegel 1976; pers. obs.). Chevallier (1996) notes that the herb "is not a narcotic… rather than disorientating the user, it tends to normalise psychological function".

E. californica contains opiate-like alkaloids [see **Papaver**, **Argemone**] including *protopine*, sanguinarine [adrenolytic, sympatholytic, AChEI, local anaesthetic, bactericidal], dihydrosanguinarine, berberine [sedative, respiratory stimulant, hypotensive, AChEI], allocryptopine [slight narcotic, anaesthetic, paralyses nerves, stimulates uterus, hypotensive], eschscholtzinine [0.015% from aerial parts], eschscholtzine N-oxide [0.02% from aerial parts], eschscholtzidine, lauroscholtzine, glaucine [adrenolytic, hypotensive, antitussive, inhibits aspiration], chelerythrine [hypotensive, analgesic, AChEI], coptisine [AChEI], isocorydine [sedative, adrenolytic, large doses induce catalepsy], chelirubine [AChEI], chelilutine and magnoflorine [escholine; weak neuromuscular blocker; see **Magnolia**]; as well as glycosides (Harborne & Baxter ed. 1993; Onda & Takahashi 1988; Preininger 1975, 1986; Rastogi & Mehrotra ed. 1990-1993; Ulrichová et al. 1983; Urzua & Mendoza 1986). E. californica growing as a garden-escapee in Stanthorpe, Queensland [Australia], harvested in November, tested strongly positive for alkaloids (Webb 1949). HCN has also been detected in the plant (Watt & Breyer-Brandwijk 1962).

Eschscholtzia californica is an annual or short-lived perennial herb to c.50cm tall, +- glaucous, nearly glabrous, with colourless juice; stems becoming 20-60cm long and falling over in age, branching, decumbent or ascending from a thick taproot. Leaves alternate, ternately compound, the segments linear or oblong, glabrous and slightly glaucous, blue-green, blades 2-6cm long, basal leaves petioled. Peduncles 3-15cm long; torus dilated to form a funnel-shaped base for the pistil, with 2 rims, the inner erect and hyaline, the outer spreading and 2-4mm wide; sepals 2, completely united into a cap (calyptra) pushed off by expanding petals, calyptra variable in size and shape, 1-4cm long; petals usually 4, fan-shaped, 2-6cm long, deep orange to light yellow; outer rim of receptacle spreading, 2-4mm wide; stamens 16-many; filaments short; anthers linear. Ovary cylindric, 1-celled, with 2 placentae; styles short; stigma with 4-6 linear divergent lobes. Fruit a thin, elongated, 10-ribbed capsule 3-8(-10)cm long, 2-valved from base towards apex; seeds grey-brown, round-oblong, 1.2-1.5mm long, reticulate with c.8-10 meshes per row.

Common in grassy and open places; native to California and Oregon, naturalised in Europe. Exhibits wide variation in habit and floral characteristics; at least 50 subspecies have been proposed (Gleason 1952; Munz et al. 1968).

Commonly available in nurseries, widely cultivated in temperate zones. Sow seeds in spring, directly into the garden-bed.

EUPATORIUM

(Compositae/Asteraceae)

Eupatorium berlandieri *DC.*
Eupatorium solidaginifolium *A. Gray* **(Koanaphyllon solidaginifolia** *(A. Gray) King et H.E. Robins***)** – pihol, shrubby thoroughwort
Eupatorium spp. – snakeroot, thoroughwort

E. berlandieri is used as a tobacco-substitute [see **Nicotiana**] by the Apache, and the Papago use E. solidaginifolium in the same manner. The two species are smoked by gulping down lungfuls of the smoke and exhaling slowly through the nostrils, as is the usual method when smoking through a chillum [see *Methods of Ingestion*]. The effect observed is a slight nervous tremor, and the plants are said to make a person 'crazy'. The genus has been credited with narcotic properties (Lipp 1995).

Several other Eupatorium spp. are used medicinally. The Tarahumara use unspecified members of the genus as purgatives (Salmón 1995). E. aromaticum ['wild horehound', 'white snakeroot'] is used as an antispasmodic and diuretic. E. cannabinum ['hemp agrimony', 'water hemp'] of Europe, n. Africa and Asia is used as a tonic, diuretic and immune stimulant. E. collinum ['yerba de angel'] from Central America is a liver tonic, and its aromatic leaves are used as a hops-substitute in brewing beer [see **Humulus**, *Methods of Ingestion*]. E. maculatum and E. purpureum ['gravelroot', 'joe-pye weed', 'queen of the meadow'] roots are widely used by native N. Americans as a stimulant, nerve tonic, sexual tonic, diuretic and antirheumatic, also easing menstrual cramps and treating kidney and bladder stones. E. perfoliatum ['boneset'] is a stimulant, tonic, antiseptic, purgative, and emetic, also inducing sweating and treating cold and flu. E. staechodosum ['ayaoana du tonkin'] of Vietnam is used for its lavender-scented leaves, which are tonic, aphrodisiac and digestive. Some species have also shown antitumour activity (Bremness 1994; Hamel & Chiltoskey 1975; Hendriks et al. 1983; Hutchens 1992; Usher 1974). In TCM, E. fortunei ['ran so'] is used as an antipyretic, emmenagogue, diuretic, and to relieve swelling in dropsy (Haruna et al. 1986).

Eupatorium spp. are often considered toxic to animals, and the chemicals they contain may become concentrated in the milk from cows who have grazed the plants. Symptoms of poisoning have been reported as including "weakness, nausea, loss of appetite, severe vomiting, tremors, liver damage, laboured breathing, jaundice, constipation, prostration, dizziness, delirium, convulsions, coma and death" (Salmón 1995). E. perfoliatum has apparently been used in N. America as an ayahuasca analogue ingredient (Appleseed 2002), but I am unsure how this affects the activity of the brew.

E. cannabinum leaves and flowers have yielded coumarin and taraxasterol (Sagareishvili et al. 1981); leaf exudate yielded the flavonoid aglycones eupafolin, hispidulin [scutellarein-6-methyl ether], pectolinarigenin [scutellarein-6,4'-dimethyl ether], centaureidin, jaceosidin and santin. These flavonoids are also found in some other Eupatorium spp. (Stevens et al. 1995). Also found are the necine-based pyrrolizidines rinderine and supinine. Aerial parts have yielded 0.15-0.68% essential oil, containing *estragole* and many other compounds. Roots have yielded euparin (Hendriks et al. 1983) and eupatoriopicrin (Sagareishvili et al. 1981).

E. fortunei whole plant [harv. Aug.] has yielded a sesquiterpene lactone of the germacranolide type [see **Calea**], eupafortunin [0.002% w/w], as well as the sesquiterpenoid eupatoriopicrin [0.039% w/w] (Haruna et al. 1986); the plant has also yielded the pyrrolizidine alkaloids supinine, rinderine, and a new alkaloid (Liu et al. 1992).

E. triplinerva essential oil has sedative properties in rats (Hendriks et al. 1983).

I have been unable to find any chemical studies of E. berlandieri or E. solidaginifolium.

Eupatorium solidaginifolium is a subshrub with a number of rigidly ascending stems or branches (30-)40-60(-100)cm tall. Leaves opposite, broadly lanceolate, 25-60(-90)mm long, base shortly rounded to truncate, apex long-attenuate and slightly acuminate, subentire, or the larger ones often with 3-5 obscure apressed teeth on each side, essentially glabrous, 3-nerved, upper leaves suppressed; petioles 2-4(-6)mm long. Short bracteate upper branches bearing rounded masses of heads, the entire end of the stem with its several corymb-bearing short branchlets forming a sort of elongate-thyrse; heads usually with only 3-5 flowers; occasionally the bracteal leaves of the peduncles are so close to the involucre as to resemble outer phyllaries; involucre obconic, c.5mm long; phyllaries more than 4, in 2-6 series, essentially uniseriate, lanceolate, very acute, mostly thin

and stramineous except for three darker vertical nerves; corolla lilac-white or pinkish-white, scarcely exserted from involucre, equally 5-toothed terminally; receptacle flat to conic, naked; ray flowers absent; disc flowers few to numerous, perfect. Style branches long and clavate. Achenes usually blackish, subcolumnar or gently narrowed to the base, 5-ribbed; pappus of slender bristles, persistent. Fl. Aug.-Nov.

Frequent in mountains of the Trans Pecos, usually in mesic canyons; Chihuahua, Coahuila, Durango, Arizona and Texas (Correll & Johnston 1970).

EVODIA [Euodia]

(Rutaceae)

Evodia bonwickii *F. Muell.* – kilt
Evodia crispula *Merrill et Perry* – gen
Evodia rutaecarpa *(Juss.) Benth.* **(Boymia rutaecarpa** *Juss.***)** – wu-chu-yu, wu-zhu-yu, goshuyu
Evodia vitiflora *F. Muell.* – toothache tree

'Wu-chu-yu', the dried immature fruit of E. rutaecarpa, has been used in TCM for thousands of years. It is pungent and bitter in character, and has many uses – such as to treat hiccough, excess bile, headache, vomiting, diarrhoea, arthralgia, cold pain in the chest and abdomen, hernia, beriberi, oedema, and oral ulcers [external use]; it stimulates circulation, slightly raises or lowers blood pressure, inhibits some intestinal parasites, and is analgesic, stimulant, carminative, stomachic and antiemetic. The dose is 3-5g, and the herb is considered incompatible with **Salvia** chinensis. It was believed that hanging the herb on the body could repel infection by devils (Hsu et al. 1986; Huang 1993; Keys 1976).

A commercial 5:1 extract of E. rutaecarpa fruit [equivalent to c.25-30g of the herb] has been used successfully in what was thought of as a kind of 'ayahuasca analogue', combined with extract of Indian **Tribulus** terrestris fruit, by at least two people (friendly pers. comm. 1998; Raver pers. comm. 2002). However, later experiments failed to show that the **Tribulus** was acting as an MAOI as had been presumed [see **Tribulus**] (friendly pers. comm. 2001), and the activity of the combination was in retrospect downplayed. In the words of the original bioassayist [who is believed to be a low MAO phenotype, and is a self-confessed 'softhead' – see *Glossary*] – "while I feel there is something there [ie. psychoactivity], it does not live up to what an ayahuasca analogue should do" (friendly pers. comm. 2002). The other known bioassayist described achieving a mild psychedelic effect from the combination (Raver pers. comm. 2002). Thus it is presumed that this E. rutaecarpa extract is psychotropic without the need for any additive plant – or that there is some interaction between E. rutaecarpa and T. terrestris unrelated to MAO activity (pers. obs.). Smaller amounts [a heaped tsp] of the same E. rutaecarpa extract exhibit nöotropic effects, and some may perceive a "mild sense of wellbeing". However, ingestion of a cruder home-made extract [which included oils present in the whole fruit] resulted in strong toxicity. Symptoms included "intense abdominal distress. After some minutes, unproductive vomiting and lengthy dry-heaving. Then not nausea, but pain and an intense burning – felt like it was corroding me internally or leaving me inflamed like a streptococcal food poisoning." This burning sensation was felt to pass through the body with the internal movements of the extract. Due to the time lapse between the bioassay and it being reported, the dose was not remembered with accuracy, though believed to correspond to somewhere between 30 and 60g of dried unripe fruit. No such toxicity was noted with use of the commercial extract mentioned earlier (Trout pers. comm.). See the chemistry of E. rutaecarpa below.

In n.e. Australia, E. vitiflora bark resin is placed against the tooth to relieve toothache. A bark decoction is reportedly rubbed on the body to relieve pains, though the identity of the plant used was not established with certainty (Cribb & Cribb 1981; Lassak & McCarthy 1990). In Papua New Guinea, E. crispula leaves are chewed by the Nkopo as a stimulant for dancing in night-long ceremonies, and the plant is used in rituals to promote equilibrium of natural forces (Schmid 1991). Evodia spp. are also used there in rituals associated with the dead (Paijmans ed. 1976). In the Mt. Hagen area, E. bonwickii bark "is chewed by men during dancing feasts" (Stopp 1963), presumably as a stimulant (pers. obs.); it is said to be psychoactive (Schultes & Hofmann 1980). Rätsch (1998) claimed it is used in PNG to treat psychological ailments, but mis-cited Stopp (1963) [as 'Scott'], who did not give any such information for this species. In the first stage of Bimin-Kuskusmin initiation rites, aromatic leaves of an Evodia sp. known as 'saakop' are crushed and inserted in the nostrils for inhalation [as well as many other plants being ingested] – it is unclear whether psychoactive effects are ascribed to its use (Poole 1987). In Malaya, all parts of an Evodia sp. ['keruin'] are used in the manufacture of dart-poisons (Bisset & Woods 1966).

E. belahe has yielded N-cinnamoyl-*tyramine* (Lundstrom 1989).

E. bonwickii was found to contain alkaloids in unspecified parts (Stopp 1963).

E. merrillii leaves have yielded the furoquinolines *skimmianine*, kokusaginine and confusameline; these compounds were found to act as antagonists of 5-HT2 receptors, in descending order of potency (Cheng et al. 1994).

E. micrococca leaf [harv. Dec.] from Yarraman, Queensland [Australia] tested strongly positive for alkaloids (Webb 1949).

E. rutaecarpa unripe fruit [as used in TCM] contains a variety of compounds, including indole, quinolone and *phenethylamine* alkaloids [0.135% total alkaloids in one analysis] (King et al. 1980). These include mostly evodiamine [8,13,13b,4-tetrahydro-14-methylindolo(2',3':3,4)-pyrido(2,1-b)quinazolin-5(7H)-one; Tschesche & Werner (1967) reported obtaining 1.5-2.45% of a crude mixture of evodiamine and rutaecarpine (see below), though these yields may have been a misprint], as well as 0.15% hydroxyevodiamine [rhetsinine; yield may be a misprint], 0.033% dehydroevodiamine, isoevodiamine, c.0.0003% [in one analysis – see above] rutaecarpine [rhetine; often referred to as a major component along with evodiamine], dihydrorutaecarpine, 14-formyldihydrorutaecarpine (Asahina & Kashiwaki 1916; Chen & Chen 1933; Haji et al. 1994; Kamikado et al. 1978; King et al. 1980; Pachter & Suld 1960; Tschesche & Werner 1967), evodiamide [N-methyl-N-(2-methylaminobenzoyl)*tryptamine*], N-(2-methylaminobenzoyl)*tryptamine* (Shoji et al. 1988), 0.0005-0.0026% *5-methoxy-DMT*, 0.00026% *DMT*, 0.00033% 6-MeO-N-methyl-THβC [N-methyl-*pinoline*] (Yu et al. 1997a, 1997b), 0.0076% goshuyamide-I [2-(2-methylaminobenzoyl)-THβC], 0.0034% goshuyamide-II [3-[2-(3-indolyl)ethyl]-1-methyl-2,4-quinazolinedione] (Shoji et al. 1989), atanine [3-dimethylallyl-4-MeO-2-quinolone] (Perrett & Whitfield 1995), 1.8-2.4% evocarpine [I suspect the yields of this quinolone were printed incorrectly – perhaps a misplaced decimal point or two – as it is otherwise not referred to as a major component] (Tschesche & Werner 1967), dihydroevocarpine [1-methyl-2-tridecyl-4(1H)-quinolone], 1-methyl-2-nonyl-4(1H)-quinolone, 1-methyl-2-undecyl-4(1H)-quinolone, 1-methyl-2-pentadecyl-4(1H)-quinolone (Kamikado et al. 1976, 1978), 2-tridecyl-4(1H)-quinolone, 1-methyl-2-dodecyl-4(1H)-quinolone, 1-methyl-2-[(Z)-5-undecenyl]-4(1H)-quinolone, 1-methyl-2-[(Z)-6-undecenyl]-4(1H)-quinolone (King et al. 1980; Tang et al. 1996), 0.0002% (7S,13bS)-7-carboxy-8,13,13β,14-tetrahydro-14-methylindolo(2',3':3,4)-pyrido(2,1β)quinazolin-5(7H)-one (Danieli et al. 1979), wuchuyine (Chen & Chen 1933), higenamine and synephrine (Hsu et al. 1986). Guanoside 3',5'-monophosphate [traces] (Cyong et al. 1982), evodinone, evogin, gushuyic acids, isorhamnetin 3-O-galactoside and quercetin 3-O-galactoside have also been isolated (King et al. 1980; Yu et al. 1997a). The essential oil [2% yield] contains evodol, limonin ['evodin'] and ocimene ['evodene'] (Asahina & Kashiwaki 1916; Chen & Chen 1933; King et al. 1980). Leaves have been shown to contain dehydroevodiamine [major alkaloid], hydroxyevodiamine (Nakasato et al. 1962), dihydroevocarpine, 1-methyl-2-pentadecyl-4(1H)-quinolone and 1-methyl-2-undecyl-4(1H)-quinolone (Kamikado et al. 1976). Unfortunately, yields for the major components of the fruit are scarce; when yields have been given by some researchers, the way in which they are presented often makes the figures virtually useless for calculating real yields from the herb [such as in Kamikado et al. 1978], and some [ie. Tschesche & Werner 1967] have reported yields which are difficult to believe.

Evodiamine is a diuretic, diaphoretic (Buckingham et al. ed. 1994), increases arterial pressure, acts as a powerful cardiotonic (Shoji et al. 1989), protects against hypothermia [induced by chlorpromazine in mice] (Haji et al. 1994), improves cerebral blood flow and may have cholinergic activity (Yamahara et al. 1989). Dehydroevodiamine reverses *hyoscine*-induced amnesia, acts as an AChEI in vitro (Park et al. 1996), is uterotonic (King et al. 1980), hypotensive in rats, and increased cerebral blood flow in cats. Isoevodiamine increased carotid blood flow in rabbits (Haji et al. 1994). Rutaecarpine increases arterial pressure (Keys 1976), acts as a uterotonic (King et al. 1980), hypotensive, analgesic and circulatory stimulant, and also slightly raises temperature (Hsu et al. 1986); rutaecarpine and limonin inhibit the CYP3A4 form of cytochrome P450, in the presence of the co-factor NADPH [nicotinamide adenine dinucleotide phosphate] (Iwata et al. 2005).

Upon degradation, evodiamine yields β-indolethylamine [rutamine; haemostatic, causes pain, stimulates CNS and plain muscle, stimulates intense uterine contractions, in large doses causes delirium, dyspepsia and intestinal hyperperistalsis]; degradation of rutaecarpine also yields rutamine (Hsu et al. 1986; Keys 1976). An ethanol/water extract [1:1] potently interacted with 5-HT1a receptors, and also interacted with D1 and D2 *dopamine* receptors, α2, β1 and β2 adrenoceptors, muscarinic cholinergic receptors, and H1 *histamine* receptors (Yu et al. 1997a, 1997b). The anti-diarrhoeal activity has been proven experimentally in mice (Yua et al. 2000).

E. vitiflora bark, leaves and branchlets tested strongly positive for alkaloids; the bark resin contains coumarins (Lassak & McCarthy 1990; Webb 1949).

E. xanthoxyloides leaf and bark from Malanda, Queensland [harv. Aug.] tested strongly positive for alkaloids (Webb 1949).

Evodia rutaecarpa is a small, densely foliaged green inodorous tree, velvety-pubescent throughout. Leaves opposite, imparripinnate, 3-45cm

long; leaflets c.5 pairs, subsessile, oblong-acute, usually rounded and oblique at base, margin entire, pellucid-punctate, underside wooly, venation faint; petiole terete, stout. Flowers small, unisexual, in axillary paniculate cymes; cymes brachiate, 7.5-10cm diam., terminal, branches very stout, peduncles very short and stout, tomentose (as are the pedicels and calyx). Flowers c.8mm diam.; sepals 4-5, imbricate; petals 4-5, sessile, valvate or slightly imbricate, nearly glabrous externally, pubescent within; disc 4-5 lobed; stamens 4-5, inserted at base of disc, in female replaced by staminodes, not much exceeding the petals, filaments hairy, subulate; anthers very large, ovate, 2-lobed at base. Ovary deeply 4-lobed, 4-celled; ovules 2 in each cell; style basal; stigma 4-lobed. Fruit of 4 coriaceous, 3-valved, 1-seeded cocci, pustular, 13mm diam.; carpels 4, opening at apex. Seeds oblong.

China, Japan, temperate regions of Sikkim Himalaya, 2100-3000m (Kirtikar & Basu 1980).

EVOLVULUS

(Convolvulaceae)

Evolvulus alsinoides *(L.) L.* **(E. acapulcensis** *Willd. ex Roem. et Schult.***; E. adscendens** *House***; E. albiflorus** *Martens et Galeotti***; E. alsinoides var. sericeus** *(Wall.) Gagnep. et Courchet nom. illeg.***; E. alsinoides var. wallichii** *Ooststr.***; E. angustifolius** *Roxb.***; E. azureus** *Vahl ex Schumach. et Thonn.***; E. chinensis** *Choisy***; E. debilis** *Kunth***; E. decumbens** *R. Br.***; E. diffusus** *Chapm.***; E. filiformis** *Willd. ex Steud.***; E. filipes** *Mart.***; E. fugacissimus** *Hochst.***; E. gracillimus** *Miq.***; E. heterophyllus** *Labill.***; E. hirsutulus** *Choisy***; E. hirsutus** *Lam.***; E. javanicus** *Blume***; E. lanceaefolius** *Span.***; E. linifolius** *(L.) L.***; E. modestus** *Hance ex Walp.***; E. natalensis** *Sond.***; E. pilosissimus** *Martens et Galeotti***; E. procumbens** *Montr.***; E. pseudo-incanus** *Span.***; E. pudicus** *Hance ex Walp.***; E. pumilus** *Span.***; E. ramiflorus** *Boj. ex Choisy***; E. ramulosus** *M.E. Jones***; E. sericeus** *Wall. non Sw.***; E. sinicus** *Miq.***; E. tenuis** *Mart. ex Choisy***; E. yemensis** *Deflers***; Convolvulus alsinoides** *L.***; C. fugacissimus** *Hochst. ex Choisy***; C. linifolius** *L.***; C. valerianoides** *Blanco***)** – sky convolvulus, tropical speedwell, shankhpushpi, vishnugandhi, vishnukranta

Evolvulus alsinoides var. sericeus *Benth.* **(E. argenteus** *R. Br.***)**

Evolvulus nummularis *(L.) L.* **(E. capreolatus** *Mart. ex Choisy***; E. dichondroides** *Oliv.***; E. domingensis** *Spreng. ex Choisy***; E. reniformis** *Salzm. ex Choisy***; E. repens** *D. Parodi***; E. veronicaefolius** *Kunth***; E. yunnanensis** *S.H. Huang***; Convolvulus nummularis** *L.***; Volvulopsis nummularium** *(L.) Roberty***)**

Evolvulus sericeus *Sw.* **(E. alsinoides var. sericeus** *(Sw.) Kuntze***; E. angustissimus** *Kunth***; E. anomalus** *Meisn.***; E. araucanus** *Phil.***; E. arenicola** *J.R. Johnst.***; E. brevipedicellatus** *Klotzsch***; E. commersonii** *Roem. et Schult.***; E. cuspidatus** *Kunth***; E. discolor** *Benth.***; E. distichophyllus** *Mart.***; E. ellipticus** *Larrañaga***; E. falcatus** *Griseb.***; E. holosericeus** *Kunth.***; E. incanus var. elongatus** *Choisy***; E. oreophilus** *Greene***; E. sericeus var. holosericeus** *(Kunth) Ooststr.***; E. uniflorus** *Sessé et Moc.***; E. virgatus** *Willd. ex Roem. et Schult.***; E. wilcoxianus** *House***; Convolvulus commersonii** *Lam. ex Steud***; C. minimus** *Aubl.***; C. proliferus** *Vahl***; Leucomalla lanuginosa** *Phil.***; Nama sericeum** *Willd. ex Roem. et Schult.***)**

Indigenous people of n.e. South Australia chew E. alsinoides var. sericeus as a pituri substitute [see **Duboisia**, **Nicotiana**], due to its mildly 'narcotic' effect. Last century, the herb had a reputation with Asian herbalists as a remedy for fever and dysentery (Cribb & Cribb 1981; Lassak & McCarthy 1990; Low 1990). In Ceylon, E. alsinoides is used as a bitter tonic and antipyretic, and the Hausas smoke the plant to treat chronic bronchitis and asthma. Muslim doctors believe it to strengthen the brain and memory. Likewise, in India, it is believed to brighten the intellect, improve complexion and appetite, and relieve diarrhoea. It is said to also have astringent and anthelmintic properties. Given with cumin and milk, it treats memory loss, nervous debility and fever (Kirtikar & Basu 1980; Nadkarni 1976). E. nummularis has also been reported from India to have weak sedative effects (Chatterjee et al. 1965).

E. alsinoides has yielded an alkaloid, evolvine [exhibits some *epinephrine*- and *ephedrine*-like effects in animal studies] (Krishnamurthy 1959), as well as betaine (Baveja & Singla 1970), triacontane, pentatriacontane, and β-sitosterol (Mehta & Shah 1959). No alkaloids were detected in an Australian specimen [whole plant] from Springsure, Queensland (CSIRO 1990). The plant has been shown to produce ergot-alkaloids [see **Claviceps**, **Ipomoea**] in liquid culture (Nambiar & Mehta 1981). A liquid extract of the herb had some *lobeline*-like effects on the cardiovascular and respiratory systems (Krishnamurthy 1959).

E. arbuscula ssp. canus has yielded 15-norpanasinsan-5β-ol-8-one, 15-norpanasinsan-5,8-dione, and caryophyllene oxide (Huneck et al. 1987).

E. argyreus contains a calystegine [see **Convolvulus**] in the aerial parts (Schimming et al. 1998).

E. nummularis has yielded 3',4',5',7-tetrahydroxy-flavonone, and the glycosides evoluside A and evoluside B (Gupta, D.R. et al. 1985).

E. sericeus [as E. sericeus var. holosericeus] has yielded convolvine, convolvamine, and convolvidine [see **Convolvulus**] , as well as 3.85% anthraquinone glycosides (Fonseca & Salive 1973).

Evolvulus alsinoides is a perennial herb with a small, woody, branched rootstock; stems numerous, often more than 30cm long, prostrate, spreading, slender, wiry, usually clothed with long spreading hairs, sometimes quite glabrous. Leaves numerous, 6-20 x 4-8mm, elliptic-oblong, obtuse, strongly apiculate, usually acute at base, densely clothed with apressed silky hairs; petioles very short, sometimes almost sessile. Flowers light blue, sometimes white, solitary, or sometimes 2 from a pair of lanceolate bracts on the peduncle; peduncles very long, filiform, axillary; pedicels filiform; calyx densely silky, sepals 5, subequal, 4mm long, lanceolate, very acute; corolla 5mm long and wide; stamens 5, filaments slender; anthers ovate or oblong. Ovary 2(rarely 1)-celled; ovules 4; styles 2, distinct from base, each cleft into 2 linear or subclavate stigmas. Capsule 3-4mm diameter, globose, thin, 4-valved; seeds usually 4, glabrous.

In tropical and subtropical areas (Kirtikar & Basu 1980), including Asia, Malesia, Pacific Islands, Africa, and the Americas; in Australia [Queensland, New South Wales, Northern Territory, South Australia, Western Australia], it grows in habitat ranging from sandy plains to rocky outcrops and grassy woodland [with **Acacia** spp. and Eucalyptus spp.] (Harden ed. 1990-1993). The form found in Australia is said to be E. alsinoides var. sericeus, reportedly distinguished by the dense layer of silky hairs on the leaves (Lassak & McCarthy 1990), though given the confusion regarding nomenclatural synonymy [see the huge listings above] I am uncertain what the real story is at this point. Harden ed. (1990-1993) lists E. alsinoides *(L.) L.* as an Australian native, the only native Evolvulus sp. occurring in Australia, with E. alsinoides var. decumbens *(R. Br.) Ooststr.* and E. alsinoides var. villosicalyx *Ooststr.* as the varieties occurring in NSW.

FAGONIA

(Zygophyllaceae)

Fagonia cretica *L.* **(F. arabica** *L.***; F. bruguieri** *DC.***; F. mysorensis** *Heyn. ex Roth***; F. sinaica** *Boiss.***)** – ustarkhar, dusparsha, dhanvayas, dharama, badavard, rosa de la virgen

The leaves and stems of this herb are used in Ayurvedic medicine to purify the blood. In Indian folk medicine, they have been used to treat asthma, fever, thirst, vomiting, dysentery, urinary discharges, typhus and tumours. It is considered to have acrid, bitter, tonic and cooling properties. The bark has also been used to treat scabies. Hill tribespeople of Sind and Afghanistan also use the plant as a fever remedy (Kirtikar & Basu 1980; Nadkarni 1976). Its leaves are used as food for camels and mules (Usher 1974). The fresh plant, or a tea made from it, has a mild cabbage-like flavour [see **Brassica**], and is soothing to the digestive tract (theobromus pers. comm.).

F. cretica leaves have yielded alkaloids, including *harman*, but no *harmine* (Ahmed et al. 1971b), though a later study did find *harmine* in the plant (Iyer & Joshi 1976). In a broad alkaloid screening, leaves, stems and flowers of F. cretica from Pakistan gave negative results (Fong et al. 1972). The whole plant [flowering or in early fruiting stages] has yielded 2.5% saponins [1.5% as F. sinaica], including oleanolic acid (Zaitschek et al. 1971) and hederagenin-derivatives, fagonin, and other triterpenoid saponins (Ahmed et al. 1971a; Iyer & Joshi 1976; Khalik et al. 2000). Also found in the plant were β-sitosterol, stigmasterol, campesterol, and 1-triacontanol (Ahmed et al. 1969). The saponin fraction from the aerial parts has shown analgesic, antipyretic, and antiinflammatory effects (Khalik et al. 2000).

F. glutinosa, F. mollis, and F. parviflora have also been reported to contain *harman* (Shulgin & Shulgin 1997), though this may be in error. These species were analysed along with F. cretica [and specimens identified as F. bruguieri and F. arabica, synonyms of F. cretica], and though they were found to contain [unidentified] alkaloids [ranging from 0.03% in F. parviflora, to 0.17% in F. glutinosa], only F. cretica contained *harman* (Ahmed et al. 1971b). F. glutinosa and F. mollis [flowering or in early fruiting stages] yielded 1.5% and 1% saponins, respectively, including oleanolic acid (Zaitschek et al. 1971).

Fagonia cretica is a small, spiny undershrub with stiff branches, often +- prostrate; twigs slender, terete, striate, glabrous, glandular. Leaves opposite, 1-3-foliate, c.12 x 2.5mm, entire, linear or elliptic, mucronate; petiole very variable, 0-3cm long, sometimes leaf-like; stipules transformed into sharp, slender spines up to 1.2cm long, persistent and continuing growth long after fall of leaves. Flowers solitary, rose-coloured, on peduncles 5-12mm long, arising from between stipules; sepals 5, deciduous, imbricate, ½ as long as petals; petals 5, 6mm long, spathulate with marked claw; disc short, inconspicuous; stamens 10, inserted on the disc; filaments filiform, naked; anthers oblong. Ovary hairy, sessile, 5-angled, 5-celled, tapering into a 5-angled style; stigma simple. Fruit 5mm long, of 5 1-seeded cocci, glandular-pubescent, deeply 5-partite almost to the

axis; cocci dehiscing along the ventral suture and separating from a horny endocarp.

India [Deccan, w. Khanadesh, Cutch, Sind, Baluchistan, Waziristan, w. Rajputana, Upper Gangetic Plain, Punjab], westwards to Afghanistan, Iran, Arabia and Mediterranean (Kirtikar & Basu 1980).

Spanish specimens have flowers in varying shades of purple, rather than the usual rose (theobromus pers. comm.).

FERRARIA

(Iridaceae)

FERRARIA GLUTINOSA

Ferraria glutinosa *(Baker) Rendl.* **(F. bechuanica** *Baker***; F. hirschbergii** *L. Bolus***; F. welwitschii** *Baker***; Moraea glutinosa** *Baker***)** – gaise noru noru, !kaishe

The roots of this iris, only available in April after the rains have come, have sacred uses amongst the Iko bushmen of the Kalahari. Much preparation is deemed necessary before the plant is consumed. A process of cleansing and obedience towards a strict diet takes place. Each man is then rubbed with the flesh and blood of a freshly killed animal, and washed clean, before the decoction of F. glutinosa is prepared. It is drunk [usually at night] for the ritual 'pogo-like' dances employed by Kalahari bushmen to awaken the !kia or ntum energy [see *Influencing Endogenous Chemistry*]. Older men, more experienced in the practice, drink less of the decoction than younger men, as it was primarily used as a 'teaching aid' for raising ntum. However, today knowledge of such affairs is gradually being lost, and only some of the elders retain the necessary knowledge of preparation and use (De Rios 1986; Rätsch 1992).

Ferraria glutinosa is a perennial herb to 90cm tall; corm depressed-globose, brown, 10-40mm diam., 2-4 internodes in length, corm tunics evanescent; stem laxly and often repeatedly branched, terete, sticky below the nodes; aerial parts dying back annually. Leaves several, the lower 2-3 entirely stem-sheathing and membranous; foliage leaves several, usually c.½ as long as stems, equitant, 4-8mm wide, linear to narrowly-lanceolate, decreasing in size above, sometimes lacking at anthesis, sometimes short or not developed at flowering. Inflorescence composed of several flower clusters (rhipidia); rhipidia terminal on main and lateral axes, several, solitary on the branches, 2-6-flowered; spathes herbaceous, outer ones 15-25(-30)mm long, obtuse to acute, inner ones 30-45(-50)mm long; flowers actinomorphic, brown, maroon, purple or yellow, usually spotted and mottled with contrasting colour, faintly scented; tepals free, lanceolate, the outer ones 28-35mm long, the inner 25-28mm long, the claws forming a wide cup c.10mm deep and 15mm diam. At rim, limbs horizontal or recurved, margins crisped; filaments 10-13mm long, united in the lower 8-10mm, free and diverging above; anthers 5mm long, appressed to the style branches, shrinking after anthesis to 2.5mm long. Ovary 5-7mm long; style slender, c.10mm long, concealed by filament column, dividing into 3 flattened branches, these finely fringed above and 4mm long; stigma lobe abaxial, at base of fringe. Capsules 12-20(-25)mm long, globose-ovoid.

In savannah and grassland, mostly in sandy soils, but also in stony ground; Botswana, Zambia, Zimbabwe, Malawi, S. Africa [n. Cape Province], Angola, Namibia (Exell et al. ed. 1960-1993).

FERULA

(Umbelliferae/Apiaceae)

Ferula asafoetida *L.* **(F. narthex** *Boiss.***; F. scorodosma** *Bent. et Trimen***; Narthex asafoetida** *Falc.***)** – asafoetida, assa-foetida, devil's dung, food of the gods, giant fennel, narthex, a-wei, bahleeka, sulanasan, hingra, shing-kun

Ferula hermonis *Boiss.* – zallouh, shilsh el zallouh, kutteira, 'Lebanese viagra'

Ferula sumbul *(Kauffman) Hook. f.* **(F. moschata** *(Reinsch) Koso-Pol.***; F. pseudooreoselinum** *(Regel et Schmalh.) Koso-Pol.***; Euryangium sumbul** *Kauffman***)** – sumbul, jatamansi, musk root

Ferula spp.

When Prometheus stole fire from the gods, he was said to have smuggled it back to humanity within a hollow fennel stem [see **Foeniculum**] (Parsons & Cuthbertson 1992); however, in this case, the plant referred to was actually a Ferula sp., or 'giant fennel' (theobromus pers. comm.). Dionysian ceremonies often featured the use of a 'thyrsus' staff, made from a giant fennel stalk, entwined with ivy, and adorned with pine cones at the tip (Ody 1993). 'Asafoetida' refers to the gummy oleoresin from the roots of F. asafoetida, with a pungent smell similar to garlic in some respects. It is fried before use, as it causes vomiting if taken raw. The Romans used it as a condiment, and it is used sparingly in some Indian cooking, as well as being an ingredient in Worcestershire sauce. It has been used for millenia by Tibetan shamans in the Himalayas, particularly amongst the Bonpo, by whom it is used to drive out spirits, a purpose for which the gum was sometimes mixed with **Acorus**, **Valeriana**, peacock feathers, snake skin and cat dung. The gum is burned as an incense for banishing, but may be taken internally to treat psychic ailments and sexual imbalances. Tibetans have also used it as an aphrodisiac, in doses of 0.3-1g, and as a tonic to reduce the effects of ageing. In Somalia it has been used in making protective amulets, and the ancient Mesopotamians used it as a medicine and prophylactic. As I understand it, if you smelt strongly enough of asafoetida no one would want to come close enough to you to fornicate anyway! In Europe, it has been used to ward off witches and illness, and to 'exorcise' the insane (Bremness 1994; Chevallier 1996; Clifford 1984; Cunningham 1994; Rätsch 1990, 1992; Simonetti 1990). In TCM, it is used as an anthelmintic, and to treat dysentery, malaria and ascites (Huang 1993).

In India, the gum from any Ferula sp. is regarded as a stimulant, expectorant and antispasmodic, though F. asafoetida is favoured as a nervine stimulant and aphrodisiac – in Tibet, its aphrodisiac effects are achieved using 0.3-1g of the gum. In Ayurveda, it is used as a stomachic, laxative, analgesic, carminative and appetite stimulant. In Unani medicine the stem is used as a brain and liver tonic, emmenagogue and anti-inflammatory; the gum is used to treat dizziness, paralysis, asthma, rheumatism, dry cough and eye problems; and leaves are used as a carminative and diaphoretic. The gum also acts as a cardiotonic, diuretic, hypotensive, and anticoagulant (Chevallier 1996; Chiej 1984; Kirtikar & Basu 1980; Nadkarni 1976; Rätsch 1990). It has strong antioxidant properties and may inhibit early stages of cancer growth (Saleem et al. 2001), though some have found it ineffective as an anticarcinogen (Aruna & Sivaramakrishnan 1992). An aphrodisiac effect is alluded to due to the CNS-activity and excitation of the 'urinary and sexual apparatus' (Rätsch 1992). Recently, F. hermonis seeds have been used as a 'herbal Viagra', though they may be toxic if taken for long periods (El-Thaher et al. 2001). F. sumbul is thought to be 'hallucinogenic' (Schultes & Hofmann 1980), and has been proposed as the identity of the valued psychotropic medicinal herb of antiquity 'silphion', written of by Dioscorides; F. asafoetida has also been suggested as representing silphion (Rätsch 1998).

The incense known as 'galbanum' comes from the related central Asian species F. galbaniflua [F. gummosa], and is an oleoresin collected in the same manner as that of F. asafoetida [see below]. It has antispasmodic and expectorant properties, and relieves digestive complaints. In central Asia, F. sumbul is used as an incense and stimulant nerve tonic, and to treat an

array of disorders including hysteria, delirium-tremens, spasms, asthma, diarrhoea and dysentery (Bruneton 1995; Chevallier 1996; Felter & Lloyd 1898; Usher 1974). Its effects have been compared to those of **Valeriana** officinalis. A 66% alcohol tincture made from roots and rhizomes [1:10], taken in a dose of c.15ml, "produced narcotic symptoms, confusing the head, causing a tendency to snore even when awake, and giving feelings of tingling, etc., with a strong odour of the drug from breath and skin which only passed off after a day or two" (Grieve 1931).

Oleoresin from F. asafoetida consists of 25% gum, 4-20% essential oil and 40-65% resin. The essential oil consists of *eugenol*, camphene, myrcene, limonene, linalool, cadinene, fenchone, geraniol, *borneol*, isoborneol, farnesol, cadinol, guaiacol, phellandrene, α-*pinene*, β-caryophyllene, β-selinene, longifoline, and many sulphide derivatives; resin also contains umbelliferone, vanillin, aresinotannol, aresinol ferulate, ferulic acid, valeric acid, asacoumarins A & B, asadisulphide, assafoetidin, foetidin, farnesiferols A-C, and kamolonol. The essential oil from the seed has been expressed in a yield of 1.5%, containing α-*pinene*, phellandrene, α-terpineol, bornyl acetate, geranyl acetate, sec-butylpropenyl-disulphide, myristic acid and a mix of coumarins (Buckingham et al. ed. 1994; Huang 1993; Lawless 1995; Morton 1977; Rastogi & Mehrotra ed. 1990-1993).

F. equisetacea roots have yielded *myristicin*, equisetin [3-MeO-4,5-methylenedioxyphenylethenal] (Bagirov 1979), and equisetan [3-MeO-4,5-methylenedioxyphenylethenoic acid] (Bagirov 1981).

F. galbaniflua oleoresin ['galbanum'] has yielded c.55% resinous compounds, including galbaresenic acid, and galbanum acid; the essential oil contains large amounts of *pinene*, as well as umbelliferone, Δ3-carene, 2-MeO-3-isobutylpyrazine, S-sec-butyl-3-methyl-2-butenethioate, methylallylsulfides, propenyldisulfides, and undecatriene derivatives (Bruneton 1995; Kunz & Wöldicke 1937).

F. hermonis roots yielded sesquiterpenes [jaeschkeanadiol, epoxyjaeschkeanadiol, jaeschkeanadiol benzoate, jaeschkeanadiol p-OH-benzoate] and daucane esters (Galal et al. 2001).

Ferula asafoetida is a perennial herb to 2.4m tall. Leaves 2-4-pinnatifid or 2-4-pinnate, pubescent at least when young, lower leaves 30-60cm, ovate, cauline sheaths large, from which spring simple or scarcely compound umbels; secondary and tertiary pinnae decurrent, entire or very irregularly crenate-serrate; petioles of leaflets winged. Terminal umbel large, compound, leafless, bearing up to 50 ray florets; sometimes involucres of bracts or bracteoles are present; flowers yellow, often polygamous; calyx teeth obsolete; petals 5, epigynous, yellow, ovate, entire, acute, retroflexed, imbricate in bud; stamens 5, epigynous, alternating with petals. Ovary inferior, 2-celled, glabrous, crowned by a large epigynous disc; ovules solitary in each cell, pendulous; styles 2, often dilated at base; stigma minute. Fruit 8 x 5mm, orbicular or ellipsoid, much compressed dorsally, lateral ridges winged, dorsal and intermediate filiform or obscure; seed 1 in each carpel, much dorsally compressed, testa thin, inner face plane.

Warm, temperate, fertile regions; Asia (Chiej 1984; Kirtikar & Basu).

The gum is extracted from the live rootstock of 4- or 5-year old plants at the start of summer. The stem is cut off at ground-level, then the roots are progressively notched, with the gum accumulating at the cuts. It is then collected, once dry (Bremness 1994; Bruneton 1995; Chevallier 1996; Simonetti 1990).

FESTUCA including some endophytes

(Gramineae/Poaceae)

Festuca argentina *(Speg.) Par.* **(F. cavillieri** *St.-Yves***; Poa argentina** *Speg.***)** – Pampa grass, coirón, coirón negro, coirón huecú

Festuca arundinacea *Schreb.* **(F. elatior** *L.***; F. orientalis** *(Hack.) V. Krecz. et Bobrov***; Bromus arundinaceus** *(Schreb.) Roth***; Lolium arundinaceum** *(Schreb.) Darbysh.***; Schedonorus arundinaceus** *(Schreb.) Dumort.***)** – tall fescue, reed fescue, fescue grass

Festuca decumbens *L.* **(Bromus decumbens** *(L.) Koeler***; Danthonia decumbens** *(L.) DC.***; Melica decumbens** *(L.) Weber***; Poa decumbens** *(L.) Scop.***; Sieglingia decumbens** *(L.) Bernh.***; Triodia decumbens** *(L.) P. Beauv.***)** – dronk grass

Festuca hieronymi *Hack.* **(F. erecta var. mutica** *Griseb.***)**

Festuca obturbans *St.-Yves.*

Festuca pratensis *Huds.* **(F. elatior ssp. pratensis** *(Huds.) Hack.***; Bromus pratensis** *(Huds.) Spreng.***; Lolium pratense** *(Huds.) Darbysh.***; Schedonorus pratensis** *(Huds.) P. Beauv.***)** – meadow fescue

(Clavicipitaceae/Balansiae)

Acremonium coenophialum *Morgan-Jones et Gams* **(Neotyphodium coenophialum** *Glenn, Bacon et Hanlin***; Sphacelia typhina** *Sacc.***)**

Epichloë typhina *(Fries) Tulasne* **(Acremonium typhinum** *Morgan-Jones et Gams***)**

Neotyphoideum tembladerae *Cabral et White, sp. nov.*

F. arundinacea is a widespread forage grass, originally from Europe, with at least 35 million hectares of it being cultivated in the US alone. From 75-90% of cultivated F. arundinacea is infected by the fungus Acremonium coenophialum, which is known to produce a variety of chemicals, including psychoactive ergot-type alkaloids [see **Claviceps**]. Infected plants have been responsible for livestock poisoning, including the well-known 'fescue foot' [only affecting cattle], symptoms of which include lameness, weight loss, arched back, fever, swelling and gangrene; death may result if the cattle are not removed from toxic pastures. The disease usually occurs most severely in times of cold weather (Bacon 1995; Hemken et al. 1984; Hungerford 1990; Lamp et al. 1990; Lyons et al. 1986; Petroski et al. 1989; Yates et al. 1969). Horses are affected with reproductive difficulties (Cross et al. 1995).

In some toxic pastures, F. arundinacea may be infected completely by Epichloë typhina (Bacon et al. 1977), which is now known to be very closely related to the Acremonium spp. [see below]. Some cases of fescue foot may be complicated by the fact that weeds of fescue crops, such as Sporobolus poiretii, Andropogon spp., Eragrostis hirsuta and Panicum anceps, as well as other Festuca spp., have been observed to support the fungi **Balansia** epichloë and B. henningsiana [see **Cyperus**/**Balansia**] in summer (Bacon et al. 1975, 1979); and also by the fact that the Acremonium spp. are frequently found growing co-symbiotically with other endophytes (An et al. 1993). Toxic hay of F. arundinacea has also been shown to support mould fungi including Fusarium poae, F. sporotrichioides, F. nivale [F. tricintum], Cladosporium epiphyllum, Alternaria spp., Epicoccum spp., Mucor spp. and Stemphylium spp., some of which produce highly toxic metabolites (Etzel 2002; Yates et al. 1969).

F. argentina, from Argentina, is also responsible for causing stock intoxications ['staggers'], in this case referred to as 'loco' or 'huecú'. In the same country, F. dissitiflora and F. heironymi are also known to cause toxic symptoms. Those associated with F. heironymi have also been called 'tembladera' ['trembling']. Toxic F. argentina is known to be infected with an unidentified Acremonium sp. (Cabral et al. 1999; Casabuono & Pomilio 1997). In S. Africa, Dutch colonists have observed the intoxicating properties which 'dronk grass', F. decumbens, has on stock animals (Bruehl et al. 1994).

F. argentina infected with an Acremonium sp. yielded loline, lolinine, N-methylloline, N-formylloline, 5,6-dehydro-N-acetylloline [see **Lolium**/**Acremonium** for further discussion of loline alkaloids] and *choline* acetate. It is thought that the tremorgenic loline alkaloids are produced by Festuca spp. in response to endophyte infection, though the ergot alkaloids [see **Claviceps**], as found in infected F. arundinacea [see below], are a product of the endophytic fungus [knowledge of this situation has recently been updated – see F. pratensis below]. F. argentina has also yielded the stilbene trans-resveratrol, and the lignans (-)-pinoresinol, (-)-pinoresinol-4-O-β-D-glucopyranoside, (+)-medioresinol-4-O-β-D-glucopyranoside, and (1S,2S,5S,6R)-2-(4-OH-phenyl)-6-(3-MeO-4-OH-phenyl)-3,7-dioxabicyclo[3.3.0]octane (Casabuono & Pomilio 1994, 1997). Neotyphoideum tembladerae has been identified as an endophyte of this species; it has also been observed on F. hieronymi and Poa huecu (Cabral et al. 1999).

F. arundinacea has yielded *harman* and *norharman* (Allen & Holmstedt 1980; Bush & Jeffreys 1975) as well as *melatonin* (Shulgin & Shulgin 1997). When infected with A. coenophialum, it has yielded ergot alkaloids [see **Claviceps**] – predominantly ergovaline [0.0002-0.0006%], as well as *ergine* [sometimes present in levels as high as ergovaline], isoergine, *ergonovine*, *chanoclavine*, *elymoclavine*, *agroclavine*, *penniclavine*, *festuclavine*, ergovalinine, ergonine, ergosine, ergoptine and ergocornine; as well as 0.17-0.5% loline alkaloids [N-acetylloline, N-formylloline, N-acetylnorloline, loline, perloline (highest levels in summer) and perlolidine], the pyrrolopyrazine alkaloid peramine [0.0004%], and ergosta-4,6,8(14),22-tetraen-3-one. A. coenophialum has been shown to produce *ergotamine* in culture. Tests indicate that the levels of ergot alkaloids, as well as perloline levels, may be boosted significantly with high nitrogen fertilisation, using 10millimoles/L of potassium nitrate or ammonium chloride. Alkaloid levels are also boosted in infected plants by witholding water (Annis & Panaccione 1998; Bacon 1995; Belesky et al. 1989; Buckingham et al. ed. 1994; Hemken et al. 1984; Lyons et al. 1986; Petroski et al. 1989; Porter 1995). Animal studies suggest that the alkaloids of A. coenophialum-infected F. arundinacea have agonist properties at D2 *dopamine* receptors (Cross et al. 1995). The endophyte Fusarium nivale has also been isolated from F. arundinacea, and has yielded γ-acetamidobutenolide [4-acetamido-2-buten-4-olide; 4-acetamido-4-OH-2-butenoic acid-γ-lactone; 2-acetamido-2,5-dihydro-5-oxofuran; N-(2,5-dihydro-5-oxo-2-furanyl)acetamide] [weak antibiotic, LD50 in mice 275mg/kg (oral)] and 8α-(3-methylbutyryloxy)-4β,15-diacetoxyscirp-9-en-3α-ol (Casabuono & Pomilio 1997; Yates et al. 1969).

F. obturbans from e. Africa has been found heavily infested with ergot, which appeared to be **Claviceps** purpurea; the fungus yielded 0.32% alkaloids, consisting of 76.9% ergokryptine, 5% ergokryptinine, 5% ergosine, 3.1% ergocornine, 0.6% ergosinine, 4.1% clavine alkaloids, and 5.3% unknown alkaloids (Brack et al. 1963).

F. pratensis infected with Acremonium uncinatum [Neotyphoideum

uncinatum] has yielded up to 0.323% loline alkaloids, concentrated in the inflorescence, especially in the seed embryo; the major alkaloid was N-formylloline, followed by N-acetylloline, N-acetylnorloline, and traces of loline and N-methylloline (Justus et al. 1997). It was suspected that the loline alkaloids were produced by the grasses in response to endophyte infection, previous to a recent study showing A. uncinatum to be capable of producing loline, N-acetylnorloline and N-formylloline in culture [see also **Lolium**] (Blankenship et al. 2001).

Endophytes recorded on other Festuca spp. include Acremonium starrii [on F. arizonica], and the closely related Epichloë typhina [on F. glauca, F. longifolia and F. rubra], once known as Acremonium typhinum (Mogen et al. 1991). F. longifolia has also been observed to support Epichloë festucae (Cabral et al. 1999). E. typhina has also been implicated in causing stock intoxications (Porter et al. 1978), and has yielded *chanoclavine I*, ergosine and ergosinine in culture (Porter et al. 1979), as well as tetraenone[ergosta-4,6,8(14),22-tetraen-3-one] (Bacon et al. 1977).

These endophytes benefit the host grasses by increasing their health, and producing toxic chemicals as a feeding deterrent (Schardl & Tsai 1992).

Festuca arundinacea is a tufted perennial 0.45-2m tall, without rhizomes, sometimes forming large, dense tussocks. Culms mostly erect, usually stout to robust, unbranched, 2-5-noded, rough towards the panicle or smooth. Leaves green; sheaths rounded on back, smooth or rough, with small narrow spreading auricles at apex, minutely hairy on auricles and at the junction with blade; ligules up to 2mm long, membranous; blades long-tapering to a fine tip, 10-60 x 0.3-1.2cm, flat, stiff, rough, or smooth only below. Panicles erect or nodding, lanceolate to ovate, loose and open or contracted, 10-50cm long, green or purplish; axis and branches rough, the latter angular, spreading, bare and undivided in the lower part, usually in pairs, with the shorter one bearing 3 or more spikelets; pedicels up to 8mm long; spikelets elliptic to oblong, 10-18mm long, closely 3-10-flowered, breaking up beneath each lemma at maturity; glumes persistent, slightly unequal to equal, pointed; lower glume narrowly lanceolate, 3-6mm long, 1-nerved; upper glume lanceolate to lanceolate-oblong, 4.5-7mm long, 3-nerved; lemmas overlapping, or later with their margins incurved, lanceolate or oblong-lanceolate in side view, pointed to blunt, 6-9mm long, broadly rounded on the back, awnless, or with middle nerve continued as a fine rough awn 1-4mm long, firm except for membranous upper margins, 5-nerved, rough especially on nerves; paleas as long as lemmas, with rough keels; anthers 3-4mm long. Grain tightly enclosed by lemma and palea. Fl. Jun.-Aug. in northern hemisphere.

Variable in robustness and size, as well as habitat; on dry calcareous soils to heavy soils, meadows, grazed pastures, river and stream banks, rough hill and downs grassland; Europe, n.w. Africa, temperate Asia, N. America (Hubbard 1978), Australia [all states except NT] (Hnatiuk 1990).

Acremonium coenophialum offers its host plant some protection against adverse conditions and insect predators. It occupies the grass more or less without symptoms, growing intercellularly in the meristems of the crown, on the adaxial epidermis of the leaf sheath, on the aleurone layer of the seed, in the root shoot internode adjacent to the vascular tissue in embryos of mature seed, and on the surface of adventitious lateral root primordia of 3-week old seedlings. Usually observed as septate, intercellular, infrequently-branched hyphae running longitudinally in the leaf sheaths; colonies on sterile seedlings sporulating prolifically with production of synnemata which radiate in all directions from small colonies; synnematous hyphae simple, hyaline; synnemata unbranched, up to 1.5mm long; conidiophores phialides of Acremonium-type, formed perpendicularly along whole length of synnemata, unbranched, non-septate, hyaline, smooth, 20-35µm long, 1.25-2.5µm wide at base, 1µm at apex, frequently becoming slightly wider to 3µm just above base; conidia subulate to falcate, hyaline, smooth, 7-12.8 x 2-3µm, produced in small groups of 2-3, forming heads at apex of phialide, frequently only 1 conidium evident, oriented horizontally at phialide apex; chlamydospores absent. Considerable variation in shape of colonies; aerial mycelium varying from dense cottony to sparse, mostly white with pale brown underside, some pale brown on both surfaces.

Other unidentified fungal endophytes, similar in ways to Gliocladium and Phialophora and with penicillate conidiophores, are sometimes found in seed of Festuca spp. in cosymbiosis with Acremonium spp. Incidentally, infected seed will remain viable to produce a plant infected with A. coeniphialum for up to 1 year, longer with freezing (Azvedo & Welty 1995; Bacon et al. 1986; Christensen & Latch 1991; Christensen et al. 1993; Siegel et al. 1995; White & Cole 1985). Also found on Poa autumnalis. P. ampla supports other unidentified Acremonium spp. (Mogen et al. 1991); P. poecila, P. rigidifolia and P. sylvestris also support unidentified Neotyphoideum spp. (Cabral et al. 1999). All Acremonium spp. are now thought to be asexual stages of different strains of Epichloë typhina (An et al. 1993; Schardl & Tsai 1992), and those from Acremonium section albolanosa are now known under Neotyphoideum (Moon et al. 2000).

FOENICULUM

(Umbelliferae/Apiaceae)

Foeniculum vulgare *Mill.* **ssp. capillaceum** *(Gilib.) Holmboe* **var. azoricum** *(Mill.) Thell.* **(F. vulgare var. azoricum** *(Mill.) Thell.***; F. vulgare ssp. sativum** *(C. Presl.) Janch. ex Holub***; F. vulgare var. sativum** *C. Presl.***)** – Florence fennel, finocchio fennel

Foeniculum vulgare *Mill.* **ssp. capillaceum** *(Gilib.) Holmboe* **var. dulce** *Batt. et Trab.* **(F. dulce** *Mill.***; F. vulgare var. capillaceum** *(Gilib.) Paol.***)** – sweet fennel, Roman fennel, dulce fennel, hinojo amargo, hinojo silvestre

Foeniculum vulgare *Mill.* **ssp. capillaceum** *(Gilib.) Holmboe* **var. vulgare** *Mill.* **(F. capillaceum** *Gilib.***; F. foeniculum** *(L.) H. Karst.***; F. officinale** *Allioni***; F. vulgare ssp. piperitum** *(Ucria) Coutinho* **var. vulgare; F. vulgare ssp. vulgare** *Mill.***; Anethum foeniculum** *L.***)** – fennel, common fennel, finocchio selvatico, fenouil, vinkel

Foeniculum vulgare *Mill.* **ssp. piperitum** *(Ucria) Coutinho* **(F. capillaceum** *Gilib.* **ssp. piperitum** *(Ucria) Rouy***; F. piperitum** *(Ucria) C. Presl.***)** – bitter fennel, wild fennel, Italian fennel, Sicilian fennel, cartucci fennel, carosella, hinojo, pepervenkel, pepper fennel

Fennel is one of the oldest cultivated plants, and was held in high regard by the Romans and Greeks. The Romans believed that snakes sucked the juice of the plant to improve their eyesight. Pliny praised its virtues along these lines, declaring that it 'enabled one to see the beauty of nature with greater clarity'. Drunk with wine, it was said to cure snake or plant poisoning. Roman legionnaires and gladiators mixed fennel seeds with their food as a stimulant and tonic [victorious gladiators were crowned with a garland of fennel], while others ate it as an anorexic. The Greek name for the plant, 'marathon' [sometimes as 'marathron'], is derived from a verb meaning 'to grow thin'. Fennel was one of the herbs held sacred to Anglo-Saxons for its power against evil, and the seeds were sometimes put in keyholes to prevent ghosts entering the home. By 812AD, Charlemagne declared it essential in every imperial garden. By the middle ages, it had become much used as a digestive, and the seeds were often chewed during church sermons to allay stomach rumblings (Bremness 1988, 1994; Lawless 1994; Ody 1993; Parsons & Cuthbertson 1992). In Tuscany, Italy, fruits of F. vulgare spp. capillaceum var. vulgare are sometimes used as an amulet to prevent the 'evil eye', placed in a 'breo' bag also containing dried Olea europea ['olive tree'] leaves [which have been blessed in Palm Sunday ceremonies], and attached to men's clothes or cow's horns (Pieroni & Giusti 2002).

The swollen lower stem and leaf bases of 'Florence fennel' [F. vulgare ssp. capillaceum var. azoricum] are eaten as a vegetable, and the roots of this and other fennel varieties are used as a medicine. The root is mainly used only to treat urinary disorders, and its medicinal properties are not as strong as those of the seeds. Leaves may be infused as a nerve tonic, or used in cooking with fish, sauces, soups and stews. The seeds are used to flavour breads, curries and apple pies; they flavour toothpaste, and are an ingredient in some versions of absinthe [see *Methods of Ingestion*, **Artemisia**]; fruits of F. vulgare ssp. capillaceum var. dulce are used as a sweet condiment. Medicinally, they are used to treat indigestion, colic, constipation and irregular menstruation, and as a galactagogue and detoxifier [eg. helping liver repair after alcohol damage]. They are useful as a wash for tired eyes, and in TCM are used for reproductive and urinary disharmonies, and to tone the spleen and kidneys. In India, they are considered stimulant, diuretic, emmenagogic and purgative (Bremness 1994; Muckensturm et al. 1997; Nadkarni 1976; Ody 1993; Watt & Breyer-Brandwijk 1962).

It has been claimed that 5-20 drops of the essential oil taken orally will produce 'hallucinations' [Lawless (1994) wrote that it is 'narcotic in large doses'] and epileptiform convulsions, as well as irritating the liver and kidneys (Gottlieb 1992; Watt 1967). Fennel tea has been known to produce 'agitation' in children or newborns (Bilia et al. 2000b), though the essential oil has been reported to make animals 'timid'. Should not be used by pregnant women. The bitter fennel oils may cause skin irritation (Lawless 1994).

F. vulgare ssp. capillaceum seed [fruit] has yielded 4-7% essential oil, containing c.3-61% *estragole* [lowest in var. azoricum, var. dulce and cultivar 'bronze'], 1-65% *anethole* [highest in the previous varieties], *apiole*, 6-25% fenchone [lowest in var. azoricum], *myristicin* [not detected in wild plants, but found in var. dulce], 2-10% limonene, chavicol, 1-6% *pinene*, camphene, 10-nonacosanone and seselin. The bitter oils may contain 18-22% or more fenchone, while sweet oils contain little or none. Leaf essential oil of F. vulgare ssp. capillaceum var. azoricum contained mostly [c.65%] trans-*anethole*, with lesser amounts of limonene, *estragole*, fenchone, 10-nonacosanone and other compounds. F. vulgare ssp. capillaceum var. dulce leaf essential oil contained c.60% trans-*anethole*, 10% phellandrene, 2% *estragole* and other compounds. F. vulgare ssp. capillaceum cultivar 'bronze' leaf essential oil contained c.58% trans-*anethole*, 20% fenchone, 4% *estragole*, and other compounds. Leaf essential oils distinguish F. vulgare ssp. capillaceum var. vulgare into three chemotypes –

those dominant in *estragole*, those dominant in trans-*anethole*, and those dominant in both *estragole* and *anethole* (Harborne et al. 1969; Harborne & Baxter ed. 1993; Lawless 1995; Muckensturm et al. 1997; Nadkarni 1976; Tardy 1905b; Watt & Breyer-Brandwijk 1962). *Myristicin* has been reported from leaf of F. vulgare (Harborne et al. 1969). Teas made from F. vulgare ssp. capillaceum var. dulce fruits contained mainly trans-*anethole*, p-anisaldehyde, *chlorogenic acid*, and quercetin-3-O-β-D-glucuronide. The traditional method of infusing the crushed fruit [2.5g] in just-boiled water [150ml] was the most efficient in extracting these compounds, compared with decoction in a microwave-oven [which resulted in lower yields of trans-*anethole*, as well as a higher relative proportion of p-anisaldehyde (possibly due to degradation of trans-*anethole*) and the other compounds], infusion or decoction of uncrushed fruit, or infusion of commercial fennel tea-bags in warm water (Bilia et al. 2000b).

F. vulgare ssp. piperitum, an uncultivated perennial differing with its short, rigid-lobed leaves, and narrow umbels with small fruits, does not bear the typical fennel aroma, and yielded no *anethole* or other phenylpropenes of interest in one analysis (Muckensturm et al. 1997). A later study, using a greater variety of wild Italian specimens, found there to be at least 5 chemotypes. Aerial parts yielded 0.04-0.38% essential oil [w/w]. Plants from Bologna and Parma were dominant in trans-*anethole*, *estragole*, and α-phellandrene; plants from Catania were dominant in trans-*anethole*, α-*pinene*, and α-phellandrene; plants from Ancona, Firenze, Livorno, Macerata and Pesaro were dominant in *estragole* and α-phellandrene; plants from Brindisi, Caltanisetta, Napoli and Taranto were dominant mostly in *estragole*, as well as α-*pinene*; and plants from Bari contained mostly α-phellandrene. Fenchone, limonene, *camphor*, and many other compounds were present in small amounts. All of these except the Bari specimens were believed to be wild hybrid material (Piccaglia & Marotti 2001).

Foeniculum vulgare is a robust, erect perennial or biennial herb to 2.5m tall, highly aromatic when crushed [smell similar to aniseed – see **Pimpinella**]; stems striate, glabrous, sometimes glaucous, rigid when mature, conspicuously jointed at the nodes, branched, filled with a white spongy pith, developing a small hollow when old. Leaves alternate, +- triangular in general outline, to 45cm long, 3-4-pinnate with finely divided ultimate segments which are narrowly linear to capillary, filiform, acuminate, cartilaginous at apex, 5-50mm long, usually widely-spaced, and not lying in the same plane; petioles with conspicuous light-coloured V-shaped sheaths at base, petioles of upper leaves usually 3-6cm long; many leaves formed at base of plant, reducing in size and number at top. Inflorescences terminal compound umbels to 15cm diam., rays stout, 4-30, flowers yellow, 2-3mm diam., short-stalked; bracts and bracteoles usually none; sepals absent; petals 5, yellow, oblong, strongly inrolled, scarcely narrowed to involute apex; stamens 5; carpels (1-)2; ovules 1 in each loculus, pendent; styles (1-)2, often thickened at base. Seeds grey-brown or yellowish-brown, 2 sections 3-8(-10.5)mm long, narrowly ovoid or ovoid-oblong, scarcely compressed, pointed apex, rounded base, arched with 5 prominent ribs, aromatic and tasting of aniseed [in some chemotypes].

In open, sunny sites with moderate rainfall, common on roadsides, drains, park tracks etc.; native to s. Europe and w. Asia, now widespread as a weed in temperate areas worldwide; occurs prolifically in southern states of Australia, and to ½ way up the east coast (Parsons & Cuthbertson 1992; Tutin et al. ed. 1964-1980).

May germinate at any time of year, flowering through summer after reaching 18-24 months of age; sets seed in autumn and winter, dies back in winter (Parsons & Cuthbertson 1992).

GALBULIMIMA

(Himantandraceae)

Galbulimima belgraveana *(F. Muell.) Sprague* **(G. baccata** *F.M. Bail.***; G. nitida** *Sprague***; G. parviflora** *Sprague***; Eupomatia belgraveana** *F. Muell.***; Himantandra baccata** *(F.M. Bail.) Diels***; H. belgraveana** *(F. Muell.) Diels***; H. nitida** *Bak. f. et Norman***; H. parviflora** *Bak. f. et Norman***)** – agara, kombe, galbulimima

The leaves and bark of this tree are consumed by some tribal warriors in areas of Papua New Guinea, to make them fierce before battle. The Nokopo use its leaf to hold lime for painting the face of a male infant in his first initiation. The plant has been used as a drug in several ways. Some decoct the bark and leaves, and add this to an extraction of a **Homalomena** sp. ['ereriba'], the combination being drunk; some simply chew the bark and leaves of agara and leaves of ereriba together; some chew the bark by itself, and may also rub it on their legs to be absorbed through the skin. The effects consist of a 'violent intoxication' with 'spectacular visions', followed by a deep somnolent dream-like state, in which one can learn from spirits. The Gimi are known to chew the bark in order to enter trance "for information about puzzling situations or forthcoming events". The symptoms described are said to be the same with either of the substances [**Galbulimima** or **Homalomena**] alone (Emboden 1979a; Glick 1967; Hamilton 1960; Paijmans ed. 1976; Schmid 1991; Schultes & Hofmann 1980).

One person experimented with chewing 10g dried, powdered agara bark, swallowing the last of it after 10min. Effects manifested after 30min., with drowsiness, mydriasis, increased heart rate, impaired concentration and dizziness leading to a relaxed hypnagogic state, wearing off with some euphoria after c.2hrs (Thomas 2005).

G. belgraveana is very variable in chemical makeup, differing from one tree to the next even in the same patch. One study found 0.21% alkaloids in leaves, and 0.33% in bark. Plants from n. Queensland [Australia] contained 12 different alkaloids, but at least 28 different alkaloids have been found in the species. Main alkaloids isolated were himbacine [hypotensive, antispasmodic, antagonist of muscarinic *acetylcholine* M2 & M3 receptors], himgravine [hypotensive], himbosine [hypotensive, antispasmodic], himandrine [hypotensive, antispasmodic] and himbadine [antispasmodic]; other alkaloids include himbeline [depressant, hypotensive], himandridine [depressant, hypotensive, antispasmodic], himandravine [CNS depressant], himgaline [alkaloid G; antispasmodic], alkaloid GB.5 [alkaloid K; hypotensive], alkaloid GB.7 [alkaloid H; hypotensive, antispasmodic] and alkaloid GB.18 [alkaloid J; CNS depressant, hypotensive, weak antispasmodic] (CSIRO 1990; Hartley et al. 1973; Zholos & Bolton 1997). In an early screening, bark harvested in October [Boonjie, Queensland] tested strongly positive for alkaloids (Webb 1949). The fruits contain an essential oil with a **Juniperus**-like odour, as well as traces of alkaloids (Webb 1948).

Galbulimima belgraveana is a tree to 35m, to 60cm thick above buttresses; buttresses, if present, to 3m high, 1m wide, 5-20cm thick; bole straight and cylindrical; crown densely compact; outer bark grey to greyish-brown, often scaly and pustular; underbark mottled greenish to yellowish-brown, inner bark pale brown rapidly changing to red-brown when exposed, bitter-tasting and resinous-smelling; twigs +- terete, lepidote; twigs, undersides of leaves, petioles, inflorescence and fruit densely to sparsely covered with copper-coloured peltate overlapping scales. Leaves otherwise glabrous, papillose, glossy, yellow- to dark-green, entire, margins slightly recurved, ovate, oblong or elliptic, (5-)6-16 x (2-)3-8cm, apex rounded, obtuse, acute or acuminate, sometimes slightly retuse, base obtuse, acute or +- attenuate; midrib deeply sulcate above, strongly raised beneath, venation embossed on both surfaces, 8-20 pairs of nerves ascending towards apex; petiole 1-2.5cm long, channelled above. Flowers bisexual, solitary, axillary on peduncle with 2 small bracts, globose to ovoid in bud, 1-2 x 1-1.5cm prior to anthesis; peduncle 1-2.5cm long with bracts 2-3mm long; calyptrate calyx and corolla lepidote, irregularly circumsessile, rupturing near base; petals absent; stamens (13-130) and staminodes (inner 13-20; outer 20-23) white, linear-lanceolate, 1-2 x 5-15mm, stamens sometimes to 2.5cm long, stamens and outer staminodes reflexed, inner staminodes +- all erect, fleshy and tapering to apex, slightly dilated at base; anthers 1-2mm long, 1-2cm from base of stamens. Ovary superior, lepidote, globose, 1-2mm long, narrowing apically into style; single locule with solitary, ventrally attached ovule; carpels free, spirally arranged on conical receptacle; plumose styles free at first, later cohering into a gelatinous mass. Fruit 1.5-3cm diam., persistently scaly, reddish, fleshy, resinous smell, +- globose; single flattened seed in each carpel. Fl. & fr. throughout the year.

Canopy tree, especially in Nothofagus spp. forest, 5-2700m; Moluccas, New Guinea, New Britain, Australia [Qld.] (Womersley ed. 1978).

GALIUM

(Rubiaceae)

Galium aparine *L.* **(G. australe** *Reiche***; G. chilense** *Hook. f.***; G. chonosense** *Clos***; G. larecajense** *Wernham***; G. pseudoaparine** *Griseb.***; G. vaillantii** *DC.***)** – cleavers, goose grass, sticky weed, sticky willie, bedstraw, hug-me-close, bedstraw, hexenhaar, hexengarn

Galium dregeanum *Sond.* **(G. mucroniferum var. dregeanum** *(Sond.) Puff***)**

Galium odoratum *(L.) Scop.* **(Asperula odorata** *L.***)** – woodruff, sweet woodruff, odorous aspérule, cleavers, queen of the wood

Galium rotundifolium *L.*

Galium witbergense *Sond.*

G. aparine is a very common weed in many temperate zones, and its young leaves may be cooked and eaten like a vegetable. The seedpods may be roasted and ground to be used as a coffee-substitute [see **Coffea**], as they have been in Ireland. Clusters of the stem were also once used by Swedish peasants to filter milk (Low 1991b; Von Bibra 1855). Tea made from the dried leaves has been reputed to be effective against insomnia (Cribb & Cribb 1981). The herb is considered a diuretic tonic which may be used to treat eczema, psoriasis, sunburn, arthritis, urinary infection, gonorrhea and liver diseases, as well as stimulating the lymphatic system. The roots, like those of many other Rubiaceous plants, yield a red dye. In Germany, G. aparine has been known as 'hexenhaar' ['witches hair'] and 'hexengarn' ['witches yarn'], suggesting some association with magic. The related G. odoratum is added to liqueurs and fruit salads, and an infusion

of the leaf is antispasmodic, mildly sedative, diuretic and tonic to the liver. The fresh, bruised leaf has anticoagulant properties, and has been used as a poultice for wounds (Bremness 1994; De Vries 1991; Tierra 1988). In Belgium and Germany, aerial parts of G. odoratum gathered before flowering are fermented in sweet white wine for 2 days to produce 'Maitrank' ['drink of May', or 'May wine'], a beverage reputed to have inebriating properties beyond those of the alcohol content alone. Maitrank is consumed in festivals in late May, due to the seasonal nature of the main herbal additive (Aardvark 2001).

Amongst the Southern Sotho in Africa, a decoction of the roots of G. dregeanum and G. rotundifolium is used "to ensure intelligence and judgement in the aspirant witch-doctor". For medicinal purposes, the same preparations are used by the Sotho in Basutoland to treat sore throats, respiratory problems, and colic (Watt & Breyer-Brandwijk 1962). The Basuto have reportedly used G. witbergense ['seharane'] in combination with other plants, especially a suspected Myosotis sp. ['sethuthu'; see *Endnotes*], to treat people suffering from hysteria. The preparation is said to give them dreams of medicinal plants they must collect for their cure (Laydevant 1932). The Nkopo of Papua New Guinea use a Galium sp. ['yirk daap' or 'wung naap'] in a paste with other plants in secretive rituals called 'kwik' (Schmid 1991).

G. aparine whole plant was shown to contain c.0.03% alkaloids in one alkaloid screening (Hultin & Torssell 1965). Aerial parts from flowering plants [growing in Anatoli, Turkey] have yielded *harmine* and *protopine* as the major alkaloids, as well as (+-)-vasicinone, (-)-1-OH-deoxypeganine, and (-)-8-OH-2,3-dehydrodeoxypeganine [see **Peganum**] as minor alkaloids (Sener & Ergun 1989); also found in the herb are iridoids [asperuloside and monotropein (see **Monotropa**)] (Swiatek & Komorowski 1973), flavonoids [luteolin], coumarins, n-alkanes and tannins. Roots have also yielded iridoids [including asperuloside and deacetylasperulosidic acid], polyphenolic acids [including caffeic acid, p-coumaric acid, gallic acid and p-OH-benzoic acid], and anthraquinones [alizarin, xanthopurpurin and galiosin] (Wren 1988). Seedlings produce nordamnacanthal, an anthraquinone aldehyde with insect antifeedant properties, though levels decrease as the plants develop (Morimoto et al. 2002).

G. odoratum has yielded asperuloside, and c.1% coumarin (Bruneton 1995), which has hypnotic and sedative properties in large doses (eg. see MacRae & Towers 1984b).

G. verum also tested positive for alkaloids [0.03%], as did G. mollugo [0.003%] (Hultin & Torssell 1965). G. verum, G. mollugo, G. palustre and G. schultesii were shown to contain monotropein and asperuloside (Swiatek & Komorowski 1973).

Galium aparine is a sticky annual herb; stems (20-)80-180cm long, slender, weak, ascending or usually scrambling, especially over other plants, sometimes erect in open places, usually unbranched, retrorsely hispid, often stout and more hairy at the nodes, +- square, 4-angled cross-section. Leaves up to 20-60 x 3-8mm, in whorls of (4-)6-8(-9), linear to narrowly lanceolate or oblanceolate, cuspidate at apex, tapering to base, papillose-hairy above, margin and midrib retrorsely hispid, midrib sunk above, prominent below. Ultimate branches of inflorescence often without bracts; pedicels long, fruiting pedicels straight, divaricately spreading, 5-20mm long; small flowers in 1-3-flowered axillary cymes, becoming cymose-paniculate on older plants; corolla 1.5-1.7mm diam., white, rotate or slightly campanulate; petals 4, acute, involute, inflexed in bud; stamens (3-)4, filaments short; anthers small, exserted. Ovary ovoid, with hooked hairs, 2-celled, with 1 ovule in each cell; styles 2, short; stigma capitate. Fruit ovoid, 1.5-3.5(-5)mm wide, covered with short hooked bristles, separating into 2 indehiscent carpels, sometimes only 1 carpel maturing. Fl. Mar.-Aug. [n. hem.].

Woods, scrub, hedges, cultivated ground; native to Europe, except n.e. Russia and parts of the Arctic; otherwise a cosmopolitan weed (Abrams & Ferris 1960; Tutin et al. ed. 1964-1980; pers. obs.).

GANODERMA

(Polyporaceae/Ganodermataceae)

Ganoderma applanatum *(Pers. ex Wallr.) Patt.* – artist's conk, ancient ling zhi

Ganoderma capense *(Lloyd) Teng*

Ganoderma japonicum *(Fr.) Lloyd* **(G. lucidum var. japonicum** *(Fr.) Bres.***)** – Japanese glossy Ganoderma

Ganoderma lucidum *(W. Curt. ex Fr.) Karst* **(G. lucidum** *(Leyss. ex Fr.) Karst***; Polyporus lucidum** *Leyss. ex Fr.***)** – ling zhi, ling chih, mannentake, denguru shyamu, dhami chyau, jhankri cha, bonpo shamaup, mushroom of immortality, red reishi

Ganoderma neojaponicum *Imaz.* – purple-black reishi

Ganoderma oregonense *Murr.* **(G. sequoiae** *Murr.***; Polyporus oregonensis** *(Murr.) Kauffmann***)**

Ganoderma sinense *Zhao, Xu et Zhang* – zhi chih, zi zhi, Chinese black reishi

Ganoderma tsugae *Murr.* **(Polyporus tsugae** *(Murr.) Overh.***)** – song shan ling zhi ['pine tree fungus', 'pine wound']

G. lucidum has been highly revered in Chinese and Japanese medicine for at least 4,000 years, sharing a similar position of pride to ginseng [see **Panax**]. It was believed to constitute an elixir of immortality, and as such many of its common names translate to such praises as 'herb of spiritual potency', 'divine mushroom of immortality', and the Japanese '1,000 year mushroom' ['mannentake']. It may be that the reputation for life extension was in part derived from the hard, petrified consistency of the mushroom; likewise, its use in aphrodisiac elixirs may have stemmed partly from the hardness of its form. Such claims for giving immortality are no doubt exaggerated, but the mushroom's healing properties are by no means mythical. There are many Chinese legends telling of men being sent on perilous journeys to find a single 'ling zhi' as the last hope for a mortally ill master, succesful procurement of such a fungus bringing about a miraculous recovery when administered. Ling zhi has always been rare and difficult to find, growing often in dangerous and inaccessible forests. The rarest type is the 'antlered' form, an abnormal growth of self-explanatory shape, which forms when growing in darker spots high in carbon dioxide. Nowadays, the mushroom is still used in the far east, both for its numerous medicinal applications, and as a talisman to ward off evil. Cultivation techniques have been perfected, allowing greater public access to the wonderful benefits of this mushroom, as well as making it more affordable (Hobbs 1995; Rätsch 1990, 1992; Stamets 1993; Willard & Jones 1990). Recently in Nepal it has been found that Kirati, Sherpa and Tamang shamans use this mushroom for shamanic flying, though it is unclear whether it is consumed for this purpose or only invoked with its mantra - some consider it the 'strongest' shamanic mushroom, although it would not seem to be so from a western psychopharmacologic viewpoint. The species is also used in Nepal to "increase shakti" [spiritual energy], divine and diagnose illness [placed externally on the patient], and to revitalise the dying. It is said to be potentially dangerous if too much is taken or the correct mantra not used (Müller-Ebeling et al. 2002), although from a medicinal perspective it is known to be quite safe [see below].

Apparently, mountain gorillas are quite keen on G. applanatum. Dianne Fossey observed these creatures gnawing on the fungus even when still attached to the host tree, due to their difficulty in removing the fruiting bodies. When they do suceed in removing a specimen, the gorillas will often bicker over the rights to its possession (Schaecter 1997).

In Vietnam, and some other parts of s.e. Asia, G. australe and G. lucidum are said to sometimes be used by thieves to drug their victims, in order to rob them quietly (Heim 1963b). Incidentally, there exists a church in Chignahuapan, Puebla [Mexico] where a specimen of G. lobatum is venerated in a shrine; on its undersurface is sketched the crucified Christ, with the sun and the moon on either side (Guzmán 1990). This illustrates a characteristic of Ganoderma spp. – when still fresh, contact with the porous underside of the cap causes a darkening due to surface bruising, allowing pictures to be drawn with a fingernail or stick.

G. lucidum has many actions on the body. It is considered an adaptogen [protecting from biological, environmental and social stress], reduces blood fat, stimulates and strengthens the immune system, lowers high blood pressure, and acts as a peripheral anticholinergic, muscle relaxant, analgesic, antiinflammatory, antiallergenic [inhibits *histamine* release], antioxidant free-radical scavenger [also oxygenating the blood, which alleviates elevation sickness], antiviral, cardiotonic, expectorant, antitussive, liver protectant and detoxifier. It improves adrenocortical function, treats heart disease, inhibits platelet aggregation, inhibits bacteria [Bacillus pneumoniae, Staphylococcus spp. and Streptococcus spp.], acts as a preventative against bronchitis [also inducing regeneration of bronchial epithelium], and increases RNA & DNA synthesis in bone marrow where immune cells are made. It has antitumour, anti-HIV, and slight antiulcer activity. It also protects against ionising radiation, if taken before and after exposure. As part of the complex immune system activity, extracts of the mushroom augment immunoglobulin G, expand memory of T cells and enhance their activity, and aid in immune-related sensitivities such as chronic pneumonia, liver disease, cancer and rheumatism (Hobbs 1995; Willard & Jones 1990).

The mushroom may also be mildly psychoactive, with effects usually described as a CNS-depressant or hypnotic (Hobbs 1995; Stamets 1999; Willard & Jones 1990). Though my own experiments with G. lucidum, G. applanatum, and what was thought to have been G. sinense confirm the mild sedative-hypnotic effects [with some batches more than others], a friend has experienced opposite effects, finding the suspected G. sinense to be very stimulating, even euphoric. This could probably not be explained by placebo effect, as I had told her that the only psychoactive effects she would experience might include mild sedation or calming [I had given the mushroom to her as a tonic medicine, rather than as a psychotrope] (pers. obs.). However, others deny that Ganoderma spp. are psychoactive at all (Rätsch pers. comm. 2002).

Ganoderma spp. are very non-toxic, and the amount to be consumed depends on the severity of the need for healing. If one is fortunate enough to have good quality specimens, about 5g may suffice for a regular dose. In case of greater illness, more than twice this amount may be used, though less is required when appropriately blended with other healing herbs. One

source recommends a decoction of 120-200g to treat mushroom poisoning. Ganoderma spp. are usually prepared by chopping or grinding to powder, though they are quite tough and soaking before hand may be useful. The mushroom is then decocted in water for 20-30 minutes, and the water consumed after cooling. A good specimen will yield several more brews from the same batch. The mushrooms may also be prepared in a tincture. The best quality is usually found with G. lucidum [harder to find; generally reddish in colour], though G. japonicum, G. neojaponicum and G. sinense share similar properties and potency, and are more readily available. The other species listed above also have medicinal properties of a similar nature, though less potent and less wide-ranging in activity. G. applanatum, for example, may require a decoction dose of 30g or more. The antlered forms are considered even better than the normal forms of G. lucidum, and caps of Ganoderma spp. are more potent than stems. When shopping for whole specimens, look for a smooth, glossy surface with no insect damage, preferably also with undamaged spore surface beneath the cap. Many people feel cleansed and refreshed after a cup of Ganoderma tea, and find the health-giving effects quite noticeable. Like all tonic and medicinal herbs, it is best consumed regularly over an extended period (pers. comms.; pers. obs.).

G. applanatum has yielded ganoderic acid AP, ganoderenic acids F, G, H & I, furanoganoderic acid, applanoxidic acids A-D and isoergosterone (Buckingham et al. ed. 1994).

G. capense cultured mycelium has yielded the pyrrole alkaloids ganoine and ganodine, the purine alkaloid ganoderpurine (Yu et al. 1991), *adenosine*, adenine, uracil and uridine (Zhang et al. 1986), a sleep-promoting substance also known as SPS-A (Komoda et al. 1990).

G. lucidum contains a wide array of chemical types, most of which synergise to produce the above effects. Isolated have been an unknown alkaloid, an unknown glycoprotein, polysaccharides [ganoderans A, B & C, β-D-glucan, β-D-glucan D-6, GL-1, FA, FI & FI-1a], *adenosine*, a protein [LingZhi-8], a steroid [ganodosterone], triterpenes [ganoderic acids, ganodermic acid, ganodermadiol, ganodermanodiol, ganodermenonol, lucidal, lucidadiol, ergosterol, fungisterol] and oleic acid (González et al. 1999; Hobbs 1995; Willard & Jones 1990).

Ganoderma applanatum is a very large grey-brown bracket fungus, 10-60cm across, 5-30cm wide, 2-8cm thick, +- flat, semicircular, hard, corky and glabrous, margin acute; upper surface knobbly, radially wavy or wrinkled, concentrically grooved and zoned, broadly attached, sessile, covered with a hard, wrinkled crust, often discoloured reddish- or cocoa-brown from deposited spores; flesh cinnamon-brown, thinner than the tube layer, bitter taste, very tough and fibrous; pores 4-5 per mm, white, bruising brown, circular; tubes 7-25mm long in each annual layer, brown; spores brown, warty, broadly ellipsoid, flattened at one end; basidia 4-spored.

Infrequently throughout the year, parasitic on trunks of broad-leaved trees, particularly beech, causing an intensive white rot; also grows on bamboos and conifers. Common throughout US, infrequent in Europe, also found in Australia [ACT, NSW, Vic, Tas] (Hobbs 1990; Jordan 1995; Phillips 1981; Shepherd & Totterdell 1988).

Ganoderma lucidum is a large, mahogany-brown to reddish, kidney-shaped bracket fungus arising from a lateral stem. Cap 4-30cm diam., 2-4cm thick, fan or kidney-shaped, margin pallid when young, +- flattened, radially wavy or wrinkled, concentrically grooved and zoned, later turning purple-brown or blackish, conspicuously glossy as if varnished; flesh cinnamon-brown, tough and fibrous, velvety; stem up to 250 x 10-30mm, dark brown, glossy, hard, hollow, stuffed with fibrous, velvety flesh; pores white, bruising brown, becoming brown with age, circular, 4-5 per mm; spores rusty pallid-brown, warty, broadly ellipsoid, flattened at one end; basidia 4-spored. Taste bitter. Summer to late autumn.

Solitary or in small groups on stumps of broad-leaf deciduous trees, favouring oak in Europe, though most wild specimens in Japan are found on old plum trees [see **Prunus**]. Europe, Asia, also on east coast of US, especially the Gulf coast and the southwest. Rare (Hobbs 1995; Jordan 1995; Phillips 1981).

The mushroom Microporellus dealbatus, of s.e. North America, resembles a ghostly white form of G. lucidum or similar Ganoderma spp. It is not regarded as being edible, but there is no record of toxicity, probably due to its hard consistency, which would tend to discourage ingestion.

GAULTHERIA

(Ericaceae)

Gaultheria anastomosans *(L. f.) Kunth* – borrachero
Gaultheria procumbens *L.* – wintergreen, checkerberry, boxberry, teaberry, mountain tea, salvador tea
Gaultheria sp. – uva camarona

In the Peruvian Andes, an unidentified Gaultheria sp. ['uva camarona'] is said to have been used as a hallucinogen, though there is little solid information on the plant and its use (Schultes & Hofmann 1980, 1992). In Colombia, G. anastomosans is known as 'borrachero' ['intoxicant'], hinting at psychotropic useage (Rätsch 1992). They are related to the common N. American G. procumbens, the leaves of which were made into a refreshing tea [see **Camellia**] during the War of Independence. The Inuit of Labrador, Canada, eat the berries as food, and use the leaves to treat paralysis, headache, muscle aches and sore throats. The Cherokee use the root to treat indigestion, and the leaf to treat cold; they have also chewed the leaves as a tobacco substitute [see **Nicotiana**] and to treat dysentery. The berries are sometimes used today in tarts and cakes. The essential oil ['oil of wintergreen', 'wintergreen oil'] is used to flavour sweets, toothpaste and root beer [see **Sassafras**]; it is stimulant, astringent, antirheumatic and diuretic (Bremness 1994; Frohne & Pfänder 1983; Hamel & Chiltoskey 1975). It is now considered toxic due to its content of methyl salicylate [see below]. Although for many people it is not a problem, one child died after ingesting 4ml methyl salicylate, and another child experienced "severe metabolic acidosis" from 10ml; other deaths have been reported. Symptoms of toxicity may include nausea, vomiting, convulsions, pulmonary oedema, pneumonia and acidosis (Battaglia 1995).

G. procumbens essential oil contains 96-99% methyl salicylate [a naturally-occuring precursor to aspirin (acetylsalicylic acid), the other being salicylic acid], formaldehyde and gaultheriline. Methyl salicylate is not actually found in the plant, yet it is formed by hydrolysis from the glycoside gaultherin [monotropitoside] (Frohne & Pfänder 1983; Lawless 1995) when the leaves are macerated in water for 24hrs before steam distillation of the oil (Bremness 1994).

Gaultheria procumbens is an erect shrub 10-20cm tall, leafy stems arising from a horizontal rhizome, bearing a few leaves crowded near summit. Leaves alternate, persistent, glabrous, elliptic-oblong, 2-5cm long, 1/3-2/3 as wide, rarely narrower or subrotund, margin entire or crenulate; petioles 2-5mm long. Flowers 5-merous, usually white, in racemes or panicles, or solitary in or just above axils, closely subtended by 2 bracteoles; pedicels nodding, 5-10mm long; calyx saucer-shaped, deeply divided; corolla tubular to campanulate, shallowly lobed, 7-10mm long, the rounded lobes c.1mm long; stamens included, filaments short, flat; anthers oblong, the pollen-sacs nearly or quite separate, each tipped with 2 erect appendages. Ovary 4-5-celled, wholly or partly superior; style short, columnar; stigma truncate. Fruit a dry or mealy bright red berry, 7-10mm diam. Fl. Jul.-Aug.

Dry or moist woods, in acidic soil; Newfoundland to Manitoba, s. to Virginia, Kentucky and Minnesota, and in mountains to Georgia (Gleason 1952).

GEOTRICHUM

(Moniliaceae)

Geotrichum candidum *Link. ex Fr.* **(Endomyces geotrichum** *Butler et Petersen***; Oidium lactis** *Pers.***; Oospora lactis** *(Fres.) Sacc.***)** – lipstick mould, sour rot, rubbery rot

G. candidum is a mould fungus that may cause sour-rot in some fruits, particularly lemons and limes [see **Citrus**], as well as tomatoes. The fungus usually only invades damaged fruit, and is spread by Drosophila spp. flies, though it can also be spread by human contact. It sometimes spoils cream and UHT milk if manufacturing machinery is poorly cleaned, and has likewise been found in margarine, cottage cheese and low-fat cheese. Sometimes it is found as a wood-decayer on interior painted surfaces. It may commonly infest the intestines of carpet pythons [Morelia spilota variegata], and sometimes causes necrosis of the scales and underlying skin in captive specimens; such an infection calls for immediate intensive cleaning of the snake's habitat, and veterinary attention (Hocking & Pitt 1996; McKenzie 1996; Simpson 1996).

G. candidum has been shown to yield the ergot alkaloids *ergine*, *elymoclavine*, *agroclavine* and ergosine [see **Claviceps**, **Ipomoea**] (El-Refai et al. 1970), as well as wybutoxine (Buckingham et al. ed. 1994). Ingestion of the fungus would be unwise, as it may contain aflatoxins [see **Aspergillus**], and can cause a disease known as 'geotrichosis', affecting oral, bronchial, pulmonary and/or intestinal parts of the body. Inhalation of the spores can cause chronic asthma (Hocking & Pitt 1996; Stamets & Chilton 1983).

Geotrichum candidum mycelial turf is cushion-like, somewhat powdery, white, with age becoming pinkish to reddish, and later dull orange; hyphae prostrate, with few septa; conidiophores short, erect, septate, producing conidia in chains at their apices; conidia short, cylindrical, truncate at both ends, 5-10 x 4μ, hyaline (Gilman 1957; Stamets & Chilton 1983). When rotting **Citrus**, it usually affects mature or over-ripe fruit that has been stored for a long time, first appearing as a pale, soft area of decay, later developing into a creamy, slimy surface growth. In tomatoes, it appears as light greenish-grey lesions which may extend from end to end of the fruit; plant tissue later weakens and gives off a sour odour, and the creamy-white mould may become visible on the flesh.

Grows best at 25-30°C, growth largely inhibited below 5°C; can grow to some degree in anaerobic conditions. Found worldwide in soil (Hocking & Pitt 1996).

GINKGO

(Ginkgoaceae)

Ginkgo biloba *L.* – ginkgo, maidenhair tree, bai guo, ying hsing, yen xing, pei go su, silver apricots

This is the oldest surviving species of tree, which 200 million years ago shared the planet with dinosaurs. Its range was drawn back into the region of China during the last ice age, where it later became much used in traditional medicine, and was cultivated around Buddhist and Taoist temples; in Japan it is also held sacred and was planted at Shinto temples. The plant is generally found only in cultivation today. Its wood, which has been used to manufacture fine items, repels insects, and the whole tree is remarkably resistant to pests, diseases and pollution. In TCM, the root ['bai guo gen'] is decocted in doses of 10-15g to treat spermatorrhoea or wet dreams; the nut kernels ['bai guo', 'ying hsing'] are decocted in a dose of 10-15g, and have an affinity for the kidneys, heart and lungs. They are sedative, antitussive, astringent, cardiotonic, digestive, anthelmintic, and an 'antidote' for alcohol poisoning. They are eaten as a food in Asia, and are served in Japanese bars to eat while drinking cold beer; in Japan, the grilled nuts are believed to be a male aphrodisiac. A few days after falling from the mother plant, the outer layer of the kernels begins to decompose, emitting a rancid odour; contact may cause skin-irritation. The nuts must be cooked before becoming edible, and consumption of more than 7 at one sitting may cause toxic symptoms. Western medicine is concentrating mostly on the leaves ['yen xing', 'pei go su'], which have been used in many ways by the Chinese – externally for skin sores and freckles, and internally for asthma, coughs, diarrhoea, frostbite, and to benefit the brain. Ginkgo is said to have been an ingredient of the famed 'soma' [see **Amanita**] (Corrigan 1993; Huang 1993; Keys 1976; Rätsch 1990).

Today, the demonstrated benefits of ginkgo leaf are impressive. It improves peripheral circulation, particularly increasing blood flow to the brain, acts as a neuroprotective agent [eg. against hypoxia, seizures and peripheral nerve damage], acts as an antioxidant free-radical scavenger, inhibits blood-platelet aggregation, increases synaptosomal *serotonin* reuptake, and increases synthesis of *dopamine* and *norepinephrine*. An extract from the yellow autumn leaves also strengthens blood vessels. Ginkgo leaf may be useful in treating vertigo, headache, impaired memory, stroke, senility, dementia, shock, asthma, coronary thrombosis, tinnitus, bladder infections and burns; as well as boosting the immune system and improving cerebral function [alertness, learning, and biofeedback with the endocrine system] (Bremness 1994; Bruneton 1995; Corrigan 1993; Fünfgeld ed. 1988; Huang 1993; Joyeux et al. 1995; Ramassamy et al. 1992; Smith, P.F. et al. 1996).

Ginkgo should not be taken with aspirin, paracetamol, *ergotamine*/*caffeine* combinations, or warfarin, as haemorrhage may result due to drastic increase in blood flow. When taking ginkgo, the diuretic thiazide should not be taken, as hypertension may result (Fugh-Berman 2000). The ginkgolic acid in leaf preparations may cause 'poison-ivy like' toxic reactions, and commercial preparations should not contain more than 5ppm ginkgolic acid (Blumenthal ed. 1998). Some commercial ginkgo preparations have unexpectedly been found to contain colchicine in levels that may damage the foetus in pregnant women (Nielsen 2001). This may be a contaminant of some compound preparations; colchicine has otherwise not been reported from G. biloba itself (pers. obs.). The seeds have caused toxicity when consumed in excess, such as in cases of 'gin-nan food poisoning' in Japan, when they have been eaten as a famine food. Symptoms usually include convulsions and unconsciousness, and sometimes death results; animals have also developed limb paralysis and auditory hyperalgesia. As would be expected, infants are more vulnerable to the toxicity. The toxicity is due largely to 'ginkgotoxin' [4-O-methylpyridoxine], possibly acting by inhibiting formation of *GABA* from *glutamic acid* in the brain, as well as antagonising vitamin B6 (Wada et al. 1988).

G. biloba leaves have yielded 0.2-0.53% sesquiterpenoids, partially consisting of the ginkgolides and bilobalides; as well as flavonoids, such as kaempferol [MAOI, protects against NMDA-induced neurotoxicity], quercetin and isorhamnetin derivatives [isorhamnetin also acts as an MAOI], amentoflavone [BZ-receptor agonist], epicatechin acetate, epigallocatechin, ginkgetin, isoginkgetin, bilobetin, bilobalone, stigmasterol, β-sitosterol, d-glucaric acid, anacardic acid, shikimic acid, ginkgolic acid [ginkgoic acid; 6-(8-pentadecenyl)salicylic acid] and derivatives of zeatin. Terpene levels are highest in leaves [ginkgolide A and bilobalide reaching a maximum at the end of summer and beginning of autumn]; roots and shoots yield lower levels [0.24% and 0.02-0.09%, respectively], decreasing as the plant ages. Seeds have yielded c.0.01% 'ginkgotoxin', ginkgolic acid, 6-tridecylresorcylic acid, 6-(pentadec-8-enyl)resorcylic acid, glucose, fructose, sucrose, fat, protein and starch (Blumenthal ed. 1998; Bruneton 1995; Corrigan 1993; Flesch et al. 1992; Fünfgeld ed. 1988; Huang 1993; Lobstein-Guth et al. 1989; Rastogi & Mehrotra ed. 1990-1993; Sloley et al. 2000; Wada et al. 1988).

Ginkgo biloba is a large resinous tree to 40m tall, straight, glabrous, with grey bark. Leaves deciduous, alternate, partly in clusters of 3-5 on spurs, slender-stalked, flat, fan-shaped, +- incised or divided at apex, usually bilobed, fern-like, up to 5-7.5cm across, veins parallel. Flowers dioecious, the staminate in catkin-like strobili; anthers borne in stalked pairs on a slender axis; female flowers on long stalks, usually with 2 ovules, scales absent, fecundation by mobile sperm-cells. Fruit drupe-like, obovoid to ellipsoid, c.2.5cm long, with a yellow epicarp and a pulpy, ill-smelling pericarp; kernel ovoid, angular, white.

Common in gardens; Japan, all over China (Borrell 1996). Many trees cultivated as ornamentals are males, to avoid the annual pile-up of smelly fruit. For propagation, collect fruit after falling, remove the pulp [with rubber gloves on] and clean the seed under running water and with scrubbing in fine sand [this should be done outside or in a well-ventilated area]. Plant in moist sand kept at 15-21°C for several months [during this time the embryo develops fully], then lower temperature to c.4°C for another few months, during which the seedling should emerge. Can also be propagated from cuttings of the hardwood, taken in winter. Frost hardy and resistant to pollution (Glowinski 1997). Trees do not produce sexual organs until 20-30 years old (Corrigan 1993).

G. biloba can not be mistaken for any other tree, and its soft, leathery leaves are a pleasure to harvest.

GLYCYRRHIZA

(Leguminosae/Fabaceae)

Glycyrrhiza glabra *L.* **(G. glandulifera** *Waldst. et Kit.***; G. hirsuta** *Pall.***; G. violacea** *Boiss.***)** – liquorice, licorice, sweet wood, palu dushi, yashti madhu

Glycyrrhiza inflata *Batalin* **(G. eurycarpa** *P.C. Li***)** – gan cao, Chinese licorice

Glycyrrhiza uralensis *Fisch. ex DC.* **(G. asperrima var. desertorum** *Regel***; G. asperrima var. uralensis** *Regel***; G. glandulifera** *Ledeb.***)** – gan cao, gan tsao, mi tsao, guo lao ['venerable national treasure'], Chinese licorice, Manchurian licorice

Liquorice is a herb that has been cultivated for centuries for its sweet, medicinal root. Used since at least 500BC, the Scythians are said to have introduced it to the Greeks, and it spread across the world from there. It has commonly been used as a sweetener and flavouring in sweets, medicines, foods, tobacco [a food and medicine for some – see **Nicotiana**], soft drinks, liqueurs, soy sauce, beers, toothpaste, mouthwash etc. (Bremness 1994; Fraser 1995; Morton 1977; Ody 1993). Liquorice root [usually G. glabra] has long been used in Ayurvedic medicine, and the Ayurvedists seem to have recognised the same virtues in it that the Chinese have [see below]. They likewise use it for respiratory [combines well with ginger – see *Endnotes*], digestive, nervous and circulatory complaints. They consider it a "restorative and rejuvenative food… [which]… calms the mind, nurtures the spirit; nourishes the brain and increases cranial and cerebrospinal fluid, promoting contentment and harmony; improves voice, vision, hair and complexion and gives strength" (Frawley & Lad 1986). In women, it is said to be an aphrodisiac (Rätsch 1990). In TCM, liquorice root [usually G. uralensis or G. inflata] is used in most herbal formulas as a kind of 'co-ordinator' for the other herbs, as it has an affinity for all the organs, and harmonises and prolongs the effects of the other constituents – as well as, of course, improving the overall taste (Huang 1993; Reid 1995; pers. obs.). *Glycyrrhizin*, the major constituent of the root, is roughly 50 times sweeter than sugar (Morton 1977)!

Liquorice root stimulates the adrenal cortex and reduces vitamin C levels there, stimulates interferon production [leading to activity against tumour-production and hepatitis], can potentiate and prolong cortisol action, and inhibits release of melanin-stimulating hormone from the pituitary. It is expectorant, sedative, tonic, antiinflammatory, anticonvulsant, demulcent to lungs and bronchi, emmolient to stomach ulcers, antipyretic, laxative, diuretic, antitussive, strengthens the immune system and reduces cholesterol and blood sugar. It is also effective in protection against many toxins by transforming them in the liver to insoluble products [see *glycyrrhizin* and glycyrrhinic acid below], and protects liver function. It can inhibit the production of antibodies, which is useful in organ transplants (Bremness 1994; Huang 1993; Reid 1995). In rats, a rhizome extract was hypotensive, and countered the effects of barbiturate-induced narcosis (Rastogi & Mehrotra ed. 1990-1993). The Chinese once used liquorice to treat poisoning from 'henbane' [see **Hyoscyamus**] and **Datura**, and decocted with soy beans [Glycine max] it has been used as a broad-spectrum antidote for poisons. It is now known to also have a 'detoxifying' effect on chloral hydrate and *cocaine* hydrochloride (Chin & Keng 1990).

The rhizome has shown adverse reactions with some pharmaceutical drugs. Interaction with oral contraceptives may cause hypertension, oedema, and hypokalaemia; taken with hydrocortisone, vasoconstriction may result; the drug also potentiates prednisolone, and they should not be combined (Fugh-Berman 2000). Liquorice may usually be taken in doses of 2-30g. It may be decocted or infused, though more is needed for infusions, and infusions can be performed more times on the same batch of herb. Continuous use can lower metabolism, decrease thyroid func-

tion, and lead to water retention, hypertension and potassium depletion. People with cardiac or kidney problems, hypertensives, overweight people and those having difficult pregnancies should avoid using liquorice too much (Chevallier 1996; Huang 1993; International...1994; Keys 1976; Morton 1977; Watt & Breyer-Brandwijk 1962). Some people claim it potentiates their *mescaline* experiences (pers. comm.), which may be related to the little-known MAOI activity of some liquorice constituents [ie. *glycyrrhizin*, glycyrrhisoflavone, glicoricone, genistein, glycocoumarin, licopyranocoumarin, licocoumarone, licofuranone, licochalcone A, licochalcone B, liquiritigenin, isoliquiritigenin and (-)-medicarpin] (Hatano et al. 1991; Pan et al. 2000; Tanaka et al. 1987).

G. glabra root yields 5-20% *glycyrrhizin*, occurring as the calcium and potassium salts of glycyrrhinic acid; after water hydrolysis it gives 1 molecule of glycyrrhetic acid [glycyrrhetinic acid] and 2 of glucuronic acid. *Glycyrrhizin* is an acidic triterpene glycoside, with structural similarity and similar activity to corticosteroids – it protects against saponin toxicity and is antitussive and antibacterial (Bruneton 1995; Huang 1993; Morton 1977; Segal et al. 1977; Watt & Breyer-Brandwijk 1962). Glycyrrhinic acid can lower the toxicity of *strychnine*, *histamine*, arsenate, snake venom, diptheria toxin, tetanus toxin and others (Huang 1993). Also found are the coumarins umbelliferone, herniarin and licopyranocoumarin; the flavonoids *apigenin*, liquiritin, isoliquiritin [both oestrogenic], neoliquiritin, liquiritigenin, isoliquiritigenin, rhamnoliquiritin, rhamnoisoliquiritin and formononetin; the glycosides liquiritoside and isoliquiritoside; licochalcones A & B, licocoumarone, licorione [inhibits gastric secretion, anti-ulcer], FM 100 [anti-ulcer, lowers gastric acidity and secretions], LX [immunosuppressant], 18-β-glycyrrhetic acid [antitussive], 28-OH-glycyrrhetic acid, glycyramarin [bitter principle], 22,23-dihydrostigmasterol, asparagin and many other compounds. The root may also contain c.20% starch, 3.8% glucose, 2.4-6.5% sucrose and 0.8% fat (International… 1994; Morton 1977; Watt & Breyer-Brandwijk 1962). Canavanine has been found in the seeds of this species, as well as in G. echinata (Bell et al. 1978; International... 1994).

A Glycyrrhiza sp. from n.w. China, used medicinally in Japan as 'seihoku-kanzo', yielded glicoricone, licofuranone, licopyranocoumarin, echinatin and genistein (Hatano et al. 1991).

Plants grown in saline soils contained greater concentrations of *glycyrrhizin*, compared to those grown in non-saline soils. *Glycyrrhizin* was found to increase in concentration in the roots as the plant grew, though there was no significant seasonal variation; highest concentrations were found in the top parts of the roots, as well as the horizontal rhizomes and other side-roots (Lerman 1972). In Japan, G. glabra [seeds sown in April, 38°N] roots were highest in isoliquiritigenin glycosides in October, though *glycyrrhizin* content continued to increase until November. Three year old plants were also richest in active constituents in October harvests. Thicker roots were the most potent (Hayashi et al. 1998).

Glycyrrhiza glabra is a perennial herb, glandular and often viscid; stems 50-100cm, stem & petioles pubescent, sometimes scabrid. Leaves imparripinnate; leaflets 9-17, 20-40(-55)mm long, elliptical, ovate to oblong, obtuse, sometimes mucronate, often viscid; stipules membranaceous, caducous. Inflorescence lax, elongate racemes; racemes exceeded by their subtending leaves, at least at anthesis; calyx weakly bilabiate; corolla strongly zygomorphic, whitish-violet, 8-12mm; 5 petals, 2 or more sometimes connate; stamens more than 5, diadelphous or monadelphous. Ovary a single unilocular carpel; style 1. Legume up to 30mm, linear-oblong, compressed, straight, glabrous or glandular-setose, sutures straight, indehiscent or tardily dehiscent. Seeds (2-)3-5.

G. glandulifera *Waldst. et Kit* refers to variants with glandular-setose legumes (Tutin et al. ed. 1964-1980).

Dry, open habitats; s. & e. Europe, w. Asia; cultivated and frequently naturalised.

May be grown from seed [soaking in conc. sulfuric acid for 30min. is said to aid germination (theobromus pers. comm.)]; usually from root cuttings or division. Plant in fertile, prepared soil 60-120cm apart. Likes deep, moist well-drained soil. Roots [rhizomes] are harvested in autumn, before the plants set fruit, from 3-4 year old plants. Plant tops are high in nitrogen, and make excellent compost. Remnants of roots are usually left in the ground to regenerate. Roots are washed and shade-dried, reducing moisture content from 50% to 10% (Morton 1977).

Members of this genus have strong weedy potential, due to their deep and vigorous root growth. Once a plant has become established it can be very difficult to remove completely, as even small pieces of buried root can later regenerate (pers. obs.).

GNAPHALIUM

(Compositae/Asteraceae)

Gnaphalium obtusifolium *L.* **(G. polycephalum** *Michx.***)** – sinjachu, rabbit tobacco, ladies tobacco, everlasting, life everlasting, makawiririotapanahi

Gnaphalium polycephalum *L.* – white balsam, old field balsam, sweet-scented life everlasting, Indian posy

Gnaphalium uliginosum *L.* – marsh cudweed

G. obtusifolium has been smoked in N. America as a milder, more aromatic substitute for tobacco [see **Nicotiana**], acting as a mild narcotic-hypnotic, causing dizziness in the uninitiated. The flowers have also been used as a pillow stuffing to ease insomnia (Emboden 1979a). The Cherokee use the plant as a decoction for colds, and as an antispasmodic. It is applied as a local anaesthetic, smoked for asthma, and made into a syrup for coughs. For persons suffering from diptheria, the decocted liquid may be blown down the throat through a **Eupatorium** stem (Hamel & Chiltoskey 1975). The Winnebago blow its smoke to revive a sick person (Kindscher & Hurlburt 1998). Other native N. Americans have used the leaves as a poultice for bruises. G. keriense of New Zealand is also used to treat bruises in the same way (Usher 1974).

G. uliginosum is used in Russia to treat high blood pressure, and is sometimes taken in parts of the British Isles to relieve catarrh. The plant is reputed to have aphrodisiac and antidepressant properties (Chevallier 1996). Juice of G. polycephalum is also reputed to have aphrodisiac properties, and the herb has been used in N. America as an astringent and diaphoretic (Felter & Lloyd 1898). G. luteoalbum ['jersey cudweed', 'karkar'], a widespread weed in Australia, was decocted by indigenous people of the Mitchell River region [Queensland] to treat general conditions of sickness (Lassak & McCarthy 1990). In Meghalaya, India, it is used to make flower wreaths and garlands for use in 'graveyard ceremonies' (Neogi et al. 1989). The Suto of southern Africa burn G. luteoalbum and G. undulatum in a room to drive away sickness. G. luteoalbum has been suspected of causing stock intoxications, but feeding experiments with rabbits did not reveal any toxicity (Watt & Breyer-Brandwijk 1932).

G. obtusifolium aerial parts have yielded 0.1% gnaphaliin [5,7-dihydroxy-3,8-dimethoxyflavone] and 0.01% methylgnaphaliin (Hänsel & Ohlendorf 1969; Opitz et al. 1971); obtusifolin and 3,5,7-trihydroxy-6,8-dimethoxyflavone have also been found in the plant (Buckingham et al. ed. 1994).

Gnaphalium obtusifolium is an annual, sometimes biennial, fragrant erect herb, c.10-80cm tall; stem thinly white-wooly, commonly becoming subglabrous or sometimes a little glandular towards base. Leaves alternate, numerous, entire, linear-lanceolate, to c.10 x 1cm, obtuse to acuminate, sessile, white-wooly beneath, above green, from glabrous to slightly glandular or slightly wooly above. Inflorescence panicle-like, branched and many-headed except in depauperate plants, flat- or round-topped and often elongate, the final clusters with the heads somewhat glomerate, disciform; involucre campanulate, yellowish-white or somewhat dingy, wooly only near base, c.5-7mm high, bracts +- imbricate, scarious at tip or nearly throughout; flowers yellow-whitish, numerous outer ones slender and pistillate, the few inner ones coarser and perfect; corolla tubular; anthers caudate; style-branches rounded or truncate, exappendiculate. Pappus of capillary bristles, sometimes thickened at summit, sometimes united at base; pappus-bristles distinct, falling separately. Achenes glabrous, small, terete or slightly compressed. Fl. Jul.-Oct.

Open, often sandy places; Nova Scotia to Manitoba, south to Florida and Texas.

G. obtusifolium var. saxicola is a lax, slender form less than 25cm tall, leaves wider and less wooly beneath, involucre usually less imbricate.

Along cliffs and ravines in south central Wisconsin (Gleason 1952).

GOMORTEGA

(Gomortegaceae)

Gomortega keule *(Mol.) Baillon* **(G. nitida** *R. et P.***; Lucuma keule** *Mol.***)** – keule, queule, hualhual

The Mapuche of Chile consume the fresh fruit of this small tree for its intoxicating, perhaps entheogenic, effect; it is also made into chicha [see *Methods of Ingestion*]. The fresh fruit is richer in essential oil than the dried fruit, and is considered more potent than the latter. Little else is recorded of this plant, the entire range of which is within 160 square kilometres in central Chile (Emboden 1979a; Rätsch 1998; Schultes & Hofmann 1980).

G. keule bark has yielded 6,8-dimethoxy-coumarin and 8-OH-6-MeO-coumarin (Espinoza et al. 1982). Some coumarins have sedative-hypnotic activity in large doses (MacRae & Towers 1984b).

Gomortega keule is a tree to 15m tall, copa pyramidal; trunk erect, cylindric, to 60cm diam.; bark greyish, rugose, with small, deep, longitudinal fissures; branches long, perpendicular to trunk, ascending towards apex; branchlets smooth, glabrous, green-yellowish to greyish. Leaves perennial, simple, opposite, decussate, coriaceous, fragile, aromatic, dark-green on upper side, light-green beneath, 5-10 x 2-4.5cm, oblong-lanceolate, ovate-elliptic to lanceolate, base attenuate, margin entire, slightly revolute; nerves prominent, secondary nerves immersed; petiole to 8-15mm long, 2-2.5mm thick, with ferrugineous hairs on underside. Inflorescence racemose, few-flowered, with (3-)7(-9) flowers, 3.5-5cm long, curving downwards; rachis and peduncle pubescent, rachis compressed, slightly

quadrangular; flowers hermaphroditic, creamy-green, 5-7mm diam.; perigonium of 6-8 unequal tepals, 2.5-5mm long to 2-2.3mm wide, oblong-ovate, obtuse to acute, concave, and pubescent on both sides; stamens in 2 unequal series, outer stamens 3-4, foliaceous, pubescent, 2.5-3mm long, inner stamens 6-7, to 2mm long, with 2 globose basal glands, pedicellate, ½ length of filaments; anthers of variable size, opening by 2 opercules. Ovary inferior, 2-3 locular, with ovule in each locule; style conical, 1.5-2.5mm long, pubescent, especially in base; stigma white, with 2-3 lobes. Fruit a drupe, obovate-globose, 3.5-7cm long, 3.5-5cm diam., yellow in maturity; seeds ovate-lanceolate, 10-13mm long x 5-6mm wide, enclosed by heavy and 'rocky' endocarp.

In disturbed ground, preferring north-facing slopes, associated mainly with Aextoxicon punctatum, Persea lingue, **Drimys** winteri [see **Canella**, **Drimys**], Weinmannia trichosperma; endemic to Chile, area of distribution now much reduced, in the Cordillera of the coast between the south of Rio Maule and Provincia de Arauco (Rodriguez et al. 1983).

GRAMMOSOLEN

(Solanaceae)

Grammosolen dixonii *(F. Muell. et R. Tate) Haegi* **(Newcastelia dixonii** *F. Muell. et R. Tate***)**

Grammosolen truncatus *(Ising) Haegi* **(Anthotroche truncata** *Ising***)**

This Australian genus of only two species is a source of hallucinogenic tropane alkaloids. Both plants yielded roughly the same constituents.

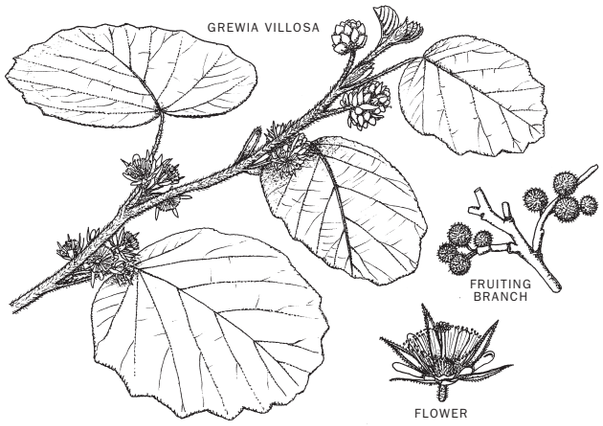
G. dixonii [mature specimen, harv. Aug.] yielded 0.004% alkaloids from aerial parts, and 0.03% from roots; the alkaloids consisted of *hyoscyamine*, *hyoscine*, and their apo-derivatives, as well as 3-α-acetoxytropane from aerial parts, and valtropine and 6-OH-*hyoscyamine* from roots (Evans & Ramsey 1983).

Grammosolen dixonii is a shrub, densely tomentose with non-glandular and inconspicuous glandular hairs; branches wooly-tomentose. Leaves crowded, alternate, often imbricate, simple, almost sessile or with petiole to 3mm long. Inflorescence a cyme, terminal on short, lateral leafy branches; flowers bisexual, actinomorphic, subtended by pairs of opposite or subopposite bracts; calyx cupular, 5-lobed, the lobes more than 1mm long; corolla narrowly tubular with spreading limb, drab white with violet striations, limb with (4-)5(-6) long, narrow lobes, volutive in bud; stamens 5, unequal, inserted at base of corolla tube; filaments pubescent at base; anthers unilocular, not cohering, dehiscing by a semicircular slit. Ovary bilocular; stigma capitate, very shortly bilobed. Fruit a smooth capsule, opening from apex by 4 valves, +- enclosed by calyx; seeds subreniform.

In deep sandy soils, often in disturbed mallee-spinifex areas; Murray region, n. Yorke Peninsula, n.e. Eyre Peninsula [S.A.] (Haegi et al. 1982).

GREWIA

(Tiliaceae)



Grewia bicolor *Juss.* **(G. salvifolia** *Heyne ex Roth, non L.***)** – al-basham, mogwana, kongolubi

Grewia mollis *Juss.*

Grewia polygama *Roxb.* **(G. helicterifolia** *Wall.***; G. hirsuta** *Vahl.***; G. retusifolia** *Pierre***)** – dog's balls, dysentery plant, plain currant, emu berries, yukk ponk mintjak, kangarn, karoom, ouraie, kou-nung, mamurrinya

Grewia villosa *Willd.* – mallow raisin, berchaga, gangetî, hlukayebe

Grewia spp. are now known for their content of β-carboline alkaloids, though the many members of the genus are often used in a variety of ways where they are found. Many bear edible fruits, barks suitable for making cordage, and wood for bows, spear shafts, and other instruments. G. asiatica [G. subinaequalis] root bark is used in tropical Asia to treat rheumatism, and the fruits relieve stomach complaints. G. carpinifolia from India and tropical Africa is used as a leaf decoction to remove head lice. The root of the s.e. Asian G. paniculata is decocted to treat fever, coughs and abdominal pains; the wood is distilled to yield acetone. 'Kanila' bark [G. salutaris] is used in Malaysia and Indonesia externally, rarely internally, as a paste to treat bruising (Usher 1974). In India, G. tiliaefolia bark mucilage is used as an emetic, with Panicum miliaceum flour, to treat 'opium' poisoning [see **Papaver**] and dysentery (Nadkarni 1976).

G. bicolor root is used by the Nuba of Sudan as a tranquilliser (Jaspers et al. 1986); it is also used in Sudan as an abortifacient (Mohamed et al. 1990). In Botswana, fruits of G. bicolor, G. flava ['moretlwa'], G. monticola ['mogwana'], G. occidentalis [tentative i.d.], G. pachycalyx ['mogwana'], G. rogersii [tentative i.d.] and G. subspatulata [also 'mogwana'] have been used as ingredients of 'khadi' mead [see *Methods of Ingestion*, **Delosperma**, **Sceletium**] (Hargreaves 1999).

In the Andaman Islands, G. microcos leaves are used as cigar wrappers for 'tobacco' [see **Nicotiana**]. Leaves of G. polygama are sometimes smoked in pipes as a tobacco substitute by the Wik Monkan of the Gulf of Carpenteria [Australia], when real tobacco is unavailable. The sweet fruit pulp is widely eaten as a food in n. Australia (Thomson 1939). Its crushed leaves are held against the teeth to relieve toothache. The Ngarinyman decoct the whole plant to treat stomach upsets and diarrhoea. The plant acts as an antiseptic, and is also used to treat sores and dysentery (Aboriginal Communities 1988; Lassak & McCarthy 1990; Smith et al. 1993).

G. bicolor root has yielded the β-carboline alkaloids *harman*, 6-OH-*harman*, and 6-MeO-*harman* [iso-*harmine*]; as well as campesterol, β-sitosterol, β-sitosterol-3-O-glucoside, stigmasterol, lupeol, and betulin (Jaspers et al. 1986); it also appears to contain a peptide with *serotonin*-like effects (Mohamed et al. 1990).

G. mollis root [harv. Nov., Kenya] yielded 0.0062% 6-OH-*harman* (Rosler et al. 1978), though c.0.062% would have been obtained if the whole crude extract was purified.

G. polygama root and leaves contain triterpenes and steroids (Aboriginal Communities 1988). Leaf from Rockhampton, Queensland [harv. Dec.] tested weakly positive for alkaloids. Tests on root bark of the same plant, as well as on leaf, stem and fruit [combined] from Yarraman [harv. May], were negative (Webb 1949).

G. villosa root has yielded *harmine*, *harmaline*, *harmol*, *harmalol*, *harman*, 6-OH-*harman* and 6-MeO-*harman* (Bashir et al. 1986, 1987); as well as 19-OH-uvaol, quinovic acid, β-sitosterol-3-O-glucoside (Bashir et al. 1983), sucrose, glucose and galactose (Bashir et al. 1987).

Grewia villosa is a coarse-leaved shrub to 3-4.6m tall. Leaves reniform to suborbicular, to 12cm long, nearly as wide, denticulate and often lobulate, +- cordate at base, digitately 5-7-nerved, tertiary nerves parallel and conspicuous; stipules broadly oblanceolate. Flowers reddish-brown, in axillary or lateral (rarely terminal) few-flowered crowded leaf-opposed cymes; common peduncle solitary and shorter than the petiole, +- branched above; pedicels very short and stout; buds densely villous; sepals valvate; petals free, contorted, imbricate or valvate; stamens usually numerous, free; anthers 2-celled. Ovary superior, 1-4-celled; ovules on axile placentas; style usually simple; stigma always lobed. Fruits entire, to 3cm long, depressed-globose, scarcely lobed, pilose and tuberculate.

Drier savannah regions, often on rocky hills; tropical Africa [Senegal, French Sudan, Ivory Coast, Gold Coast, Nigeria], Arabia and India (Hutchinson & Dalziel 1954-1972).

GRIFFONIA

(Leguminosae/Caesalpiniaceae)

Griffonia simplicifolia *(M. Vahl ex DC.) Baill.* **(Bandeiraea simplicifolia** *(M. Vahl ex DC.) Benth.***; Schotia simplicifolia** *M. Vahl ex DC.***)** – toto, totolimo, kpokirikpo, gbogotri

The durable stems of this African shrub are used for walking sticks, or woven into baskets after baking them to become pliable. The stems and roots are also commonly used as chew-sticks. The leaves yield a black dye, and in Nigeria they are put inside chicken sheds to kill lice. Root starch is used by Peki women as a face powder. In Ghana, dried ripe fruits are sometimes made into whistles and feeding spoons for babies. In the Ivory Coast, a leaf decoction is reputed to be aphrodisiac, emetic, purgative, antitussive, and 'pelvic decongestant', as well as relieving diarrhoea. Also, in Ghana, the leaves are fed to sheep and goats to stimulate reproduction (Burkill 1985-1997; Dwuma-Badu et al. 1976). The seeds are now widely used as a natural source of *5-hydroxytryptophan* [*5-HTP*], extracted and marketed by health supplement companies.

G. simplicifolia dried seeds may contain over 1% *5-HTP* (Bell & Fellows 1966); 6-10% has been found in fresh, mature seeds. Immature seeds contain mostly *5-HTP*, as well as indole-3-acetyl-*aspartic acid* and other unidentified indoles. Germinating seeds contain *5-HTP*, 5'-OH-indole-3-acetic acid and an unidentified 5-OH indole. Pods contain c.0.1-0.2% each of *5-HTP* and *serotonin* [*5-HT*]. Leaves of young plants, grown

in England, contained *5-HTP*; leaves of mature plants, grown in Ghana contained mostly *5-HTP* [peaking at c.1.2% Nov.-Jan., also peaking Apr.-May] and *5-HT* [peaking at c.1.3% Feb.-Apr.], as well as *tryptophan* [0.2%, only in Apr.-May] (Fellows & Bell 1970). Roots also yielded *5-HTP*, griffonin and griffonilide (Dwuma-Badu et al. 1976; International... 1994); stems have also yielded *5-HT* (Smith 1977b). Complications similar to mild *serotonin* syndrome have been observed following interaction between *5-HTP*-rich commercial extracts of G. simplicifolia and smoked **Sceletium** anatomicum, and for this reason caution is advised (friendly pers. comm.; theobromus pers. comm.).

Griffonia simplicifolia is a hard-wooded shrub, usually lianous. Leaves simple or unifoliate, not bilobed, +- ovate, rounded, or widely cordate at base, rounded or shortly obtusely acuminate at apex, 6-12 x 3-6cm, glabrous and shining, prominently 3-nerved at base; stipels mostly absent. Inflorescence mostly showy, greenish flowers numerous in pyramidal racemes, at length reflexed, zygomorphic, rarely subactinomorphic; bracteoles sometimes large and enclosing flower in bud, softly tomentose, with a curled hook-like branch at base; sepals 5; calyx with 5 distinct lobes in bud, united at base into a long tube, softly tomentose outside, c.1cm long; petals 5, the upper one inside in bud, the others variously imbricated; stamens 10, free or variously connate; anthers various, sometimes opening by terminal pores. Ovary superior, 1-celled, 1-carpellate. Fruits obliquely oblong, inflated, up to 4-5cm long, blackish and reticulate; stipe slender, 1-1.5cm long, pubescent; pods explode on drying.

Grass savannah; Liberia, Ivory Coast, Togo, Nigeria, Ghana, Gabon, Congo (Hutchinson & Dalziel 1954-1972).

GUIERA

(Combretaceae)

Guiera senegalensis *Lamarck*

This west African shrub is used to treat rheumatic pain, chest infections and dysentery, and as a galactogogue after childbirth. The plant has CNS-depressant and antiinflammatory activities, and relieves diarrhoea (Mahmoud & Khalid 1997). When given to mice [i.p.], the leaf extract detoxified [in vitro] venom from the snakes **Naja** nigricollis and Echis carinatus (Abubakara et al. 2000).

G. senegalensis root has yielded several β-carboline alkaloids [*harman*, *tetrahydroharman* and leptocladine (2-methyl-1,2,3,4-*tetrahydroharman*)]; tannins are also present. Leaves have yielded 0.008% 5-methyldihydro-flavasperone, a napthopyran, as well as saponins and tannins. Flavonoids and mucilage are also found in the plant (Combier et al. 1978; Koumare et al. 1969; Mahmoud & Khalid 1997; Odebiyi & Sofowora 1978; Shulgin & Shulgin 1997).

Guiera senegalensis is a small shrub, covered with scattered black dots; branchlets softly tomentellous. Leaves opposite or subopposite, oblong-elliptic, rounded or slightly cordate at base, mucronate at apex, 3-5 x 1.5-3cm, softly tomentose grey on both surfaces with scattered black glands beneath; petiole without a pair of glands. Yellowish flowers in dense, shortly pedunculate involucral heads, the heads c.1cm diam.; bracts enclosing the flowers in bud, ovate, c.7mm long; petals very narrow, 4-5; calyx tube adnate to ovary; stamens 4-10, rarely more; filaments inflexed in bud; anthers versatile, didymous, opening lengthwise by slits; disc epigynous. Ovary inferior, 1-celled; style simple; ovules 2-6, suspended from apex of ovary by slender funicles. Fruit linear, radiating, 3-4cm long, crowned by persistent perianth, densely silky-villous.

Abundant in sandy wastes and semi-desert areas; Senegal, Gambia, Mali, Guinea-Bissau, Guinea, Niger, n. Nigeria (Hutchinson & Dalziel 1954-1972).

GYMNOCALYCIUM

(Cactaceae)

Gymnocalycium achirasense *H. Till et Schatzl ex H. Till* **(G. monvillei ssp. achirasense** *(H. Till et Schatzl ex H. Till) H. Till***)**
Gymnocalycium asterium *Y. Ito ex Castellanos*
Gymnocalycium baldianum *(Spegazzini) Spegazzini* **(G. sanguiniflorum** *(Werdermann) Werdermann***)**
Gymnocalycium calochlorum *(Boedeker) Ito* **(G. proliferum** *(Backeberg) Backeberg***)**
Gymnocalycium carminanthum *Borth et Koop*
Gymnocalycium comarapense *Backeb.*
Gymnocalycium denudatum *(Link et Otto) Pfeiffer ex Mittler*
Gymnocalycium gibbosum *(Haworth) Pfeiffer* **(G. brachypetalum** *Speg.***; G. chubutense** *(Speg.) Speg.***; G. gerardii** *(Boedeker) Ito***; G. reductum** *(Link) Pfeiff. ex Mittl.***; Cactus gibbosus** *Haw.***; Echinocactus gibbosus** *De Candolle***; E. mackieanus** *Hooker***; E. nobilis** *Haw.***; E. reductus** *Schum.***)**
Gymnocalycium horridispinum *G. Frank ex H. Till* **(G. monvillei ssp. horridispinum** *(G. Frank ex H. Till) H. Till***)**
Gymnocalycium leeanum *(Hook.) Britton et Rose* **(Echinocactus leeanus** *Hook.***)**
Gymnocalycium mesopotamicum *Kiesling*
Gymnocalycium monvillei *(Lem.) Br. et R.* **(G. multiflorum** *(Hook.) Br. et R.***; G. ourselianum** *(Cels ex Salm-Dyck) Y. Ito***; G. schuetzianum** *H. Till et Schatzl***)**
Gymnocalycium moserianum *Schütz* **(G. bodenbenderianum ssp. intertextum** *(Backeb. ex H. Till) H. Till***; G. intertextum** *Backeb. ex H. Till***)**
Gymnocalycium netrelianum *(Monville ex Labouret) Br. et R.*
Gymnocalycium nigriareolatum *Backeb.* **(G. hybopleurum** *(Schumann) Backeb.***)**
Gymnocalycium oenanthemum *Backeb.*
Gymnocalycium paraguayense *(Schumann) Schütz*
Gymnocalycium quehlianum *(F. Haage ex Quehl) Vaupel ex Hosseus*
Gymnocalycium ragonesei *Castellanos*
Gymnocalycium riograndense *Card.*
Gymnocalycium riojense *Fric ex Till et Till*
Gymnocalycium stellatum *Speg.*
Gymnocalycium striglianum *Jeggle ex H. Till*
Gymnocalycium triacanthum *Backeb.* **(G. platygonum** *(H. Till et W. Till) Pilbeam* [misapplied]**; G. riojense** *Fric ex H. Till et W. Till***)**
Gymnocalycium uebelmannianum *Rausch*
Gymnocalycium valnicekianum *Jajó* **(G. bicolor** *Schütz***; G. grandiflorum** *Backeb.***; G. immemoratum** *Castell. et Lelong***; G. kurtzianum** *(Guerke) Br. et R.***; G. mostii** *(Guerke) Br. et R.***; G. tobuschianum** *Schick***)**
Gymnocalycium vatteri *Buining* **(G. ochoterenae ssp. vatteri** *(Buin.) Papsch***)**

This genus of mostly small, globular cacti could easily have fallen within the group of plants known as 'peyote', 'peyotl' or 'peyotillo' in n. Mexico [see **Lophophora**], if only they grew in that region – they are instead confined to South America. Some Gymnocalycium spp. look superficially very similar to **Lophophora** spp., except for the presence of spines. It has been temptingly mentioned, through anecdotal information, that 'peyote-like' cacti are used shamanically in parts of South America, though such use is never openly discussed. It has been thought possible that Gymnocalycium spp. and/or Matucana spp. may be involved [see *Endnotes*] (Trout & Friends 1999; Trout pers. comm.). The chemistry of the genus, once obscure, has recently been illuminated by the work of Czech chemist Roman Štarha. All yields given are from fresh cacti, though it should be noted these analyses have been performed on seedlings cultivated in Europe, and wild populations or mature plants would be expected to yield higher levels of alkaloids.

G. achirasense yielded 0.00007% *mescaline*, 0.00013% N-methylmescaline, 0.00025% N,N-dimethylmescaline, 0.00159% *tyramine*, 0.00045% N-methyltyramine, 0.00129% *hordenine* and 0.00097% anhalamine [6,7-dimethoxy-8-OH-THIQ; see **Lophophora**].

G. asterium yielded 0.00013% *mescaline*, 0.00031% N-methylmescaline, 0.0005% N,N-dimethylmescaline, 0.00089% *tyramine*, 0.00012% N-methyltyramine, 0.001% *hordenine*, 0.00011% O-methylanhalidine, 0.00054% anhalamine, and traces of anhalidine [6,7-dimethoxy-8-OH-2-methyl-THIQ], *anhalonidine*, anhalonine [6-MeO-1-methyl-7,8-methylenedioxy-THIQ], *pellotine* and lophophorine [1,2-dimethyl-6-MeO-7,8-methylenedioxy-THIQ].

G. baldianum yielded <0.0001% *mescaline*, <0.0001% *tyramine*, c.0.001% *hordenine*, and <0.0001-0.001% each of anhalinine [6,7,8-trimethoxy-THIQ], anhalidine, anhalamine, *anhalonidine*, anhalonine, *pellotine* and lophophorine.

G. calochlorum yielded c.0.001% *hordenine*, 0.0001-0.001% each of *mescaline*, *tyramine*, and *anhalonidine*, and <0.0001% N-methylmescaline, anhalinine, anhalidine, anhalamine and *pellotine* (Štarha 1996).

G. carminanthum yielded 0.00006% *mescaline*, traces of N-methylmescaline, 0.0008% N,N-dimethylmescaline, 0.00007% *tyramine*, traces of N-methyltyramine, 0.00016% *hordenine*, 0.00007% O-methylanhalidine, 0.00088% anhalamine and traces of *anhalonidine* (Štarha et al. 1998).

G. comarapense yielded <0.0001% each of *mescaline*, N-methylmescaline, N-methyltyramine, *hordenine*, anhalamine and *pellotine*, and 0.0001-0.001% *tyramine* (Štarha 1995a).

G. denudatum yielded traces of *mescaline*, 0.00008% N-methylmescaline, 0.00073% N,N-dimethylmescaline, 0.00066% *tyramine*, 0.00061% N-methyltyramine, 0.00052% *hordenine*, 0.00025% O-methylanhalidine, 0.00006% anhalinine, 0.0001% O-methylanhalonidine [MAO-A inhibitor (Bembenek et al. 1990)], 0.00048% anhalamine, and traces of anhalidine and *anhalonidine* (Štarha et al. 1998).

G. gibbosum was found to contain a mix of alkaloids, believed to consist of *mescaline*, anhalamine and lophophorine (Ducloux 1930); a later analysis found no *mescaline*, but 0.001% each of N-methyltyramine, *hordenine*, anhalamine, anhalinine, O-methylanhalidine and O-methylanhalonidine, 0.0001-0.001% each of N-methylmescaline, anhalidine, anhalonine,

pellotine and lophophorine, and <0.0001% *tyramine*, N,N-dimethylmescaline and *anhalonidine* (Štarha et al. 1997).

G. horridispinum yielded 0.0001-0.001% *mescaline*, c.0.001% each of *hordenine* and *tyramine*, and <0.0001% each of N-methyltyramine, N-methylmescaline and anhalinine (Štarha 1996).

G. leeanum yielded *mescaline* [tentative], *tyramine*, N-methyltyramine, *hordenine*, anhalonine [tentative] and lophophorine [tentative] (Ducloux 1930; Shulgin & Shulgin 1997).

G. mesopotamicum yielded traces of *tyramine*, N-methyltyramine, *hordenine*, *mescaline* and N-methylmescaline, 0.00279% N,N-dimethylmescaline, 0.0019% anhalamine and 0.00005% *anhalonidine* (Štarha et al. 1998).

G. monvillei yielded <0.0001% *mescaline*, c.0.001% *hordenine*, 0.0001-0.001% each of *tyramine*, N-methyltyramine, anhalonine, *anhalonidine* and *pellotine*, and <0.0001% each of N-methylmescaline, N,N-dimethylmescaline, anhalinine, anhalidine, anhalamine, O-methylanhalidine, O-methylanhalonidine and lophophorine (Štarha et al. 1997).

G. moserianum yielded 0.00007% *mescaline*, 0.00151% N-methylmescaline, 0.00071% N,N-dimethylmescaline, 0.00077% *tyramine*, 0.0001% N-methyltyramine, 0.00011% *hordenine*, 0.00007% O-methylanhalidine, 0.00007% anhalidine, 0.00007% anhalinine, 0.00007% O-methylanhalonidine, 0.00014% *anhalonidine*, 0.00215% anhalamine, 0.00012% *pellotine*, and traces of anhalonine and lophophorine (Štarha et al. 1998).

G. netrelianum yielded 0.0001-0.001% each of *mescaline* and *hordenine*, and 0.0001% each of *tyramine*, N-methylmescaline and *pellotine* (Štarha 1995a).

G. nigriareolatum yielded 0.00006% *mescaline*, 0.00006% N-methylmescaline, 0.00009% N,N-dimethylmescaline, 0.00047% *tyramine*, 0.00008% N-methyltyramine, 0.0014% hordenine, 0.00012% O-methylanhalidine, 0.00019% anhalamine and 0.00012% *anhalonidine* (Štarha et al. 1998).

G. oenanthemum yielded <0.0001% each of *mescaline*, N-methylmescaline, N,N-dimethylmescaline, N-methyltyramine, anhalidine, anhalamine, anhalonine, O-methylanhalidine, O-methylanhalonidine and lophophorine, 0.0001-0.001% each of *tyramine*, *anhalonidine* and *pellotine*, and c.0.001% *hordenine* (Štarha et al. 1997).

G. paraguayense yielded 0.00011% *mescaline*, 0.00041% N-methylmescaline, 0.00427% N,N-dimethylmescaline, 0.00047% *tyramine*, 0.00104% N-methyltyramine, 0.00043% *hordenine*, 0.00505% O-methylanhalidine and 0.00017% *anhalonidine* (Štarha et al. 1998).

G. quehlianum yielded <0.0001% each of *mescaline*, N-methylmescaline, N,N-dimethylmescaline, anhalinine, anhalonine, *anhalonidine*, *pellotine* and lophophorine, 0.0001-0.001% each of *tyramine*, N-methyltyramine and O-methylanhalonidine, and c.0.001% *hordenine* (Štarha et al. 1997).

G. ragonesei yielded traces of *mescaline*, N-methylmescaline and N,N-dimethylmescaline, 0.00009% *tyramine*, 0.00005% N-methyltyramine, 0.0035% *hordenine*, 0.00048% O-methylanhalidine, 0.00006% anhalidine, 0.00109% anhalinine, 0.00007% O-methylanhalonidine, and traces of *anhalonidine* and *pellotine* (Štarha et al. 1998).

G. riograndense yielded 0.0001-0.001% each of *mescaline* and *tyramine*, and 0.0001% each of N-methylmescaline, N-methyltyramine, *hordenine*, anhalinine, anhalidine, *anhalonidine*, anhalonine, *pellotine* and lophophorine (Štarha 1995a).

G. riojense yielded 0.004% *hordenine*, 0.002% *tyramine*, and <0.0001% each of *mescaline*, N-methylmescaline, N-methyltyramine, anhalinine, *anhalonidine*, O-methylanhalonidine and *pellotine* (Štarha et al. 2002).

G. stellatum yielded <0.0001% each of *mescaline*, N,N-dimethylmescaline, N-methyltyramine, anhalamine, O-methylanhalonidine and lophophorine, 0.0001-0.001% each of *tyramine*, N-methylmescaline, anhalinine, anhalonine, *anhalonidine* and *pellotine*, and c.0.001% *hordenine* (Štarha et al. 1997).

G. striglianum yielded c.0.001% each of *mescaline*, N-methylmescaline, anhalamine and *pellotine*, and 0.0001% each of *tyramine*, *hordenine*, anhalinine, anhalidine, anhalonine, *anhalonidine* and lophophorine (Štarha 1995a).

G. triacanthum yielded traces of *mescaline*, N-methylmescaline, N,N-dimethylmescaline and *tyramine*, 0.00005% N-methyltyramine, 0.00054% *hordenine*, 0.00015% O-methylanhalidine, 0.00014% anhalinine, 0.00006% *anhalonidine* and traces of anhalidine (Štarha et al. 1998).

G. uebelmannianum yielded 0.0001-0.001% each of *mescaline*, *tyramine*, N-methyltyramine, *hordenine*, anhalinine, anhalamine, *anhalonidine*, O-methylanhalonidine and *pellotine*, and 0.0001-0.001% each of N-methylmescaline, N,N-dimethylmescaline, anhalonine, anhalidine, O-methylanhalidine and lophophorine (Štarha et al. 1997).

G. valnicekianum yielded c.0.001% *hordenine*, 0.0001-0.001% each of *tyramine* and *anhalonidine*, and 0.0001% each of *mescaline*, N-methyltyramine, anhalinine, anhalonine, *pellotine* and lophophorine (Štarha 1995a).

G. vatteri yielded 0.0001-0.001% each of *mescaline*, N-methylmescaline, N-methyltyramine, *anhalonidine* and *pellotine*, c.0.001% each of *tyramine*, *hordenine* and anhalinine, and <0.0001% each of anhalidine, anhalonine and lophophorine (Štarha 1996).

Gymnocalycium vatteri is a solitary globular cactus, matt olive green, to c.4cm high, 9cm diam.; ribs 8-16, broad, c.2.5cm high; areoles greyish, each with 1-3(-5) yellowish-brown, adpressed spines. Flowers diurnal, white, sometimes with reddish centre, c.5cm long, 4cm diam.; tube and ovary with large, blunt, membranous scales, with completely bare axils. Fruit blue-grey when ripe; seed glossy brown, to 1mm long, mussel-shaped.

Fl. summer.

Cordoba, Argentina. Needs good light; minimum temp. 10°C (Cullmann et al. 1986; Innes & Glass 1991).

GYMNOPILUS

(Agaricaceae/Cortinariaceae)

Gymnopilus aeruginosus *(Pk.) Sing.* **(Pholiota aeruginosa** *Peck***)** – midoritake ['green mushroom'], magic blue gym
Gymnopilus braendlei *(Pk.) Hesler*
Gymnopilus intermedius *(Sing.) Singer*
Gymnopilus lateritius *(Pat.) Murrill*
Gymnopilus liquiritiae *(Fr.) Karst.*
Gymnopilus luteofolius *(Peck) Sing.* **(Pholiota luteofolia** *(Peck) Saccardo***)**
Gymnopilus luteoviridis *Thiers.*
Gymnopilus luteus *(Peck) Hesler*
Gymnopilus pampeanus *(Speg.) Singer* **(G. spectabilis ssp. pampeanus** *(Speg.) Sing.***)**
Gymnopilus punctifolius *(Pk.) Sing.*
Gymnopilus purpuratus *(Cooke et Mass.) Singer* **(Flammula purpurata** *(Cooke et Masse.) Sacc.***)**
Gymnopilus sapineus *(Fr.) Maire* **(Pholiota sapinea** *sp. auct.***)**
Gymnopilus spectabilis *(Fr.:Fr.) A.H. Sm.* **(G. junonius** *(Fr.:Fr.) P.D. Orton***; G. spectabilis var. junonius** *(Fr.:Fr.) Kühner et Romagn***; Pholiota spectabilis** *(Fr.:Fr.) P. Kumm.***)** – o-warai-take ['big laughing mushroom'], giant laughing mushroom, big gym
Gymnopilus subpurpuratus *Guzmán-Davalos et Guzmán*
Gymnopilus validipes *(Peck) Hesler*
Gymnopilus viridans *Murrill.*

Known in Japan as 'o-warai-take' ['big laughing mushroom'], G. spectabilis is known to be 'intoxicating', as has been observed in several documented cases. One woman, in Cleveland, 1942, took "a few nibbles" of a specimen she had found, and later experienced "glorious visions of colour and sounds of music, with no feeling of discomfort whatever"...she later returned to normal and said that "if this were the way one died of mushroom poisoning, she was all for it"! Also, a man in Massachusetts, 1966, ate 2-3 caps fried in butter [he also gave some to his wife and his neighbour], and felt "disconnected" and "woozy" 15mins later. He experienced pleasant colour intensifications, and thoughts were scattered, even though his mind felt sharp (Buck 1967; Sanford 1972; Walters 1965). This species is now used as a non-traditional entheogen on a small scale in parts of the eastern US (pers. comm.). In the mountains of Oguni, Japan, this species is eaten as food, after boiling and discarding the water (Kusano et al. 1986). G. validipes has also caused accidental inebriation in two people from Michigan who mistook the mushrooms for Armillaria mellea [see below] (Hatfield & Valdes 1977; Hatfield et al. 1978).

The Yurimagua of Amazonian Peru once prepared a "strongly intoxicating" potion from a type of mushroom growing on fallen trees, mixed with a "kind of reddish film that is found usually attached to rotting trunks". The latter growth was said to be "very hot to the taste." This practice seems to now be extinct. Of the potion, it was reported by Jesuit missionaries that "No person who drinks this brew fails to fall under its effects after three draughts of it, since it is so strong or, more correctly, so toxic". The mushroom has been proposed to be **Psilocybe** yungensis (Schultes 1967a). Jochen Gartz suggested that the mushroom is more likely a Gymnopilus sp., G. purpuratus being an excellent candidate (Gartz 1996). However, Gartz seems to have confused the mushroom with the "reddish film", by referring only to mushrooms that "appeared on fallen trees as a kind of reddish growth with a spicy taste". He also notes that **Psilocybe** spp. "grow almost exclusively on wood sprigs and tree bark debris" (Gartz 1996). **Psilocybe** yungensis is, however, known to grow on "very rotten wood" (Guzmán 1983).

The subjective effects from active Gymnopilus spp. have been described by modern-day experimenters as being different from *psilocybin/psilocin* alone. Sedation, body numbness, and mild *psilocybin*-like effects are often described, with some also mentioning an alcohol-like component to the experience (Byron pers. comm.; Hoodoo pers. comm.). The psychotropic effects of the other compounds found in these species [especially in G. spectabilis, the most thoroughly studied species] have not been investigated in humans. Human bioassays seem to indicate that these lesser-known compounds are physiologically active.

A bioassay of G. liquiritiae from Japan [thanks to Hoodoo] produced

results quite different from those attributable to *psilocybin/psilocin*. A dose of 5g dry fruiting bodies was chewed thoroughly and swallowed over the course of 25 minutes, immediately after which a mild numbing of the tongue was noted. The fungi were less fibrous than most **Psilocybe**s, and thus easier to chew. Smaller fruiting bodies were generally far more bitter than the larger ones. Apart from the intense bitterness, the taste was not strong or objectionable. Occasional brief, mild bouts of nausea were experienced earlier in the experience, but these were easy to overcome. The effects developed slowly and almost imperceptively over the next 1-2hrs, first noted as a greatly increased sensitivity to the volume of music. No other auditory enhancement or distortions were noted. The effects mainly consisted of a gentle, relaxed inebriation that is difficult to describe. The body as a whole felt 'soft and fuzzy'; physical contact was similarly 'velvety' and pleasant, but sexual feelings were suppressed. No visual alterations were noted, other than a slight softening of focus, which disappeared when an object was looked at directly. Thought processes seemed not to be affected at all, and a general feeling of pleasant lucidity and contentment was present throughout. Overall, the experience lasted c.6hrs, with no after-effects. At the dose used in this experiment, I was left with the impression that the effects of G. liquiritiae are pleasant and interesting, but not psychedelic in any great sense (pers. obs.). However, at least some Japanese specimens have been found to contain *psilocybin* [see below].

G. aeruginosus specimens from Michigan and Washington [as well as N. American specimens of unstated origin] were shown to contain *psilocybin*, though specimens from Ohio (Hatfield & Valdes 1977; Hatfield et al. 1978) and Japan contained none (Koike et al. 1981). Also found are the styrylpyrone-derivatives bis-nor-*yangonin* [0.1%] and hispidin [up to 1%] (Hatfield & Brady 1971); bis-nor-*yangonin* and hispidin are related to the kava-pyrones [see **Piper 2**], but the former compound appears to be inactive at up to 50mg/kg in rats (Hatfield et al. 1978). However, the researchers were evaluating it for 'hallucinogenic' activity, so this does not necessarily mean that bis-nor-*yangonin* is totally inactive (pers. obs.).

G. aurantiophyllus was shown to contain 0.1-1% bis-nor-*yangonin* and <0.1% hispidin (Hatfield & Brady 1971); no *psilocybin* was detected in specimens from Washington (Hatfield et al. 1978).

G. braendlei has been found to contain *psilocybin* (Allen et al. 1992), <0.1% bis-nor-*yangonin* and up to 1% hispidin (Hatfield & Brady 1971).

G. decurrens has yielded bis-nor-*yangonin* (Hatfield & Brady 1969).

G. fulgens from the Netherlands did not contain *psilocybin* (Stijve & Kuyper 1988).

G. intermedius has yielded *psilocybin* (Allen et al. 1992).

G. lateritius has been shown to contain *psilocybin* (Guzmán et al. 2000).

G. liquiritiae from Japan has yielded 0.012-0.029% *psilocybin* (Koike et al. 1981), though specimens from Alaska contained none (Hatfield et al. 1978). Japanese specimens have been found to be active from [1-]5g dry (Hoodoo pers. comm.).

G. luteofolius is presumed to be active, due to its bluish or greenish bruising reaction (Stamets 1996), though *psilocybin* was not found in samples from Washington and Michigan (Hatfield et al. 1978); it was found to contain <0.1% each of bis-nor-*yangonin* and hispidin (Hatfield & Brady 1971).

G. luteoviridis has yielded *psilocybin* (Allen et al. 1992).

G. luteus from Michigan was shown to contain *psilocybin* in only 1 of 3 collections (Hatfield et al. 1978); *psilocybin* was also detected in N. American specimens of unstated origin (Hatfield & Valdes 1977).

G. obscurus was found to contain more than 3% bis-nor-*yangonin* and 0.1-1% hispidin (Hatfield & Brady 1971).

G. pampeanus is sometimes considered a variety of G. spectabilis, and similarly has a very bitter taste (Southcott 1996); it might possibly also be psychoactive, though no *psilocybin*, *psilocin* or *serotonin* were found in Brazilian specimens (Stijve & de Meijer 1993).

G. punctifolius has been shown to contain 0.42-3% bis-nor-*yangonin* and 0.21-3% hispidin [upper values estimated based on chromatographic and mass-spec. data] (Hatfield & Brady 1971; Repke et al. 1978); no *psilocybin* was found in specimens from Washington (Hatfield et al. 1978).

G. purpuratus [both cultivated and 'wild-harvested' from introduced patches in Germany – see below] yielded high levels of alkaloids – 0.15-0.32% *psilocybin*, 0.15-0.29% *psilocin*, and 0.01-0.05% *baeocystin*. *Psilocin* levels drop quickly in storage. 'Wild' specimens contained slightly greater alkaloid levels than the cultivated specimens, though the difference was not very significant. The bitter taste is not present in European specimens (Gartz 1991, 1996), but is in Australian specimens (Shepherd & Totterdell 1988; Young 1994).

G. sapineus has been shown to contain *psilocybin* (Guzmán et al. 2000).

G. spectabilis from Michigan was shown to contain *psilocybin* in 2 of 5 collections; *psilocybin* was also found in collections from Ohio and Ontario, and N. American collections of unstated origin. Those from California, Idaho, Massachusetts, New Mexico, Washington, England, and Europe have not been found to contain *psilocybin* or similar indoles (Hatfield & Brady 1969; Hatfield & Valdes 1977; Hatfield et al. 1978; Kusano et al. 1986; Stijve & Kuyper 1988). Based on these chemical analyses, and reports of willing ingestion, it has been generalised that specimens from western states of the US are +- inactive, whilst those from eastern states are active; however, it has been suggested that positive results with this species may be due to misidentification (pers. comms.). This would not be unlikely as many Gymnopilus spp. look quite similar superficially, and can be difficult for the novice [and even some supposed 'experts'] to tell apart (pers. obs.). Japanese specimens have been believed to be psychoactive, but *psilocybin* has not been found in them (Koike et al. 1981; Kusano et al. 1986); human bioassays of up to 10g [d/w] of Japanese specimens have produced only mild relaxation and non-psychedelic visual disturbances (Hoodoo pers. comm.).

Other compounds identified in G. spectabilis include bis-nor-*yangonin* [0.03% w/w] and hispidin [0.0016% w/w] (Hatfield & Brady 1969, 1971), the bis-nor-*yangonin* derivative methyl-5-OH-7-p-OH-phenyl-3-keto-4Z,6E-heptadienoate, polyisoprenepolyols named gymnoprenols [including 0.013% (w/w) gymnopilene], 4,6-decadiyne-1,3,8,10-tetraol [0.003% w/w], 4,6-decadiyne-1,3,8-triol [0.003-0.015% w/w], ergosterol [0.006-0.02% w/w], ergosteryl peroxide [0.0006-0.035% w/w], cerevisterol [0.006% w/w], galactitol, *choline* [0.35% w/w], palmitic acid [0.003% w/w] and α,α'-trehalose [0.039% w/w] (Findlay & He 1991; Kusano et al. 1986; Nozoe et al. 1983a). Three of the gymnoprenols have been renamed gymnopilins. The gymnopilins were shown to be 'neurotoxic' in unpublished animal studies [in that they depolarise nerve cells], and are reportedly the bitter principles in the mushroom (Nozoe et al. 1983b; Tanaka et al. 1993). The doses used to elicit neurotoxicity in animals were not given. Human experiments with this species have not displayed signs of neurotoxicity at usual doses [several specimens or less] (pers. comms.). I suspect that the emphasis on the supposed neurotoxicity of these compounds, without the research data being available for public scrutiny, may stem from a misguided attempt to discourage ingestion.

At least in this species [G. spectabilis], bitterness does not seem to correlate with psychoactivity. In specimens collected over several years from the same tree stump, bitterness was observed to increase with the apparent age of the organism. Collections made in early years were barely bitter at all. The specimens were strongly active at a dosage of 100g fresh [or 10g dried], though some effects were noticeable at 10g fresh [1g dried] (Byron pers. comm.).

G. subpurpuratus is thought to possibly contain *psilocybin* due to its greenish bruising reaction (Allen et al. 1992).

G. validipes from Michigan yielded 0.12% *psilocybin*, and also gave *psilocin* when subjected to hydrolysis (Hatfield & Valdes 1977; Hatfield et al. 1978).

G. ventricosus [from Pacific n.w. US], which is often mis-identified as G. spectabilis, did not contain any *psilocin* or *psilocybin* (Beug & Bigwood 1982; Hatfield et al. 1978).

G. viridans from Ontario was shown to contain *psilocybin* (Hatfield et al. 1978), as were N. American specimens of unstated origin (Hatfield & Valdes 1977).

The related Pholiota mutabilis has yielded *phenethylamine* (Lundstrom 1989).

Pholiota squarroso-adiposa was found to contain bis-nor-*yangonin* [estimated 1.8%] and hispidin [est. >0.04%] (Brady & Benedict 1972).

Gymnopilus purpuratus has a cap 15-42(-200)mm across, flesh thin, broadly convex without umbo, evenly covered by minute fibrillose pointy scales, purplish to ruby on yellow background, dry; margin inrolled at first, incurved later, occasionally stained blue. Stem not hollow, up to 6-10 x 30-80mm, very rarely up to 15cm tall, cylindrical to slightly club-shaped, coarse fibrils, striated, +- smooth, pale yellowish-brown above, concolorous with cap below, lower stem area and base bruising greyish-blue to greenish when injured and with age, flesh thick. Cortina sulphur yellow to yellowish-brown, almost appendiculate along margin, fibrous at apex without forming a true annulus; disappears with age. Gills close, golden yellow at first, rusty yellow later due to maturation of spores, edges concolorous with lamellae, adnate to sinuate (to slightly decurrent). Basidia c.35µ long, club-shaped, 4-spored; spores 6-12.5 x 4.3-7.3µ, elliptical to almond-shaped, punctate, yellowish- to ochre-brown. Smell none; taste bitter.

Gregarious on rotten wood. Native to Australia [S.A., Vic., W.A.] and S. America [Chile, Argentina]; it has also appeared spontaneously in e. Germany [possibly from imported S. American grain coated with traces of spores, which were fed to pigs in Germany, the manure being liquified and mixed with wood chips for composting] (Gartz 1996; Shepherd & Totterdell 1988; Young 1994). Late summer to early winter (Phillips 1981).

G. spectabilis grows in east to southeast N. America, Europe and the British Isles [it has been recorded from Australia, but this might be a confusion with G. pampeanus]. It has a very bitter taste and closely resembles G. ventricosus, an inactive species (Stamets 1996). It is also sometimes confused with Armillaria mellea ['honey mushroom'], an edible medicinal mushroom used by the Chinese to increase blood flow to the brain and heart, and as an analgesic and anticonvulsant; it has shown some antihypertensive and antibiotic actions (Hobbs 1995). A. mellea is said to be inedible when raw, producing severe gastro-intestinal upsets (Bresinsky

& Besl 1989).

G. pampeanus is found in South Australia from April to May, on stumps and sometimes roots of Pinus spp. and Eucalyptus spp. (Grgurinovic 1997).

Gymnopilus spp. are also sometimes potentially confused with the deadly toxic Galerina spp. [such as Galerina autumnalis (Pholiota autumnalis)] (Stamets 1996) and Pholiotina spp. – consult a good guide-book for descriptions of these.

HAMMADA [including Haloxylon]

(Chenopodiaceae)

Hammada articulata *(Moquin) Bolòs et Vigo* **(Caroxylon articulatum** *Moq.***; Haloxylon articulatum** *Bunge***)**

Hammada articulata var. scoparia *(Pomel) Iljin* **(H. articulata ssp. scoparia** *(Pomel.) Bolòs et Vigo***; H. scoparia** *(Pomel) Iljin***; Arthrophytum scoparium** *(Pomel) Iljin***; Haloxylon scoparium** *Pomel.***)**

Hammada leptoclada *(Popov) Iljin* **(Arthrophytum leptocladum** *Popov ex Iljin***; Haloxylon leptocladum** *(Popov. ex Iljin) Korovin***)**

Hammada wakhanica *(Pauls.) Iljin* **(Anabasis wakhanica** *Pauls.***; Arthrophytum wakhanicum** *(Pauls.) Iljin***; Haloxylon wakhanicum** *Eug. Kor.***)**

Haloxylon persicum *Bunge, ex Boiss. et Buhse* **(Arthrophytum ammodendron var. acutifolium** *Minkw.***; A. persicum** *Sava***)**

These herbs have no indigenous uses that I am aware of, except for Haloxylon persicum, which is used in central Asia for fuel, forage, wood, and stabilising sand dunes (Komarov ed. 1936). The chemistry of some of these plants, which contain β-carboline alkaloids, makes them potentially useful MAO-inhibitors for use in ayahuasca analogues [see *Methods of Ingestion*]. The presence of *tryptamine*-, *phenethylamine*-, piperidine- and tetrahydroisoquinoline-alkaloids is also of interest.

H. articulata has yielded carnegine as a major alkaloid [see **Carnegiea**], as well as N-methyl-isosalsoline (Carling & Sandberg 1970).

H. articulata var. scoparia has yielded *tetrahydroharman* and *N-methyltryptamine* [*NMT*] (Shulgin & Shulgin 1997).

H. leptoclada leaf and stem have yielded 0.4-3.7% alkaloids, including *tetrahydroharman* [0.092%], 2-methyl-1,2,3,4-*tetrahydroharman* [leptocladine; 0.722%], 2-methyl-THβC, 3-methyl-THβC, and *NMT* [0.088%]; 1-year old shoots at flowering yielded 3.7% alkaloids [0.575% *NMT*] (Orazkuliev et al. 1964, 1965; Platonova et al. 1959; Rousseau et al. 1967; Shulgin & Shulgin 1997; Yurashevskii 1939, 1941); the herb has also yielded N-methyl-*phenethylamine* (Smith 1977a) and allantoin (Yurashevskii 1941).

H. wakhanica has yielded 2-methyl-1,2,3,4-*tetrahydroharman* (Shulgin & Shulgin 1997) and *NMT* (Smith 1977b).

The closely-related Haloxylon persicum has yielded 5.4% alkaloids, including *anabasine* as a major alkaloid, with smaller amounts of *nicotine* and cotinine, which is an auto-oxidation product of *nicotine* (Habib et al. 1975; Muhtadi & Hassan 1981), and thus might not actually occur in the fresh plant.

Haloxylon salicornicum has yielded 8 alkaloids from the leaves and stems, which combined have an LD50 in mice of 6.2mg/kg [i.p.] (Sandberg 1962; Sandberg et al. 1960). The alkaloids include betaine, haloxine [a piperidine derivative] (Sandberg 1972), halosaline, aldotripiperideine (Michel et al. 1967), *tyramine*, N-methyl-*tyramine* and synephrine (Smith 1977a).

Hammada leptoclada is a perennial sub-shrub, 25-60cm high, stem rugged, profusely branched, branches opposite, covered with greyish bark, joints brittle; fresh branches somewhat rigid, not succulent, glabrous, smooth, cylindric or terete, pale green or glaucescent. Leaves opposite, thickish, rather stiff, subulate, subcylindric, terete, short, 1-3mm long on green shoots, +- obtuse, subappressed to stem or scarcely spreading. Inflorescence broadly paniculate, of elongated spikes; flowers solitary, in axils of scale-like bracts, perfect, 5-merous, with lateral herbaceous bracteoles; bracteoles green, orbicular, rotundate, +- stiff, margins narrowly membranaceous or scarious, obtusely keeled in panicle, widely spaced, as long as or slightly shorter than flower; perianth segments leafy or subherbaceous, with basal tufts of flexuous hairs, margins membranaceous or scarious, obtuse, winged in fruit just above middle, wings subrotundate or suborbicular, membranaceous, rounded at base, horizontally expanded to 7-8(-10)mm; stamens 5; anthers oblong-oval to rounded-oval; filaments connate for much of length to a hypogynous disc, deeply compound at base, lobed, alternating with staminodes; staminodes semiorbicular glandular-ciliate, thickened at margin, reaching beyond middle of perianth, lobes semiorbicular or subtruncate, glandular or glandular-fimbriate. Ovary 1-locular, superior, with 1 basal ovule; disc semiorbicular, papillose-fimbriate; stigmas 2-5, subsessile, short, thick. Fruit 2-2.5mm diam., apex concave, loosely enclosed by lobes of fruiting perianth; seed horizontal, with spiral embryo. Fl. Apr.-May.

Gravelly slopes, in pebbles, pebbly- and sandy-desert, saline sand borders, 'clayey solonchak soils'; central Asia (Komarov ed. 1936).

HEDYOSMUM

(Chloranthaceae)

Hedyosmum toxicum *Cuatrec.* **(H. cumbalense** *H. Karst.***; H. granizo** *Cuatrec.***)** – granicillo, granicillo pequeno, chisco de monte, granizo, granizo de paramo, chavarquero, guayusa, guayusa hembra

Hedyosmum translucidum *Cuatrec.* – granicillo del grande, granizo, granizo morada, guayusa, sachguayusa, aquaquin

H. toxicum is used near Pasto, Colombia, on rare occasions, due to its great strength. Its aromatic leaves are decocted and drunk as a strong intoxicant, violent emetic and stomach tonic. An infusion may be used to treat stomach trouble, colic and chills; the leaves are also sometimes used to flavour, and probably strengthen, alcoholic beverages. H. translucidum is used in the Putumayo of Colombia – the aromatic leaves are made into a hot infusion, which is taken as a tonic, stimulant and digestive. The common name of 'guayusa' given to these plants suggests that they may be regarded as substitutes for **Ilex** guayusa (Schultes & Raffauf 1990; Todzia 1988). Their chemistry is obscure.

Hedyosmum toxicum is a dioecious, aromatic shrub or columnar tree 1-7m tall, with a narrow crown; trunk gnarled with prop-roots; bark grey, smooth, slightly fissured; wood white, soft, turning orange exposed to air; young stems quadrate, purple, smooth to verrucose, glabrous to scurfy or hirsute; older stems terete, smooth, glabrous, often hollow, with leaf-scars; internodes 0.5-2.2cm long, nodes swollen. Leaves narrowly elliptic, elliptic to obovate, 1.1-5.3 x 0.5-1.8cm, apex acuminate, base rounded to truncate, margins serrate with ascending, often white-tipped teeth 2.5-4mm distant, crassulate-coriaceous, smooth, shiny, glabrous, dark green above, lighter beneath with margins white to purple-black when fresh; midveins impressed above, raised and glabrous to hirsute below; free portions of petioles purple, 0.1-0.4cm long, smooth to verrucose to scurfy, glabrous to hirsute, inflated, flared at apex, quadrangular, each distal margin with 2 caducous, fimbriate, stipular appendages 1-2mm long that continue down sheaths as raised ciliate to fimbriate lines, extending to 0.5mm beyond free portion of petioles. Male inflorescence green, terminal, in a solitary spike 2.1-4.4 x 0.6-1cm; subtending leafy bracts 0.1-1.1cm long; rachis with basal annulus; peduncles 1-2mm long or sessile; stamens 90-160 per spike, congested, becoming 0.5-1mm distant on axis; anthers yellowish-green, 1.5-3 x c.1.5mm. Female flowers usually terminal, sometimes axillary, composed of a solitary cymule, subtended by a pair of yellow, green or purplish leafy bracts 0.1-1.8cm long (enclosing flowers completely except for stigmas), cymules with 2-8 clustered flowers, 5-10mm long and wide, terminal cymules sessile, axillary ones on rachis 2-5mm long; flowers trigonous, 4-6 x c.2mm, with or without a pore on each face; perianth lobes 1.5-2mm long, basally united, with free portions triangular, acute; stigmas green to purple, linear, terete, 2-4mm long with very short papillae. Fruiting cymules purple to black, globose, 0.9-1.5cm diam.; seeds trigonous, c.3mm long, brown, smooth. Fl. and fr. all year.

In elfin, cloud and subpáramo forest from 2700-3500m; Colombia to Peru (Todzia 1988).

HEIMIA [including Decodon]

(Lythraceae)

Heimia montana *(Griseb.) Lillo*

Heimia myrtifolia *Cham. et Schlecht.* **(Decodon myrtifolius** *Kuntze***; Nesaea myrtifolia** *Desf.***)** – abre-o-sol ['sun-opener'], herba da vida ['herb of life'], quiebra arado ['plow breaker'], quiebra yugo

Heimia salicifolia *Link* **(H. syphilitica** *DC.***; Decodon salicifolius** *Kuntze***; Nesaea salicifolia** *Kunth***; N. syphilitica** *Steud.***)** – sinicuiche ['twisted foot'], sinicuilche, sinicuil, yerba de las animas ['herb of the spirits'], cuauxihuitl, huauchinolli, hauchinal, jarilla, grandadillo, anchinol, xoneculli, chapuzina, rosilla de puebla

Decodon verticillatus *(L.) Ell.* – swamp loosestrife, water oleander

The flowers of H. salicifolia have been observed adorning the statue of the Aztec deity Xochipilli [see **Turbina**] (Wasson 1973). This plant is prepared into a magical beverage by inhabitants of the highlands of Tamaulipas and Veracruz, Mexico. Healers prepare the plant by soaking the wilted [or dried] crushed leaves in water and leaving the mixture to ferment in the sun for a day. The leaves are then pressed out and discarded; at this point some sources say the beverage is consumed, others say it is left for further fermentation before consumption. Some say it is sometimes mixed with alcoholic beverages to add strength. Indigenous users claim the drink helps them to remember past events from long ago. It causes a pleasant drowsiness and giddiness, mild intoxication, darkened vision, hypothermia, slowed heart-rate, mildly reduced blood pressure, di-

lation of coronary vessels, and skeletal muscle relaxation. The most interesting aspect of the experience is an auditory factor, where sounds seem to be far away or distorted. No negative effects are reported, but overindulgence can cause a yellowish tinge to vision the next day. Continued overuse reputedly leads to memory deficits. Experiments by western psychonauts have produced variable results, some experiencing the effects, others not noticing them. Medicinally, the plant is said to act as a general tonic, sudorific, antipyretic, haemostatic, emetic, laxative, diaphoretic, diuretic, astringent, antisyphilitic and vulnerary. It is used to treat chest complaints, dysentery, indigestion, slow-healing ulcers, dermatitis contracted from **Rhus**, and inflammation of the womb after childbirth (Blomster et al. 1964a; Jiu 1966; Malone & Rother 1994; Ott 1993; Rätsch 1992; Schultes & Hofmann 1980, 1992; Tyler 1966). It has been said to cause "violent perspiration" (Webb 1948), though no modern-day users of the plant have reported this, that I am aware of.

Around 10g of dry leaves, or the equivalent wet amount, is said to constitute a single dose (Gottlieb 1992). Others have reported a "heaped handful" of leaves to be sufficient for one person (pers. comm.). A single experiment with a smaller, unweighed quantity [a small cupped-handful] of H. salicifolia leaves [from a plant growing in Melbourne, Australia], prepared by the traditional method, produced inconclusive results. A mild relaxation and anxiolysis were the only perceptible effects at this dose (pers. exp.). The most interesting effects noted from H. salicifolia have resulted from smoking concentrated extracts of the herb. Both an "unspecified resin" and a 28x extract were used by two psychonauts, the latter in a smoked dose of "2 cones" through a water-pipe. The experience lasted 30-90 minutes, was positive in nature, and involved strong visual effects – one of the psychonauts reported "snakes flowing in and out of his body". A smokeable extract of this herb may be prepared with acetone as the solvent, using a small amount of ammonia for basifying (Torsten pers. comm.).

There has been much confusion regarding the taxonomy of Heimia spp., many researchers regarding it to be a monotypic genus, with H. salicifolia as the only representative. Others hold that H. myrtifolia differs enough in its morphology and natural range to be considered a separate species. Under this view, Mexican plants are H. salicifolia and S. American plants are H. myrtifolia (Blomster et al. 1964a; Douglas et al. 1964). It was only recently that H. montana [from s. Bolivia and n. Argentina] was recognised as another member of this genus. Although difficult to distinguish morphologically, it is now believed these 3 species can be differentiated by chromatographic comparison (Rother 1990).

H. montana aerial parts have yielded 0.05-0.16% *cryogenine* [vertine], 0.03-0.22% lythrine, 0.001-0.22% lyfoline, 0.01% lythridine, 0.003-0.25% demethylvertine, 0.003% heimidine, 0.006% alkaloid H-17, 0.003% H-18, 0.017% H-19 and 0.02% H-20. Nesodine was detected by TLC in an analysis of a different harvest (Rother 1990).

H. myrtifolia has yielded 0.0055% *cryogenine* [see below], 0.177% lythrine, 0.003% lythridine (Douglas et al. 1964) and nesodine [detected by TLC] (Rother 1990).

H. salicifolia foliage has yielded up to 1.4% quinolizidine alkaloids, including 0.199-0.86% *cryogenine*, 0.18-0.66% lyfoline, 0.055-0.66% lythrine, 0.09-0.55% nesodine, 0.0013% heimine, lythridine, 0.0023% sinine, 0.0042% sinicuichine, vesolidine, cryofoline, and traces of heimidine, demethylvertine [both tentatively detected by TLC], demethyllasubines I & II, anelisine, abresoline and demethylabresoline. Sitosterol [0.01%] and l-mannitol [1.4%] have also been isolated. Roots and seeds are alkaloid-free. Seedlings [5-10 days old] have yielded *cryogenine* and decodine. *Cryogenine* is often stated to be "the active component", however, a synergistic action should be expected as the activity of an extract differs from that of *cryogenine* alone (Appel et al. 1965; Blomster et al. 1964a; Dominguez et al. 1975; Douglas et al. 1964; Hörhammer et al. 1973; Kaplan & Malone 1966; Malone & Rother 1994; Rother 1990; Rother et al. 1965; Rother & Schwarting 1975; Tyler 1966).

D. verticillatus aerial parts have yielded 0.06-0.42% alkaloids, including [as % of total alkaloids] 0.5% *cryogenine*, 10.2% verticillatine, 0.5% vertaline, 6.4% decodine, 0.7% decaline, 0.5% decamine and 7% decinine (Ferris 1962).

Heimia salicifolia is a slender deciduous shrub to (1.5-)3m tall, usually much smaller, glabrous throughout. Leaves mostly opposite, sessile to short-petioled, linear-oblanceolate to linear-lanceolate, c.(1-)5 x 1cm, apex obtuse to acute, base attenuate. Flowers solitary and short pedunculate in the axils, inodorous; peduncle to 2mm long; calyx broadly campanulate, (4-)5-9mm long, with triangular acuminate lobes that become closely connivent over the capsule; petals 5-6(-7), orange-yellow, oval to obovate, (10-)12-17mm long, fugacious; stamens 10-18. Ovary 3-6-locular; style slender; stigma capitate. Capsule globose, 4-celled, c.4mm diam., loculicidally dehiscing. Fl. Mar.-Jun. in natural habitat.

Along resacas, streams, or in wet soil in brushlands; Rio Grande plains of s. Texas, south through Texas and Mexico to S. America; also in Jamaica, and naturalised near Brisbane, Australia (Correll & Johnston 1970; Hewson & Beesley 1990). Can be difficult to distinguish from other Heimia spp. (Malone & Rother 1994).

Cultivate by sowing the tiny seed thinly on top of a fine, firmly packed soil; water with mist or by perfusion from the bottom, keeping shaded and moist until seeds germinate. Gradually introduce to full light, and let soil dry between waterings; thin and transplant carefully [root systems are large] when about 3cm tall. May be grown in a permanent outdoor position in hot climates – elsewhere, they should be kept in large pots and brought inside for winter. Prefers well-drained soil and infrequent but thorough waterings. May also be propagated from cuttings or layers (Grubber 1973). Seedlings may take a long time to put on much growth after germination (pers. obs.), though they grow quickly after this (pers. comms.).

HELICHRYSUM

(Compositae/Asteraceae)

Helichrysum aureonitens *Sch. Bip.* **(H. helodes** *Hiern***)**
Helichrysum decorum *DC.*
Helichrysum epapposum *Bolus* **(H. flavum** *Burtt Davy***)**
Helichrysum foetidum *(L.) Moench* **(Gnaphalium foetidum** *L.***)** – imPepo, im pepho, muishondblaar, everlasting
Helichrysum gymnocomum *DC.*
Helichrysum herbaceum *(Andrews) Sweet* **(H. squamosum** *(auct. non. Jacq.) Thunb.***; Xeranthemum herbaceum** *Andrews***)**
Helichrysum italicum *(Roth.) G. Don.* – curry plant, cari, canugioro, canugiulo, hoja santa, imortelle, Italian everlasting
Helichrysum kraussii *Sch. Bip.* **(H. steetzii** *(Vatke) O. Hoffm.***)** – imPepo, im pepho
Helichrysum leiopodium *DC.* **(H. asperifolium** *Moeser***; H. nudifolium** *(L.) Less.***; H. quinquenerve** *(Thunb.) Less.***; Gnaphalium nudifolium** *L.***)**
Helichrysum odoratissimum *(L.) Sweet* **(Gnaphalium odoratissimum** *L.***)**
Helichrysum platypterum *DC.* **(Cassinia alba** *O. Hoffm.***; Gnaphalium amplum** *Kuntze***)**
Helichrysum stenopterum *DC.* **(Achyrocline stenoptera** *(DC.) Hilliard et Burtt***)** – imPepo, im pepho

Zulu shamans in South Africa inhale the fumes of H. foetidum, H. stenopterum and/or H. decorum to enter a trance-state; H. aureonitens may also be so used (DeSmet 1996, 1998; Schultes & Hofmann 1980). H. kraussii is reportedly similarly used as a magical incense in Natal. Shamans or diviners harvesting the plant take special care to leave the roots in the ground (Cunningham 1993). In addition, the Zulu burn leaves and stems of H. aureonitens, H. epapposum, H. gymnocomum, H. herbaceum, H. leiopodium, H. odoratissimum and/or H. stenopterum "to invoke the goodwill of the ancestors" (De Smet 1998). The flowers of H. foetidum produced euphoric opiate-like effects, when smoked by several subjects (E pers. comm.). H. stenopterum is used in the form of a deodorant lotion or body wash by Zulu women. H. foetidum has also been applied to 'festering sores' as a dressing to aid the healing process. H. leiopodium is used by the Suto as a steam-bath, to relieve a person who is having nightmares, or suffering fever. A decoction of H. platypterum root is drunk by Suto men as a sexual tonic, to "renew their virility". Ash prepared from a Helichrysum sp. is drunk mixed with beer by the Bikita of Zimbabwe, to 'cure' epilepsy (Watt & Breyer-Brandwijk 1932). In Italy, H. italicum is used to treat migraine, respiratory illnesses, rheumatism, allergies, and eye and skin disorders, amongst other medicinal uses (Opitz et al. 1971). In the Tuscany region, the aerial parts of the wild plant are burned on Christmas eve to prevent the 'evil eye' and bring good omens (Pieroni & Giusti 2002).

H. aureonitens aerial parts have yielded aureonitol, galangin, caryophyllene epoxide, triterpenes and hydrocarbons (De Smet 1998).

H. cooperi flowers yielded 2.23% helichrysin [6'-O-methyl-chalcononaringenin 4'-glucoside], a chalcone flavonoid glucoside, as well as (-)-2-O-methyl-chiroinositol and luteolin 7-glucoside (Wright 1976).

H. decorum aerial parts have yielded a dihydrochalcone derivative (De Smet 1998).

H. foetidum has yielded helichrysin from the involucral leaves.

H. italicum aerial parts have yielded gnaphaliin [see **Gnaphalium**]; flowers have yielded linalool, sitosterol, ursolic acid, 3 diketones and a caffeic acid-derived diterpene (Opitz et al. 1971).

H. leiopodium leaves and roots have yielded helichrysin (Watt & Breyer-Brandwijk 1962).

H. maracandicum flowering aerial parts have yielded the coumarins *scopoletin*, iso-*scopoletin*, umbelliferone and aesculetin (Baimukhametov & Kamissarenko 1990).

H. stenopterum aerial parts have yielded 0.09% γ-curcumene, 0.02% α-curcumene, 0.06% γ-curcumene-endoperoxide, 0.01% caryophyllene, 0.01% aromadendrene and 0.24% combined phloroglucinol derivatives (Jakupovic et al. 1986).

Plants from the genus Helichrysum have also yielded α-pyrone derivatives (Jakupovic et al. 1986).

Helichrysum stenopterum is an erect herb to 50cm tall, little or

not branched, thinly wooly throughout, sometimes almost hairless; stems with narrow wings descending from leaf margins. Leaves alternate, well-spaced, spreading, entire, narrow, mostly sessile, tapering to a fine point, margin slightly recurved, c.4cm x 6mm, usually densely white-hairy on both sides. Inflorescence rather loosely branched with dense, compact clusters of numerous flower heads; involucral bracts yellow, c.3mm long, pointed, slightly longer than florets; receptacle flat or convex, surface pitted, honeycombed or bearing scales or bristles; florets few or many, mostly bisexual; corolla cylindrical, usually hairless, 5-toothed, yellow; anthers tailed and appendaged. Ovary often ribbed or angled; style often swollen at base, branches blunt-tipped. Pappus of bristles, rough or feathery at tip. Fl. Apr.

Swamps; Usutu forests, Hawane Falls, Ukutula – S. Africa, up to 1300m (Compton 1976).

HELICONIUS [including Agraulis]

(Nymphalidae, subfamily Heliconiinae)

Heliconius charitonia *(L.) Kluk* **(H. charithonia** *(L.) Latreille***; Papilio charitonia** *L.***)** – zebra longwing
Heliconius cydno ssp. galanthus *Bates*
Heliconius erato ssp. petiveranus *Doubleday* **(H. demophon** *Ménétriés***; H. erato ssp. demophon** *Ménétriés***)** – small postman
Heliconius ethilla ssp. eucoma *Hübner*
Heliconius ismenius ssp. clarescens *Butler*
Heliconius melpomene ssp. rosina *Boisduval* – postman
Heliconius sara ssp. thamar *Hübner* **(Nereis thamar** *Hübner***; Papilio rhea** *Crama***)** – small blue Grecian
Heliconius wallacei ssp. flavescens *Weymer* – blue Grecian
Heliconius spp. – longwings, passionvine butterflies
Agraulis vanillae *(L.) Boisduval et Leconte* **(Dione vanillae** *(L.) Hübner***; Papilio vanillae** *L.***)** – gulf fritillary

These are a complex group of butterflies with a life-cycle similar to that of the glasswing butterfly [see **Acraea**]. As with **Acraea**, larvae of some Heliconius spp. feed on plants of the family Passifloraceae, including **Passiflora**, accumulating the cyanogenic and β-carboline compounds characteristic of many of these plants. The cyanogenic compounds, however, are generally considered of primary importance in this relationship, as the accumulation of these compounds renders the larvae and butterflies distasteful and toxic to predators (Spencer 1988). They are generally much longer-lived than most other butterflies, with an average lifespan of several months, as compared to 10 days for many species [though some butterflies do overwinter]. They have also evolved relatively large brains and excellent memory, with their brain learning centres being much larger than usual. The creatures are very variable in appearance, due to their ability to acquire new markings to suit changing environments (Murawski 1993).

Adult butterflies, which had been fed as larvae on β-carboline-containing plant material [plant species not noted by Cavin & Rodriguez], were analysed by HPLC/MS, and shown to contain small amounts of β-carboline alkaloids. As well as those listed below, the samples also contained 6-MeO-*harman* and *harmaline* as confirmed by TLC (Cavin & Rodriguez 1988) – it is not clear whether this applied to all samples analysed. Cavin & Bradley (1988) tested for the presence of *harman*, *norharman* and *harmine* only, but noted that other β-carboline alkaloids were probably present, also. Many Heliconius spp. also contain the pigment 3-OH-L-kynurenine in their wings (Tokuyama et al. 1967). This compound might have psychotropic effects [see kynurenine in *Neurochemistry*]. A Heliconius sp. was found to contain xanthommatin in the wings (Numata & Ibuka 1987).

H. charitonia larvae, fed on **Passiflora** biflora, accumulated mostly *harmine* and *norharman*, with only minor levels of *harman* (Cavin & Bradley 1988). H. charitonia ssp. tuckeri is known to feed on P. incarnata (McGuire 1999).

H. cydno ssp. galanthus contained mostly *norharman*, with smaller amounts of *harman* and *harmine* (Cavin & Rodriguez 1988). H. cydno is known to feed on **Passiflora** ambigua, P. auriculata, P. biflora, P. coriacea, P. costaricensis, P. guazumaefolia, P. lancearia, P. laurifolia, P. oerstedii, P. pittieri, P. quadrangularis and P. vitifolia (Spencer 1988).

H. erato ssp. petiveranus contained mostly *harmol*, *harmine* and *norharman*, with small amounts of *harman* and *harmaline* (Cavin & Rodriguez 1988). H. erato is known to feed on **Passiflora** alata, P. amethystina, P. auriculata, P. biflora, P. caerulea, P. capsularis, P. chelidonea, P. coriacea, P. cuneata, P. cuspidifolia, P. edulis, P. gracillima, P. hahnii, P. incarnata, P. jileki, P. laurifolia, P. miersii, P. misera, P. organensis, P. pohlii, P. pulchella, P. punctata, P. resticulata, P. rhamnifolia, P. rubra, P. sidaefolia, P. suberosa, P. talamacensis, P. tricuspis, P. trifasciata, P. truncata, P. tuberosa, P. vespertilio, P. violacea, P. warmingii, Dilkea parvifolia and Tetrastylis ovalis (Spencer 1988).

H. ethilla ssp. eucoma contained similar proportions of *norharman* and *harmine*, and traces of *harman* (Cavin & Rodriguez 1988). H. ethilla is known to feed on **Passiflora** alata, P. alba, P. amethystina, P. bahiensis, P. cyanea, P. edulis, P. eichleriana, P. garckei, P. jileki, P. kermesina, P. miersii, P. oerstedii, P. picturata, P. racemosa, P. recurva, P. rhamnifolia, P. setacea, P. sidaefolia, P. vellozii, P. violacea and Tetrastylis ovalis (Spencer 1988).

H. melpomene ssp. rosina contained mostly *norharman*, with only traces of *harman* and *harmine* (Cavin & Rodriguez 1988). H. melpomene is known to feed on **Passiflora** acuminata, P. alata, P. ambigua, P. bahiensis, P. capparidifolia, P. coccinea, P. cyanea, P. edulis, P. eichleriana, P. glandulosa, P. jileki, P. laurifolia, P. ligularis, P. maliformis, P. menispermifolia, P. misera, P. nitida, P. oerstedii, P. quadriglandulosa, P. serrato-digitata, P. spinosa, P. tricuspis, P. tuberosa, P. violacea, P. vitifolia and Tetrastylis ovalis (Spencer 1988).

H. ismenius ssp. clarescens larvae, fed on **Passiflora** biflora, accumulated mostly *harmine* and *norharman*, with moderate levels of *harman*; the faecal excretions contained mostly *norharman*, and *harmine* was present only in traces, or not at all. Eggs of grown butterflies fed on this species also contained 6-MeO-*harman*. With larvae fed on P. oerstedii, *norharman* was predominant. In butterflies developed from larvae that had been fed on **Passiflora** costaricensis or P. quadrangularis, the alkaloids were retained, but mostly in the form of *norharman* (Cavin & Bradley 1988).

H. sara ssp. thamar contained similar proportions of *norharman*, *harman* and *harmine* (Cavin & Rodriguez 1988). H. sara is known to feed on **Passiflora** auriculata, P. candida, P. cirrhiflora, P. costata, P. edulis, P. faroana, P. jileki, P. mansii, P. mucronata, P. pentagona, P. rhamnifolia, P. spinosa, P. suberosa, P. truncata and Tetrastylis ovalis (Spencer 1988).

H. wallacei ssp. flavescens contained small amounts of *harman*, with only traces of *norharman* and *harmine* (Cavin & Rodriguez 1988). H. wallacei is known to feed on **Passiflora** coccinea, P. glandulosa, P. quadriglandulosa and P. vitifolia (Spencer 1988).

Agraulis vanillae larvae, fed on **Passiflora** biflora, were shown to contain a high proportion of *harman*, with minor levels of *norharman* and *harmine* (Cavin & Bradley 1988). A. vanillae is also known to feed on P. incarnata both in the wild and in cultivation (McGuire 1999).

Heliconius butterflies lay their eggs [often individually, as some Heliconius larvae are cannibalistic] usually on **Passiflora** spp. [to guard against consumption by rampant larvae, some passionvines grow small yellow protrusions to mimic eggs, giving the impression they are already occupied – some also secrete a sugary substance to attract wasps and ants, which eat the larvae and eggs]. The eggs, often yellow, are smaller than a grain of rice, +- ovate with flattened ends like a barrel, and longitudinally ribbed. After hatching, the small caterpillar, often with long black spines, eats its egg and then sets to work on the **Passiflora** vine; over the next 2 weeks it sheds and grows 4 times; the next 2 weeks sees progression to pupa [chrysalis] stage, and finally to adult butterfly. The adults have rather elliptic wings, and a slow, unwavering flight pattern; they often roost together in groups at night. They feed on nectar and pollen, as well as rotting fruit, dung and urine. Their colours are often mimicked by other species, to take advantage of the reputation of Heliconius spp. to predators as being distasteful.

Heliconius spp. are distributed from the tip of Florida, south through the Caribbean, and Central & South America; usually found near disturbed sites and forest edges in tropical zones. Species and subspecies of Heliconius are known to interbreed in the wild, making for a taxonomist's nightmare (Murawski 1993; Watson & Whalley 1975).

HELICOSTYLIS and BROSIMUM

(Moraceae)

Helicostylis pedunculata *Benoist* – takini
Helicostylis tomentosa *(Poepp. et Endl.) Rusby* **(H. affinis** *Steud. ex Miq.***; H. duckei** *Hawkes***; H. obtusifolia** *Standl.***; H. podogyne** *Ducke***; H. poeppigiana** *(Mart.) Trécul***; Greeneina affinis** *(Steud. ex Miq.) Kuntze***; G. poeppigiana** *(Mart.) Kuntze***; Olmedia asperula** *Standl.***; O. poeppigiana** *Mart.***; O. polycephala** *Pittier***; O. tomentosa** *Poepp. et Endl.***; Trymatococcus guanabarinus** *Duarte***)** – takini[?], letterhout, manletterhout
Brosimum acutifolium *Huber* **ssp. acutifolium** *C.C. Berg* **(B. acutifolium** *Huber***; Brosimopsis acutifolia** *(Huber) Ducke***; Piratinera acutifolia** *(Huber) Pittier***)** - takini, takweni, tauni, mururé, tamamuri, iari

In Surinam, French Guiana and possibly n.e. Brazil 'takini' trees are considered sacred by the Carib, Galibi and Arawak; the latter group figure it in their mythology relating to the origin of shamanism. The bark is considered the most important part - it is slashed deeply to yield a sap or latex, first flowing translucent, then red and slightly frothy. It is this red sap which is used to prepare a shamanic intoxicant. The Arawak, in their shamanic initiation ceremonies, used the fumes of the latex in conjunction with tobacco [see **Nicotiana**]. Wayãpi and Palikur shamans drink the latex [c.500ml per dose, taken all at once] and smoke the bark to become allied with the spirits of the tree. Newly initiated Cariña shamans are given

two small gourds of takini latex to utilise in their practice. It is also used by some 'bushinenge' [descendants of runaway African slaves] in Surinam. The latex is considered mildly toxic, and hallucinogenic. For a long time takini was thought to be referable to H. pedunculata and/or H. tomentosa (Buckley et al. 1973; Moretti et al. 2006; Schultes & Hofmann 1980; Schultes & Raffauf 1990), but it is now known to be B. acutifolium ssp. acutifolium [however, the Palikur recognise 3 types of takini, so it may be that other plants are also used, if they are not simply varieties of the same species]. This, as well as B. utile and probably other members of the genus, are better known for their medicinal use in the Amazon to treat rheumatism and inflammation; side effects may include sweating and spinal pains (Moretti et al. 2006). B. utile latex has also been used to treat indigestion and asthma, and as a tonic and purgative. The Tikuna decoct bark of an unidentified B. sp. known as 'palo sangre' and 'toa-ta-a-ru-nai' with **Tabernaemontana** aff. divaricata to relieve pain from menstruation and childbirth (Schultes & Raffauf 1990).

H. scabra latex is said to be "very toxic", and in Brazil, H. coriacea latex is used as a fatal poison (Schultes & Raffauf 1990).

B. acutifolium ssp. acutifolium latex from French Guiana was found to contain *bufotenine* [23.4-25µg/ml in red latex, 0.7µg/ml in white latex] (Moretti et al. 2006); trunk bark has yielded small amounts of the flavonoids liquiritigenin, isoliquiritigenin, hydroxylonchocarpin, hydroxyisocordoin, luteolin, naringenin [see **Citrus**], 3,7-dihydroxy-4'-methoxyflavan, 4'-OH-7,8-(2",2"-dimethylpyran)flavan, 4'-OH-7,8-(3"-OH-2",2"-dimethylpyran)flavan, 7,4'-dihydroxyflavan, brosimines A & B, brosimacutins A-M and acutifolins A-F; the lignans mururins A-C; and syringaldehyde, coniferaldehyde, sitosterol & stigmasterol (Takashima & Ohsaki 2001; Takashima et al. 2005; Torres et al. 2000).

Crude aqueous ethanol extracts from the Helicostylis spp. produced CNS-depression, supposedly similar to that produced by **Cannabis**, in mice and rats. The LD50s of the extracts [given i.p.] were 2.5g/kg [H. tomentosa] and 3.1g/kg [H. pedunculata] (Buckley et al. 1973).

Brosimum acutifolium ssp. acutifolium is a dioecious tree to 35m tall, with latex; leafy twigs 2-5mm thick, white puberulous. Leaves (elliptic-)oblong-lanceolate, often markedly convex, 5-18cm long, 2.5-7cm wide, chartaceous, apex acuminate to mucronate, base acute to obtuse, margin entire, upper surface scabrous to scabridulous, underside usually slightly scabridulous, rather densely hairy, hairs minute to rather long and straight or curved, costa often with uncinate hairs, veins nearly plane above, prominent beneath, 8-15 pairs of secondary veins, without parallel tertiary veins; petioles 3-6mm long, often with uncinate hairs; stipules free, not fully amplexicaul, 2-8mm long, white appressed-pubescent. Inflorescence geminate or solitary in leaf axils. Staminate inflorescences globose, 4-8mm diam.; peduncle 5-8mm long, white puberulous; receptacle white puberulous; flowers many; perianth lacking; stamens 1-3, filaments 0.2-0.5mm long; anthers 0.15-0.2mm long and wide, connective rather broad; bracts many, white puberulous. Pistillate inflorescences (sub)globose, 8-12mm diam.; peduncle c.1cm long, white puberulous; receptacle white puberulous; flowers 1-5, embedded in receptacle; bracts many, white puberulous; ovary adnate to embedded perianth; stigmas vittiform to filiform. Fruit adnate to enlarged receptacle; fruiting receptacle subglobose to subdiscoid, to c.2.5cm diam., yellow to orange at maturity; seeds c.1cm long, without endosperm.

In forests and savanna; Surinam to Pará, Brazil.

B. acutifolium ssp. interjectum is found in w. Pará and e. Amazonas; ssp. obovatum is found in Guyana, Peru and Brazil [Amazon Basin, w. from Manaus] (Lanjouw & Stoffers ed. 1975).

Helicostylis pedunculata is a dioecious or monoecious tree to 25m tall, with pale yellow latex; leafy twigs 2-7mm thick, pale yellow, tomentose to sublanate. Leaves distichous, pinnatinervate, elliptic to lanceolate, 10-28 x 5-12cm, sometimes widest above middle, slightly inequilateral, coriaceous to chartaceous, acuminate to mucronate, obtuse at base, above tomentose on the costa, otherwise puberulous, glabrescent to scabridulous, beneath tomentose; margin often denticulate to dentate, mostly towards apex; veins almost plane above, prominent beneath, 10-17 pairs of secondary veins, most tertiary veins parallel; petioles 6-18mm long; stipules 5-9mm long, subsericeous to tomentose. Inflorescences on short axillary shoots, unisexual, involucrate. Staminate flowers up to 6 together, 8-9mm diam., with discoid receptacle; peduncles 5-15mm long, tomentellous; involucre with 5-6 series of ovate, acute, tomentellous bracts; perianth 1-1.3mm high, 4-lobed; filaments c.1-1.5mm long; anthers 0.6-0.7 x c.2mm. Pistillate flowers solitary or usually accompanied by 1-2 staminate flowers, discoid, 8-11mm diam.; peduncle 6-25mm long, tomentellous, often bracteate; flowers c.15-30; perianth 1.5-2mm high, 4(-6)-parted, tomentellous, inner tepals cohering by weak entangled thin hairs on inner surface. Ovary hairy at apex; style subterminal, 0.2-2.1mm long, hairy; stigmas vittiform, 2-3mm long, not or somewhat twisted. Infrutescences convexly discoid to hemispherical, 2-3cm diam.; fruiting perianth pale yellow, tomentellous; fruit ellipsoid, 7-8mm long; seed c.6mm long.

From Surinam to Para, Brazil; in Surinam in forests of the interior and the savannah, confined to the east part of the country (Pulle ed. 1966).

HERACLEUM

(Umbelliferae/Apiaceae)

Heracleum dulce *Fisch* – sladkaya trava, uchkui, inchkou, sweet grass

Heracleum lanatum *Michx.* **(H. elegans** *(Crantz) Jacq.***; H. intermedium** *Gaudin***; H. maximum** *Bartr.***; H. montanum** *Schleicher***; H. sphondylium ssp. elegans** *(Crantz) Schübl. et Mart.***; H. sphondylium ssp. montanum** *(Schleicher ex Gaudin) Briq.***; Pastinaca lanata** *(Michx.) Koso-Pol.***; Sphondylium lanatum** *(Michx.) Greene***)**

Heracleum lehmannianum *Bunge*

Heracleum pyrenaicum *Lam.* **(H. alpinum** *L.* **ssp. pyrenaicum** *(Lam.) Rouy et Cam.***; H. sphondylium** *L.* **ssp. pyrenaicum** *(Lam.) Bonnier et Layens.***)**

Heracleum sphondylium *Cham. et Schlecht non L.* – hogweed, hexenkohl

Heracleum spp. – cow parsnip

The Kamchadals of Siberia have been known to eat the fresh stems and petioles of H. dulce, to provide an 'alcohol-like' intoxication. The herb was also sometimes made into a wine, and in the past, vodka was distilled from the stem. Many other Heracleum spp. are eaten fresh or marinated when young (Brekhman & Sam 1967; Shishkin ed. 1986b). In Ladakh, India, excessive consumption of H. thomsoni leaves and fruits by goats has been known to result in blindness (Bhattacharyya 1991).

In China, H. lanatum tubers are considered "an excitant of the nerve centres, an anodyne to treat headache, influenza, dizziness, toothache, pain in the nerves of the face" (Perry & Metzger 1980). The tuber of H. lanatum was used by many Native American groups to treat colds, flu, cough, headache, sore throat and cramps; it has also been applied as a poultice on swellings, bruises, boils and rheumatic pains. The Winnebago also used it in their sweat-lodges. The roots, young leaves and shoots of H. sphondylium are sometimes brewed into a beer [see *Methods of Ingestion*]. In herbal medicine, a plant tincture is given for general debility. The leaves are used in homoeopathy as a digestive and sedative, and its fruits are said to be aphrodisiac (Bremness 1994; Kindscher & Hurlburt 1998). In some areas of Europe the plant is made into a vaginal douche cream [also containing Chelidonium majus (see *Endnotes*) and Satureja montana] "to increase sexual desire in frigid women" (Islam et al. 1991). In Germany, H. sphondylium has been known as 'hexenkohl', hinting at a past relationship with witches (De Vries 1991).

Air-dried leaves of some unspecified Heracleum spp. contained c.1.25% essential oil; fruits yielded 0.23-1.75% essential oil (Shishkin ed. 1986b). Antoside, rutin, epi-rutin, kaempferol [MAOI (Sloley et al. 2000)], quercetin, *scopoletin*, (R)-heraclenol and bergapten have also been found in the genus (Basargin 1976; Buckingham et al. ed. 1994; Svendsen et al. 1959).

H. candicum contains 3-phenylpropanal and 3-phenyl-1-propanol (Buckingham et al. ed. 1994).

H. lanatum has yielded angelicotoxin, angelicin, angelic acid, lanatin, sphondin, phellandrene and hydrocarotin; as well as psoralen from the roots [under investigation for treatment of AIDS, leukaemia and psoriasis] (Buckingham et al. ed. 1994; Perry & Metzger 1980).

H. lehmannianum contains an essential oil with c.80% *anethole* (Vuishenskii 1936).

H. pyrenaicum has yielded *apiole* (Buckingham et al. ed. 1994).

H. sphondylium root has yielded the coumarins pimpinellin, isopimpinellin, isobergapten, phondin, sphondylin and umbelliferone (Svendsen et al. 1959).

H. wallichii roots yielded the alkaloids cycleanine and isochondrodendrine, as well as columbianetin, marmesin, vaginidiol and stigmasterol (Gupta et al. 1976).

Heracleum dulce is a biennial or perennial herb 1.5-2m tall; stem thick, deeply furrowed with sparse hairs mainly at nodes. Leaves ternate, rarely pinnate-compound (2 pairs); petiolules of first pair of lateral segments 3-4cm long, other segments sessile, all broadly ovate, ternately or pinnately cut into ovate, pointed, largely and irregularly toothed lobes, terminal segment surrounded, deeply lobed, lobes broadly ovate, pointed, sometimes slightly overlapping; leaves glabrous above, with fine hairs mainly along nerves beneath; upper leaves usually ternate, with expanded sheath. Umbels many-rayed, all rays with finely spreading hairs; involucre lacking; stem under umbel densely covered with long hairs; leaflets of involucels many, linear-lanceolate, as long as or longer than flowering umbellets; flowers white; calyx 5-toothed, teeth small, triangular; petals obovate, +- deeply notched or 2-lobed, peripheral petals enlarged. Ovary spreading-hairy; stylopodium broadly conical; styles twice as long as stylopodium. Fruit 6-8mm long, 7-8mm wide, glabrous or sparsely hairy; dorsal canals usually ½ length of fruit, rarely slightly longer, commisural canals broader, ½ length of fruit.

Subalpine meadows, forest edges, very frequent in riparian valleys; Kamchatka, Siberia (Shishkin ed. 1986b).

HETEROPTERYS [Heteropteris]

(Malpighiaceae)

Heteropterys aphrodisiaca *O. Mach.* – nó de cocherro, nó de porco, guaco, tintureiro, resedá amarelo, jasmin-amarelo
Heteropterys chrysophylla *(Lam.) H.B.K.* **(Banisteria chrysophylla** *Lam.***)** – Brazilian gold leaf

In Mato Grosso, Brazil, some Heteropterys spp., known as 'nó de cocherro', are used as aphrodisiacs (Mors & Rizzini 1966). The vernacular name [meaning 'dog-knot'] refers to the appearance of the root, which looks like a dog's penis. The Amazonian H. aphrodisiaca is one of these plants, and its roots are saved for special occasions, when the women serve an infusion or decoction of it to their husbands. It is also used in folk medicine to "produce physical and mental well-being". Recent research has confirmed that the leaf and root improve sexual function, as well as enhancing memory and learning, and acting as an antioxidant and general tonic or rejuvenator (Baill pers. comm.; Biosintética 2000; Carvalho 2000). H. macrostachya and H. riparia are considered toxic, and the latter is known as 'dog-killer' in the Amazon. Seeds of H. macrostachya and H. suberosa are also used there to make a tea to treat diarrhoea (Schultes 1950; Schultes & Raffauf 1990).

A specimen of H. chrysophylla growing ornamentally in Brisbane [Queensland, Australia; harv. Mar.] was found to contain alkaloids in the leaf, which were not identified (Webb 1949), though presumed by Ott (1993) to be β-carboline alkaloids. Due to the close relationship of the plant to **Banisteriopsis**, it would not be surprising if this is so.

Plants of the genus Heteropterys have been reported to have yielded saponins, phenolic acids and tannins (Schultes 1950).

Heteropterys chrysophylla is a liana. Leaves opposite, ovate to oblong-ovate or lanceolate, 5-10cm long, acute or short acuminate, glabrous, shining, prominently reticulate above, lustrous-pubescent and veiny beneath, thick-membranous or leathery, rounded or subcordate at base, short-petioled. Flowers in panicled, often leafy-bracted cymes; calyx with 8 glands, or glandless; sepals 5, ovate, 3-4mm long, the glands fully ½ the length of the sepal body, sepals often recurved at tip, persistent; corolla yellow, orange or purple; petals 5, entire, undulate or erose-denticulate, larger petals somewhat longer than sepals; stamens 10; filaments subulate; anthers very thick. Ovary 3-lobed; styles 3, distinct, unequal. Samaras 2-3 together or solitary, wing conspicuous, thickened along dorsal side, 4.5-5.5cm long, the wing red-sericeous, dilated at apex, auricled at base on ventral side, body crownless.

Puerto Rico, Brazil (Fridericus & De Martius ed. 1965-1975; Small 1910 [for genus detail]).

Banisteria chrysophylla *Bello* represents a different plant, now known as Heteropterys wydlerana *Adr. Jussieu fide Niedenzu* (Gates 1982).

HIERACIUM

(Compositae/Asteraceae)

Hieracium pilosella *L.* **(H. canum** *Vuk.***; H. leucophyllum** *Schur***; Pilosella officinarum** *(Vaill.) F. Schultz et Schultz-Bip.***; P. communis** *A.-T. Mon.***)** – hawkweed, mouse-ear hawkweed, devil's weed, haret hogeurt

This common European herb has occasionally been used in the Danish 'underground' as an agent to expand consciousness. A dose of 1-2 cigarettes smoked is said to produce the desired effects (Ott 1993), which are very mild (Montgomery pers. comm.). An ethanol extract of the commercially-available dried herb was found to be more effective, but still mild (theobromus pers. comm.). One bioassay [by 2 people] of the smoked herb resulted in a perceived widening of peripheral vision (Wise pers. comm.).

Shepherds in rural southern Europe sometimes use the plant to apply to small wounds, to aid in healing. The herb is also used to treat brucellosis ['Malta fever'], a chronic bacterial disease of farm animals that is easily transmitted to humans. The fresh plant is antibiotic and diuretic; the dried plant is astringent (Chiej 1984; Martin et al. ed. 1996). The related 'rabbit's ear hawkweed', H. venosum, is used by the Cherokee [in combination with **Mitchella** repens] in the form of a root tea, to treat bowel complaints (Hamel & Chiltoskey 1975). In southern Africa, H. polydon is an ingredient in a compound medicine used by the Southern Sotho to treat sterility (Watt & Breyer-Brandwijk 1962).

H. pilosella has yielded pilosellin, hieracin, oxy-coumarin, umbelliferone, luteolin, tannin and a bitter substance (Bate-Smith et al. 1968; Buckingham et al. ed. 1994; Chiej 1984).

Hieracium pilosella is an abundantly stoloniferous perennial herb with milky juice, generally with a slender elongate rhizome, 3-25(-40)cm tall, throwing out stolons which root at the nodes; stem leafless or with a single much reduced leaf, viscid-puberulent or subtomentose, sparsely or moderately spreading-hispid with gland-tipped, usually blackish hairs, often also long-setose. Leaves basally clustered in a rosette, recumbent, spatulate or oblanceolate or a little broader, entire, 2-13 x 0.6-2cm, tawny-tomentose with stellate hairs beneath, and with some long glandless setae as well, greenish-grey and glabrous above except for the very long setae, those of the stolons similar but smaller, underside hoary; stolons bearing alternate leaves, becoming smaller towards apex. Flower heads solitary (rarely 2-3), then long-pedunculate, ligulate, yellow, often tinged with dark red beneath; involucre cylindric to hemispheric, 7-11mm high, stellate, shortly hispid with black, sometimes gland-tipped hairs, occasionally long-setose also; involucre bracts imbricate, lanceolate, closely packed. Achenes c.1.5-2mm long, terete or prismatic, mostly narrowed towards base, apex truncate, +- strongly ribbed and sulcate; pappus of numerous grey, slightly sordid capillary bristles. Fl. May-Sep.

On high ground and in dry, upland pastures and fields; native to Europe and Britain, widely established in N. America [Newfoundland to N. Carolina to Minnesota, also in Oregon]. Many subspecies, hybrids, and varieties exist (Chiej 1984; Gleason 1952).

HOMALOMENA

(Araceae)

Homalomena belgraveana *Sprague*
Homalomena cordata *Schott* **(H. alba** *Hassk.***; H. aromatica** *(Roxb.) Schott***; H. cordata** *Zoll.***)** – koktaar, kuschu-gundubi
Homalomena cf. ereriba – kuumang, ereriba, 'dream man'
Homalomena lauterbachii *Engler*
Homalomena versteegii *Engler*

In parts of the Fore region of Papua New Guinea's eastern highlands, leaves of a Homalomena sp. ['ereriba'] are decocted to be drunk with the leaf and bark preparation made from **Galbulimima** belgraveana ['agara']. This results in a kind of agitated delirium, ending in sleep. Alternately, for the same effects, several leaves [and sometimes also a portion of rhizome] may be eaten along with 7-8 "penny-sized" pieces of agara bark [probably referring to the old British or Australian pennies, roughly 31mm diam.]. It is also said that either plant can be eaten alone for the same effect. The plant is often used by men in order to achieve the eventual sleep-state, in which they divine from their dreams. The species used, sometimes referred to as H. cf. ereriba, is thought to possibly be equivalent to H. belgraveana (Emboden 1979a; Hamilton 1960; Ott 1993; Schultes & Hofmann 1980). Schultes & Hofmann (1992) depicted H. lauterbachii to represent this plant, though it was not clear whether or not they were suggesting it as a possible species identity.

The Bimin Kuskusmin of PNG consume Homalomena spp. [along with many other plants – see also **Boletus** and *Endnotes*] in the 10th and 11th stages of their initiation. In the 10th stage, H. cordata [which causes "visually vivid dream-like states"] is eaten with a **Boletus** sp., **Pandanus** julianettii, galangal [see **Kaempferia**, **Alpinia**], agara, **Polygala** sp. flower, Lithocarpus sp. nuts [see *Endnotes*], Colocasia esculenta ['taro leaf'] and Medinilla sp. sap. In the 11th stage, H. cf. ereriba [which "enhances the blurred vision of trance"] is eaten with a **Heimiella** sp. and a **Russula** sp. [see **Boletus**], P. julianettii, **Castanopsis** acuminatissima, galangal, agara, **Musa** sp., taro leaf, Baccaurea sp. fruit, and skin of the frog Litoria angiana [see *Endnotes*] (Poole 1987). In PNG, H. cordata is also used in some areas for rain magic, and similarly H. versteegii is used for love magic (Ott 1993).

In India, the rhizomes of H. cordata have been used as an 'aromatic and stimulant' herb (Nadkarni 1976). In Vietnamese folk medicine, the roots are used in the form of an infusion or alcoholic tincture, as a general tonic, antiinflammatory, and to strengthen the skeleton and 'cure stomach diseases' (Todorova et al. 1988). Malays use the aromatic H. rubescens in the preparation of a fish poison called 'ipoh' (Chopra et al. 1965; Nadkarni 1976). In TCM, H. occulta rhizome ['qian nian jian' ('thousand years of health')] is used in doses of 4.5-9g to strengthen sinew and bones, and to relieve pain and swelling from traumatic injuries, particularly in the elderly (Bensky & Gamble 1993).

H. cordata rhizomes have yielded [w/w] 0.8-1.1% essential oil, containing 71.2-80% linalool, and smaller amounts of many other compounds; rhizomes have also yielded the sesquiterpenes homalomenol A [0.03%], homalomenol B [0.006%], homalomenol C [0.005%], homalomenol D [0.011%], 1β,4β,7α-trihydroxyeudesmane [0.028%], (-)-α-cadinol [0.007%], (-)-T-muurolol [0.006%], oplopanone [0.01%], oplodiol [0.03%] and bullatantriol [0.023%] (Sung et al. 1992a, 1992b; Todorova et al. 1988).

H. rubescens rhizome contains an essential oil rich in linalool (Todorova et al. 1988).

Homalomena cordata is an erect herb, stem ascending, robust, strongly fibrous, 2-4.5cm diam., to 22cm or more tall. Leaves crowded near apex of stem, herbaceous, broadly- to elongate-cordate, with usually inwardly directed basal lobes; basal lobes c.2.5-3(-5) times shorter than anterior lobe, +- broadly triangular, apex rounded, 5-8cm long, 7-13cm wide, short-acuminate, with 7-8(-10) thin to rather broad primary nerves

and very numerous, densely placed, parallel, much thinner secondary and tertiary nerves; all nerves arcuating into leaf-margin, green or sordid-purple, 19-40 x 16-32cm; petiole slender to rather stout, in lower half widened into a robust sheath (or not so), suffused with green or red, 20-76cm long, sheath conspicuous, flabellate, pinnately nerved. Inflorescence an elongated spadix at or near apex, usually several together, lower portion female mixed with staminodes, upper portion male; peduncle thin, gradually widened towards apex, suffused with green or red, 6-22cm; flowers many, unisexual, naked; spathe when still inrolled oblong, straight or slightly narrowed, not constricted, mucronate, herbaceous, 3.25-8.5cm long, c.1.25-1.75cm diam., when expanded 2.25-2.75cm broad; stalk of spadix thin, 3-6mm; female portion of spadix cylindric, whether or not widened towards apex, 1.25-2cm long, 4-8mm diam.; male portion cylindric, whether or not tapering towards ends, 1.5-3cm x 4-10mm; stamens free, 2-4(-6) in fertile flowers, 0.5-0.66mm high; staminodes few, 1.5-1.75mm, at base of female flower; connective very narrow, linear, not concealing anther-cells; thecae oval, much longer than the broad filament; anthers ellipsoid or clavate, slightly shorter than filaments, dehiscing by a split; ovary oblong, sometimes narrowing into the minute style, 3-celled; ovules numerous, on a central placenta; pistil c.1.75mm high; stigma c.1mm across, discoid or lobed. Fruit a berry, oblong to ovoid, yellow, 1.5-4mm; seeds 1-5, on a long funicle, longitudinally striate.

In mixed- and teak-forest, swampy places, watersides; south-east Asia (Backer & Bakhuizen van den Brink 1968).

HORSFIELDIA

(Myristicaceae)

Horsfieldia superba *Warb.* **(Myristica superba** *Hook. fil.***)** – pendarah

Trees from this genus are sometimes used medicinally in s.e. Asia. For example, in India, H. mystax roots are bruised and applied as a poultice "in reducing inflammatory tumours and as an antidote to snake-bites." The powdered root is taken as an anthelmintic and febrifuge, and root bark is used as an antidote to poisons (Nadkarni 1976).

H. superba contains indole alkaloids – leaves yielded 0.0007% *5-methoxy-DMT*, 0.008% 6-MeO-2-methyl-THβC [2-methyl-*pinoline*] and 0.037% horsfiline [5-MeO-2'-methylspiro[3H-indole-5,5'-pyrrolidin]-2(1H)-one,1] (Jossang et al. 1991).

Horsfieldia superba is a large tree 30m or more tall, young parts red-tomentose; branches stout; branches, leaves beneath and panicles scurfily rusty-tomentose. Leaves stiffly coriaceous, bright red-brown, 30-46 x 10-20.3cm, densely tomentose when young, glabrous when adult, elliptic-lanceolate or oblanceolate, loosely stellate-tomentose beneath; midrib very stout; nerves 15-30 pairs sunk above, strongly raised beneath, firm, nearly straight; petiole thick, 6-19mm long. Flowers usually very small, yellow, globose, fragrant, rarely sessile. Male flowers in lax panicles or sub-umbellate clusters, c.15cm long and wide, in axils of fallen leaves, tomentose; perianth coriaceous, glabrous, obovoid-elliptic, obtuse, yellow, 3-4-toothed, 42-51mm long; pedicel as long as perianth, very stout; staminal column subsessile, solid, ovoid, obtuse; anthers 10-20, closely confluent to their tips in a subsessile column, not apiculate. Female flowers on stout woody racemes, tomentose; perianth glabrous, tubular, 2-3-toothed; stigmas very small, sessile. Fruit ovoid-globose, rough, yellow, very fleshy, 7.6cm long, nearly 5.1cm across, pericarp thick; seed testa thin, aril scarcely laciniate.

In forests; Singapore, Malacca, Selangor, Kuala Lumpur, Perak, Penang (Hooker 1954-1961; Ridley 1923).

HUGONIA

(Linaceae)

Hugonia oreogena *Schlechter*

This New Caledonian shrub has been shown to contain trace amounts of an important indole alkaloid. I am not aware of any traditional or modern uses for this plant.

H. oreogena root bark yielded 0.42% alkaloids, mostly of the pyrrolizidine type – absouline, isoabsouline, absouline N-oxide and isoabsouline N-oxide, as well as 0.00036% *5-methoxy-DMT*. Trunk bark yielded 0.41% alkaloids of similar constituency, although *5-methoxy-DMT* was not noted. All of these, except for *5-methoxy-DMT*, were found in H. penicillanthemum trunk bark, which yielded 0.54% alkaloids (Ikhiri et al. 1987b).

Hugonia oreogena is an unarmed shrub, sometimes climbing. Leaves alternate, stipulate, petiolate, obtuse, 2.3-2.6cm wide. Inflorescence paniculate; flowers hermaphroditic; sepals 5; petals 5, twisted; no disc; stamens 10, some from base of tube, tube and stamens glabrous, stamens shorter than styles; anthers dehiscing by 2 longitudinal slits. Ovary free, 5-locular; styles 5; ovules anatropous, pendant, from the interior angle of the locule, 2 in each locule, raphe internal. Fruit a drupe with several locules (Guillaumin 1948).

HUMULUS

(Cannabaceae)

Humulus japonicus *Sieb. et Zucc.* **(H. scandens** *(Lour.) Merr.***; Antidesmia scandens** *Lour.***)** – lu cao, Japanese hop

Humulus lupulus *L.* – hops, hop vine, hops vine, common hop, European hop, beer flower, hopfen, lupolo, hymel, pi jiu hua

In 1AD, Pliny named hops as the 'willow wolf', after its habit of twining around willow trees [Salix spp.], and from this Latin name 'lupulus' was derived. The 'hop vine' [H. lupulus] has been a popular garden plant and vegetable – in spring, young shoots were sold in markets, and eaten like asparagus spears. By the 8th century, brewers throughout much of Europe had begun using hops [as the freshly dried flowers] in beer-making, for their clearing, flavouring and preservative actions. The British resisted the use of hops until the 17th century, believing it to be a "wicked weed that would spoil the taste of the drink and endanger the people". For centuries, they had used instead plants such as 'ivy' [Hedera helix – may actually refer to other plants that are ivy-like in appearance] and 'costmary' [**Tanacetum** balsamita] to brew their ale. Still, hops were also believed to 'purge excess anger', and German-style hops-beer ['bier'] was seen as a more "physical drink to keep the body in health", preferable to English ale. Eventually legislation effectively banned the addition of herbs other than hops to beer; largely, it seems, because hops are not as intoxicating as some of the preferred additives [see also *Methods of Ingestion*] (Bremness 1988; Buhner 1998; Mabey et al. ed. 1990; Ody 1993).

Medicinally, hops have been used for far longer than in brewing. They have been used as a pillow-stuffing or infused tea for their sedative, anxiolytic and soporific effect; the tea is very bitter. Excessive use can cause dizziness, stupor and mild jaundice in some people. Hops flowers relax the smooth muscle of the digestive tract, easing gastrointestinal pain or irritation; they are also antispasmodic, diuretic and oestrogenic [causing anaphrodisia in men; galactagogue in women, may interfere with menstruation]. Skin contact with flower pollen may cause dermatitis (Hobbs 1993; Mabey et al. ed. 1990; Siegel 1976). In TCM, the dried flower strobiles are used [as 'pi jiu hua'] to treat tuberculosis, and are also recognised as being an anticonvulsant, as well as causing a "sexual-stimulating effect on females". H. japonicus aerial parts are also used to treat tuberculosis, cystitis, dysentery and other infections (Huang 1993).

Hops flower strobiles may be smoked for mild psychoactive effects, though the smoke is harsh, and can result in headache. The strobiles can also be made into a strong bitter tea for similar effects (Gottlieb 1992; Haesler pers. comm.; Siegel 1976).

In the 1940's, it was claimed by two researchers that experimental grafts of hops to **Cannabis** roots resulted in hops vines bearing "as much drug as leaves from intact hemp plants". It was theorised that cannabinoids were produced in the **Cannabis** rootstock, and transported into the grafted hops vine (Clarke 1981). Later experiments showed that this had no basis in fact. Although the two species cross-grafted very well, there was no translocation of cannabinoids to the hops vine (Crombie & Crombie 1975).

H. lupulus flower strobiles may yield 0.3-1% essential oil, which varies in composition across different strains of the plant; 0.2-0.6% prenylflavonoids; 3-18% bitter resinous constituents, which are collectively referred to as 'lupuline'; and c.3.5% tannins. Common constituents of the essential oil include 2-methyl-3-butene-2-ol [sedative hypnotic], 8-prenylnaringenin [a potent phytoestrogen; see also naringenin in **Citrus**], humulene, humulene epoxide, luparone, luparol, luparenol, lumulone, lupulone [has caused nausea, vomiting, loose stools and dizziness in some people], xanthohumol, xanthohumol B, valeric acid, isovaleric acid [see **Valeriana**], myrcene, farnesene, selinine, linalool, limonene, geraniol, *citral*, caryophyllene and α- & β-*pinene*. The compound 2-methyl-3-butene-2-ol is present only in traces in fresh hops, but after 2 years storage at room temperature the level has been shown to increase to c.0.15% (Chapman 1928; Hänsel et al. 1982; Harborne & Baxter ed. 1993; Hobbs 1993; Huang 1993; Mabey et al. ed. 1990; Ramic et al. 1986; Tabata et al. 1997; Tekel et al. 1999). The tendrils have been shown to contain neochlorogenic and *chlorogenic acid*s, rhamnoglucoside, kaempferol 3-monoglucoside, isoquercitrin, rutin, and ferulic acid- and p-coumaric acid-derivatives; tendrils twined around a support also contained an aesculetin-derivative [less so in aged tendrils; see **Aesculus**] and a gentisic acid-derivative (Tronchet & Bas 1964).

H. japonicus aerial parts have been reported to contain humulone, lupulone, asparagine, *choline* and luteolin (Huang 1993).

Humulus lupulus is a perennial, twining vine to 10m long; rootstock stout, branched; stems tall, scabrid or prickly with reversed bristles. Leaves opposite, petioled, cordate, toothed, palmatinerved; principal leaves as wide as long, 7.5-10cm diam., heart-shaped at base, 3-5 lobed to below middle, lateral lobes obliquely ovate-oblong, terminal lobes ovate-lanceolate, constricted at base; upper leaves commonly broadly-ovate, un-

lobed; stipules lateral, persistent. Flowers dioecious. Male flower panicles 5-15cm long, 7.5-12.5cm across; flowers c.6mm diam.; sepals 5, imbricate; stamens 5, adnate to sepals, erect in bud; no pistillode. Female flowers in pairs in axils of broad bracts of catkin-like ovoid spikes (strobiles) c.1(-3-6)cm long, 13mm diam., cylindric, straw-yellow, bracteate and 2-bracteolate; bracts entire, mostly blunt, scarious, very glandular at base; sepal a membranous scale; ovary sessile, compressed; ovule pendulous, campylotropous; styles 2, subulate; stigmas conspicuous, slender. Fruiting flowers c.3.8cm diam., scales orbicular; fruit an ovoid spike of imbricate bracts; achenes enclosed in sepal, 2 in each axil; albumen scanty or none; embryo a flat helix. Yellow glands secreting 'lupuline' occur on most of plant, but mostly on strobiles (Gleason 1952; Kirtikar & Basu 1980).

Most commercially-grown hops are seedless hybrids. Seeds can be very difficult to obtain, and require their natural dormancy to be broken prior to germination. Plants are often cultivated from rootstock division. Cultivate in well-drained, humus-rich soil, in full sun with protection from wind. Requires climbing supports. Usually grown from cuttings or suckers; seed-grown plants will have a higher incidence of undesirable males. Strobiles should be harvested when ripe in summer to mid-autumn, and dried quickly – they rapidly lose potency with exposure to air once cut (Grubber 1973; Ody 1993; Whitten 1999).

HYGROCYBE including HYGROPHORUS

(Agaricaceae/Hygrophoraceae)

Hygrocybe conica *(Scop. ex Fr.) Kummer* **(Hygrophorus conicus** *(Scop. ex Fr.) Fr.***)** – conical wax cap, witch's cap, witch's hat, conical slimy cap

Hygrocybe psittanica *(Schaeff. ex Fr.) Raith.* **(H. psittanica** *(Schaeff. ex Fr.) Wünsche***; Hygrophorus psittanicus** *(Schaeff. ex Fr.) Fr.***)** – parrot wax cap, parrot toadstool

Hygrophorus erubescens *(Pers. ex Fr.) Fr.* **(Limacium erubescens** *(Pers. ex Fr.) Wünsch***)**

Hygrophorus hypothejus *(Fr.) Fr.* **(Limacium hypothejus** *(Fr.) Kumm.***)** – pine-wood waxy cap, late fall waxy cap, olive-brown waxy cap, herald of winter

Hygrophorus marginatus *Peck.* – orange-gilled waxy cap

H. conica is known to cause 'intoxications' and to be 'poisonous'. Although also considered by many to be edible, it is apparently not recommended (Bresinsky & Besl 1989; Connor 1977; Ford 1910/1911b; Phillips 1981). There are reports of death attributed to consumption of this species, which is considered a doubtful identification (Ford 1910/1911b; Heim 1963b). Heim listed it as a toxic mushroom, along with **Amanita** phalloides and Pholiota [Galerina] autumnalis, under the category "mycétisme choléríforme" (Heim 1963b). H. psittanica is regarded in Europe as being "edible but not good due to its sliminess" (Phillips 1981).

I have heard of several reports of people ingesting H. conica in the US. One individual consumed "too much" of the fungus [amount unspecified], and experienced a "narcotic/drunk/stupor-like" effect which he experienced dysphorically, because of the high dose (pers. comm.). Some have described "an odd sensation of lightheadedness and numbness" (Toro 2004, quoting Arora). Others have described effects lasting 4-5hrs, comparable qualitatively to a mild dose of *psilocybin*, yet "repeatedly fading on and off". One individual who ingested 1g [dry] of Japanese specimens experienced these effects, but also "awoke in the middle of the night with severe diarrhoea that lasted 45 minutes". H. conica specimens from California and Montana have also been rumoured to be similarly psychoactive (Hoodoo pers. comm.). Hygrophorus erubescens and H. marginatus have been claimed to exert CNS effects (Norland 1976), though no further data was provided to support the assertion. H. marginatus is considered edible, though an injected extract [route not given] was toxic to a guinea pig [it was also non-toxic to a larger guinea pig, and to other animals] (Ford 1910/1911b).

See also the closely related Hygrophoropsis spp. in the *Endnotes*.

The pigments of Hygrocybe spp. are called hygro-aurins, and technically are betalain-like compounds of muscaflavin with various amino acids; the pigments of **Amanita** muscaria have a similar structure. The blackening reaction in H. conica and H. ovina results from the oxidation of L-*DOPA* which is found in these fungi (Bresinsky & Besl 1989). It is worth investigating whether a psychotropic *adrenochrome* or dopachrome analogue is formed as an intermediate in this process [eg. see **Solanum**].

Hygrocybe nigrescens has been shown to contain small amounts of muscarine [see **Amanita**, *Neurochemistry*], of which 65% was present as the inactive epi-muscarine (Stadelmann et al. 1976).

H. psittanica has a greenish-tinge under its whitish-yellow flesh colour, and sometimes shows slight bluing (Phillips 1981). Specimens from Germany were shown to contain *psilocybin* [estimated at c.0.05%], as well as traces of *psilocin* and *tryptophan* (Gartz 1986b). Other tests, using 5 samples from the US and Switzerland [H. psittanica var. psittanica], failed to detect these alkaloids; they were also absent in a sample of H. psittanica var. californica (Stijve & Kuyper 1988).

Hygrophorus hypothejus has been claimed to contain *tryptamine*-derivatives (Norland 1976), though no further data was provided to support this assertion. This species has yielded a lectin, HHL, which agglutinates type A & B blood-group erythrocytes (Veau et al. 1999). It is considered edible, though an injected extract [route not given] was lethal to a guinea pig; it had no effect on other animals (Ford 1910/1911b).

Caution should be exercised, as these genera have been little studied chemically.

Hygrocybe conica has a cap 2-5(-6)cm across, at first sharply conico-convex to conical, then applanate with a broad umbo, becoming distorted and often cracked with age, yellow to orange-reddish, centre sometimes darker, becoming black when bruised or with age; margin decurved, often irregular, when old also straight and sometimes pellucid-striate; surface at first somewhat glutinous, later dry, slightly shiny to matt. Stem 20-60(-120) x 8-10mm, bright yellow and blackening, terete or slightly flattened, equal or somewhat clavate, longitudinally striate and mostly intertwined to some extent, hollow; at first moist to somewhat glutinous, later dry; base whitish, becoming black. Flesh watery/juicy, of mild taste, smell occasionally fruit-like. Gills sinuate, pale yellow with white raised margin when young, later olive-yellow to greenish-olive, soon becoming flecked with grey and finally black, free to narrowly adnate, with intercalated lamellulae, fairly crowded when young, later somewhat distant. Spore print white; spores broadly ellipsoid, sometimes a few constricted in the middle, 7-9(-12) x 4-5(-8)µ; basidia 4-spored, sometimes mixed with a few 2-spored ones. Fr. summer-late autumn.

Common in grass in fields, lawns, roadsides in Europe, in forests in North America; also found in Japan (Bresinsky & Besl 1989; Phillips 1981).

HYOSCYAMUS

(Solanaceae)

Hyoscyamus albus *L.* – white henbane

Hyoscyamus aureus *L.*

Hyoscyamus boveanus *Asch. et Schweinf.*

Hyoscyamus desertorum *Täckh.*

Hyoscyamus faleslez *Coss.*

Hyoscyamus muticus *L.* – Egyptian henbane, Indian henbane, sakaran ['drunken'], koh i bhang ['mountain hemp']

Hyoscyamus niger *L.* – henbane, foetid nightshade, poison tobacco, hog's bean, insane root, infidel's opium, pilsener kraut, bilsenkraut, hexenkraut, appolinaris, beleno, lang-tang, tian xian zi, koh i bhang, bhang, vajrabhang, khursani ajavan, ajwaina-kurasam, laliwah, parasikava

Hyoscyamus physaloides *L.* **(Physochlaina physaloides** *(L.) G. Don.***; P. pseudophysaloides** *Pascher***; Scopolia physaloides** *(L.) Dunal***)**

Hyoscyamus reticulatus *L.* – bhang, koh i bhang

Hyoscyamus spp. – henbane

Henbane has long been known for its intoxicating properties, and was mentioned by the early Egyptians, Greeks and Romans (Schultes 1969c; Schultes & Hofmann 1980). The Greeks held it sacred to Apollo, and H. albus has been claimed to have been an ingredient of the incense thought by some to have been used by Apollo's Oracle at Delphi [see **Laurus**]. For the Romans, it was sacred to Jupiter, and they used it in love potions. The Greeks probably added it to their legendary wines, and the Gauls used the juice of the plant to tip their arrows. In mediaeval times, Germanic peoples added H. niger to their 'pilsener' beer, and witches reportedly used it in their flying ointments [see *Methods of Ingestion*]. Many bath-houses used the seeds on the heating plates, to 'incite pleasure'. It has been said that the mere smell of the fresh plant can inebriate. At one time, pieces of henbane root were strung around infant's necks to prevent fits and relieve the pain of teething [presumably the child would suck on its necklace for the effects to become manifest, or the alkaloids would be absorbed through the skin] (De Vries 1991; Morton 1977; Ott 1993; Rätsch 1992; Schultes & Hofmann 1980; Wasson et al. 1978).

In ancient China, henbane was referred to as 'lang-tang', and the seeds as 'tian xian zi'. The herb was steeped in wine to be used as a tonic, treating mania, malaria, dysentery and parasitic skin diseases. The seeds had a reputation for producing a 'violent delirium', causing one to see spirits, if crushed before consumption (Li 1978). The leaves and flowering tops are still sometimes used in TCM, with a dose of 130-320mg being given for ailments such as neuralgia and gastric spasms (Keys 1976). In Baluchistan, H. muticus and H. reticulatus are smoked as **Cannabis**-substitutes. Henbane is smoked with tobacco [see **Nicotiana**] or **Cannabis** in Kashmir, Hakims smoke the seeds, and some Hindu saddhus are known to smoke henbane with their **Cannabis**. In Nepal, it is used as a sedative. Nepalese shamans sometimes smoke it with tobacco when holding a serious healing ceremony, and as an antidepressant; the seeds are also sometimes smoked with **Cannabis**. Kirati women commonly brew the seeds in with their 'chhang' beer [see *Methods of Ingestion*], using 5-6 seeds per litre. Oddly, in India H. niger is used to treat "hysteria, mental and maniacal

excitement, epileptic mania, chronic dementia with insomnia, and neuralgia" (Chopra et al. 1965; Müller-Ebeling et al. 2002; Nadkarni 1976). Of course the narcotic effect of the herb partly accounts for some of these applications, though prescription against mental disorders seems counter-intuitive, given the known effects of the plant in larger doses. However, Nadkarni (1976) states that the effects as a "deliriant are milder than those of belladonna [see **Atropa**], but greater as hypnotic, and more reliable and rapid." It is also worth mentioning his caution that "In over-doses, **Hyoscyamus** is a narcotic poison, producing delirium, coma and death, and its operation is generally very rapid" (Nadkarni 1976).

In Iran, smoke from the burning seeds of H. muticus is inhaled to relieve toothache. The dried, powdered plant, mixed with dates or milk, has been reported to sometimes be used by Arabs 'for criminal purposes'. An antidote to the hallucinogenic effects of the drug, if taken early enough, was said to be a mixture of water, butter, pulverised dates and pepper [see **Piper 1**], which causes profuse sweating (Morton 1977). Some Arabian peoples regard henbane as a narcotic and aphrodisiac, burning it to ward off demons, as well as adding H. faleslez to their spiced coffee [see **Coffea**]. The Tungus of s. Siberia likewise use roasted H. physaloides seeds as a coffee-substitute (Rätsch 1992), reported earlier as being instead H. niger (Von Bibra 1855). In the Shetul Valley of Afghanistan, H. niger is sometimes mixed with **Amanita** muscaria and an Impatiens sp., to make a psychotropic remedial ointment for external application (Mochtar & Geerken 1979). H. reticulatus is also used as an intoxicant in Afghanistan. Bedouins of the Egyptian desert smoke H. boveanus flowers for their inebriating properties (Ott 1993). In Israel, traditional healers use H. aureus to treat toothache, rheumatism, and eye infections (Palevitch et al. 1986).

Since the post-conquest introduction of H. niger to N. America, many indigenous tribes have taken up use of the plant, in manners similar to **Datura**. The Seri, for example, of the Gulf of California and Shark Island, add the leaves or seeds to their 'chicha' or 'pulqué' [see *Methods of Ingestion*], or simply infuse them in water and drink, for the analgesic and soporific properties of the herb (Rätsch 1992).

Henbane is little used today in herbal medicine, though it has been used to control urinary spasms, as well as spasms related to asthma and digestive disorders, and as an analgesic, mydriatic and sedative. It may also help ease travel sickness, and some symptoms of Parkinson's Disease (Bremness 1994).

Occasionally H. niger [and probably other species] have been used by western experimenters for psychotropic effects, though this is not common. In Australia, where this species grows as an occasional weed, there is one literature report regarding a 20-year-old who chewed on 4 flowers at the suggestion of his friends, who had heard that the plant was psychoactive when chewed. He was shortly after "brought to hospital by police, having been found lying on the footpath and behaving in a bizarre manner [...] he was found to be experiencing gross visual hallucinations, and was too excitable and restless to account for himself, although he complained of thirst and difficulty in seeing [...] Twenty-four hours later he complained only of inability to read, but he remained excitable. Fourty-eight hours after his admission to hospital, accommodation was normal, and he was discharged." No mention was made of what became of this man's friends. Accidental intoxications have been far more common, when children or adults have mistaken the plant for an edible one. In 1910, 25 people ate the roots, mistaking them for horseradish; they "all suffered strange hallucinations, but had recovered in 12 hours." In Turkey, intoxications from Hyoscyamus spp. are relatively common. Considering some of the colloquial names for the plants in Turkey, two of which translate to 'insane root' and 'infidel's opium' (Sands & Sands 1976), one must wonder if all of these ingestions have been accidental.

All Hyoscyamus spp. contain similar mixes of anticholinergic tropane alkaloids, predominantly *hyoscyamine* and *hyoscine*, and thus share similar psychotropic properties. The roots are often the most potent part of the plant. *Hyoscyamine* is usually the dominant alkaloid, though young plants contain higher levels of *hyoscine*.

H. albus leaves yielded 0.21-0.56% alkaloids, roots 0.1-0.14% and seeds 0.16%, consisting of *hyoscyamine* and *hyoscine* (Henry 1939); leaves have also been found to contain 5 calystegines (Bekkouche et al. 2001).

H. aureus flowers have yielded 0.9% *hyoscine* and 0.2% tetramethylputrescine [tetramethyldiaminobutane; possibly an artefact of the extraction process], but no *hyoscyamine* (Paris & Saint-Firmin 1967).

H. desertorum contains *hyoscine* and *hyoscyamine* as the major alkaloids. Leaves yielded 0.195% [harv. 1.5-3 months old] to 0.23% alkaloids [3.5-5.5 months old]. Total alkaloids in flowering plants [at the stage of unopened flowers, 1 wk after flowers opening, 2 wks, 3 wks, 4wks, respectively] were measured in various organs – leaves [0.058%; 0.11%; 0.02%; 0.029%; 0.014%], stems [0.28%; 0.193%; 0.15%; 0.304%; 0.055%], roots [0.475%; 0.36%; 0.498%; 0.08%; 0.157%], and flowers [-; 0.166%; 0.094%; 0.37%; 0.071%]. Seeds from ripe fruits yielded 0.063% alkaloids. Of the two major alkaloids, *hyoscyamine* is the predominant one in stems, roots, and radical leaves 3.5-5.5 months old; *hyoscine* predominates in radical leaves 1.5-3 months old, flowers, ripe fruits, seeds, and leaves just before flowers open (Sabri et al. 1973).

H. muticus, grown in Sudan, yielded 0.63% alkaloids in summer, 0.34% in winter, from leaves and stems; alkaloid yields from the roots remained +- constant from seedling stage until flowering – 0.57-0.58% in summer, and 0.54% in winter. Alkaloid yields were measured through 3 stages of flowering [onset of flowering; flowering and fruiting; first fully ripe fruit] in various organs [each given as summer, winter] – leaves [0.69%, 0.75%; 1.33%, 1.07%; 1.64%, 2.15%], stems [0.38%, 0.33%; 0.4%, 0.5%; 0.34%, 0.47%], roots [0.41%, 0.56%; 0.61%, 0.53%; 0.58%, 0.71%], and flowering and fruiting tops [1.76%, 0.95%; 1.14%, 0.67%; 1.28%, 0.94%]. *Hyoscyamine* was the major alkaloid in all parts, with smaller amounts of *hyoscine*, especially in roots (El Sheikh et al. 1982). Seeds have yielded 0.87-1.34% alkaloids, mostly *hyoscyamine* (Henry 1939). Indian plants yielded 0.1% alkaloids from leaf [w/w], mostly *hyoscyamine*, as well as 0.02% *hyoscine*, and tetramethylputrescine (Chopra et al. 1965). Specimens from S. Africa [presumably whole plant] yielded 0.77% *hyoscyamine* (Anon. 1916a). Flowers alone have yielded 0.75% *hyoscyamine*, 0.25% *hyoscine*, and 0.1% tetramethylputrescine (Paris & Saint-Firmin 1967). A commercial sample of Indian henbane, impossible to identify confidently [probably H. muticus], yielded 0.016% *hyoscine*, 0.01% *hyoscyamine*, and 0.0015% *tropine* (Evans & Partridge 1949).

H. niger roots yielded 0.15-0.17% alkaloids; flowering tops and leaves have yielded 0.045-0.1% alkaloids; seeds have yielded 0.06-0.1% alkaloids. *Hyoscyamine* is the dominant alkaloid, with lesser amounts of *hyoscine*, and possibly *atropine* (Henry 1939). Whole plant yielded 0.04% *hyoscyamine*, 0.028% *hyoscine*, and 0.0025% tropine (Evans & Partridge 1949). Seeds also yielded traces of three withanolides [see **Withania**] – daturalactone-4, hyoscyamilactol and 16α-acetoxyhyoscyamilactol (Ma et al. 1999); calystegine N1 has also been found in the plant (Bekkouche et al. 2001).

H. pusillus contained only traces of alkaloids (Ott 1993).

H. reticulatus [whole plant] yielded 0.116-0.24% alkaloids, and seeds yielded 0.082%, consisting of *hyoscyamine* and unidentified alkaloids. Tetramethylputrescine has also been found in the plant (Henry 1939).

Hyoscyamus spp. have also yielded apo-*hyoscine*, nor-*hyoscine*, belladonnine, ψ-tropine, cuscohygrine, littorine [in 2 species], and possibly tigloidine and tigloyloxytropane (Buckingham et al. ed. 1994; Evans 1979).

Hyoscyamus niger is a biennial herb; stems erect, up to 1m tall, very leafy, stout, viscid-hairy. Leaves grey-green, 7.5-20(-30)cm long, oblong to oblong-ovate with conspicuous veins, nearly entire or coarsely and irregularly toothed, or sometimes deeply lobed, slightly downy, with long, glandular, black-tipped hairs beneath the midrib and veins, lower leaves narrowed to a short petiole, upper leaves partly clasping the stem. Flowers large, sessile or short-stalked opposite the upper axils, forming a leafy, secund, spike-like inflorescence; calyx campanulate, persistent and reticulately veined in fruit; corolla c.3cm wide and long, narrowly campanulate or almost funnelform, slightly zygomorphic, the limb somewhat oblique and lobes slightly unequal, throat purple, limb dingy yellow with purple veins; stamens 5, separate, all fertile; anthers opening by longitudinal clefts, 3 longer than other 2. Fruiting calyx 2-2.5cm long, much surpassing the subglobose capsule; capsule enclosed by the calyx, circumsessile near summit; seeds reniform, papillate.

Sunny coastal areas; native to Europe, naturalised as a weed in some temperate zones (Gleason 1952; Morton 1977).

Plant seed in spring, thinly 60-90cm apart; keep moist until germination. Will grow in a wide variety of soils (Grubber 1973). Light may be necessary for germination, as the plant often grows in newly disturbed ground (theobromus pers. comm.).

HYPERICUM

(Guttiferae/Clusiaceae)

Hypericum macgregorii *Chun.* – soam gaman

Hypericum patulum *Thunb.* **(Komana patula** *(Thunb.) Y. Kimura ex Hondra***; Norysia patula** *(Thunb.) J. Voigt***)** – goldencup St. John's wort, thumbhul, kinshibai

Hypericum perforatum *L.* **(H. nachitschevanicum** *Grossh.***; H. officinarum** *Crantz***; H. perforatum var. confertiflora** *Debeaux***; H. perforatum var. microphyllum** *H. Lév.***)** – hypericum, St John's wort, goatweed, Klamath weed, Tipton weed, amber, scare-devil, solterrestris, herba John, hexenkraut, hexenblume

Hypericum spp.

In Papua New Guinea, the Nkopo use H. macgregorii in rain magic (Schmid 1991). The Indian H. patulum is used for its seeds, which are an aromatic stimulant (Nadkarni 1976).

The common name of H. perforatum, 'St John's wort', apparently stems from several symbolic observations. Its petals turn blood-red when crushed, and it flowers around June 24, anniversary of the decapitation of John the Baptist (Parsons & Cuthbertson 1992; Polunin & Robbins 1992). Also, the knights of St. John of Jerusalem used the plant during the Crusades to aid in the healing of sword-wounds. The related H. andro-

saemum ['tutsan' – 'all-heal'] has also been used to treat wounds and inflammation. In Scandinavia, H. perforatum has been associated with the Nordic god Baldur. The plant also has an age-old reputation for dispelling evil spirits, for which it was sometimes burned. The insane were often given infusions of the herb for its antidepressant properties. Two of its German names, 'hexenkraut' ['witch herb'] and 'hexenblume' ['witch flower'], obviously suggest a past usage by witches. It is sometimes used in TCM to treat hepatitis, appendicitis, abscesses and snakebite. The herb is sedative, antidepressant, antiseptic, antiinflammatory, antibacterial, antiviral, diuretic, expectorant, emmollient and astringent. The oil may soothe burns, improve blood flow, and relieve gastritis and stomach ulcers. The plant has been implicated in stock-poisonings, causing contact dermatitis and photosensitisation. Greg Whitten, an organic herb farmer, has noted that prolonged contact with the fresh herb when harvesting [3-4hrs, through both skin contact and inhalation of vapours] can result in a strong inebriation. If the contact lasted over several days, the inebriation was described as more of a "melancholic depression" (Bremness 1994; Cunningham 1994; De Vries 1991; Keeler 1975; Ody 1993; Polunin & Robbins 1992; Watt & Breyer-Brandwijk 1962; Whitten 1999).

Previously used in western herbalism mainly as a safe sedative for hyperactive children, H. perforatum preparations are now widely popular as a herbal antidepressant, with few or no side-effects [photosensitisation reactions have occurred in some people]. These products are now competing well with Prozac™, for treatment of minor depression (De Smet & Nolen 1996; Katzenstein 1998; Linde et al. 1996; Raffa 1998; pers. obs.). Commercially-available H. perforatum preparations are usually 'standardised' for content of *hypericin*, a quinone pigment that is a major component of the herb, and was previously thought to be the 'main active ingredient' (pers. obs.), or for hypericins in general, including *hypericin*, pseudohypericin [the 2 major hypericins], protohypericin, protopseudohypericin and cyclopseudohypericin. Protohypericin and protopseudohypericin rapidly convert to *hypericin* and pseudohypericin on exposure to light. Hypericins are found primarily in glands which cover the plant, but are most concentrated on leaf margins and flowers. It is now thought that the phloroglucinol derivative hyperforin is responsible for much [but not all] of the antidepressant activity of H. perforatum (Sirvent et al. 2002).

H. perforatum herb has shown some very weak MAO- and COMT-inhibiting properties [see *Neurochemistry*], as well as weakly inhibiting *serotonin* and *norepinephrine* re-uptake, but the full mechanism of action is yet to be shown, and is clearly a synergistic one between the various compounds present. It has been suggested that the MAOI effect would be due to an unidentified xanthone component (Bruneton 1995; Perovic & Muller 1995; Raffa 1998; Suzuki et al. 1984). The herb also induces cytochrome P450 3A4 and 3A5 activity [see *Neurochemistry*], and has been shown to potently inhibit cytochrome P450 isoenzymes other than the types mentioned above, with extended use (Coxeter et al. 2003; Fugh-Berman 2000; http://www.dml.georgetown.edu/depts/pharmacology/clinlist.html). This herb usually must be taken daily for several weeks to become fully effective (Katzenstein 1998; pers. comm.), and should not be combined with MAOIs or *serotonin* re-uptake inhibitors, as symptoms of *serotonin* syndrome may result (Fugh-Berman 2000). Antidepressants which have shown interactions with St. John's wort include sertraline, nefazodone, fluoxetine, paroxetine and amitriptyline. Some studies suggest that St. John's wort may interfere with the activities of some antiarrhythmic [digoxin], antiretroviral [indinavir], immunosuppressant [cyclosporin, tacrolimus], oral contraceptive and anticoagulant drugs. However, more evidence is needed to determine the extent of these interactions in humans (Coxeter et al. 2003).

H. crispum has been shown to contain *hypericin* (Schindler 1954).

H. hirsutum has been shown to contain *hypericin* and pseudohypericin, though a later study found only 0.043% *hypericin* (Kitanov 2001; Schindler 1954).

H. kalmianum inhibits human plasma AChE (Orgell 1963b).

H. maculatum has been shown to contain 0.058% *hypericin* and pseudohypericin, combined (Kitanov 2001).

H. maculatum var. genuinum was shown to contain 0.01% *hypericin* in stems, 0.08% in leaves, and 0.306% in flowers; H. maculatum var. punctatum was shown to contain 0.009% *hypericin* in stems, 0.078% in leaves, 0.542% in flowers, and 1.42% in the stamens (Schindler 1954).

H. perforatum has yielded 0.0095-0.466% *hypericin*, pseudohypericin, protohypericin, protopseudohypericin, hyperforin [inhibits uptake of *serotonin*, *dopamine*, *norepinephrine*, *GABA* and *glutamine*], adhyperforin, hyperin, epicatechin, *chlorogenic acid*, emodinanthranol, pseudohypericodihydrodianthrone, hypericodihydrodianthrone, 2-methyloctane, flavonoids [including luteolin, rutin, isoquercitrin, quercitrin, quercetin, amentoflavone (BZ-receptor agonist), *apigenin* derivatives, hyperoside], and 0.065-0.113% of a volatile oil, containing caryophyllene, *pinene*, limonene and myrcene (Bruneton 1995; Buckingham et al. ed. 1994; Chaterjee et al. 1998; Constantine & Karchesy 1998; Kartnig et al. 1996; Nielsen et al. 1988; Polunin & Robbins 1992; Raffa 1998; Schindler 1954; Singer et al. 1999; Watt & Breyer-Brandwijk 1962). One study of the dried herb found c.5% flavonoids, c.80% of which was a mixture of hyperoside and rutin (Borkowski 1960). *Melatonin* has also been found in the leaf [0.000175%] and flower [0.000439%] (Murch et al. 1997).

Different parts of two varieties were tested for *hypericin* content. H. perforatum var. angustifolium was shown to contain 0.011% in stems, 0.062% in leaves, 0.308% in flowers, and 1.414% in the stamens; H. perforatum var. vulgare was shown to contain 0.136% in the 'whole drug', 0.305% in the 'whole drug' minus stems, 0.01% in stems, 0.122% in leaves, 0.431% in flowers, and 1.565% in stamens. In the flowers, higher levels of *hypericin* are also found in petals, compared to the whole flower (Schindler 1954). Flowers of Swiss plants yielded 0.2-0.5% *hypericin* and 0.5-1% pseudohypericin. Flowers, sepals and capsules of plants from the Pacific n.w. US yielded 0.01-0.08% *hypericin* and 0.08-0.62% pseudohypericin. Limited data suggests that plants growing in sites with strong sunlight may contain greater levels of hypericins; this also seems to be the case for plants exposed to heavy grazing from herbivores, and plants exposed to insect pests (Sirvent et al. 2002). In early stages of growth, H. perforatum yielded 3.67-5.27% flavonoids; highest yields were obtained later, during the flowering period, which was followed by a decline in flavonoid content. Leaves and sepals, particularly of young growth, were the organs with the greatest flavonoid yields. Plants grown in humid regions gave higher flavonoid yields, but the variety of flavonoids present was small, whereas plants from arid regions gave lower yields, but with greater variety (Alyukina & Klyshev 1969).

Commercial preparations of H. perforatum, which are usually 'standardised' to *hypericin* content, have been shown to contain levels of *hypericin* ranging from 47-165% of labelled concentrations (Constantine & Karchesy 1998).

Many other Hypericum spp. have been shown to contain *hypericin* and/or pseudohypericin [as % combined, unless stated otherwise] – H. annulatum [H. degenii; 0.066%], H. attenuatum [0.072%], H. aucheri [0.031%], H. barbatum [0.306%; *hypericin* not found in earlier studies], H. bithynicum [0.056%], H. boissieri [0.512%], H. cerastoides [0.029%], H. elegans [0.104%], H. empetrifolium [0.009% *hypericin*], H. formosissimum [0.054% pseudohypericin], H. linarioides [0.019%], H. montanum [0.04%], H. montbretii [0.174%], H. olympicum [0.015%], H. origanifolium [0.064%], H. perfoliatum [0.056%], H. polyphyllum [0.012%; not found by earlier studies], H. richeri [0.134%], H. rochelii [0.232%], H. rumeliacum [0.263%], H. tetrapterum [0.052%], H. thasium [0.124%], H. triquetrifolium [0.09%] and H. umbellatum [0.063%]. An earlier study found *hypericin* in H. scabrum, though neither *hypericin* or pseudohypericin were found in the most recent analysis (Kitanov 2001).

Hypericum perforatum is an erect perennial herb to 1.2m tall, usually less; stems often reddish, glabrous, with 2 opposite longitudinal ridges bearing dark glands; several stems arise from a woody crown or rootstock, woody at base, branched mostly in upper ½, branches opposite and paired. 2 opposite, sessile leaves under the fork of each pair of branches; leaves green, lighter on lower surface, in opposite pairs, 1.5-3cm long, ovate to linear, sessile, glabrous, entire, covered with small oil glands which are seen as translucent dots. Flowers golden yellow, c.2cm diam., numerous in terminal clusters, often in groups of 3; sepals 5, green, sepals of young buds often with reddish markings, especially at tips; petals 5, rounded-lanceolate, often with glands that appear as black dots along margins; stamens yellow, numerous in 3 bundles. Fruit a sticky, many-seeded 3-celled capsule, 5-10mm long, with 3 persistent styles as long as fruit; seeds dark brown or black, cylindrical with rounded ends, c.1mm long, densely pitted.

Humid and subhumid temperate regions, 500-1000m; Great Britain, Europe to Central China, n. Africa, Australia [every state except NT]; a widespread weed.

Plants do not flower in first year, and may lie decumbent early in life (Chiej 1984; Parsons & Cuthbertson 1992). Due to its status as a noxious invasive weed in some countries [such as Australia], it is not advisable to cultivate this herb unless it can be contained within a controlled area. If you can locate unsprayed wild patches of the plant, there will be no need to cultivate it, anyway! Harvest the tops when the first flowers are opening, and dry without heat. Stems and flowers often take longer to dry than the leaves (Whitten 1999).

HYPOMYCES

(Hypocreaceae/Clavicipitaceae)

Hypomyces aurantius *(Pers. ex Fr.) Tulasne* **(H. cesatii** *(Mont.) Tulasne et Tulasne***; H. subaurantius** *Heinrichson***; Bonordenia aurantia** *(Pers. ex Fr.) Schulzer***; Nectria aurantia** *(Pers. ex Fr.) Fr.***; N. cesatii** *Montagne***; Sphaeria aurantia** *Pers.***)** – golden Hypomyces

This mould fungus is known to grow on other fungi, particularly species of the family Polyporaceae [see **Lycoperdon/Scleroderma**], and has been recorded growing on some Agaricaceae [eg. Coriolus pubescens in Ukraine – see *Endnotes*] (Rogerson & Samuels 1993). In Hueyapan, Mexico, H. lactifluorum and H. macrosporus, growing on what is probably a Lactarius sp., are eaten as food – the former is said to cause puckering in the mouth (De Avila & Welden 1980).

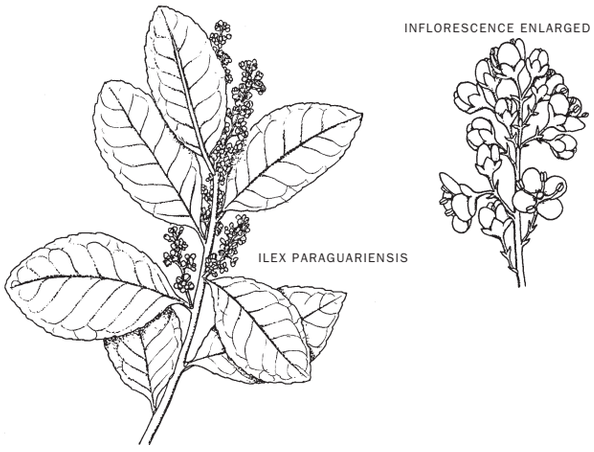
H. aurantius in liquid culture has yielded the ergot alkaloids [see **Claviceps**] *elymoclavine*, *agroclavine*, *chanoclavine*, ergokryptine and ergokryptinine (Yamatodani & Yamamoto 1983).

Hypomyces aurantius has subiculum typically yellowish-orange, orange, red to rusty-red, varying from almost white to buff, through many shades of orange and red, floccose and effuse, often covering the entire host, occasionally spreading over a large portion of surrounding substrate, turning violet to purplish-red in KOH; hyphae 4-6µm wide, much branched and often at right angles, septate, smooth, thin-walled, cells often becoming enlarged and thick-walled, up to 10-12µm wide with wall 1-1.5µm thick, loosely interwoven; perithecia globose to ovate or obpyriform, 250-575 x 200-375µm, gregarious, pale to golden yellow, orange or red; papillate; asci cylindrical to clavate, 100-140 x 6-7µm, apex thickened with a pore; ascospores fusiform to lanceolate, 2-celled, verrucose, apiculate; conidiophores arising in aerial mycelium, indefinite in length, verticillately branched with 3 or more branches arising from one point, branches sparingly septate or aseptate, each terminating in a single conidiogenous cell, its base tapering slightly to the tip, its apex proliferating retrogressively and percurrently; conidia at first globose to subglobose, becoming ellipsoidal or obovoidal, (8.5-)10-16(-21) x 5-7.5(-10)µm, 0-1-septate, with a basal hilum and often with refractive material at apex, conidia produced singly and held end to end in dry chains; chlamydospores oblong-oval, 18-48 x 12-18µm, 1-4-celled, constricted at septa, pale brown to reddish-brown, wall 1-3µm thick.

Common in north and south temperate zones, rare in tropical regions (Rogerson & Samuels 1993).

ILEX

(Aquifoliaceae)



Ilex amara *(Vell.) Loes.* – caa-una, caachira
Ilex ambigua *(Michaux) Chapman* – holly
Ilex aquifolium *L.* – European holly, English holly, holy tree, Christ's thorn, bat's wings, holm chaste, hulm, hulver bush, tinne
Ilex argentina *Lillo* **(I. tucumanensis** *Speg.***)**
Ilex brevicuspis *Reissek* **(I. caaguazuensis** *Loes.***; I. theezans var. acrodonta** *auct. non. (Reiss.) Loes.***)**
Ilex caroliniana *(Lam.) Loes.* **(I. cassine** *Walt. non L.***)**
Ilex cassine *L.* – cassina holly, cassena, yaupon
Ilex crenata *Thunb.* – Japanese holly
Ilex crepitans *Bonpland* – caa-una, caachira
Ilex dahoon *Walter* – dahoon holly, yaupon
Ilex dumosa *Reissek*
Ilex gigantea *Bonpland* **(I. theezans var. fertilis** *(Reiss.) Loes.***)** – caa-una, caachira
Ilex guayusa *Loes.* – guayusa, huayusa, guanusa, wayusa, wais, weisa, kopiniak
Ilex humboldtiana *Bonpland* – caa-unina, caa-una, caachira
Ilex integerrima *Reissek*
Ilex microdonta *Reissek*
Ilex mitis *(L.) Radlk.* **(I. capensis** *Sond. et Harv.***; I. monticola** *Tul.***; Sideroxylon mite** *L.***)**
Ilex opaca *Aiton* – American holly
Ilex ovalifolia *Bonpland*
Ilex paraguariensis *Saint-Hilaire* **(I. curitibensis** *Miers***; I. domestica** *Reiss.* **var. glabra** *Reiss.***; I. mate** *St.-Hil.***; I. paraguayensis** *Hook.***; I. paraguensis** *D. Don.***; I. sorbilis** *Reiss.***; I. theaezans** *Bonpl. ex Miers***; Cassine gongonha** *Raben.***; C. gouguba** *Guibourt***; Chomelia amara** *Vell.***)** – maté, yerba maté, yerba de palos, Paraguay tea
Ilex perado *Soland.*
Ilex pseudobuxus *Reissek*
Ilex tarapotina *Loes.* – té o maté
Ilex taubertiana *Loes.*
Ilex theezans *Mart. ex Reissek*
Ilex vomitoria *Soland.* – yaupon, black drink
Ilex yunnanensis *Franch.* **var. eciliata** *var. nov.* – shui-cha-tze ['tea growing by the water']

These trees and shrubs, all related to the 'true European holly' [I. aquifolium] are known for their content of purine alkaloids and for their ceremonial uses. Magically, holly is said to be an excellent protective herb (Cunningham 1994). One of the best known of these would be 'yerba maté' [or simply 'maté' – the name for both the beverage and the vessel it is consumed from], I. paraguariensis, which is widely consumed in parts of S. America [Bolivia, Brazil, Chile, Paraguay, Peru, Argentina] as a daily beverage which stimulates the CNS and suppresses hunger. It is also available commercially. Leaves of the tree are harvested with their twigs attached, and quickly roasted in a pan or dried over a fire. The leaves are then beaten free from the twigs, before being powdered and packaged. Sometimes the leaves are cured in a specially constructed oven, to retain more of the aroma of the herb. Yerba maté is drunk from a special tin gourd, which is also called maté. This consists of a gourd with a tube ['bombilla'] entering from the top like a straw, and the bottom of the tube holds a fine spherical strainer. The herb is put into the gourd, a little cold water poured in to moisten it, and near-boiling water is poured in. The drink is sucked up in quick sips through the tube, whilst the liquid is still very hot. It may be passed around the group, or kept to one's self. The herb may have further boiling water added 3-4 times, until the residue is exhausted. Western users may wish to let the herb infuse and cool for longer, as native users seem less sensitive to the scalding heat of the drink. In higher doses, maté is known to have slightly stupefying properties (Hume 1953; Peckolt 1883; Von Bibra 1855; pers. obs.). Guarani shamans make a strong decoction of it to enter a trance (Rätsch 1992).

I. amara, I. argentina, I. brevicuspis, I. crepitans, I. dumosa var. dumosa, I. gigantea, I. humboldtiana, I. integerrima, I. microdonta, I. ovalifolia, I. pseudobuxus, I. taubertiana, and I. theezans have been used as substitutes or adulterants of I. paraguariensis where it is not available or is in short supply, though I. paraguariensis is the only such species in cultivation (Filip et al. 1998, 2001; Peckolt 1883). I. tarapotina from n. Peru is said to be the source of a maté derivative called 'té o maté', of unknown effects. Similarly, a tea substitute [see **Camellia**] is made from leaves of I. yunnanensis var. eciliata, along the border of China and Tibet (Hu 1949; Hume 1953).

I. guayusa [usually known as 'guayusa'] is also similarly used, though it is considered more potent. It is mostly employed in the Peruvian/Ecuadorian region, by the Jivaro [including the Achuar Shuar], Pintsche, Zaparo, Canelo, Kokama and others. It was probably once used in Bolivia, based on findings of the leaves in the 5th century tomb of a Bolivian highland shaman. The leaves are collected in the lowlands, strung together, and carried to the village, where they are dried for use. Unlike many magical plants, guayusa was used and even sold by the missionaries of the area, for whom it was an important source of revenue. Some tribes cultivate it near their huts. Guayusa leaves are boiled whole in water for an hour to be drunk every morning [the decoctions being called 'wayus'], sometimes also throughout the day. Large amounts are consumed in a sitting – one dose may consist of a 2.2 litre decoction containing an extract of c.18g I. guayusa leaves. To avoid excessive stimulation and side effects from *caffeine* overdose, users cause themselves to vomit shortly after consumption, eliminating roughly half of the *caffeine* consumed. The beverage itself does not appear to act as an emetic. Ritual cleansing of the body in such a way is considered very important to these indigenous groups, and they learn how to induce emesis from an early age. Although it makes more sense to simply drink less of the beverage [as do women], men seem to enjoy drinking large quantities of the beverage and participation in the male bonding of the daily ritual including emesis. The drink is said to help bad nerves, stomach troubles, chills, venereal infections, female sterility, faulty menstruation, malarial fevers and liver pains. Even without emesis, guayusa is said to remove impurities through sweat and phlegm. It is usually prepared exclusively by men, though it may be consumed by all, and is often consumed at social occasions or given to dogs before hunting trips. It is considered a good omen to have a dream in which one sees a pot of guayusa boiling. Fittingly, the drink itself in sufficient dose is said to impart 'little dreams' on the drinker, which are used to aid in divining the success of a hunt. Strong decoctions are known to sometimes cause visual disturbances [as well as other symptoms of *caffeine* overdose], such as sticks on the forest floor seeming to move like snakes, though these effects are often seen as undesirable, and overly potent strains of I. guayusa are usually avoided. Guayusa may also be drunk before taking ayahuasca [see **Banisteriopsis**] to cleanse the system, or it may be taken with ayahuasca [or added to the brew] to 'kill the taste, prevent hangover' and 'give strength to deal with ayahuasca'. It has been used as a headache remedy by the Quicha (Bennett 1992; Lewis et al. 1991; Ott 1993; Patiño 1968; Rätsch 1992; Schultes 1967a; Schultes & Raffauf 1990).

I. cassine, I. dahoon and I. vomitoria are said to be used to make a stimulating drink by the Choctaw, Cherokee, Creek, Seminole, Alabama,

Karankawa and Natchez of the south-eastern US. It seems, however, that only I. vomitoria is actually used, early writers confusing these species. The 'black drink' or 'yaupon' is prepared from the leaves, which are roasted to dryness in a clay pot over fire, before water is added to make a strong decoction. It acts as a stimulant, strengthening tonic, emetic and purgative, and is taken at the opening of tribal councils and other important occasions. Sometimes, drinking sessions would continue for several days. James Adair wrote that "no one is allowed to drink it in council unless he has proved himself a brave warrior". Tobacco [see **Nicotiana**] may sometimes be added to the drink, which is consumed from conch shells. It also causes sweating [said to purify physically and morally], and is said to evoke 'ecstasies'. It is used in the training of shamans amongst the Seminole. Sometimes, the leaves are smoked as a tobacco substitute. I. cassine and I. vomitoria were also used as tea substitutes [see **Camellia**] by southern rebel forces during the American Civil War (Alikaridis 1987; Cooke 1860; Hamel & Chiltoskey 1975; Hume 1953; Power & Chesnut 1919b; Rätsch 1992).

Dried leaves of I. aquifolium are infused to make a beverage in the Black Forest, as well as having been employed in folk medicine as an antipyretic, antirheumatic, diuretic and astringent. In Corsica, the roasted fruits have been used as a coffee substitute [see **Coffea**]. Both parts are known to be purgative and emetic, and to produce a 'mild narcosis' (Alikaridis 1987; Chiej 1984; Ott 1995a; Von Bibra 1855). Early European pagans have been said to have offered holly twigs to forest faeries (Alikaridis 1987). I. opaca produces very similar symptoms – vomiting, diarrhoea and stupor (Foster & Caras 1994), though the Cherokee use the berries for indigestion and colic (Hamel & Chiltoskey 1975). The leaves have also been used as a tonic, cardiac stimulant, diuretic and purgative (Alikaridis 1987). In southern Africa, Sotho shamans use I. mitis and divinatory dice to prevent bewitchment of sick patients. Small pieces of the bark are chewed by the Kgatla as a purgative (Watt & Breyer-Brandwijk 1962). In Malaya, small amounts of I. cymosa bark ['kayu kelingat kuali'] are used in the manufacture of dart-poisons (Bisset & Woods 1966).

I. ambigua leaves were found to contain *caffeine* and *theobromine* (Bohinc et al. 1978).

I. aquifolium fruits have yielded neoxanthin, mutachrome, lutein, phytofluene, carotenes, pelargonidin-3-bioside, pelargonidin-3-glucoside, pelargonidin-3-xylosylglucoside, cyanidin-3-xylosylglucoside, α-amyrin, uvaol, 2-trichloromethylpropan-2-ol, 27-p-coumaroxyursolic acid, p-OH-benzoic acid, vanillic acid and fatty acids; leaf has yielded *theobromine*, rutin, quercetin, kaempferol [MAOI (Sloley et al. 2000)], sitosterol, baurenol, uvaol, erythrodiol, α-amyrin, β-amyrin, oleanolic acid, *chlorogenic acids*, fatty acids, amino acids and sugars (Alikaridis 1987).

I. argentina has yielded more than 0.5% *theobromine* (Suzuki et al. 1992); another analysis found only traces, and extreme traces of *caffeine*.

I. brevicuspis was not found to contain any detectable xanthines (Filip et al. 1998).

I. caroliniana contains *theobromine* (Alikaridis 1987).

I. cassine leaf yielded 0.27-0.32% *caffeine*, though species identification may have been in error (Power & Chesnut 1919b); *theobromine* has also been found (Alikaridis 1987).

I. crenata contains *theobromine* (Bohinc et al. 1975).

I. dumosa was found to contain traces of *caffeine* and *theophylline* (Filip et al. 1998).

I. guayusa leaf has yielded 1.69-7.69% *caffeine* [this high value was from a wild plant], traces-0.12% *theobromine*, *theophylline* [traces or none] (Lewis et al. 1991), *chlorogenic acid*, and an essential oil with traces of vanillin, fatty oil, tannins and resins (Rätsch 1992). A cold water infusion of the leaves [for 24hrs] was more effective in extracting the alkaloids of the leaf than was boiling in water for 10mins, though boiling in water for 1hr [the traditional method] was most effective (Lewis et al. 1991).

I. microdonta was found to contain traces of *caffeine* and *theobromine* (Filip et al. 1998).

I. opaca leaves have not yielded any purines, though they have been shown to contain nonacosane, *choline* and *acetylcholine* (Alikaridis 1987).

I. paraguariensis leaf has yielded 0.13-2.2% *caffeine* [only 0.02-0.03% in young leaves, dried 'without special care'; in one analysis, roasted maté from Parana (Brazil) yielded 0.55% *caffeine*, whereas unroasted maté from the same place yielded 1.67%] (Filip et al. 1998; Hume 1953; Lewis et al. 1991; Lindner 1956; Nagata & Sakai 1985; Ott 1995a; Peckolt 1883; Power & Chesnut 1919a), 0.15-0.9% *theobromine*, *theophylline* [none or traces], adenine, 5-10% *chlorogenic acids* [caffeic acid, 5-O-caffeoylquinic acid, 3-caffeoylquinic acid, *chlorogenic acid*, neochlorogenic acid, monocaffeoylquinic acid, dicaffeoylquinic acid, 3,4-, 4,5-, and 3,5-dicaffeoylquinic acids, feruloylquinic acid, p-coumarylquinic acid and others], flavonoids [rutin, kaempferol, kaempferol-3-O-rutinoside, quercetin, quercetin-3-O-glucoside], triterpenes [mostly ursolic acid, possibly also α-amyrin], ascorbic acid [vitamin C], thiamine [vitamin B1], riboflavin [vitamin B2], carotene, nicotinic acid, matesaponin 1 [c.1.23%], trigonelline, *choline*, amino acids, sugars, resins, fatty oil, and c.0.55% essential oil containing traces of vanillin. Unroasted leaves from Parana have yielded 0.25% of an aromatic substance different to the essential oil [which was extracted with ether]. The leaf contains no true tannins, but the 'pseudotannin' cafe-tannic acid or caffetannin [which is identical with *chlorogenic acids*, which give caffeic acid on hydrolysis]; some early research found mate-tannic acid [1.68% in roasted leaves, 4.5% in unroasted], reported to be similar but different to caffe-tannic acid. Small twigs have yielded [w/w] 0.26% *caffeine*. Fruits have also yielded *caffeine*, *theobromine* and *theophylline*, as well as fatty acids (Alikaridis 1987; Bruneton 1995; Buckingham et al. ed. 1994; Filip et al. 1998, 2001; Gosmann et al. 1989; Lewis et al. 1991; Lindner 1956; Ohem & Hölzl 1988; Peckolt 1883; Rastogi & Mehrotra ed. 1990-1993). Tea made from the leaves [using tea bags containing 1.8g leaf, or loose leaf (8.52g)] yielded 1.05-15.83mg *caffeine* per cup (De Camargo & Toledo 1999). Leaf extract showed some degree of BZ-receptor agonist activity (Medina et al. 1989). Tea made from the leaves has also shown antioxidant, hepatoprotective, choleretic, and hypocholesteremic properties; these activities are thought to be due to phenols, particularly the flavonoids and caffeoyl-derivatives [*chlorogenic acids*] present (Filip et al. 2001).

I. perado leaves have yielded *theobromine* (Bohinc et al. 1975).

I. pseudobuxus was found to contain c.0.0006% *theophylline* and traces of *caffeine* (Filip et al. 1998).

I. pubescens leaves have yielded *scopoletin*, aesculetin, 6-methyl-7-OH-coumarin, glaberide I, oleanolic acid and ursolic acid (Alikaridis 1987).

I. theezans was found to contain traces of *caffeine* and *theophylline* (Filip et al. 1998).

I. vomitoria leaf has yielded 0.09-1.67% *caffeine* and 0.04% *theobromine* (Lewis et al. 1991; Power & Chesnut 1919b).

Ilex paraguariensis is an evergreen shrub or small tree 4-7m tall. Leaves simple, persistent, alternate or rarely opposite, dark green, coriaceous, elliptic to obovate, 2.5-13(-25)cm long, 2-6.4cm wide, margins undulate and coarsely crenate in the upper 2/3, upper surface usually shiny, petiolate; stipules minute and caducous. Flowers unisexual, rarely some appearing perfect, in numerous small cymes along the current year's growth, usually 1-2cm long, peduncles 0.5-0.8cm long; sepals usually 4, 0.4-0.6mm long, persistent, imbricate and usually connate at base; petals usually as many as sepals, 1.5-2mm long, connate at base, white or greenish, rotate, caducous; stamens as many as petals, inserted at base of corolla, staminodia in pistillate flowers similar to fertile stamens but usually smaller; anthers usually dithecal, opening by longitudinal slits. Ovary superior, angled or lobed, (2-)4-6(-24)-carpellate, carpels connate, ovary 4-celled, rudimentary in staminate flowers; ovules 1(-2) per cell, pendulous on axile placentas, usually anatropous; style terminal, usually absent; stigmas 4, distinct or connate. Fruit a drupe, with as many 1-seeded pyrenes as carpels, dark red to brownish, c.6mm diam.

Native to Paraguay and adjacent Argentina and Brazil; cultivated and sparingly naturalised in Hawaii (Wagner et al. 1990).

Cultivate from seed, after freeing them from the flesh of the fruit; germinate with heat and/or in a humidity tent. Transplant to final site when c.15cm tall, planting 4-5m apart; likes a shaded position [young plants are easily killed by hot sun] and damp soil, and may benefit from a trench dug around the base to hold water. When 1-2m tall, trees can do with less shade, and harvesting may take place some 4 years after this point. Harvest may take place at various times – in Argentina and some areas of Brazil, Feb. to late Jul. is the preferred time, in Paraguay Dec. to Aug., and in some other areas of Brazil, Mar. to late Sep. However, harvesting young leaves in August may be damaging to the plant as this is when it puts out new shoots. Leaves are most aromatic when fruits are nearly ripe. Three grades of yerba maté have been encountered. These are 'caá-cuy' [new leaves of barely developed shoots, delicate texture, pleasant flavour, yellowish colour – rarely found for sale], 'caá-mirim' or 'herba mansa' [leaves only, with midribs removed] and 'caá-guacu', 'caá-una' or 'yerba de palos' [large and old leaves, plus twigs and wood fragments, strong bitter flavour, inferior quality – most commonly encountered]. In some areas such as Rio de Janeiro the leaves are sold either whole or powdered. With powdered maté, quality is tested by taking a small amount in the palm of the hand and blowing on it; if most of it blows away, it has probably been heated too much in the drying process (Peckolt 1883).

ILLICIUM

(Magnoliaceae/Illiciaceae)

Illicium parviflorum *Michx. ex Vent.* **(Badianifera parviflora** *(Michx. ex Vent.) Kuntze***)** – yellow anise, yellow anise tree of Florida, small-flowered anise shrub, small anise tree

Illicium religiosum *Sieb. et Zucc.* **(I. anisatum** *L.***; I. japonicum** *Sieb.***)** – Japanese star anise, sacred anise tree, hana noki, shikimi noki, hana shimiki [possibly derived from ashikimi, 'evil fruit'], dai ui kio, iririshi ya mu, koshiba, anasphal, anashuppu, badian, moso, mang-tsao ['mad herb']

Illicium verum *Hook. f.* **(I anisatum** *Lour.***; I. san-ki** *Perr.***; Clausena sanki** *(Perr.) J.F. Molina***)** – star anise, Chinese star anise, hwai hiang, bajiao hui xiang, ta hui xiang, kai-ko, dai uikio, hakkaku uikio, anasphal, anasuppan, anasapurvem, badian, badian-i-khatai, raziyanje-khatai, ewas

'Star anise' [I. verum], not to be confused with 'anise' or 'aniseed' [see **Pimpinella**], has been known to the Chinese since at least 100BC. It is commonly used as a cooking spice, and is an ingredient of Chinese five-spice. Its generic name comes from the Latin 'illicere' ['to attract'], referring to the alluring smell of the fruit and foliage. The dried fruits are believed to bring luck, and are burned as an incense to 'increase psychic powers'. Medicinally, the fruits stimulate appetite and digestion, relieve flatulence, rheumatism, chest complaints and pain. They are sedative and considered to be warming and to restore the normal flow of ch'i. The related I. religiosum is planted around Japanese Buddhist temples and near graves; it is considered sacred, and was introduced to Japan from China [and perhaps Korea] by Buddhists. When in flower, it is used to adorn consecrated vessels, altars and tombs. Powdered bark and leaves are also made into incense sticks, which are burnt in Buddhist temples and during religious rites. Unlike I. verum [with which it has been confused in the past], the fruit does not have a very agreeable aroma or taste, though the seed kernel does have a sweetish taste. All parts of the plant, especially the fruits, are considered poisonous in Japan. In China, it is reputed to cause "paroxysms of frenzy" if consumed by humans (Anon. 1881b; Bremness 1994; Cunningham 1994; Eykman 1881; Huang 1993; Müller-Ebeling et al. 2002; Simonetti 1990).

The essential oils of some Illicium spp. are known for their content of useful phenylpropenes [see also **Myristica**, **Sassafras**].

I. floridanum ['poison bay'] leaves and branches yielded an essential oil rich in linalool [20.23-24.86%] and linalyl acetate [12.32-15.54%], and also containing traces of (E)-*methylisoeugenol* [c.0.04%] and many other compounds (Tucker & Maciarello 1999). In Alabama, the leaves are considered posionous (Anon. 1881b).

I. majus fruits have a taste similar to that of 'mace' [see **Myristica**] (Anon. 1881b), and thus may have similar chemistry (pers. obs.).

I. parviflorum leaves and branches yielded an essential oil rich in *safrole* [67.26-69.04%], *methyleugenol* [11.02-12.76%], and linalool [12.15-14.17%], and also containing traces of *eugenol* [2.04-2.28%], *elemicin* [0.59-0.73%], (E)-*isosafrole* [c.0.02%] and many other compounds (Tucker & Maciarello 1999).

I. religiosum seed essential oil has yielded *safrole*, *eugenol*, cineol, *borneol*, and possibly *anethole* or *estragole* (Tardy 1905a).

I. verum fruit and seeds have yielded 2.5-9% essential oil, of which 71-90% may be trans-*anethole* and 5% *estragole*, as well as *safrole*, anisaldehyde, limonene, linalool, cinnamyl acetate, cis-ocimene, chavicol methyl ether, p-MeO-phenylacetone, p-propenylphenol, *pinene*, phellandrene, dipentene, terpineol, p-cymene, bisabolene, feniculin, farnesol, trans-α-farnesene, β-caryophyllene, nerolidol, salicylic acid and many other trace compounds (Anon. 1911a; Battaglia 1995; Bruneton 1995; Morton 1977; Schermerhorn et al. ed. 1957-1974).

Illicium verum is a glabrous, evergreen, slow-growing tree to 18m or more tall. Leaves mostly alternate, thick, leathery, sometimes clustered or seemingly whorled, petioled, without stipules, usually obovate to oblong-elliptic, to 15.5cm long. Peduncles quite short, nearly or quite bractless. Flowers solitary or 2-3 together, rarely in clusters on trunks and old branches, axillary, bisexual; flowers globose, perianth segments 7-12 in several series, to c.1cm long, the largest often as broad as long, not spreading, at first whitish but changing to pink and then to purple; stamens 11-20, with short filaments and basifixed anthers; carpels many, separate in a circle, with superior 1-celled ovary. Fruit star-shaped, of many separate 1-seeded follicles.

S.e. China and n.e. Vietnam.

Propagate by seed or by cuttings of half-ripened wood (Bailey & Bailey 1976). Trees are productive only after 15 years, giving 3 harvests a year. Fruits are gathered just before they are ripe, and dried quickly in the sun (Simonetti 1990).

INOCYBE

(Agaricaceae/Cortinariaceae)

Inocybe aeruginescens *Babos* – fibrehead mushroom
Inocybe calamistrata *(Fr.) Gill.*
Inocybe coelestium *Kuyp.*
Inocybe corydalina *Quél* **var. cordyalina**
Inocybe corydalina *Quél* **var. erinaceomorpha** *(Stangl et Vesel.) Kuyp.*
Inocybe haemacta *(B. et Cooke) Sacc.*
Inocybe tricolor *Kühner*

I. aeruginescens first attracted attention in e. Germany, from 1977-1986, due to a series of [perhaps not all] unintentional intoxications deriving from confusion with the 'fairy ring mushroom' Marasmius oreades, which is edible. Symptoms were typical of *psilocybin*-type activity, and the species was later confirmed to contain this class of tryptamines (Gartz 1995, 1996). I. haemacta has likewise been shown to be psychoactive [see below for details] (Stijve & Glutzenbaum 1999). Some researchers have not been able to find *psilocybin* in some of the species discussed here – while others have [see below]. The active species so far found exhibit bluing [or greening] when bruised, as a possible indicator of usefulness, but caution should still be exercised due to the known presence of toxins within the genus.

Human poisonings have resulted from the consumption of I. infida [from New York], with symptoms including "nausea, vomiting, diarrhoea, pain and a general feeling of unrest, all the affected individuals being restored to normal health within a few hours". I. rimosa is also claimed to be "very poisonous". I. infelix was found to be highly toxic to rabbits and guinea pigs, having a 'narcotic' effect, which was frequently followed by death in the guinea pigs (Clark & Smith 1914; Ford 1910/1911b). I. decipiens was found to be similarly toxic to animals (Ford et al. 1913).

I. aeruginescens has yielded 0.03-0.5% *psilocybin*, and 0.15-0.52% *baeocystin*; only traces of *psilocin* [0.02%] or none were detected. Also found, in similar yield to *psilocybin* and *baeocystin*, was a new 4-substituted *tryptamine* of unknown structure [c.0.35%], named aeruginascin by Gartz. He believed it may contribute to consistent euphoric effects in the inebriation. Lower alkaloid concentrations have also been reported, but these were from old specimens. *Psilocybin* was also found in the mycelial culture [0.01-0.1%], which bruises bluish-green (Gartz 1986c, 1988, 1990d; Gurevich 1995; Semerdzieva et al. 1986; Stijve et al. 1985; Wurst et al. 1992). In one bioassay, 2.4g of dried specimens was sufficient for moderately strong psychedelic effects (Gartz 1995).

I. calamistrata from Germany was shown to contain *psilocybin*, *psilocin*, *baeocystin* and *tryptophan* (Gartz 1986b), though 6-year old samples did not contain detectable tryptamines. It has a blue-green stem, though this is the natural colour rather than a bruising reaction (Stijve et al. 1985).

I. coelestium specimens from Germany [3yrs old] yielded 0.035% *psilocybin* and 0.025% *baeocystin* (Stijve et al. 1985).

I. corydalina var. corydalina specimens from France [8yrs old] yielded 0.011% *psilocybin*, 0.007% *baeocystin*, and no *psilocin*; Austrian specimens [3yrs old] yielded 0.032% *psilocybin*, 0.092% *baeocystin*, and no *psilocin* (Stijve et al. 1985); specimens from Sardinia [Italy] yielded 0.021% *psilocybin* and 0.72% *psilocin* (Ballero & Contu 1998); Swiss specimens yielded 0.023-0.03% *psilocybin*, 0.025-0.06% *baeocystin* and no *psilocin* (Stijve & de Meijer 1993); Russian specimens [some 8yrs old] yielded 0.008% *tryptophan*, 0.002% *psilocybin* and traces of *baeocystin*; a different Russian collection [5yrs old] yielded 0.004% *psilocybin* from both caps and stems, though only the caps yielded *baeocystin* [0.006%] (Gurevich 1995); *psilocybin* and *baeocystin* were also detected in German specimens (Gartz 1986b). One study found muscarine, but no *psilocybin*, but this finding has not been duplicated (Stamets 1996). This species, usually found in N. America and Europe, has also been found in India (Allen & Gartz 1997).

I. corydalina var. erinaceomorpha specimens from Germany [3yrs old] yielded 0.1% *psilocybin* and 0.04% *baeocystin* (Stijve et al. 1985).

I. haemacta specimens from Austria [3yrs old] yielded 0.17% *psilocybin*, 0.02% *psilocin* and 0.034% *baeocystin* (Stijve et al. 1985), which were also detected in German specimens (Gartz 1986b). Stijve & Kuyper (1985) reported the same yields as Stijve et al. (1985) but with the absence of *psilocin*; Swiss specimens yielded 0.02-0.042% *psilocybin* and 0.003-0.008% *baeocystin*, but no *psilocin* (Stijve & de Meijer 1993). Czech Republic specimens were found to contain *psilocybin* and *psilocin* (Stríbrný et al. 2003). The species has a pinkish-red bruising reaction, as well as bluing (Stamets 1996). Bioassays in four people using freeze-dried fruiting bodies [containing on average 0.1% *psilocybin*, 0.02% *baeocystin* and traces of *psilocin*] from Switzerland [harv. Sep./Oct.] showed 7g to be a moderately psychedelic dose (Stijve & Glutzenbaum 1999).

I. hirsuta var. maxima has been shown to contain *tryptamine*, and no muscarine (Robbers et al. 1964).

I. tricolor has been shown to contain *psilocybin* and *baeocystin* (Gartz 1996).

Many species of Inocybe, often red-staining ones, contain the toxic cholinergic muscarine [see **Amanita**, *Neurochemistry*], in amounts up to 0.8%, and fatalities have occurred (Bresinsky & Besl 1989); as an example, muscarine has been found in I. flocculosa [0.19%], I. griseolilacina [0.063%], I. pudica [0.027%], I. napipes [0.55-0.71%] and I. trechispora [0.25%], as well as at least 19 other species. I. patouillardi has caused poisonings in Europe (Hatfield & Brady 1975; Robbers et al. 1964; Stijve et al. 1985), and has yielded *phenethylamine* (Lundstrom 1989).

Inocybe aeruginescens has a cap (1-)2-3(-5) cm across, conic at first, expanding with age to convex and eventually plane with obtuse umbo; margin incurved when young, soon straightening; surface adorned with radial fibrils, more floccose towards disc; colour sordid buff to sordid ochraceous-brown, often with greenish tinges, darker olive-greenish at umbo – umbo dry, silky, usually smooth. Stem 22-50 x (2-)3-7mm, equal to swelling at base, solid, whitish to pallid at first, becoming bluish-green from base upwards; surface pruinose near apex, longitudinally fibrillose below; partial veil cortinate, soon disappearing. Gills adnate to nearly free, crowded, pale greyish-brown to clay-brown with greenish tones or bruising greenish where injured, up to 3mm deep. Bluish-green staining mostly disappears after picking. Spores clay-brown, smooth, ellipsoid, inaequilateral, 7-10 x 4-5μ; basidia 20-23 x 6-8μ, clavate, 4-spored; pleurocystidia

31-71 x 12-24µ, narrow to broadly fusiform, subclavate, with clear to yellowish tinged walls; cheilocystidia scattered, similar to pleurocystidia, 18-31 x 8-14µ. Odour 'soapy'. Fr. May-Jun.[-Oct.].

In sandy soils, and beneath poplars [Populus spp.], linden [**Tilia** spp.], oak [Quercus spp.], birch [Betula spp.] and willows [Salix spp.]; central Europe and n.w. North America – widely distributed across temperate zones. Inocybe spp. can be very difficult to identify, even for mycologists, and thus severe caution is advised with this genus (Gartz 1995, 1996; Stamets 1996).

IOCHROMA

(Solanaceae)

Iochroma fuchsioides *(Humb., Bonp. et Kunth) Miers* **(Chaenesthes fuchsioides** *Nob.***; I. puniceum** *Werderm.***; I. sodiroi** *Dammer***; I. umbrosa** *(HBK.) Miers***; Lycium fuchsioides** *HBK.***)** – guatillo, paguando, borrachero, borrachero andake, arbol de campanilla, totubjansush, nacadero, flor de quinde ['hummingbird flower'], quatillo

Iochroma grandiflorum *Benth.* – contrahechizo

I. fuchsioides is used as a shamanic hallucinogen by the Kamsá and Ingano of the Sibundoy Valley, in the southern Colombian Andes. It is usually only used in cases of difficult divination, due to its great strength and unpleasant side-effects. A handful of fresh bark is rasped from the stems, and an equal amount of fresh leaves is picked; these are decocted in water and drunk. Between 1-3 cupfuls of a strong decoction is consumed over about 3 hours, and the effects may last for at least a day. In past times when it was more frequently used, a tea made from **Hedyosmum** translucidum ['granicillo'] would be administered to aid in recovery from the intoxication. The trunk and root barks have also been used as a purgative in cases of internal bleeding, and to treat colic, stomach ache and digestive difficulties; a root infusion is given in cases of difficult childbirth (Schultes 1977b; Schultes & Raffauf 1990). In Peru, I. grandiflorum is sometimes added to **Trichocereus** pachanoi brews (Rätsch 1998).

Unidentified alkaloids have been detected in I. fuchsioides, which are thought to probably be tropanes [eg. *hyoscine*] (Schultes 1977b). Obscure withanolides [see **Withania**] have been isolated – withanolide D, 18-acetoxywithanolide D, 18-acetoxy-4-deoxy-5,6-deoxy-5-withanolide D and 18-acetoxy-5,6-deoxy-5-withanolide D (Raffauf et al. 1991).

I. coccineum has also yielded withanolides – withaferine A, withacnistine and iochromolide (Alfonso & Kapetanidis 1991).

I. cyaneum leaves and stems have yielded three hydroxycinnamic amides – N,N-di-dihydrocaffeoylspermidine, caffeoylputrescine [paucine] and feruloylputrescine [subaphylline] (Sattar et al. 1990).

Iochroma fuchsioides is a shrub or small tree 3-4.5(-6)m tall, densely branched; branches red-brown, tomentellous. Leaves oblong-obovate, slenderly attenuate to petiole, obtuse, 10-15 x 5.5-9cm, subfasciculate, +-glabrous above, white-tomentellous beneath, brown-tomentellous along veins; petiole brown-tomentellous, 20-30mm long. Flowers 25-35mm long, in umbellate clusters, axillary and terminal; pedicels ashy-tomentellous, elongate, cernuous; calyx c.5mm long, subglabrous, brown-tomentellous, bilobed, margin unequal, shortly 5-dentate, with intervening teeth in the plicature of each sinus; corolla tubular-campanulate, flaring at mouth, 8-9(-11)mm wide at mouth, deep red, externally tomentellous or rarely subglabrous, puberulent within; stamens included or sometimes slightly exserted, filaments thickened and densely tomentose at base; stigma greenish. Fruit a red berry, ovate-oblong to pyriform, acute to acuminate, 15-25mm long, 6-15mm wide, with enlarged persistent calyx, splitting on one side to the base.

At 2000-3000m altitude; Colombia, Ecuador (Miers 1848; Schultes 1977b).

May be grown outdoors in warm climates, from seed or cuttings taken in early spring; cuttings may take several weeks to root (Grubber 1973).

IPOMOEA

(Convolvulaceae)

Ipomoea amnicola *Morong* **(I. nuda** *N.E. Br.***; I. nuda** *Peter***)**

Ipomoea aquatica *Forsk.* **(I. reptans** *Poir.***)** – potato-vine, kalmishak, kangkung

Ipomoea argillicola *R.W. Johnson*

Ipomoea argyrophylla *Vatke*

Ipomoea asarifolia *(Desr.) Roem. et Schult.* **(I. beladamboe** *Roem. et Schult.***; I. crassifolia** *Cav.***; I. grisebachii** *Prain***; I. nymphaeifolia** *Griseb.***; I. pes-caprae var. heterosepala** *Chodat et Hassl.***; I. repens** *Lam.***; I. urbica** *(Salzm.) Choisy***; Amphione asarifolia** *(Desr.) Raf.***; Convolvulus asarifolius** *Desr.***; C. rugosus** *Rottler***)** – salsa brava, batatarana

Ipomoea cairica *(L.) Sweet* **(I. cavanillesii** *Roem. et Schult.***; I. funaria** *Larrañaga***; I. palmata** *Forssk.***; I. pentaphylla** *Cav.***; I. senegalensis** *Lam.***; I. stipulacea** *Jacq.***; I. tuberculata** *(Desr.) Roem. et Schult.***; I. vesiculosa** *P. Beauv.***; Batatas cavanillesii** *(Roem. et Schult.) G. Don***; B. senegalensis** *G. Don***; Convolvulus cairicus** *L.***; C. cavanillesii** *(Roem. et Schult.) Spreng.***; C. limphaticus** *Vell.***; C. tuberculatus** *Desr.***)** – Cairo morning glory, mile-a-minute, wasovivi

Ipomoea sp. aff. calobra *Hill et Muell.* **(not=I. calobra** *Hill et Muell.***)** – weir vine

Ipomoea carnea *Jacquin* – borrachero ['intoxicant'], matacabra ['goat killer'], toé

Ipomoea carnea ssp. fistulosa *(Mart. ex Choisy) D.F. Austin* **(I. fistulosa** *Mart. ex Choisy***; I. nicaraguensis** *(Donn. Sm.) House***)** – amapola, algodão-bravo

Ipomoea coccinea *L.* **(Convolvulus coccineus** *L.***; Quamoclit coccinea** *(L.) Moench.***)** – red morning glory, star Ipomoea

Ipomoea costata *F. Muell. ex Benth.*

Ipomoea diamantinensis *J.M. Black ex Eardley*

Ipomoea digitata *L.* **(I. paniculata** *(L.) R. Br.***; Convolvulus paniculatus** *(Burm. f.) Kuntze***; C. paniculatus** *L.***; Quamoclit digitata** *(L.) G. Don***)** – bidarikand, vidari, vrashavalli, payasvini, phalmodika

Ipomoea hederacea *Jacquin* **(I. desertorum** *House***; Convolvulus hederaceus** *L.***; Pharbitis githaginea** *Hochst.***; P. hederacea** *(L.) Choisy***; P. hispida** *A. Rich.***)** – pharbitis, mirchai, bildi

Ipomoea hederifolia *L.* **(I. angulata** *Lamk.***; Quamoclit angulata** *Boj.***; Q. hederifolia** *(L.) G. Don.***)** – Texas red morning glory

Ipomoea hildebrandtii *Vatke*

Ipomoea hybrida 'Darling' *Hort.* **(I. nil 'Darling'** *Hort.***)**

Ipomoea involucrata *P. Beauv.* **(I. pileata** *Roxb.***; Convolvulus perfoliatus** *Schumach. et Thonn.***)** – nguenga

Ipomoea lacunosa *L.*

Ipomoea leptophylla *Torr.* – bush morning glory, big-root morning glory, man-root, bush moonflower, wild potato vine, kahts-tuwiriki ['whirlwind medicine'], pezuta nige tanka ['big-stomach medicine']

Ipomoea muelleri *Benth.*

Ipomoea nil *(L.) Roth* **(I. cuspidata** *Ruiz et Pavon***; I. githagenia** *A. Rich.***; I. hederacea** *Auct. non Jacq.***; Convolvulus nil** *L.***; C. tomentosus** *Lour.***; Pharbitis nil** *(L.) Choisy***)** – qian niu zi [seed in TCM], kaladana ['black seed'], nil, nil-kalmi ['blue-leaf']

Ipomoea oblongata *E. Mey. ex Choisy* **(Turbina oblongata** *(E. Mey. ex Choisy) A. Meeuse***)** – mothokho

Ipomoea orizabensis *(Pelletan) Ledeb. ex Steudl.* **(I. longipedunculata** *(M. Martens et Galeotti) Hemsl.***; I. superba** *(Kunth) G. Don***; I. tyrianthina** *Lindl.***; Convolvulus orizabensis** *Pelletan***; C. sanguineus** *Willd. ex Roem. et Schult.***; C. serotinus** *DC.***; C. superbus** *Kunth***; Pharbitis longipedunculata** *M. Martens et Galeotti***; P. serotina** *(DC.) Choisy***; Quamoclit serotina** *(DC.) G. Don***)** – yerba de las ánimas ['herb of souls']

Ipomoea parasitica *(Kunth) G. Don* **(I. perlonga** *B.L. Rob.***; Convolvulus circinnatus** *Willd. ex Roem. et Schult.***; C. parasiticus** *Kunth***)**

Ipomoea pes-caprae *(L.) R. Brown* **(I. biloba** *Forssk.***; I. brasiliensis** *(L.) G. Mey.***; I. brasiliensis** *(L.) Sweet***; I. maritima** *(Desr.) R. Br.***; Convolvulus bilobatus** *Roxb.***; C. brasiliensis** *L.***; C. maritimus** *Desr.***; C. pes-caprae** *L.***)** – goatsfoot convolvulus, purple beach convolvulus, coast morning glory, endabari, waljno-jo, ale, aliali, lauwere, lavere, dopatilata

Ipomoea pes-tigridis *L.* **(I. capitellata** *Choisy***; I. hepaticifolia** *L.***; Convolvulus pes-tigridis** *(L.) Spreng.***)**

Ipomoea petaloidea *Choisy* **(I. bufalina** *Choisy***; I. nymphaefolia** *Blume***; I. peltata** *(L.) Choisy***; Convolvulus bufalinus** *Lour.***; C. crispatulus** *Wall.***; C. peltatus** *L.***; Merremia borneensis** *Merr.***; M. bufalina** *Merr. et Rendle***; M. distillatoria** *(Blanco) Merr.***; M. elmeri** *Merr.***; M. peltata** *(L.) Merr.***; Operculina bufalina** *Hall. f.***; O. petaloidea** *Ooststr.***; Spiranthera peltata** *(L.) Bojer***)**

Ipomoea piurensis *O'Donnell*

Ipomoea purpurea *(L.) Roth* **(Convolvulus purpureus** *L.***; Pharbitis purpurea** *(L.) Voigt***)** – purple-flowered morning glory, purple-flowered bell vine, jalambu, jalapha

Ipomoea quamoclit *L.* **(I. cyamoclita** *St.-Lag.***; Convolvulus pennatifolius** *Salisb.***; C. pennatus** *Desr.***; C. pinnatus** *Desr.***; C. quamoclit** *(L.) Spreng.***; Quamoclit pennata** *(Desr.) Bojer***; Q. pinnata** *(Desr.) Bojer***; Q. quamoclit** *(L.) Britton***; Q. vulgaris** *Choisy***)** – cypress vine morning glory

Ipomoea rubrocaerulea *Hook.* **(Convolvulus rubrocaeruleus** *(Hook.) Dietrich***; Pharbitis rubrocaeruleus** *(Hook.) Planch.***)**

Ipomoea sinensis *(Desr.) Choisy* **(I. biflora** *(L.) Pers.***; Convolvulus sinensis** *Desr.***)**

Ipomoea stans *Cav.* **(I. jaliscana** *House***; Convolvulus firmus** *Spreng.***; C. sinuatus** *Sessé et Moc.***; C. stans** *(Cav.) Kunth***)** – tumbavaqueros

Ipomoea trichocarpa *Elliott*

Ipomoea verbascoidea *Choisy*

Ipomoea violacea *L.* **(I. glaberrima** *Bojer ex Bouton***; I. grandiflora** *(Jacq.) Hallier f.***; I. longiflora** *R. Br.***; I. macrantha** *Roem. et Schult.***; I. punticulata** *Benth.***; I. tricolor** *Cav.***; I. tuba** *(Schltdl.) G. Don.***; Calonyction grandiflorum** *(Jacq.) Choisy***; C. jacquinii** *G. Don.***; C. tuba** *(Schltdl.) Colla***; Convolvulus grandiflorus** *Jacq.***; C. tuba** *Schltdl.***)** – badoh negro, tlitliltzin, badúngas, piH pu'ucte-sh ['broken-plate flower'], la'aja shnash ['seed of the Virgin'], gui réh

Ipomoea wrightii *Gray* **(I. gracilipes** *Hassl.***; I. pulchella** *Roth.***; I. spiralis** *House***)** – palm-leaf morning glory

Once used by the Aztecs as an alternative psychotrope to 'ololiuqui' [**Turbina** corymbosa], the black, angular seeds of the morning glory I. violacea [proposed to be the Aztec 'tlitliltzin'] are still used in Mexico, mostly in the Zapotec and Chatin area of Oaxaca. In some villages, the seeds from either vine are used; in this case, the I. violacea seeds ['macho'] are taken by males, and the **Turbina** corymbosa seeds ['hembra'] are taken by females. I. violacea is chemically more potent than T. corymbosa, but they contain the same essential components, and are both used for the same means of divination or consultation. The seeds are taken at night in relative seclusion; the dose is usually 7 seeds or a multiple of 7; or 13 seeds or a multiple of 13; or a thimble-full, which are ground to a powder and soaked in cold water for ½ an hour or more, before being finely strained, and the liquid consumed (Lipp 1990; Schultes & Hofmann 1980, 1992; Wasson 1961, 1963). I. violacea seeds are reportedly chewed [a dose of 200-500] in Zimbabwe as a 'hallucinogen' (De Smet 1998).

I. orizabensis is known as 'yerba de las ánimas' ['herb of souls'] in Mexico (Diaz 1979); though this species is not known to currently be used in any way, the seeds have been shown to contain ergoline alkaloids [see below] (Amor-Prats & Harborne 1993). I. stans rhizome is used in Mexico to treat epilepsy and hysteria, and as a choleretic – stems and roots had a CNS-depressant action in rats. Very large doses are said to be intoxicating in humans, lasting about 10hrs. I. murucoides ['palo bobo', 'banú'] is known to be poisonous, and may cause paralysis (Heffern 1974; Jiu 1966). The leaves of I. murucoides and I. arborescens have similar medicinal properties to those of I. violacea and ololiuqui, but it is not known whether they are psychoactive (Fields 1969). The Maya and other ancient Mesoamerican cultures once used the latex from I. alba, mixed with the latex from Castilla elastica, to make the rubber from which many items were fashioned, notably including the rubber balls used in the infamous ball-game of the Maya. The latex of I. alba served to strengthen the rubber, as latex of C. elastica alone becomes brittle when dry and does not keep its form well (Hosler et al. 1999).

I. carnea is known to have intoxicating properties in Ecuador (Schultes & Hofmann 1980); it has been claimed to sometimes be added to ayahuasca in the Amazon (Rätsch 1998) [see **Banisteriopsis**] but it might not be particularly safe or recommended for human use [see its chemistry discussed below]. In Brazil, I. carnea ssp. fistulosa is known to cause stock intoxications which manifest gradually, symptoms including lassitude and disequilibrium. The lethal dose of the fresh plant in cattle was 9kg/100kg. I. asarifolia also causes stock intoxications in Brazil, with symptoms including tremor, rocking of the head, and disequilibrium; affected animals frequently recover (Pott & Alfonso 2000). In Paraíba, n.e. Brazil, I. riedelii and I. sericophylla have intoxicated goats, sometimes fatally (Barbosa et al. 2006). In Dominica, I. denticulata and I. tiliacea are known as 'caapi' [see **Banisteriopsis**] (Trout ed. 1998).

The Fang of Central Africa use a maceration of the whole plant of I. involucrata as a stimulant, and in shamanic healing (Akendengué 1992). Root juice from I. verbascoidea has been claimed to be 'narcotic'. In southern Africa, I. oblongata has been reported as an ingredient of a compound drug ['sehoere' – see *Methods of Ingestion*] consumed by the Basuto in intoxicating ritual feasts (Laydevant 1932). The Southern Sotho snuff the powdered leaf of I. oblongata var. hirsuta mixed with tobacco [see **Nicotiana**]; the plant is also used to 'drive away lightning'. I. purpurea is used by the Zulu as a purgative, as which it is very effective (Watt & Breyer-Brandwijk 1932). Interchangeably with I. nil, the seeds are used in TCM as a purgative, in a dose of 3-6g. Nausea and vomiting result from overdosage, and the seed should not be used during pregnancy (Huang 1993). I. nil seeds are also used as a purgative in India, under the name 'kaladana' or 'nil', names which may also apply to seeds from a variety of related and unrelated plants [**Calonyction** muricatum, Clitoria terneata, Indigofera tinctoria, Nigella sativa (see *Endnotes*), **Piper** nigrum] (Austin 2000).

I. aquatica is given to treat "nervous and general debility" in w. Bengal, and is applied as a poultice to treat febrile delirium in Cambodia. In Burma, the juice of the plant is used as an emetic to treat poisoning from opium [see **Papaver**] or arsenic (Datta & Banerjee 1979). Its leaf sap is mixed with a root decoction of water lily [**Nymphaea** spp.] and given as a sedative to treat insanity in Tanganyika (Burkill 1985-1997). In Vietnam, the leaf is given to treat mushroom-induced 'intoxication' (Heim 1963b; Morgan 1995). In Australia, the plant was suspected of poisoning horses – "animals developed shivers and stiffness, and died soon after being ridden" (Webb 1948). However, I. aquatica leaves are commonly eaten as a vegetable in some parts of s.e. Asia (Nadkarni 1976; Perry & Metzger 1980).

I. sp. aff. calobra [earlier reported incorrectly as I. calobra] has caused stock intoxications ['staggers'] in s. Queensland [Australia], and is suspected of containing lysergic acid-type alkaloids. Also suspected of causing stock intoxications in Australia are I. muelleri (Der Marderosian et al. 1974; Everist 1974; Parsons & Cuthbertson 1992), I. coccinea, I. hederacea, I. heterophylla, I. learii and I. cairica [as I. palmata]. In the case of I. sp. aff. calobra, some symptoms of the intoxication in sheep were described – "it staggers badly when walking, the hind legs being straddled, apparently in an efort to maintain balance, and the sheep seems no longer able to judge the kind of obstacle it encounters". Death sometimes results, either from misadventure, or possibly from the direct effects of the plant itself (Webb 1948).

I. pes-caprae ssp. brasiliensis leaves are used as a poultice around the north coast of Australia to treat painful wounds and sores; it has a mild anti-*histamine* action (Aboriginal Communities 1988). I. pes-caprae roots and leaves have tonic and purgative actions (Nadkarni 1976). Roots and stems are reputed to cause vertigo if eaten over an extended period. The leaves are decocted in Fiji and consumed to treat menstrual disorders and as a female tonic following childbirth. The shoots reputedly have some anti-cancer activities. Also in Fiji, crushed leaves of I. petaloidea are infused to relieve headache and earache, sometimes combined with **Macropiper** vitiense. The roots are sometimes taken with **Evodia** hortensis bark to relieve chills and attacks of rigor (Cambie & Ash 1994). I. quamoclit has apparently been used in Australia as a snuff, and to treat snakebite; it has a purgative action (Webb 1948).

The tuber of I. digitata is taken in India as an aphrodisiac with ghee [clarified butter] and honey. It is also part of a compound aphrodisiac, fried in butter with equal parts of **Syzygium** aromaticum, 'cardamom' [Elettaria cardamomum], **Myristica** fragrans, **Mucuna** pruriens, 'almonds' [see **Prunus**], Asparagus racemosus, 'quince' [Cydonia oblonga] seeds and Hygrophila spinosa seeds (Nadkarni 1976). In n. Ghana, the root is sometimes pulverised and added to a composite intoxicating snuff for shamanic initiation [see **Piper 1**] amongst the Kusasi (De Smet 1998).

I. leptophylla roots are burned by the Pawnee of N. America; the smoke treats nervousness and bad dreams. The pulverised, dried root is dusted on the body as an analgesic, or to revive a fainted person. It is eaten raw by the Lakota for stomach trouble (Kindscher 1992). The Nkopo of Papua New Guinea use I. batatas ['yawot', 'sweet potato'] in rituals to promote hunting success (Schmid 1991). The Siona of the Amazon know this species as 'yahi', a Tukano name meaning 'sorcerer's plant' (Trout ed. 1998). When eaten in large amounts, the tubers can reputedly act as an aphrodisiac in women (Rätsch 1990).

Seeds of commercial morning glories [usually I. violacea cultivars, though I. purpurea has been used by Italian psychonauts] have been used by adventurous westerners as a psychotropic drug since their native usage and chemical content became apparent in the early 1960's, and even earlier in isolated experiments. Such use was most noted amongst students, and reactions were varied – people consuming the seeds whole usually experiencing no effects, and those who had ground them experiencing the expected effects to varying degrees depending on dosage. Many users have been disappointed, expecting an LSD-like experience, which is generally not to be found when *ergine* is the predominant alkaloid [see below]. Sometimes psychonauts have admitted themselves to hospitals due to the unexpected nature of the effects, such as in one case where a 20-year old woman ingested 250 commercial I. violacea seeds (Cohen 1964; Festi & Samorini 1999b; Ingram 1964; pers. comm.). See **Turbina** for further discussion.

It is estimated that 5g of morning glory seeds containing 0.04% ergot alkaloids should be sufficient for psychedelic effects (Wilkinson et al. 1986); one 'underground' source suggests 5-10g of seeds; many modern experimenters report using 100-300 seeds or more to produce effects (Gottlieb 1992; Ingram 1964; pers. comms.). These upper reaches are no doubt due to the fact that commercial cultivars of the wild species seem to often be much less potent in terms of alkaloid levels (Ott 1993). Seeds of active Ipomoea spp. can be smoked for a mild "**Cannabis**-like euphoria" lasting c.1 hour; for this purpose, they should be packed in a clean tobacco-pipe with a large bowl, and the ground seeds will need to be re-lit for each inhalation (Trout & Friends 1999). As the alkaloids would not be active by combustion, it is most likely that other compounds found in the seeds are responsible for this activity; gibberellins have been suggested as possible candidates (theobromus pers. comm.).

Commercial morning glory seeds are usually from a cultivar or mix of cultivars of I. violacea; they may be coated with poisonous fungicides [such as N-trichlorete] or other chemicals to discourage ingestion – thus, they should be washed thoroughly with warm, soapy water and dried fully before use. The infusion made from morning glory seeds is soapy-tasting; the resinous material responsible for this seems to cause nausea and purging, and is found in the seed pulp. There are chemicals in the seed husk that are only slightly water soluble, and these seem to counteract the psychedelic effects, as well as causing headache and blurred vision. A more effective extraction process should help one to get the best experi-

ence from these seeds [see *Producing Plant Drugs*]. Other side effects reported are vomiting, diarrhoea, drowsiness, numbness of extremities, and muscle tightness (Chao & Der Marderosian 1973a; Cohen 1964; Ingram 1964; pers. comm.).

The psychedelic components of the morning glories are ergot alkaloids [see **Claviceps**] – ergoline and clavine alkaloids, some very closely related to LSD [lysergic acid diethylamide; a semisynthetic compound], concentrated in the seeds, and often found in traces in the vegetation. *Ergine* [LA-111; lysergic acid amide] is usually considered the main active chemical, but as its activity is reportedly soporific and 'foggy', with little true psychedelic activity, the other chemicals present no doubt play a role in developing the full psychoactivity of the seeds [such as *agroclavine*, *elymoclavine*, lysergene (partial 5-HT2a-agonist, also affects α1-adrenoceptors in rat), *lysergol*, *festuclavine* and *penniclavine*] (Pertz 1996; Yui & Takeo 1958a, 1958b). *Ergine* and isoergine are partly present in the seeds as lysergic acid N-(1-OH-ethyl)amide and the iso-derivative; under hydrolysis in isolation, they easily convert to *ergine*, isoergine and acetaldehyde. Lysergic acid N-(1-OH-ethyl)amide might also be responsible for some of the more psychedelic effects (Schultes & Hofmann 1980), which seems to be supported by the observation that freshly harvested seeds are the most effective (theobromus pers. comm.). Seeds high in alkaloids have high lipid levels, mainly consisting of linoleic acid and palmitic acid (Genest & Sahasrabudhe 1965).

I. alba seeds have yielded indolizine-type alkaloids – ipalbine, ipalbidine, ipomine, isoipomine, methoxy-ipomine, dimethoxy-ipomine and ipalbidinium (Ikhiri et al. 1987a).

I. amnicola seed [fresh] yielded 2 ergoline alkaloids [0.039%] (Amor-Prats & Harborne 1993).

I. aquatica mature seeds [as I. reptans] have been shown to contain gibberellins (Matsuo et al. 1984); fresh seed was also reported to have yielded 0.006% ergoline alkaloids, though subsequent tests detected none (Amor-Prats & Harborne 1993). It should be mentioned that these authors refer erroneously to Nair et al. 1986 [misquoted as Geetha et al. 1996] for the positive test, though this latter paper contains no reference to alkaloids, or yields thereof. Nair et al. (1986) did, however, find quercetin derivatives, napthoquinones, gentisic acid, protocatechuic acid, vanillic acid, syringic acid, and saponins in the leaves. Aerial parts have shown hypoglycaemic effects in rats (Malalavidhane et al. 2000), and potently inhibit prostaglandin synthesis in vitro. Stems have yielded 0.006% N-trans-feruloyl-*tyramine*, 0.0016% N-cis-feruloyl-*tyramine*, 0.014% *scopoletin* and 0.012% umbelliferone (Tseng et al. 1992).

I. argillicola seed [fresh] yielded 3 ergoline alkaloids [0.084%] (Amor-Prats & Harborne 1993).

I. argyrophylla seed yielded 0.27% alkaloids, including *agroclavine* [0.04%], ergosine [0.05%] and ergosinine [0.07%] (Stauffacher et al. 1965).

I. asarifolia growing in Thailand was found to contain indole alkaloids in leaves and seeds, with higher levels in seeds (Jirawongse et al. 1979). Another analysis found ergolines in leaves, stems and seeds, but not fruit; seeds were shown to contain mainly *chanoclavine*, as well as ergometrine, ergometrinine and 3 unidentified alkaloids (Nunes et al. 1982b).

I. batatas mature seeds have been shown to contain numerous gibberellins (Matsuo et al. 1984).

I. cairica seed [fresh] yielded 0.009-0.02% ergoline alkaloids, but subsequent tests revealed none (Amor-Prats & Harborne 1993). The lower value is quoted erroneously from Nair et al. 1986 [see above]. Seeds also contain glycosidal resins known as glykoretins. Aerial parts have yielded the lignanolides arctigenin and trachelogenin [which exhibited cytostatic activity, as well as inhibiting replication of the HIV-1 virus], and traces of the coumarins *scopoletin* and umbelliferone (Eich et al. 1990; Trumm & Eich 1989). Traces of HCN were detected in the leaf and root (Watt & Breyer-Brandwijk 1962).

I. calobra leaf [from St. George, Queensland, Australia; harv. Feb.] tested weakly positive for alkaloids. Stem and root gave weak and inconclusive reactions (Webb 1949).

I. sp. aff. calobra has yielded calystegine B2 and swainsonine [see **Swainsonia**] (Griffin & Lin 2000).

I. cardiophylla seed yielded unidentified ergoline alkaloids (Chao & Der Marderosian 1973a).

I. carnea seeds were found to contain at least 3 alkaloids, 2 of which were tentatively identified as *ergine* and isoergine (Lascano et al. 1969); leaves, flowers and seeds have yielded [w/w] swainsonine [0.0029% in leaves, 0.0028% in flowers, c.10 times higher in seeds; see **Swainsonia**], 2-epi-lentiginosine [α-mannosidase and glycosidase inhibitor], N-methyl-trans-4-OH-l-proline and calystegines B1, B2, B3 [mannosidase-inhibitor] and C1 [B1, B2 & C1 inhibited rat lyosomal β-glucosidase] (Haraguchi et al. 2003; Ikeda et al. 2003). Latex yielded carnein, a serine protease enzyme (Patel et al. 2007).

I. carnea ssp. fistulosa leaf yielded 0.006% ergoline and clavine alkaloids [including *agroclavine* and α-dihydro-*lysergol*]; the non-alkaloidal fraction from the leaf extract was sedative, hypnotic, CNS-depressant and muscle-relaxant in rats and mice (Rastogi & Mehrotra ed. 1990-1993; Umar et al. 1980).

I. coccinea seed has yielded 0.04% alkaloids, consisting solely of *elymoclavine* (Gröger 1963); a later analysis found 0.003-0.0043% alkaloids, consisting mostly of *elymoclavine*, followed by ergonovinine, ergosine, *agroclavine*, *chanoclavine*, and traces of *ergonovine* and ergosinine (Wilkinson et al. 1987). I. coccinea var. hederifolia seed [fresh] yielded traces of *elymoclavine*, and 11.7% lipids (Genest & Sahasrabudhe 1966).

I. costata seed [fresh] yielded 3 ergoline alkaloids [0.046%].

I. diamantinensis seed [fresh] yielded 2 ergoline alkaloids [0.018%] (Amor-Prats & Harborne 1993).

I. digitata tubers have yielded 0.02% paniculatin, a glycoside, which showed oxytocic, hypertensive, respiratory stimulant, vasoconstrictor and bronchoconstrictor activity (Matin et al. 1969).

I. hederacea seed yielded 0.003% alkaloids [28% ergonovinine, 23% *elymoclavine*, 16% *agroclavine*, 16% *chanoclavine*, 16% *ergonovine*, trace *penniclavine*] (Wilkinson et al. 1986); as well as *lysergol* (Chao & Der Marderosian 1973a) and pharbitisin. The seeds are a drastic purgative, cathartic and anthelmintic (Nadkarni 1976). Other studies failed to detect any ergoline alkaloids (Abou-Chaar & Digenis 1966; Gröger 1963), and there may have been contamination with I. violacea seed in the positive tests.

I. hederifolia seed [fresh] yielded 0.004-0.016% ergoline alkaloids (Amor-Prats & Harborne 1993), though the higher value is quoted erroneously from Nair et al. 1986 [see above] and others have found none (Gröger 1963); another analysis found 0.0031-0.0044% alkaloids, consisting mostly of ergosine and *chanoclavine*, with lesser amounts of *elymoclavine*, and traces of *ergonovine*, ergonovinine and ergosinine (Wilkinson et al. 1987). The seed has also yielded pyrrolizidine alkaloids – 0.02% ipanguline A and 0.025% isoipanguline A. Roots yielded ipanguline B and isoipanguline B; aerial parts without seed yielded all four compounds, as well as 34 other ipangulines – total ipanguline content in shoots and young leaves was measured at 0.45% (Jenett-Siems et al. 1993, 1998).

I. hildebrandtii seed yielded 0.03% *festuclavine* and 0.2% cycloclavine (Stauffacher et al. 1969).

I. hybrida 'Darling' seed [fresh] yielded 0-0.016% alkaloids and 9.7-11.3% lipids (Genest 1965; Genest & Sahasrabudhe 1966; Taber et al. 1963a).

I. lacunosa seed yielded 0.001% alkaloids [62% *chanoclavine*, 38% ergosinine, trace *elymoclavine* and *agroclavine*]; interestingly, seeds that had been penetrated by the larvae of an unknown insect gave yields nearly double those of 'normal' seeds (Wilkinson et al. 1986). The plant has also yielded quamoclitic acid (Buckingham et al. ed. 1994).

I. leptophylla seed yielded 0.02% alkaloids [*chanoclavine*, *ergine*, isoergine, *ergonovine*, and unidentified ergolines] (Chao & Der Marderosian 1973a; Der Marderosian 1967).

I. muelleri seed [fresh] yielded 0.005-0.011% alkaloids [13.2% *ergine*, 11.5% isoergine, 6.4% *elymoclavine*, 4.8% *ergonovine*, 3.5% lysergic acid α-OH-ethylamide, 2.6% *penniclavine*, 2.4% ergometrinine, 2.1% *lysergol*, 2% isolysergic acid α-OH-ethylamide, 2% molliclavine, 1.8% *chanoclavine*-II, α-dihydrolysergol, and isochanoclavine, as well as other unidentified alkaloids]; 121-day old leaves yielded 0.0015% alkaloids, and similarly aged stems yielded 0.001% alkaloids (Amor-Prats & Harborne 1993; Chao & Der Marderosian 1973a; Everist 1974).

I. nil 'Scarlet O'Hara' seed [fresh] yielded 0-0.014% alkaloids, and 11.2-14.3% lipids. I. nil 'Royal marine' seed yielded 0.001% alkaloids. It is thought that these are non-ergoline alkaloids (Genest 1965; Genest & Sahasrabudhe 1966; Genest et al. 1965; Rice & Genest 1965; Taber et al. 1963a). Japanese strains ['Chiyo no okina', 'Matzukaze', and 'Yuki'] yielded 0.007-0.011% alkaloids (Staba & Laursen 1966); many contain none, including the 'Tall mixed', 'Candy pink' and 'Double rose marie' varieties (Friedman et al. 1989; Genest et al. 1965). Some of the positive results may have arisen from I. violacea seed contamination. Up to 0.07% alkaloids have been found in some strains of I. nil seed. The plant is known as a strong irritant purgative; a dose of 50 seeds can cause purging (Der Marderosian & Youngken 1966; Festi & Samorini 1999b; Genest & Sahasrabudhe 1966). This is most likely due to the purgative glycoside pharbitin, found at c.2% in seeds (Huang 1993). I. nil seeds also contain gibberellins (Matsuo et al. 1984) and the growth hormone muristerone A (Austin 2000).

I. obscura seed has yielded ipobscurine A [N-(p-coumaroyl)-*serotonin*] and ipobscurine B, an unusual *melatonin*-conjugate (Eich et al. 1989).

I. orizabensis seed [fresh] yielded 4 ergoline alkaloids [0.163%].

I. parasitica seed [fresh] yielded 13 ergoline alkaloids [0.16%]; foliage also bears significant quantities of the alkaloids (Amor-Prats & Harborne 1993).

I. pes-caprae mature seeds have been shown to contain gibberellins (Matsuo et al. 1984); fresh seed has also yielded 0.004-0.009% ergoline alkaloids (Amor-Prats & Harborne 1993; Rastogi & Mehrotra ed. 1990-1993), which were also found in the foliage (Tofern et al. 1999). The plant has also yielded 6"-O-acetylhirsutin (Buckingham et al. ed. 1994), pescapriside E, glycoretin (Cambie & Ash 1994), quercetin, 3',4'-dimethoxyquercetin, ferulic acid, vanillic acid, syringic acid and p-coumaric acid (Nair et al. 1986). Leaves contain citric, fumaric, maleic, malic, succinic and tartaric acids (Cambie & Ash 1994). The aerial parts showed anal-

gesic effects in mice, and were shown to contain alkaloids, steroids, terpenoids, and flavonoids (De Souzaa et al. 2000a). Leaves of ssp. brasiliensis contain triterpenes, steroids and small amounts of saponins (Aboriginal Communities 1988); indole alkaloids have been found in leaves and seeds of plants growing in Thailand, with higher levels in seeds (Jirawongse et al. 1979).

I. pes-tigridis seed [fresh] yielded 0.0025% ergoline alkaloids (Rastogi & Mehrotra ed. 1990-1993), though subsequent tests detected none (Amor-Prats & Harborne 1993).

I. petaloidea seed yielded 0.5-0.678% ergoline alkaloids, mostly *lysergol*, as well as *chanoclavine* and other ergoline alkaloids; the phytoecdisones [polyhydroxylated steroids] muristerone, ecdisone, crustecdisone and makysterone A were also obtained (Ferrari 1979, 1980). Leaves have yielded the alkaloid convolamine (Perry & Metzger 1980).

I. piurensis seed yielded 0.0024% *chanoclavine*, 0.0005% each of *ergine* and lysergic acid α-OH-ethylamide, and 0.0002% ergobalansinine; these are also found in the stems and leaves (Jenett-Siems et al. 1994; Tofern et al. 1999).

I. plebeia leaf, stem and fruit [combined] from Brisbane, Australia [harv. Apr.] gave weak-positive reactions for alkaloids in some tests (Webb 1949).

I. purpurea seed [fresh] yielded 0-0.0816% alkaloids [*chanoclavine*, *elymoclavine*, *agroclavine*, *ergonovine*, ergonovinine and ergosine in similar amounts; trace ergosinine], though the positive results may be due to confusion with I. violacea, as others have found no indole alkaloids (Amor-Prats & Harborne 1993; Der Marderosian & Youngken 1966; Hahn 1990; Taber et al. 1963a; Wilkinson et al. 1986); gibberellins have been reported from mature seeds (Matsuo et al. 1984). The plant has also yielded 4.8% of a purgative resin (Watt & Breyer-Brandwijk 1932) and 3,11-dihydroxytetradecanoic acid (Buckingham et al. ed. 1994). A dose of 100-150 seeds was deemed similar to 75-150mcg LSD, but lasting only 4 hours; higher doses produced pronounced side-effects, including narcosis, nausea, cold extremities and torpor (Festi & Samorini 1999b).

I. quamoclit seed [fresh] yielded 0.005-0.006% ergoline alkaloids, though subsequent tests found none (Amor-Prats & Harborne 1993); another analysis found 0.0043-0.0057% alkaloids, consisting mostly of *elymoclavine*, *chanoclavine* and ergonovinine, with smaller amounts of ergosinine and traces of *penniclavine* (Wilkinson et al. 1987).

I. riedelii has yielded 0.14% swainsonine, as well as calystegines B1, B2 & C1 (Barbosa et al. 2006).

I. rubra seed yielded unidentified ergoline alkaloids (Chao & Der Marderosian 1973a).

I. rubrocaerulea seeds have yielded 0.02-0.05% alkaloids – only *elymoclavine* was found in some samples; others contained up to 6 alkaloids [*chanoclavine*, *ergine*, isoergine, *ergonovine*, and lysergic acid α-OH-ethylamide]; others contained none. Similarly, aerial parts contained the previous 6 alkaloids [0.012%] in some samples (Gröger 1963). In feeding tests, detached leaves were shown to be capable of converting *elymoclavine* to *penniclavine* (Gröger 1964).

I. rubrocaerulea var. praecox seed [fresh] yielded 0.057% alkaloids (Taber et al. 1963a); others detected 0.01-0.04% alkaloids, including *ergine*, isoergine, *chanoclavine*, *elymoclavine* and other indoles (Beyerman 1964).

I. sericophylla has yielded 0.11% swainsonine (Barbosa et al. 2006).

I. sinensis seed [fresh] yielded 0.007% ergoline alkaloids, though subsequent tests found none (Amor-Prats & Harborne 1993), and the positive result was referenced erroneously from Nair et al. 1986 (see above).

I. tamnifera seed yielded unidentified ergoline alkaloids (Chao & Der Marderosian 1973a).

I. trichocarpa seed yielded 0.004% alkaloids [28% *chanoclavine*, 20% ergosinine, 19% *elymoclavine*, 16% *penniclavine*, 6% *agroclavine*, 5% *ergonovine*, 5% ergosine, trace ergonovinine and *festuclavine*] (Wilkinson et al. 1986).

I. violacea seed yielded 0.006-0.117% alkaloids [58.33% *ergine*, 8.33% isoergine, *agroclavine*, 8.33% *chanoclavine*, 8.33% *elymoclavine*, *festuclavine*, *lysergol*, isolysergol, *penniclavine*, 8.33% *ergonovine*, ergometrinine, lysergic acid α-OH-ethylamide, isolysergic acid α-OH-ethylamide, and 6 unidentified alkaloids] (Amor-Prats & Harborne 1993; Chao & Der Marderosian 1973a, 1973b; Der Marderosian & Youngken 1966; Hahn 1990; Hofmann 1961, 1963, 1995; Schultes & Hofmann 1980). Seeds were analysed for alkaloid content at different stages of maturity – alkaloid content was highest [c.0.1%] in early stages of development, though the major alkaloid at this stage was *chanoclavine*. The level of *ergonovine* decreased as maturation progressed, but its proportion of the total alkaloids increased. *Ergine* levels rose through maturation to become the dominant alkaloid at maturity. Second harvests of seed always yielded higher alkaloid levels (Genest 1966). Immature fruits from plants in Rockhampton, Queensland [Australia], harvested in December, tested weakly positive for alkaloids. The plants were identified as I. longiflora [a synonym of I. violacea], but the identification was uncertain (Webb 1949). Mature seeds have also been found to contain gibberellins (Matsuo et al. 1984). Aerial parts yielded a resinous glycoside, tricolorin A [0.4%] (Pereda-Miranda et al. 1993), and the stems have yielded calystegines [see **Convolvulus**] (Schimming et al. 1998).

I. violacea 'Blue star' fresh seed yielded 0.02-0.048% alkaloids and 16.4% lipids (Der Marderosian & Youngken 1966; Genest & Sahasrabudhe 1966).

I. violacea 'Flying saucers' fresh seed yielded 0-0.057% alkaloids [0.0025% *ergine*, 0.0053% isoergine, 0.0234% clavines], and 15.6% lipids; aerial parts [fresh] yielded traces-0.00035% alkaloids; roots [fresh] yielded 0-0.00033% alkaloids (Der Marderosian & Youngken 1966; Genest 1965; Genest & Sahasrabudhe 1966; Genest et al. 1965; Staba & Laursen 1966).

I. violacea 'Heavenly blue' fresh seed yielded 0.005-0.066% alkaloids [0.0077% *ergine*, 0.0042% isoergine and 0.0124% clavines; in another test (as % of total alkaloids) 30% *elymoclavine*, 40% *chanoclavine*, 9.7% each of *penniclavine*, ergosine and ergosinine, and traces of *agroclavine* and *ergonovine*], 0.31-0.84% *chlorogenic acid* and 15.2-22.1% lipids. Aerial parts [fresh] yielded 0.0025-0.0047% alkaloids; roots [fresh] yielded 0-0.0015% alkaloids (Der Marderosian & Youngken 1966; Friedman et al. 1989; Genest 1965; Genest & Sahasrabudhe 1966; Genest et al. 1965; Staba & Laursen 1966; Taber et al. 1963a; Wilkinson et al. 1986, 1987). As morning glory seeds are occasionally a contaminant of grain crops, such as soy, experiments were conducted with this cultivar to discover the relative degradation of the seed chemicals through the baking process, to simulate bread baked from contaminated grains. It was found that the ergoline alkaloids only experienced moderate loss, whilst *chlorogenic acid* content was almost totally destroyed (Friedman & Dao 1990).

I. violacea 'Major' fresh seed yielded 0.026% alkaloids and 16.3% lipids (Genest & Sahasrabudhe 1966).

I. violacea 'Pearly gates' fresh seed yielded 0.015-0.120% indoles [65.8% *tryptophan*, 10.7% *chanoclavine*, 1.1% *elymoclavine*, 2.7% *ergonovine*, 0.9% ergometrinine, 4.7% *ergine*, 0.23% isoergine and *penniclavine*], and 14.7-18.1% lipids. Aerial parts [fresh] yielded 0.0032-0.013% alkaloids; roots [fresh] yielded 0-0.0005% alkaloids (Beyerman 1964; Der Marderosian & Youngken 1966; Genest 1965; Genest & Sahasrabudhe 1966; Genest et al. 1965; Staba & Laursen 1966; Taber et al. 1963a).

I. violacea 'Summer skies' fresh seed yielded 0.053-0.079% alkaloids [*ergine*, isoergine, *ergonovine*, *elymoclavine*, *chanoclavine*, *penniclavine* and *tryptophan*] (Der Marderosian & Youngken 1966).

I. violacea 'Wedding bells' seed yielded 0.023-0.075% alkaloids [0.011% *ergine*, 0.0026% isoergine and 0.0147% clavines] and 15.2% lipids; the alkaloidal fraction produced an excited intoxication in mice, the excitation being more prevalent than in the mouse intoxication caused by the 'Pearly gates' variety (Der Marderosian & Youngken 1966; Genest 1965; Genest & Sahasrabudhe 1966; Genest et al. 1965; Rice & Genest 1965).

The human LD50 for the alkaloid extract of I. violacea horticultural varieties was estimated to possibly be 1-2g (Genest et al. 1965).

I. wrightii seed yielded 0.0023-0.0038% alkaloids, consisting mostly of ergosine, with lesser amounts of *chanoclavine*, ergosinine, *penniclavine*, *agroclavine* and *elymoclavine* (Wilkinson et al. 1987).

Ipomoea violacea is an annual/perennial vine, much branched, glabrous throughout. Leaves membranaceous, entire, ovate, 4-10cm x 3-8cm, deeply cordate, long acuminate, often soon caducous; petioles up to 1.5cm long. Inflorescence cymose, 3-4-flowered; peduncle thickened, hollow, wandlike, longer than petiole; bracts triangular-ovate, acute, up to 1.2mm long; bracteoles similar but minute. Flowers 5-7cm wide, solitary or clustered, axillary; sepals triangular-ovate, acute to obtuse, often mucronulate, 5-6mm long, subequal, exterior ones marginate, dorsally carinate; corolla infundibuliform, 5-7cm long, tube white, 5-8mm diameter, corolla limb white, red, purple, violet-blue or blue, often spotted or blotched, midpetaline bands well-defined by 2 distinct nerves; stamens 5, included. Ovary 2-4 celled; ovules 4(-6); style simple, filiform; stigma capitate. Fruit a dehiscent ovoid capsule, 13mm long, 4(-6)-valved; seeds 1-4(-6), glabrous, very dark brown to black, 3-angled, back rounded (like a c.¼ segment of a hemisphere) with a central, shallow groove, other sides concave, hilum pear-shaped, depressed, containing translucent trichomes. Size of seeds differs in cultivars, though wild plant seed is 5.5-6.5 x 3-3.5mm, 100 seeds weighing c.2.43g. Seeds of cultivars are generally larger and heavier.

From w. & s. Mexico to Guatemala, West Indies and tropical S. America (Bailey 1968; Der Marderosian et al. 1964; Schultes & Hofmann 1980; Wagner et al. 1990).

Gather seeds as pods become brown, papery and dry. Seeds should be nicked and soaked for 2hrs in warm water before sowing; plant about 1cm deep. Grows in strong, well-drained soil in a sunny site; hardy once established. Water moderately (pers. comms.; pers. obs.).

IRYANTHERA

(Myristicaceae)

Iryanthera longiflora *Ducke* **(I. paradoxa** *(Schwacke) Warb.***)** – cumala colorada

Iryanthera macrophylla *(Benth.) Warburg* **(I. dialyandra** *Ducke***; Myristica macrophylla** *Benth.***; Palala macrophylla** *(Benth.) Kuntze***)** – cumala

Iryanthera ulei *(Benth.) Warburg* **(I. congestiflora** *J.F. Macbr.***; I. hostmannii** *(Benth.) Warb.***; I. leptoclada** *Markgr.***)** – wiri-saka, chaw, ka-wee-a-ka-he, peé-wa-ree, te-roó-rai, ucuúba, cumala

The barks of these plants were reportedly once used by the Bora and Witoto of Amazonian Peru to prepare orally-ingested entheogenic pellets, in the same manner as with **Virola** spp. [probably taken sublingually – see **Virola**]. The aromatic bark of I. ulei is stripped and used by the Secoya to make perfumed arm-bands, and they also use the leaves as a perfume. I. ulei bark resin is also used in Peru for what may be oral thrush. The inner bark and sap of many species [such as I. cf. elliptica, I. juruensis and I. paraensis] are used to treat fungal infections. Leaves have been used as a poultice for wounds (Ott 1993; Schultes & Holmstedt 1971; Schultes & Raffauf 1990; Schultes et al. 1977a). In the Río Purús of Brazil, I. tricornis ['pucuna caspi', 'balo'] is frequently used to manufacture blowguns (Duke & Vasquez 1994; Schultes & Raffauf 1990).

I. coriacea and I. juruensis trunk woods yielded flavans [3',4-dihydroxy-5,7-dimethoxyflavan and 2'-OH-7-MeO-4',5'-methylenedioxyflavan] (Franca et al. 1974).

I. macrophylla bark was analysed and found to contain no detectable alkaloids (McKenna et al. 1984b), though material reported as I. ulei did contain alkaloids [see below] (Holmstedt et al. 1980; Schultes & Raffauf 1990). The plant has yielded juruenolide and 1-(2,4-dihydroxy-6-MeO-phenyl)-3-(3,4-dimethoxyphenyl)-1-propanone (Buckingham et al. ed. 1994).

I. ulei bark yielded 0.000013% *5-methoxy-DMT* in one analysis (Holmstedt et al. 1980), though a later analysis of this species found no alkaloids (McKenna et al. 1984b). Schultes & Raffauf (1990) report that the material analysed by Holmstedt et al. (1980) was actually I. macrophylla. I. ulei bark has yielded c.0.0035% dihydrochalcones, lignoflavonoids [iryantherins B (0.004%), D (0.0032%), E (0.0039%) & F (0.0009%; a ligno-bis-dihydrochalcone)], and neolignans [0.0018% trans-burchelin and 0.0012% cis-burchelin]; trunk wood has yielded 0.0006% dihydrochalcones, 0.025% diarylpropanes, 0.09% sitosterol and 0.036% juruenolide, a lactone (Conserva et al. 1990a, 1990b; Vieira et al. 1983).

I. crassifolia, I. juruensis and I. paraensis barks were analysed, and found to contain no detectable alkaloids (McKenna et al. 1984b). As I. macrophylla and I. ulei were also found to be alkaloid-negative by McKenna et al. [though not ignoring the positive report of Holmstedt et al. above], it would seem either that these plants are highly chemically-variable, and/or alkaloids may not actually be the psychoactive agents in preparations made from these plants. Perhaps knowledge of the location of specimens with desirable chemistry has diminished over time, as more powerful plant-teachers have since come into greater use [ie. **Virola**]. Perhaps the samples analysed were simply collected at times of low or nil alkaloid content, and samples collected at other times from particular patches would contain useful levels of alkaloids. Further studies are needed, which could be difficult as these plants might no longer be used as psychotropes, complicating attempts to obtain reliable information from native sources.

Iryanthera macrophylla is a monoecious tree, to 17m tall; inner bark frequently exuding reddish liquid; branches ferruginous-strigose when young. Leaves alternate, simple, entire, oblong to obovate-oblong, glabrous, thick-coriaceous, fragile when dry, often finely rugose or minutely papillose, 17-35(-40) x 5-12(-14)cm, subcordate, rounded, or obtuse at base, apex obtusely cuspidate or short-acuminate, costa very prominent, venation convolute, pinnate, secondary nerves 14-20 on each side, anastomosing toward margins; petioles 10-20mm long, robust, narrowly winged distally. Inflorescences minutely strigose externally, fasciculate-racemose or narrowly-paniculate, 1-3 in leaf axils, or on defoliate branches, female inflorescences often on old bark of trunk or branches; male inflorescences elongate, (2-)3-7(-11)cm long, rachis stout, swollen at fascicles; fascicles 6-13 per inflorescence, essentially sessile, flowers 4-12 per fascicle, apetalous; pedicels slender, to 5mm long, bracteolate at summit; bracteole cupuliform or cleft to base, 0.7-1.5mm long; perianth campanulate, 2-3mm long, flaring distally, 3-lobed about 1/3 of length, lobes valvate, thin-carnose and strigose; filament column 1.5-2.2mm long; anthers 3(-4), c.0.5mm long, free to base, 2-celled, dehiscing longitudinally. Ovary superior, sessile, usually ellipsoid, glabrous, 1-celled; ovule 1, +-basal; style short; stigma subsessile. Mature fruits usually 3-4 per inflorescence, transversely ellipsoid, coriaceous, carinate, 2-valved, 8-24mm long, 10-26mm broad, pericarp 1.5-6mm thick, usually woody, covered with an aril, aril inconspicuously laciniate distally; seeds transversely ellipsoid or subglobose, uniform in colour.

Amazonian Peru [Loreto – Rio Huallaga basin, 220m], Brazil, Guyana (Smith 1938).

ISLAYA

(Cactaceae)

Islaya minor *Backeberg* **(I. bicolor** *Akers et Buining***; I. brevicylindrica** *Rauh et Backeb.***; I. copiapoides** *Rauh et Backeb.***; I. divaricatiflora** *Ritter***; I. flavida** *Ritt.***; I. grandiflorens** *Rauh et Backeb.***; I. grandis** *Rauh et Backeb.***; I. islayensis** *(Först) Backeb.***; I. islayensis var. minor** *(Backeb.) Ritter***; I. krainziana** *Ritt.***; I. maritima** *Ritt.***; I. minuscula** *Ritt.***; I. mollendensis** *(Vaupel) Backeb.***; I. paucispina** *Rauh et Backeb.***; I. paucispinosa** *Rauh et Backeb.***; I. unguispina** *Ritt.***; Eriosyce islayensis** *(Först.) Kattermann***; Neoporteria bicolor** *Akers et Buin.***; N. islayensis** *(Först.) Donald et Rowley***; N. krainziana** *(Ritt.) Don. et Rowl.***; Parodia minor** *(Backeb.) Borg***)**

This small, slow-growing cactus from s. Peru is not known to be used in any way. It has yielded 0.0017% *mescaline*, as well as 0.0038% *DMPEA*, *phenethylamine*, *tyramine*, N-methyltyramine, 3-MeO-tyramine [homovanillylamine], *hordenine*, corypalline [7-OH-6-MeO-2-methyl-THIQ] and *pellotine* (Doetsch et al. 1980).

Islaya minor is a simple, short plant, +- spherical, to c.13cm tall, 7cm across; ribs to c.17, 1cm wide, 6mm high; areoles 3cm apart, initially bearing whitish-grey felt; radial spines 20-24, to 6mm long, thin; centrals 4, cruciform, to 18(-20)mm long, stouter, thicker below; all spines rigid, black at first, becoming grey. Flowers 2.2cm across, gold to light greenish-yellow, arising from felted area. Fruit hairy, carmine, to 6mm long, at first globular, ripening to elongate, with some persistent bristles and perianth at apex; seeds flat black.

Southern Peru [above Mollendo] (Backeberg 1959, 1976).

Prepare soil from 2 parts grit/1 part humus; requires good drainage, and less water than most cacti; withold all water in winter; min. temp. 8°C. Adapt to full sun when several years old; keep lightly shaded otherwise. Older plants often do not do well on their own roots, and grafting is recommended (Trout & Friends 1999).

ISOTOMA

(Campanulaceae/Lobeliaceae)

Isotoma anethifolia *Summerh.*

Isotoma longiflora *(L.) C. Presl.* **(Hippobroma longiflora** *(L.) G. Don.***; Laurentia longiflora** *(L.) E. Wimm.***; L. longiflora** *(L.) Endl.***; Lobelia longiflora** *L.***; Rapuntium longiflorum** *Mill.***)** – star of Bethlehem, cimora toro, misha veneno, estrella, lagrimas de San Diego, revienta caballos

Isotoma petraea *F. Muell.* – rock isotome, rock bluebell, euro fingers, wild tobacco, minekalpa, tundi-wari, pulbawari, anterlp, irranerratye, wanngati, multu, yarrampa, mara-kanyala

Isotoma spp.

I. longiflora is reportedly sometimes added to **Trichocereus** pachanoi brews in Peru, along with other plants (Davis 1983; Schultes 1967a). The Cuna of Panama also use the latex of I. longiflora medicinally (Ott 1993), and the herb has been decocted to treat asthma (Usher 1974).

An Australian species, I. petraea, is sometimes chewed [or occasional-

ly decocted and drunk] as a 'pituri' substitute [see **Duboisia**], or mixed in small quantities with pituri or wild tobacco [see **Nicotiana**] to add potency, in the Mt. Margaret region. For use, the leafy stalks are fire-dried and powdered, sometimes mixed with **Acacia** aneura ash. They are said to have 'narcotic and stimulating' effects, as well as causing analgesia and treating colds. It is considered by some to be very poisonous, and its juice can cause soreness or even temporary blindness if brought into contact with the eyes. The crushed foliage is also sometimes used as a poultice for headaches. This species is also suspected of having caused stock intoxications (Cribb & Cribb 1981; Lassak & McCarthy 1990; Latz 1995; Low 1990; Reid & Betts 1979).

The active chemicals in some Isotoma spp. are *lobeline* and related alkaloids, which have pharmacological activities comparable in some ways to *nicotine* [see **Lobelia**, *Chemical Index*].

I. anethifolia from Australia yielded 0.24% alkaloids, consisting of partially racemic *lobeline*, lobelanidine, and 1-[6'-(2"-OH-2"-phenylethyl)-1'-methyl-1',2',5',6-tetrahydroxypyridin-2'-yl]butan-2-one. The alkaloid fraction caused "neurological and respiratory deficits" in mice, emesis and convulsions in cats, and was cardioactive in cats and dogs (CSIRO 1990); however, the doses used were not specified. Herbage from Stanthorpe, Queensland [harv. Nov.] tested strongly positive for alkaloids (Webb 1949).

I. fluviatilis from Stanthorpe [harv. Nov.] gave negative tests for alkaloids (Webb 1949).

I. longiflora has yielded [w/w] 0.00066% *lobeline*, 0.0004% lobelanidine, lobelanine and 0.002% (-)-cis-8,10-diphenyllobelidiol (Arthur & Chan 1963). Root and leaf from Innisfail, Queensland [harv. Aug.] tested strongly positive for alkaloids (Webb 1949).

I. petraea has yielded 0.26% alkaloids with *lobeline*-like activity (CSIRO 1990), and probably contains *lobeline* itself (Lassak & McCarthy 1990).

Isotoma longiflora is an erect annual or biennial herb; stems coarse, fleshy, 15-50(-80)cm long, glabrous or pubescent. Leaves alternate, 6-25 x 1.5-8cm, glabrous or pubescent on veins, apex obtuse to acute, mucronulate. Flowers in racemes or solitary and axillary; peduncles long, with leaf-like bracts; pedicels erect at anthesis, but declined in fruit, 5-10mm long, pubescent; hypanthium 10-nerved, 8-11 x 3-5mm, sparsely pubescent; calyx shortly tubular, lobes 10-22mm long; corolla tubular, slightly zygomorphic, 7-15mm long, pubescent externally, glabrous within, +- notched on anterior, with lobes almost equal, spreading horizontally, very shortly and obliquely campanulate at base, lower 3 lobes often with markings; stamens 5, fused adnate to corolla tube; anthers fused around style, white, anterior anthers smaller, bearing a long bristle, upper 3 slightly longer and +- curved down at apex onto lower ones. Ovary inferior or semi-inferior, 2-locular; style 1, slender; stigma +- hairy, slightly swollen, scarcely 2-lobed. Capsule ellipsoid, 1.8-2.5 x 1-1.5cm, pendent, 2-valved, loculicidally dehiscent within calyx lobes; seeds 0.6-0.8mm long, numerous.

In low elevation areas with moderate rainfall, especially disturbed areas; originally endemic to West Indies, now naturalised as a weed throughout much of the tropics (Carolin & Tindale 1994; Harden ed. 1990-1993 [for genus detail]; Wagner et al. 1990).

JASMINUM

(Oleaceae)

Jasminum abyssinicum *R. Br.*
Jasminum floribundum *R. Br.* - hab el tsalim
Jasminum grandiflorum *L.* **(J. officinale var. grandiflora** *(L.) Stokes***)** – jasmine, jati
Jasminum officinale *L.* – common jasmine, white jasmine, queen of the night, chamba, jazminero, mallika
Jasminum spp. – jasmine

Jasmine, an oil normally obtained from J. officinale or J. grandiflorum, is well known as a perfume of love. The Indian god of love, Kama, is said to tip his arrow with jasmine flowers in order to pierce the heart through the senses. The flowers are said to make the mind receptive to the energies of mantras. Ayurvedists consider it to be useful for heart diseases, diabetes, biliousness, burning sensations, eye, tooth or mouth problems, skin and blood diseases, and thirst; it is also sedative, antispasmodic, tonic, uplifting, euphoric, inebriating, aphrodisiac, emmenagogic, haemostatic, emollient and antibacterial. The medical formulary of Al-Kindi advised that oil of jasmine and 'asafoetida' [see **Ferula**] be combined for a few days, before applying it to the penis before intercourse, for an effective aphrodisiac for both partners. The oil may also be mixed with sesame oil and rubbed onto the head as a nervine sedative. The leaves may be boiled in oil to yield a balsam which is applied to strengthen vision, and to treat insanity. The fruits of the plant are considered narcotic. Indians make an offering of 'yellow jasmine' [J. humile] to Shiva and Ganesh. The Chinese sometimes give balls of jasmine to drunk guests to 'clear the head', and they used it to clear the atmosphere around sick people. 'Arabian jasmine', J. sambuc, is added to jasmine tea [see **Camellia**] in China for its scent and flavour. It is apparently used in some Buddhist ceremonies (Bremness 1994; Chevallier 1996; Frawley & Lad 1986; Kirtikar & Basu 1980; Lawless 1995; Martinez-Lirola et al. 1996; Nadkarni 1976). Leaves of J. abyssinicum in Eritrea, and J. floribundum in Abyssinia, have been used as inebriants (Rätsch 1998).

J. grandiflorum flowers have yielded up to 0.38% essential oil, consisting of 54-65% benzyl acetate, 20% linalyl acetate, 15% linalool, 24% free alcohols, 3.5% primary alcohols, 2.5-3% cis-jasmone, 3% benzyl benzoate, vanillin, 10% geraniol, 2.5% indole, 0.5% methyl anthranilate, farnesol, nerolidol, phytol, *eugenol* and numerous other trace components. The best quality oil [and best yield] is obtained from flowers harvested in the early morning, or in the evening (Battaglia 1995; Kotlyarova 1959; Rastogi & Mehrotra ed. 1990-1993). Apparently jasmine oil stimulates *enkephalin* release in the brain [note – Lawless gave this as 'encephaline', which as far as I can tell, does not exist, leaving *enkephalin* as the only likely neurotransmitter this could refer to – Ed.] (Lawless 1994).

J. racemosum from Queensland [Australia] tested positive for alkaloids in leaf and root [leaf strongly so, in some tests]; bark gave both positive and negative results in different tests. Leaf of J. simplicifolium and herb of J. suavissimum also tested positive for alkaloids (Webb 1949).

Jasminum spp. have also yielded jasminine, syringin, cantleyine, γ-caryophyllene and octahydro-6-OH-7-methyl-1-oxocyclopenta[c]pyran-4-carboxylic acid (Buckingham et al. ed. 1994).

Jasminum officinale is a twining shrub, puberulous when young; branches striate. Leaves opposite, simple, imparripinnate, 5-10cm long; leaflets 3-7, the terminal one 2.5-7.5 x 1-2.5cm, usually distinctly larger than the rest, ovate or lanceolate, acuminate, the lateral leaflets shorter and relatively wider, acute, sessile or shortly petiolulate, the distal pair sometimes with wide connate bases; petiole and rachis narrowly margined. Flowers 1.7-2.5cm across, in terminal few-flowered cymes or corymbs and axillary pedunculate few-flowered cymes shorter than the leaves or the cymes often reduced to a single flower; pedicels of the cyme-flowers 7.5-18mm long, those of the solitary and corymb-flowers often much longer; bracts up to 1.3cm long, linear-subulate or narrow-linear; calyx 7.5-18mm long, puberulous, tube 2.5-3.8mm long, lobes 5, subulate, 2-4 times as long as tube; corolla hypocrateriform, usually white, tube narrow and 1.3-1.8cm long, with 5 ovate or elliptic spreading lobes, imbricate in bud; stamens 2, included in corolla tube; filaments very short; anthers attached at the back near base, connective usually mucronate. Ovary 2-celled; ovules usually 2 in each cell, attached near base; style cylindric; stigma at length usually 2-fid. Berry didymous or often by suppression simple; carpels 2, 7.5-10mm long, ellipsoid or subglobose, colourless, translucent; seed usually solitary in each carpel.

Himalaya from the Indus east, into the inner valleys of India, as well as in Afghanistan and Iran; often cultivated (Kirtikar & Basu 1980).

Jasmine oil is very delicate; the flowers are handled carefully after harvesting, and kept cool. One method of extracting the oil involves scattering the flowers over trays or glass plates smeared with purified odourless oil. After 1-4 days, the flowers have withered, and their scent has passed into the oil. The oil may be further enriched by adding more fresh flowers, anywhere up to 20 times. This procedure is known as 'enfleurage' extraction, and produces an oil known as an 'enfleurage pomade'; this may be made into 'enfleurage absolute' by washing the oil with alcohol. An oil of lower purity [but higher yield] is obtained by macerating the flowers in cold-pressed vegetable oil, in a sealed vessel, for 4-8 weeks [shaking once a day] before straining the oil (Battaglia 1995).

JATROPHA

(Euphorbiaceae)

Jatropha curcas *L.* **(J. moluccana** *Wall.***; Castiglionia lobata** *Ruiz et Pav.***; Curcas purgans** *Medic.***)** – physic nut, angular-leaved physic nut, purging nut, bhernda, jangli-erandi, dandenahri, kesugi
Jatropha dioica *Cerv.* **(Mozinna spathulata** *Ort.***)** – sangre de drago, drago, leather stem, rubber plant, tlapelex patli
Jatropha gossypiifolia *L.* **(Adenoropium gossypiifolium** *(L.) Pohl.***)** – piñón colorado, chuvanna kodala-vanakku
Jatropha grossidentata *Pax et Hoffm.* - purgative nut, canioja, maske engioatite
Jatropha macrantha *Arg.* - huanarpo macho
Jatropha moluccana *L.* **(Aleurites moluccana** *(L.) Willd.***; A. triloba** *Forst. et Forst.***)** – candlenut tree, Indian walnut, tarkal, nappalla, askhota, akhrot

J. dioica is thought to most likely be the herb 'drago' documented in the 19th century to have been used by Native Americans of s.e. Texas, who smoked the leaves and bulbs of the plant to induce 'ecstatic visions' (Lipp 1995). In n.e. Mexico, extracts of the plant are used to treat toothache, gum disease and skin cancer (Villarreal et al. 1988), and act as an astringent (Jiu 1966). The related J. gaumeri ['pomolche'] from Mexico is used to treat snakebite, in the form of a root decoction (Usher 1974). Resin

from Jatropha spp. may also be used as 'copal' incense [eg. see Bursera and Protium in *Endnotes*] (Case et al. 2003).

Seeds of the Indian J. gossypiifolia are emetic, and are said to cause insanity (Nadkarni 1976). In Peru, J. gossypiifolia leaves are used as a defense against sorcerers; only 5-lobed leaves are used for this purpose (Luna & Amaringo 1991). J. grossidentata is used in Paraguay, where Ayoré shamans smoke the dried root for shamanic initiation, and to communicate with animal spirits. However, one researcher who tried it under the supervision of an Ayoré shaman perceived no effects. The Lengua-Maskoy consider it to have magical and dangerous properties, causing sore eyes with conjunctivitis, and they do not touch it. J. macrantha is used in n. Peru as a popular male aphrodisiac. J. multifida is sometimes known as 'cabalonga' [see **Strychnos**, and Thevetia in *Endnotes*] and thus might be psychoactive (Rätsch 1998; Schmeda-Hirschmann et al. 1992). J. curcas has reportedly been used in Peru as an ayahuasca additive [see **Banisteriopsis**], also known as 'piñón colorado'; this might perhaps be a confusion with J. gossypiifolia. Two ayahuasqueros reportedly added the leaves [4-10] to their ayahuasca, which also consisted of **Banisteriopsis** caapi ['12 pieces'], **Diplopterys** caberana [200 leaves], and a Dieffenbachia sp. ['patiquina', 3 leaves; see *Methods of Ingestion*] in one case; B. caapi ['8-12 pieces'], **Psychotria** viridis [30 leaves], and **Brunfelsia** grandiflora [10 leaves] in the other (Gnostic Garden 2001). The seed of J. curcas yields an oil ['curcas oil'] that is used as a purgative, lubricant and lamp oil (Usher 1974). In India, the seeds are said to be 'acro-narcotic' (Nadkarni 1976); they have been used to poison rats (Bremness 1994), and as an ordeal poison in e. Africa (De Smet 1998). The roasted nuts of J. moluccana [a plant found from n.e. Australia to India] are taken as an aphrodisiac, yet raw they are a poisonous purgative (Lassak & McCarthy 1990; Nadkarni 1976).

J. curcas seeds contain curcin [jatrophin], a lectin (De Smet 1998) similar to ricin from Ricinus spp., as well as caseine and c.30% of a fixed oil contaning jatrophic acid (Nadkarni 1976).

J. dioica var. sessiflora roots have yielded the diterpenes riolozatrione, epoxytrione and citlalitrione, as well as β-sitosterol and jatropholone B (Villarreal et al. 1988).

J. gossypiifolia roots have yielded 2α-OH-jatrophone, 2β-OH-jatrophone and 2β-OH-5,6-isojatrophone; and a lignan, 2-piperonylidene-3-veratryl-3R-γ-butyrolactone [a GBL-derivative – see *GHB* in *Chemical Index*]. Seeds contain an oil rich in saturated acids [73.8% of oil], including mostly palmitic acid [31.4%] (Rastogi & Mehrotra ed. 1990-1993).

J. grossidentata root has yielded the diterpenoids caniojane, 1,11-bis-epi-caniojane, jatrogrossidione, 2-epi-jatrogrossidione, jatrogrossidion, 4E-jatrogrossidentadion, 4Z-jatrogrossidentadion, 15-epi-4E-jatrogrossidentadion, 15-epi-4Z-jatrogrossidentadion, isojatrogrossidion, 2-epi-isojatrogrossidion, 2-OH-isojatrogrossidion and 2-epi-OH-isojatrogrossidion; as well as a coumarino-lignan and another unnamed lignan (Jakupovic et al. 1988; Schmeda-Hirschmann et al. 1992)

J. moluccana seed [both mature and immature] tested strongly positive for alkaloids, from plants growing in Queensland, Australia. Bark harvested in February gave negative results (Webb 1949).

J. podagrica stems have yielded the alkaloid tetramethylpyrazine, which has been shown to be hypotensive, spasmolytic, and cardiac depressant, as well as blocking neuromuscular transmission, in animal experiments (Ojewole 1980).

J. capensis, J. curcas and J. multifida all tested positive for HCN (Watt & Breyer-Brandwijk 1962).

Jatropha dioica var. dioica is a perennial, scarcely woody shrub; rootstocks buried, orange, horizontal, to 1m or longer; stems thick, fleshy, terete, folded on drying, simple or sparingly branched, rising at intervals, wand-like, 20-60cm tall, usually arcuate, with short lateral spurs; sap clear, astringent, turning blood-reddish on exposure to air. Leaves fasciculate on the spurs, subsessile, deciduous, blades spatulate or linear, widest towards apex, rarely palmately 2-3-lobed with the middle lobe the longest, apex usually blunt, base narrowed, margin entire, mostly 6-10mm wide, (2-)5-6 times as long as wide; stipules subulate-lanceolate, c.2.5mm long, early deciduous. Male and female flowers on separate plants. Male flowers in greatly reduced cymes, appearing to be in dense terminal or axillary fascicles; bracts and sepals 5, +- scarious, usually entire and non-glandular; calyx 3-3.5mm long, silvery-puberulent throughout; corolla whitish, about ½ as long as calyx, cylindrico-urceolate with recurved lobes, the reddish tube usually longer than lobes and +- hirsute within at base; petals 5, alternate with sepals; glands 5, opposite sepals; stamens regularly 10, the filaments partially united; anthers ovate to linear, often 1mm long or less. Female flowers in reduced, often merely 1-flowered cymes; sepals 5, herbaceous; corolla cylindrico-urceolate with recurved lobes, the tube usually longer than lobes and more or less hirsute within at base; petals 5, alternate with sepals; locules of ovary and styles 1-2, with 1 ovule in each locule; styles (when 2) coherent to some extent, unequally or irregularly bilobed; stigmas thickened and fungoid. Capsules 1-2-locular, each locule 1-1.2cm thick, about 15mm long (thus, when 2-locular, fruit is wider than long); locules apiculate and loculicidal; seeds subglobose or somewhat flattened along ventral line, essentially smooth and brownish.

In scrub; s. & w. Texas [common in Rio Grande Plains, n.w. to Val Verde county, and n. to Bexar, Blanco and Uvalde counties], s. to Oaxaca, Mexico (Correll & Johnston 1970).

JUNIPERUS

(Cupressaceae)

Juniperus angosturana *R.P. Adams*

Juniperus communis *L.* – common juniper, ginevro, ginepro, zinevro, dhupi

Juniperus excelsa *M. Bieb.* **(J. foetida var. excelsa** *(M. Bieb.) Spach***)** – Greek juniper, spiny Greek juniper

Juniperus indica *Bertoloni* **(J. wallichiana** *Hook. f. et Thomson ex Parl.***; Sabina wallichiana** *(Hook. f. et Thomson ex Parl.) W.C. Cheng et L.K. Fu***)**

Juniperus macropoda *Boiss.* **(J. excelsa** *Wall.* **; J. excelsa var. farreana** *P.N. Mehra***; J. excelsa** *Marschall et Bieb.* **var. polycarpos** *(K. Koch) Takhtajan***; J. excelsa var. polycarpos** *(K. Koch) Silba***; J. polycarpos** *K. Koch.***; J. seravschanica** *Komarov***; J. turcomanica** *B.A. Feltsch.***)** – Himalayan juniper, Indian juniper, dhup

Juniperus oxycedrus *L.* **(J. rufescens** *Link***)** – Spanish cedar, prickly juniper, ginebró, ginebre, enebro de la miera, cade

Juniperus pseudosabina *Fisch. et C.A. Mey.* **(J. centrasiatica** *Komarov***; J. sabina** *Pall. non L.***; Sabina centrasiatica** *(Kom.) Cheng et Fu***; S. fischeri** *Antoine***; S. pseudosabina** *(Fisch. et C.A. Mey.) W.C. Cheng et W.T. Wang***)** – scrub juniper, xinjiang juniper, dwarf pine, shug-pa

Juniperus recurva *Buch.-Ham. ex D. Don* **(J. religiosa** *Royle ex Carrière***; Sabina recurva** *(Buch.-Ham. ex D. Don.) Antoine***)** – Himalayan juniper, drooping juniper, high-altitude juniper, dhupi

Juniperus scopulorum *Sarg.* **(J. occidentalis var. pleiosperma** *Engelm.***; J. virginiana var. montana** *Vasey***; J. virginiana var. scopulorum** *(Sarg.) Lemmon***; Sabina scopulorum** *(Sarg.) Rydb.***)** – mountain red cedar, Colorado red cedar, Rocky Mountain juniper, weeping juniper

Juniperus virginiana *L.* **(Sabina virginiana** *(L.) Antoine***)** – red cedar, eastern red cedar, southern red cedar, Virginia red cedar, juniper bush, cedar apple, maazi, tawatsaako, hante, hante sha, savin

Juniperus spp. – junipers, gin berry, ginepro, enebro

'Junipers' are a common group of trees worldwide, cultivated or wild, with a long history of medicinal and magical use. The ancient Egyptians made use of J. drupacea and J. phoenicea [as well as Cedrus libani] as sources of 'cedar oil', to be used for sacred incenses and in the mummification process. Ancient Germanic peoples had a reverence for the juniper as the 'tree of life', or 'world tree', and throughout Europe even now one might find sprigs of juniper hung over doorways as protection against evil – a reminder of mediaeval ages when juniper branches were burnt frequently to dispel evil beings. Germanic and Finnish peoples once added juniper berries to their beer [see *Methods of Ingestion*], and a simple decoction of the berries was said to bring the gift of prophecy. Juniper berries have been said to increase male potency when carried, a questionable proposition (Cunningham 1994; Lawless 1994; Rätsch 1992).

In the area around n.w. Pakistan live the Dards and the Kaffir, whose shamans have a mystical relationship with juniper. They, like the Hunza, use it by inhaling the smoke of the burning plant and dancing into a drumbeat-driven trance. The Hunza also sometimes drink warm goat's blood in this ritual, and add **Peganum** harmala seeds to the burning vegetation. Many Siberian shamans inhale juniper smoke to fall into a stuporous intoxication, as do Sherpa, Tibetan, Tamang and Nepali shamans in the Himalayas. Himalayan usage is usually centred on branch tips of J. macropoda, J. communis and J. recurva. In Tibet, J. pseudosabina ['shug-pa' – also a name applied to other valued incense junipers in Tibet] is burned as incense to treat delirium (Clifford 1984; Müller-Ebeling et al. 2002; Rätsch 1992); likewise, in India J. macropoda smoke is inhaled to treat delirium of fever (Nadkarni 1976). Tibetan Bon shamans offer juniper branches in ritual sacrifices, as well as using the berries "as a narcotic to induce ecstatic trances". In Tibet, juniper incense is also called 'tsang', and sacred juniper trees are believed to be home to spirits. The column of smoke from such incense is said to form a kind of magical ladder meeting the sky, which coaxes deities to descend. Women may smoke their genitals with juniper incense to entice spirits of recently deceased lamas to reincarnate in their wombs (Dunham et al. 1993).

Junipers and/or cedars are generally highly revered by native N. American tribes for their endurance and longevity, as well as for their medicinal and spiritual properties. Native American 'peyote' groups [see **Lophophora**], especially the Tarahumara, may burn J. virginiana during all peyote rituals as a purifying incense. The leaves and berries may also be smouldered in sweat lodges for their therapeutic properties. The Pawnee inhaled the smoke to relieve nervousness and nightmares, and the Cheyenne used it as a sedative tea to relieve coughs and hyperactivity (Kindscher 1992; Schultes 1937a; Rätsch 1992).

Following the reported Asian use of J. macropoda and similar species, they have been suggested for use as a 'legal hallucinogen' (Gottlieb

1992; Siegel 1976). Gottlieb (1992) gave directions for use – "Leaves and branches are spread upon embers of fire. Person places blanket over head while inhaling smoke" – though he probably had not tried this himself.

J. communis is the most commonly used species of juniper medicinally and commercially. Native Americans boiled the berries for colds, and they were later used to flavour gin. The berries yield an essential oil which is aphrodisiac, nervine, sudorific, antiseptic, diuretic, antirheumatic, antiinflammatory, digestive and detoxifying. Steam inhalations of the berries are excellent for coughs and colds. The oil may irritate the skin, and should not be used by pregnant women (Bremness 1994; Chiej 1984; Lawless 1994; Mabey et al ed. 1990). In Tuscany, Italy, branches of the wild plant are burned on Christmas eve to prevent the 'evil eye' and bring good omens (Pieroni & Giusti 2002).

Juniperus spp. have broadly similar effects, and apart from those listed under the species below, the following compounds have been found in the genus – silicolin [deoxypodophyllotoxin], dihydroanhydro-podorhizol, savinin, sugars and vitamin C (Harborne & Baxter ed. 1993; Mabey et al. ed. 1990). Some species not otherwise mentioned here have leaf essential oils very rich in *camphor*, such as J. ashei [64.9%], J. saltillensis [42.1%], J. osteosperma [33.4%], and J. pinchotii [31.4%] (Adams 2000b). Essential oil contents may vary considerably even within trees of the same species, though the least variation is encountered in winter (Tatro et al. 1973).

J. angosturana leaf essential oil was shown to contain α-*pinene* [23.1%], δ-3-carene [11.5%], elemol [8.5%], *elemicin* [10.2%], *camphor* [0.9%], *safrole* [0.1%], traces of *estragole*, and many other compounds (Adams 2000b).

J. communis var. nana essential oil has yielded 20% α-*pinene*, 1.1% β-*pinene*, 8.7% limonene, 8.5% myrcene, 8% *borneol*, 7.2% β-caryophyllene, 7% germacrene D, 3.9% α-humulene, 10.4% δ-cadinene, 1.3% α-cadinol, 1.7% sabinene, and traces of camphene, α-copaene, α-cubebene, p-cymene, β-phellandrene, α-terpineol, α-terpinene, γ-terpinene, terpinolene and terpinen-4-ol (Proenca da Cunha & Roque 1990).

J. excelsa leaves yielded an essential oil containing cedrol [28.1-30.8%], α-*pinene* [22.5-26.5%], limonene [5.5-22.6%], and smaller amounts of many other compounds, including *camphor* [0.2-0.5%] (Adams 2001); berries have yielded diterpenes, including isocommunic acid, (-)ent-transcommunic acid, isopimaric acid, sandracopimaric acid [antibacterial], and a new labdane diterpene 3α-acetoxy-labda-8(17),13(16),14-trien-19-oic acid; and a sesquiterpene, 4α-OH-cedrol. An extract of the plant has shown CNS-depressant activity in rats (Topçu et al. 1999).

J. indica [harv. Nepal] leaf essential oil was shown to consist mostly of sabinene [26.1%], as well as β-*thujone* [16%], α-*thujone* [2.3%], trans-sabinyl acetate [15.7%], terpinen-4-ol [7.2%] and many other compounds (Adams 2000a).

J. macropoda leaves have yielded an essential oil containing α-*pinene* [15.5-68.8%], myrcene [1.2-20.7%], cedrol [0-26.4%], limonene [1.2-9%], and smaller amounts of many other compounds, including β-*thujone* [0-0.2%], *camphor* [traces-1.7%] and *borneol* [0%-traces] (Adams 2001); as well as isoflavones [junipegenins A-C, irigenin, iridin and 5,7,3',5'tetrahydroxy-4'-methoxyisoflavone] and stilbenes [resveratrol and piceid (resveratrol-3-O-β-D-glucoside)] (Sethi et al. 1980, 1981); berries have yielded 0.007% hypolaetin 7-glucoside (Siddiqui & Sen 1971).

J. oxycedrus leaf and stem extracts have shown sedative, analgesic, and antiinflammatory effects in mice, and exhibited low toxicity. Extracts have also been found to partially antagonise *acetylcholine*, *histamine* and *serotonin* in vitro (Moreno et al. 1998).

J. pseudosabina [harv. Mongolia] leaf essential oil was shown to consist mostly of α-*pinene* [52%], as well as cedrol [10.7%], sabinene [5.8%], β-*pinene* [4.5%], myrcene [3.8%], 2-nonanone [3.4%], linalool [2.1%], germacrene D-4-ol [2%] and many other compounds (Adams 2000a).

J. recurva [harv. Nepal] leaf essential oil has been shown to consist mostly of δ-3-carene [23.7%], as well as limonene [18.4%], sabinene [13.4%], α-*pinene* [6.9%], elemol [3.9%], terpinen-4-ol [3.7%], and many other compounds (Adams 2000a).

J. scopulorum essential oil has been found to contain *safrole* (Harborne & Baxter ed. 1993).

J. virginiana leaves and twigs yielded podophyllotoxin, which has some tumour-inhibiting properties (Kupchan et al. 1965); this species has also yielded α-eudesmol, which was shown to inhibit neuronal Ca2+ channels sensitive to ω-agatoxin IVA [a peptide toxin isolated from the funnel web spider, Agelenopsis aperta] (Asakura et al. 1999).

Juniperus macropoda is a small to medium-sized tree with fibrous, vertically fissured reddish-brown bark, peeling in fibrous strips. Leaves on young plants and on lower branches of older ones are subulate and pungent; on most branches, the leaves are scale-like, closely adpressed, with a large oblong or elliptic gland in the centre of the back. Male flowers found at tips of branches; catkins small, cylindric, ovoid, axillary or terminal, and solitary; stamens decussate or in threes, connective enlarged, ovate or peltate at apex, bearing 2-6 globose pollen-sacs near base. Female flowers found terminating short side branches; cones composed of 2-6 opposite or ternate scales, the scale usually not all fertile; ovules 1-2 to each fertile scale, upright. Fruit a berry-like cone, 7.5mm diameter, globose, bluish-black, very resinous, tips of scales forming transverse ridges; seeds 2-5.

In the Himalayas from Nepal west up to 4270m, also in Baluchistan, Afghanistan, Iran and Saudi Arabia (Kirtikar & Basu 1980).

The taxonomy of Juniperus spp. is quite confused, with species synonymy constantly being revised based on new findings. The listing at the head of this chapter should be regarded as only one interpretation of the taxonomic relations of the species discussed.

JUSTICIA

(Acanthaceae)

JUSTICIA PECTORALIS VAR. STENOPHYLLA

Justicia caracasana *Jacquin* – curia

Justicia gendarussa *Burman f.* **(J. nigricans** *Lour.***; Gendarussa vulgaris** *Nees***)** – venco tudo Africano

Justicia ideogenes *Leonard*

Justicia pectoralis *Jacquin* **(Dianthera pectoralis** *(Jacq.) J.F. Gmel.***; D. pectoralis** *(Jacq.) Murray***; Ecbolium pectorale** *(Jacq.) Kuntze***; Psacadocalymma pectorale** *(Jacq.) Bremek.***; Rhytiglossa pectoralis** *(Jacq.) Nees***; Stethoma pectoralis** *(Jacq.) Raf.***)** – masha-hara-hanak, boo-hanak, yakayú, Jamaica garden balsam, herbe aux charpentieres, sèpantye

Justicia pectoralis *Jacquin* **var. stenophylla** *Leonard* – mashihiri, masha-hiri, masha-hari, ya-ko-yoo, shäri kä henakö

Justicia prostrata *Gamble*

In Venezuela and Brazil, J. pectoralis and J. pectoralis var. stenophylla [which is probably a growth form of J. pectoralis, rather than a distinct variety] are used in the preparation of entheogenic snuff made principally from **Virola** spp., usually V. theiodora. The leaves are toasted, powdered and mixed with the **Virola** resin, but there are reports of Justicia being used on its own to prepare an 'epéna' weaker than that made primarily from **Virola** spp. Snuff made from this Justicia is also called 'machohara', and is said to send the user into a trance. Usually, the plant is added mainly for its aroma and many tribes may consider it to have only negligible potency. It is prepared by sun-drying or fire-drying the leaves, which are then toasted on a heated piece of clay until crisp – the leaves are then crushed between the hands, and then ground with mortar and pestle to a fine powder. The snuff is so fine that it is often mixed with ashes of Elizabetha princeps bark to give bulk and help hold it together. J. pectoralis is also used as an aphrodisiac, and to treat pulmonary infection and pneumonia by the Puinave (Brewer-Carias & Steyermark 1976; Chagnon et al. 1971; Lizot 1985; Macrae & Towers 1984b; Prance 1972; Schultes 1990; Schultes & Raffauf 1990; Seitz 1967), and is also used to treat coughs and colds in the Caribbean (Ott 1993).

In Venezuela, J. caracasana is added to 'lickable' tobacco preparations [see **Nicotiana**] (Ott 1993). J. ideogenes is used by the Kofan of n.w. Amazonia, who rub a decoction of the plant over the lower limbs to treat 'palsy-like trembling'; the plant may have antidepressant properties (Schultes 1993). In Candomble, Brazil, living plants of J. gendarussa ['venco tudo Africano'] are believed to protect against a form of the 'evil eye' that targets financial affairs (Voeks 1997). In Madagascar, the Tanala use the plant in sorcery, in unspecified ways (Ott 1993). In the Malay Peninsula, it is used obscurely as a magic plant, as well as for medicine. The leaves are used externally to treat headache, rheumatism, lumbago and swellings, or internally as a diaphoretic, febrifuge, purgative and asthma treatment (Perry & Metzger 1980). In Nepal, J. adhotoda ['aatashu dhu', 'asura'] herbage is sometimes used an an incense material (Müller-Ebeling et al. 2002).

J. gendarussa leaves contain a 'slightly toxic, non-volatile alkaloid', and are rich in potassium; roots have yielded justicine, and essential oil (Perry & Metzger 1980); the plant has also yielded 2-aminobenzyl alcohol and 2-(2-aminobenzylamino)benzyl alcohol (Lorenz et al. 1999). A decoction or alcohol extract of the roots, taken in a dose of 1-2g/kg, produces slight paralysis; 10-20g/kg may act as an "antipyretic and depressant producing

violent diarrhoea and eventually death" (Perry & Metzger 1980).

J. ghiesbreghtiana has yielded 0.089% justiciamide [(-)-N-(2-OH-4,5-dimethoxyphenyl)-2S,4S)-γ-OH-*glutamic acid*], as well as racemic allantoin and an α-malamidic acid derivative (Lorenz et al. 1999).

J. pectoralis has yielded 2.4% betaine [anticonvulsant], 0.42-1.18% coumarin [sedative and hypnotic near toxic levels, analgesic, spasmolytic; highest in mature leaves], *scopoletin*, 0.3-0.58% umbelliferone [spasmolytic; highest in mature leaves], β-sitosterol and traces of vasicine [hypotensive, bronchodilator, respiratory stimulant, uterotonic; see **Peganum**] (Macrae & Towers 1984b; Schultes 1990). Whole plant from Guadeloupe yielded flavonoids – 0.0022% swertisin, 0.004% 2"-O-rhamnosylswertisin, 0.0019% swertiajaponin and 0.001% 2"-O-rhamnosylswertiajaponin (Joseph et al. 1988). 34g of the herb taken with 3g **Peganum** harmala seeds, in an aqueous extraction, proved to be psychoactive in a human bioassay (pers. comm.).

J. pectoralis var. stenophylla has been reported to contain trace amounts of tryptamines by two researchers, although others have found none (Schultes 1990). TLC analysis tentatively identified traces of *DMT* and *N-methyltryptamine* from August harvests; a November analysis showed the tentative presence of *5-methoxy-DMT* (Heffter 1996; Trout ed. 1997d).

A snuff sample ['mashahari'] believed to consist solely of J. pectoralis var. stenophylla yielded 0.052% *5-methoxy-DMT* and 0.009% *DMT* (McKenna et al. 1984b).

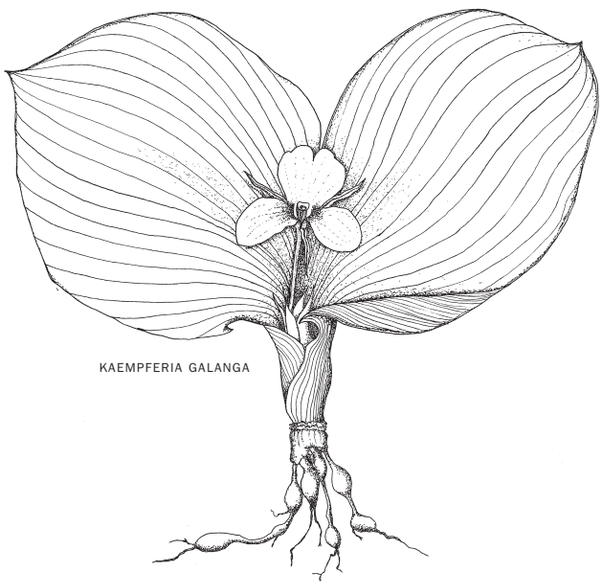
J. prostrata has yielded *carpacin* (Harborne & Baxter ed. 1993).

Justicia pectoralis is a compact herb to 30cm high; stems ascending, sometimes rooting or prostrate at base, subquadrangular, alternately bisulcate, glabrous, pilose from bud, strongly decurrent; internodes short, usually less than 2cm. Leaves numerous, glabrous on both sides, narrowly lanceolate, attenuate, entire, base acute, cuneate; petioles slender, to 6mm long. Inflorescences terminal spikes up to 10cm long, dichotomous, glandulose-pubescent, hairs filiform; bracts and bracteoles setaceous; flowers distant, secund; calyx 5-fid, lacinia slightly subcapillary above, subulate, c.2mm long, 0.25mm wide, puberulous; corolla white or violet, sometimes purple spotted, c.7-8mm long, slightly pubescent externally; stamens exserted c.1mm beyond corolla throat; style c.7mm long. Capsules clavate, c.8mm long; seed flattish, c.15mm wide, rough, reddish-brown.

Eastern Colombia, adjacent Amazonian Brazil; often semicultivated (Fridericus & De Martius ed. 1965-1975; Schultes & Hofmann 1980).

KAEMPFERIA and ALPINIA

(Zingiberaceae)



KAEMPFERIA GALANGA

Kaempferia galanga *L.* – galangal, maraba, shannai [rhizome in TCM], kuunkuun, sidhoul, camphor root, gisol, spice lily

Alpiniablepharocalyx *(J.C. Wendl.) K. Schum.* **(Languasblepharocalyx** *(K. Schum.) Hand.-Mazz.***)**

Alpinia galanga *(L.) Sw.* **(A. galangal** *(L.) Willd.***; Amomum galanga** *(L.) Lour.***; Am. medium** *Lour.***; Languas galanga** *(L.) Stuntz***; Maranta galanga** *L.***)** – galanga, galangal, galanga major, greater galanga, Siamese ginger, Laos root, da gao liang jiang [rhizome in TCM], rieng, rom deng, kha ta deng, pa da goji, sugandhavacha, kulinjana

Alpinia kumatake *Makino* **(A. formosana** *K. Schum.***; A. hokutensis** *Hayata***; A. intermedia** *Gagnep.***; A. kelungensis** *Hayata***; A. koshunensis** *Hayata***; A. oblongifolia** *Hayata***; A. satsumensis** *Gagnep.***; Languas formosana** *(K. Schum.) Sasaki***; L. hokutensis** *(Hayata) Sasaki***; L. intermedia** *(Gagnep.) Sasaki***; L. kelungensis** *(Hayata) Sasaki***; L. koshunensis** *(Hayata) Sasaki***; L. oblongifolia** *(Hayata) Sasaki***)** – Taiwan galangal, ginger lily, pinstripe ginger, shell ginger, shellflower ginger, Formosan ginger, mei-shan-jiang

Alpinia officinarum *Hance* **(Languas officinarum** *(Hance) Farw.***)** – galangal, lesser galangal, Chinese ginger, gao liang jiang [rhizome in TCM]

Alpinia speciosa *(J.C. Wendl.) K. Schum.* **(A. zerumbet** *(Pers.) B.L. Burtt et R.M. Sm.***; Languas speciosa** *(J.C. Wendl.) Small***; Zerumbet speciosum** *K. Schum.***)** – light galangal, shell ginger, shellflower ginger, Queen's candle ginger, pink porcelain lily, China lily, shan-jiang

As 'maraba', the rhizomes of K. galanga are consumed in the Morobe and Fore regions of Papua New Guinea [PNG], being chewed and swallowed, or made into a drink; it is thus said to be entheogenic, aphrodisiac, euphoric, and productive of pleasant and prophetic dreams. It is also used as an entheogen by the Bimin-Kuskuskmin of PNG, in the final 3 stages of their initiations. For this purpose, it is eaten with **Boletus** sp., **Heimiella** sp., **Russula** sp. and **Psilocybe** mushrooms, and is said to bring about a detached, dream-like state on its own. The Jamu of India add it to powders used as stimulants, aphrodisiacs, or elixirs of longevity (Hamilton 1960; Paijmans ed. 1976; Poole 1987; Rätsch 1992; Schultes & Hofmann 1980).

K. galanga rhizome has also been used in India to treat food poisoning, tetanus, inflammation of the mouth, abscesses, coughs and colds, and is considered to be a stomachic, carminative and cholagogue. Powdered and mixed with honey, it is used to treat coughs; boiled in oil, it is applied externally to a blocked nose. Sometimes, the rhizome is chewed with betel nut [see **Areca**]. In much of s.e. Asia, it is a popular flavouring and stimulant; the leaves are also cooked as a vegetable, or added to curries. The rhizome juice may also treat sore throats, headache, birthing pain and skin conditions; it has antibacterial properties. In Malaysia, it is added to an arrow poison made from Antiaris toxicaria (Bremness 1994; Emboden 1979a; Kirtikar & Basu 1980; Nadkarni 1976; Perry & Metzger 1980; Tewtrakul et al. 2005). To the Akha of n. Thailand, Kaempferia spp. are very important in warding off malicious spirits (Anderson 1993). The African K. ethele is said to have produced stupor in a horse (Watt 1967).

The rhizome of K. galanga is also used in TCM in small amounts, and is considered to be warm, fragrant, and pungent in quality, with an affinity for the lungs. It is used to treat vomiting, diarrhoea, toothache, intestinal parasites, and cold pain in the chest and abdomen. The Chinese prepare it after collection from December-March. The rhizome is washed, cut into 1cm-thick slices, bleached over sulphur fumes for 1 day, and dried on a bamboo screen (Hsu et al. 1986; Perry & Metzger 1980).

A. galanga rhizome is considered in Ayurvedic medicine to be pungent, bitter, hot and stomachic; it is used to improve appetite, taste and voice, and to treat bronchitis and heart disease. In the Unani system, it is considered aphrodisiac, tonic, diuretic, expectorant and carminative, and is used also to treat headache, lumbago, rheumatism, sore throat, chest pain, diabetes, tuberculosis, burning sensations in the liver, and kidney disease. Hakims consider it disinfectant, and use it to treat impotence, nervous debility, bronchitis and dyspepsia. The rhizome is also added to 'bazar' spirits, to make the liquor more intoxicating (Frawley & Lad 1986; Kirtikar & Basu 1980; Nadkarni 1976). Its essential oil is the source of 'Essence d'Amali' (Bremness 1994). A. malaccensis is also a source of this perfume, and its rhizome is chewed in n. India and Malaysia as a betel nut substitute [see **Areca**] (Usher 1974).

A. officinarum is lesser used in Indian medicines, though it is known as a stimulant, stomachic and carminative (Nadkarni 1976). Its rhizome is used in TCM as a stomachic (Huang 1993). The rhizomes of A. speciosa have been used as a substitute for both A. galanga, and ginger [Zingiber spp. – see *Endnotes*] (Kirtikar & Basu 1980). Alpinia spp. rhizomes are much used in s.e. Asian cooking as a spice [especially as an ingredient of some Thai curries], and are commonly available in grocers, either fresh or sliced and dried [usually labelled simply as 'galangal'] (pers. obs.).

An Alpinia sp. known as 'khraanik' is eaten peeled and crushed with salt as one of the psychoactive ginger types consumed in stage one of the Bimin-Kuskuskmin initiation rites (Poole 1987), mentioned above and further under other entries [see *Endnotes*]. The Nkopo of PNG use an Alpinia sp. ['yoma kaa'] in rituals to achieve a harmonious state ['gisam'] with natural forces (Schmid 1991).

Modern experimentation with galangal has been clouded with widespread confusion regarding the identity of rhizome material. In many cases, people seeking K. galanga have purchased and used A. galanga or A. officinarum, without knowing there is more than one plant known as 'galangal'. These latter two species are the ones more commonly sold in Asian groceries and used in cooking. Though K. galanga is used for these purposes, it is less commonly encountered in Western countries. However, the **Alpinia** spp. do seem to share some similar psychotropic effects with K. galanga. Several dosage recommendations have been suggested [eg. 6cm fresh rhizome; 60g fresh; 1 heaped tsp dried and powdered]. It is usually eaten, though the juice may be drunk if using fresh rhizomes. One in-

ternet psychonaut claimed to have successfully prepared a smokeable petroleum-ether extract [dried], from a defatted, basified syrup prepared by water decoction. The material was smoked by vapourisation in a free-base pipe. The effects for some people [such as the aforementioned psychonaut] can manifest as mild euphoria and stimulation, with mild 'LSD-like' sensory distortions lasting several hours or more. Others have achieved no effect at all, except for gastric upset and diarrhoea (pers. comms.). One person who ingested 1 cubic cm of fresh rhizome [definitely identified as K. galanga] on numerous occasions reported a pleasant stimulating and euphoric effect. Higher doses were not attempted due to fearing the potential toxicity of *borneol*, which he believed to be a major component of the essential oil [see below] (theobromus pers. comm.). Animal studies using an ethanol extract of the rhizomes observed CNS depression and analgesia, but no toxicity (Kanjanapothi et al. 2004).

K. galanga rhizome has yielded large quantities of essential oil [1.11% v/w in one analysis], containing *borneol* [2.87%], camphene [2.47%], l-Δ3-carene, carvone [11.13%], methyl-cinnamate [23.23%], ethyl-cinnamate, ethyl-p-MeO-cinnamate [31.77%], p-MeO-styrene [may be an artefact of extraction], α-*pinene* [1.28%], eucalyptol [9.59%], kaempferol [see below], kaempferide, p-MeO-cinnamic acid, ethyl p-MeO-transcinnamate, methyl p-MeO-cinnamate, pentadecane [6.41%], benzene [1.33%], alpinetin, α-terpineol, β-phellandrene, dihydro-β-sesquiphellandrene, 3-caren-5-one, 3-(4-OH-phenyl)-2-propenoic acid, p-methylcumaric acid ethylester, and cinnamic aldehyde. Constituents and their proportions appear to vary in nature. A fraction from the rhizome was shown to inhibit MAO; this has been attributed to ethyl-p-MeO-transcinnamate, which also has some anti-cancer effects (Buckingham et al. ed. 1994; Hsu et al. 1986; Noro et al. 1983; Panicker et al. 1927; Rastogi & Mehrotra ed. 1990-1993; Tewtrakul et al. 2005). Some MAOI activity might also be attributable to the flavonoid kaempferol, which has recently shown MAOI activity, as well as acting as a neuroprotectant against NMDA-induced neurotoxicity (Sloley et al. 2000).

A. blepharocalyx seeds have yielded 4'-OH-*5,6-dehydrokawain*, phloroglucinol, and a variety of diarylheptanoids (Ali et al. 2001).

A. galanga rhizome has yielded *eugenol*, 1,8-cineole, *pinene*, linalool, cedrol, *camphor*, methyl cinnamate, quercetin, kaempferol, quercetin-3-methyl ether, isorhamnetin, kaempferide, galangin, galangin-3-methyl ether, galanal A & B, galanolactone, 1,5-bis(4-OH-phenyl)-1,4-pentadiene, 3-(4-OH-phenyl)-2-propenal and 8(17),12-labdadiene-15,16-dial (Buckingham et al. ed. 1994; Rastogi & Mehrotra ed. 1990-1993; Schermerhorn et al. ed. 1957-1974).

A. kumatake rhizomes have yielded *5,6-dehydrokawain* and dihydro-*5,6-dehydrokawain* (Kimura et al. 1966).

A. officinarum rhizome has yielded 0.5-5% essential oil, containing *eugenol*, *pinene*, cineol, cadinene and methylcinnamate (Keys 1976), as well as kaempferol, kaempferide, galangol, galangin, alpinin, and a variety of sesquiterpenes (Buckingham et al. ed. 1994; Rastogi & Mehrotra ed. 1990-1993; Schermerhorn et al. ed. 1957-1974).

A. speciosa rhizomes have yielded *5,6-dehydrokawain* and dihydro-*5,6-dehydrokawain*, flavokavain B, dihydroflavokavain B [see **Piper 2**], cardamomin, alpinetin, and methyl trans-cinnamate; cardamomin and alpinetin have also been found in the seeds (Itokawa et al. 1981; Kimura et al. 1966); dihydro-*5,6-dehydrokawain* has also been found in the leaves (Tawata et al. 1996).

Alpinia galanga is a perennial herb with elongate, leafy stems and horizontal tuberous rootstocks, slightly aromatic. Leaves 23-45 x 3.8-11.5cm, oblong-lanceolate, acute, glabrous, green above, paler beneath, with slightly callous white margins; sheaths long, glabrous, ligule reaching 10mm long, usually shorter, rounded. Flowers greenish-white, in dense-flowered terminal panicles 15-30cm long; branches short; rachis pubescent; pedicels 3-4mm long; bracts 10mm long, ovate-lanceolate; bracteoles large, sometimes enveloping buds; calyx 10mm long, tubular, irregularly 3-toothed; corolla 2-3cm long, tube cylindric, 13mm long, lobes oblong, obtuse, subequal, 6mm wide, the upper usually broader and more convex than the lateral; lip 2.2cm long; claw green, 6 x 2.5mm; blade white striated with red, rather more than 13mm long, broadly elliptic, shortly 2-lobed at apex, with a pair of subulate glands at base of claw; stamen 1, perfect, 2cm long; filament flattened; anther cells diverging at top, occasionally with an orbicular crest; lateral staminodes minute or obsolete. Ovary 3-celled; ovules few or many on each placenta; style filiform; stigma subglobose. Fruit the size of a small cherry, orange-red, globose, dry or fleshy, usually indehiscent; seeds globose or angled.

Tropical forest margins; s.e. Asia, India, Ceylon, Malay Islands. Often cultivated (Kirtikar & Basu 1980).

Kaempferia galanga is a leafy, tuberous herb, aromatic; root fibres fleshy, cylindric. Leaves 2, spreading horizontally, lying flat on surface of ground, 6.3-15 x 4.5-9cm, rotund-ovate, deltoid-acuminate, thin, deep green, 10-12-ribbed, sometimes with red margin; petioles short, channelled. Flowers in terminal spikes, singly or 6-12 from centre of the plant between the leaves, fugacious, fragrant, opening successively; bracts lanceolate, green, short; calyx as long as outer bracts; corolla tube 2-5cm long, lobes lanceolate, pure white, a little shorter than tube; lateral staminodes 1-2cm long, cuneate-obovate, white; lip rather more than 2.5cm long and nearly the same wide, deeply 2-lobed, the lobes with a lilac spot at base; connective produced into a quadrate 2-lobed appendage; stamen 1, perfect; filament short. Ovary 3-celled; ovules many on 3 axile placentas; style long, filiform; stigma turbinate. Fruit an oblong capsule with thin pericarp; seeds subglobose, with small lacerate aril (Kirtikar & Basu 1980).

In grassy areas (Emboden 1979a). India, China, s.e. Asia, often cultivated; country of origin uncertain (Backer & Bakhuizen van den Brink 1968; Perry & Metzger 1980).

Cultivate by root division in spring. Not frost-tolerant – in cold areas, grow indoors in a pot with rich soil. Water heavily, less so near end of summer, hardly at all in winter (Grubber 1973).

KEISKEA

(Labiatae/Lamiaceae)

Keiskea japonica *Miq.* – shimobashira

This Japanese mint was recently discovered to be psychoactive during a small wave of experimentation with members of the family Labiatae, following discovery of the activity of diterpenes from **Salvia** divinorum. Taken sublingually, 4-5 of the large, bitter leaves were active after being held in the mouth for at least 10 minutes. The effects are reportedly similar to the other 'lesser-active' **Salvia** spp. [as opposed to the highly-active S. divinorum], and consist of a mild euphoria and '**Cannabis**-like' effects, as well as disturbing balance (pers. comm.). The herb is also mildly psychoactive when smoked, although the sample which I bioassayed was at least 5 years old. Fresher material may have been subjectively stronger in effect. The only side effect noted was a mild headache, which might perhaps have been due to the age of the sample (pers. obs.).

Keiskea japonica is a perennial herb; stems c.60cm long, 4-angled, slightly pilose or glabrous, often branched in upper part. Leaves opposite, toothed, thinly chartaceous, broadly lanceolate to narrowly ovate, 6-15(-20) x 2-5.5cm, apex abruptly long-acuminate, base long-acuminate, rarely subobtuse, margin acutely toothed except near base, puberulent on midrib above, glabrous or thinly pilose on nerves beneath; petioles 5-30mm long. Verticils 2-flowered, forming 1-sided spikes 5-12cm long, shortly pilose; bracts broadly linear, small, persistent; flowers bisexual, pedicelled; calyx deeply 5-toothed, actinomorphic, campanulate, with lanceolate lobes, hairy on throat, 3mm long at anthesis, 5-6mm long in fruit, nearly as long as pedicels, exceeding the bracts; corolla white, c.7mm long, shallowly lobed, tube broadened in upper part, with ring of hairs inside, limb slightly bilabiate, lower lip 3-lobed, midlobe slightly larger; stamens 4, didymous, exserted, upper pair shorter, filaments glabrous; anthers 2-locular. Ovary superior, deeply 4-lobed; style solitary, gynobasic; ovules 4, erect. Nutlets usually solitary, globose, dark brown, 1.5-2mm across, with darker reticulations. Fl. Sep.-Oct.

Mountains; Honshu [Kanto district and westward], Shikoku, Kyushu [Japan] (Ohwi 1965).

KOCHIA

(Chenopodiaceae)

Kochia scoparia *(L.) Schrad.* **(K. parodii** *Aellen***; K. scoparia var. alata** *Blom***; K. virgata** *Kostel.***; Bassia scoparia** *(L.) A.J. Scott***; Chenopodium scoparia** *L.***)** – summer cypress, Belvedere cypress, ti fu, di fu zi, di fu dze, sao jou tsao ['broom grass'], kaura-ro

This herb is used in Polish medicine in the form of an infusion, to treat heart troubles and rheumatism (Drost-Karbowska et al. 1978). In TCM, leaves and seeds are used as a cardiotonic, and seeds as a tonic, diuretic, astringent, antiphlogistic and blood purifier, as well as to treat impotency, eczema and rubella. They are considered cold, sweet and bitter, with an affinity for the kidneys. A leaf decoction may be used as an eyewash to improve night vision, or as a body wash for skin disorders; shoots and stems also treat dysentery and diarrhoea (Kirtikar & Basu 1980; Perry & Metzger 1980; Reid 1995; Wen et al. 1995). In China and Japan, K. scoparia is also cultivated for its young shoots, which are eaten as a vegetable, and for its seeds, which are ground into flour. The related 'salt bush' [K. aphylla] is an important drought stock-feed in Australia (Usher 1974). In India, K. indica is used as a cardiac stimulant (Nadkarni 1976).

In one test, dried aerial parts of K. scoparia yielded 0.00028% *harman* and 0.00005% *harmine*, from a total of 0.06% crude alkaloids, the remainder of which was not analysed; extraction of the alkaloids may not have been complete. Flowering tops yielded 2.2% betaine (Drost-Karbowska et al. 1978). Seeds contain saponins called momordins, and triterpenoid glycosides (Wen et al. 1995).

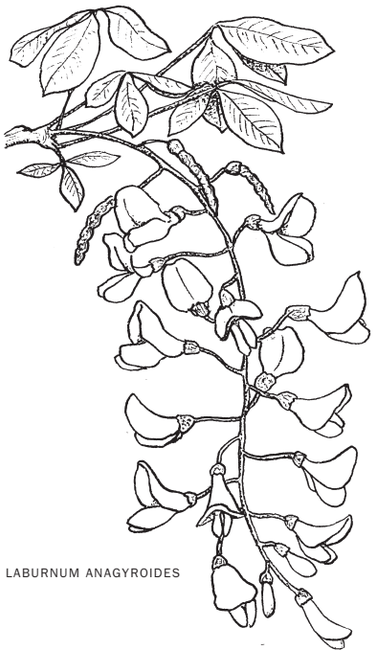
Kochia scoparia is a tall annual herb, 90-150cm high, glabrous or pubescent, strict, erect; branches erect and stems slender, white, smooth, the ultimate twigs pilose or villous. Leaves alternate, sessile, narrow, en-

tire, 2.5-3.8cm, green, linear-lanceolate, acute, midrib distinct. Flower clusters in leafy panicled spikes; flowers axillary, hermaphrodite or mainly female (rarely only male); bracts 0; perianth subglobose; lobes 5, coriaceous, incurved, closing over the utricle, girt by 5 free or confluent horizontal wings; stamens 5, usually exserted, inserted at the bottom of perianth; anthers larger, ovate. Ovary depressed-globose; style slender; stigmas 2-3, capillary; utricle depressed, membranous. Fruiting perianth very variable, wings short, semicircular, scarious, nerved, entire, shorter than the diameter of the disc. Seed horizontal, ovoid or orbicular; testa membranous; albumen scanty; embryo annular.

Central Europe west to Spain, east to n.w. India, north and central Asia to Japan (Kirtikar & Basu 1980), escaped weed in N. America (Usher 1974).

LABURNUM and CASSIA

(Leguminosae/Fabaceae)



LABURNUM ANAGYROIDES

Laburnum anagyroides *Medic.* **(Cytisus laburnum** *L.***; L. vulgare** *Presl.***)** – golden shower, golden chain, golden rain, common laburnum, llavia de oro, zoloti dozhd

Laburnum spp. – golden chain, golden shower

(Leguminosae/Caesalpiniaceae)

Cassia fastuosa *Willd.* – paricà

Cassia fistula *L.* – Indian laburnum, purging cassia, pudding pipe tree, golden shower, rajavraksha, nripadruma aragbhada, amulthus, sonhali

Cassia lucens *Vogel*

Cassia occidentalis *L.* **(Senna occidentalis** *(L.) Link***)** – coffee senna, negro coffee, fedegoso, kasamarda, kasondi

Cassia spp.

Laburnum spp., sometimes grown as ornamental trees, have been responsible for poisoning children who have eaten the green pods or seeds, or sucked on the flowers [usually of L. anagyroides]. There is usually complete recovery after 12 hours (Bruneton 1995; Forrester 1979; Foster & Caras 1994; Hatfield et al. 1977; Turner & Szczawinski 1991).

Related, though clearly distinct, is the genus Cassia, of which C. fistula ['Indian laburnum'] is also known as 'golden shower' in reference to the beautiful yellow inflorescence. It acts as a purgative, and the pulp from inside the seed pods has been used to flavour Bengal tobacco [see **Nicotiana**]; its flowers are also offered to some Hindu deities (Bremness 1994). Many other Cassia spp. [including C. angustifolia, C. australis, C. alata, C. pleurocarpa, C. occidentalis, C. senna] also have purgative properties in all parts, and when used as such, are usually referred to as 'senna'. Boiling destroys this property, so the herbs are usually infused in water (Cribb & Cribb 1981; Morton 1977). When roasted, the seeds lose their purgative properties, and are then sometimes used as coffee substitutes [see **Coffea**]. C. pleurocarpa is also reputed to be toxic to stock animals (Cribb & Cribb 1981), acting as a purgative and sometimes causing fatalities (Gardner & Bennetts 1956). In Nigeria, the seed of C. occidentalis is used as a coffee substitute, and is considered toxic unroasted. The leaf is given with palm oil for convulsions (Watt 1967). In India, the seeds [dose – 0.3-0.8g] are given in milk for the same purpose, in children. A decoction of the roots, leaves, and flowers is also used to treat spasms and hysteria (Nadkarni 1976). In Brazil, the plant has caused intoxications in cattle, with symptoms including disequilibrium, tremors, weakness, dragging of the rear hooves and diarrhoea. If a fully-toxic dose has been consumed [c.1kg of seeds per 100kg], the animals lie down and die (Pott & Alfonso 2000).

In Brazil, C. fastuosa is referred to as 'paricà' [see **Anadenanthera** and **Virola**] (Schultes 1955a), pointing to a possible previous use as a snuff ingredient. C. closiana is known in South America as 'quebracho' ['axe-breaker' – see **Aspidosperma**] (Trout ed. 1998), probably for its hard wood. In n.w. Amazonia, the Kubeo use the dried, powdered leaves of C. lucens as a memory tonic (Schultes 1993). Aboriginal people from northern Australia have used the ash of C. artemisoides ['silver cassia', 'blue bush cassia', 'parka'] to mix with chewing tobacco (Lassak & McCarthy 1990).

L. anagyroides is considered the most toxic of the Laburnum spp., all of which contain *cytisine*-like alkaloids [see **Cytisus** and **Sophora**] which can cause drowsiness intermittent with excitement, delirium, dizziness, restlessness, incoordination, confusion, dilated pupils, burning sensation in mouth and throat, nausea, vomiting, abdominal pain, diarrhoea, rapid or irregular heartbeat, sweating, salivation, cold skin and respiratory difficulties. Via the oral route, effects manifest within 1hr, and recovery may occur after 12-24hrs. Severe poisoning may lead to more severe hallucinations, convulsions, and even coma and death from respiratory paralysis. Bark and seeds are the most concentrated in *cytisine*; 20 seeds have been lethal in children. Alkaloid content may vary considerably (Barlow & McLeod 1969; Bruneton 1995; Forrester 1979; Hatfield et al. 1977; Turner & Szczawinski 1991). Smoking a cigarette of the dried flowers might be a safer method of ingestion, to produce a sub-toxic inebriation. It may be appropriate to prepare them in a similar manner to **Cytisus** canariensis flowers (pers. obs.).

L. anagyroides contains the alkaloids *cytisine* and N-methyl-*cytisine* in all parts, as well as laburnine in the seeds; seed pods have also yielded sparteine [affects muscarinic *acetylcholine*-receptors], thermopsine and 3-OH-11-nor-*cytisine*; leaflets also yielded anagyrine [affects muscarinic *acetylcholine*-receptors]. Leaflets have yielded 0-0.55% alkaloids; shoots 0.39-0.97%; petioles 0.54%; stem bark 0.47%. Flowers have yielded up to 0.62% alkaloids [this might have used the whole inflorescence; in another assay, petals yielded 0.23%, calyx none, and remaining flower parts 0.01%]; pedicels have yielded up to 1.98% alkaloids, and central rachis 1.61%, decreasing as the seed pods develop. During development and ripening, alkaloid levels increase in the seeds and decrease in the pods; ripe seed has yielded 0.5-1.96[-2.83]% alkaloids, ripe pods 0.08%. Hydrolysed leaf has yielded the flavonoids daidzein, genistein [MAOI (Hatano et al. 1991)] and isoprunetin; flowers have yielded the terpenoids lutein, lutein epoxide, violaxanthin and β-carotene (Harborne et al. ed. 1971; Henry 1939; International… 1994; Schmeller et al. 1994; White 1943b). The plant slightly inhibited human plasma AChE (Orgell 1963b).

Some Cassia spp. contain toxic compounds; for example, C. absus yielded the terpenoid chakisine, which has similar effects to *cytisine* in animals (Watt & Breyer-Brandwijk 1962). C. alata, C. fistula, C. siamea and C. sieberiana all produce HCN (Watt & Breyer-Brandwijk 1962). C. alata leaves have also yielded [w/w] 0.0037% *tyramine* (Wheaton & Stewart 1970). Glycosides such as sennoside A and sennoside B are primarily responsible for the purgative activity of many Cassia spp. (Cribb & Cribb 1981; Morton 1977).

C. occidentalis leaves, stems and pods have yielded *choline*, betaine, stachydrine, trigonelline and unidentified bases (Ghosal et al. 1970b); the herbage has also been shown to contain *GABA* (Durand et al. 1962).

Laburnum anagyroides is a hardy shrub or small tree to 10m tall, with spreading branches close to the ground; twigs with close-pressed hairs. Leaves alternate, trifoliate; leaflets elliptical-oblong, pubescent underneath, subsessile to 8cm long; petioles long; stipels none, stipules minute or none. Inflorescence showy pendulous terminal or axillary racemes to 46cm long; flowers golden yellow, 2cm long, pea-like; bracts and bracteoles small, early caducous; calyx tube very short, campanulate, obscurely bilabiate, lips obtuse, short, upper lip bidentate, longer, lower lip tridentate, usually ciliate, petals free, standard orbicular or broad-ovate, upcurved, without basal ears or tubercles, wings shorter than standard, obovate, keel very short, incurved, glabrous, not beaked; stamens 10, monadelphous; anthers alternately long and short. Ovary stalked, many-ovuled; style glabrous; stigma terminal, small. Pods in clusters, to 8cm long, silky, persistent, long-stalked, linear, narrow, nearly flattened, sutures thickened or slightly winged, slightly constricted between seeds, continuous within, 2-valved, tardily dehiscent; seeds several, kidney-shaped, dark brown. Fl. spring-summer.

Native to central and southern Europe; grown as an ornamental, and an occasional garden escape (Allen & Allen 1981; Foster & Caras 1994; Tamplon 1977; Turner & Szczawinski 1991).

LACTUCA

(Compositae/Asteraceae)

Lactuca altissima *Bieberstein*
Lactuca canadensis *L.* – wild lettuce
Lactuca canadensis var. elongata *(Muhl.) Farw.* **(L. elongata** *Muhl.***)**
Lactuca indica *L.* **(L. brevirostris** *Champ. ex Benth.***; L. mauritiana** *Poir.***; Pterocypsela indica** *(L.) C. Shih***)** – wild lettuce
Lactuca sativa *L.* **(L. scariola var. sativa** *Moris***)** – garden lettuce, salad lettuce
Lactuca sativa var. capitata *L.*
Lactuca serriola *L.* **(L. scariola** *L.***)** – wild lettuce, prickly lettuce, compass plant
Lactuca virosa *L.* – wild lettuce, prickly lettuce, bitter lettuce, poor man's opium
Lactuca spp. – lettuce, wild lettuce

The narcotic properties of lettuce varieties have been known since antiquity. The ancient Egyptians considered lettuce [probably L. serriola] to be aphrodisiac, using the seed oil to treat impotence, and held it sacred to Min, the fertility god. Dioscorides recognised the plant as being soporific, cooling and emmolient, and claimed that the seeds could dispel sexual desire. The famed Greek physician Galanus used to eat lettuce leaves in the evening to help himself sleep. Aphrodite was said to have lain the dead body of Adonis on a bed of lettuce leaves, according to Greek mythology. The herbs have also been added to witch's flying potions for their psychotropic properties in Europe. In Lebanon, powdered lettuce seed is used to calm feverish patients, and to deter boys from masturbating excessively! Lactuca spp. are also used by some Native Americans in ritual smoking blends (Bremness 1988; Duke 1983; Harlan 1986; Rätsch 1992; Von Bibra 1855).

The Cherokee use L. canadensis as a calming sedative to induce sleep [and also, paradoxically as a stimulant], and as an analgesic. Like other Lactuca spp., it is also cooked and eaten as a vegetable (Hamel & Chiltoskey 1975). The latex from L. canadensis, in large doses, has been reported to cause "delirium, confusion of the brain, vertigo and headache, dimness of vision, salivation, difficult deglutition, nausea and vomiting, and retraction of the epigastric region, with a sensation of tightness; distension of the abdomen, with flatulence; urging to stool followed by diarrhoea; increased secretion of urine; spasmodic cough, oppressed respiration, and tightness of the chest; reduction of the pulse 10 to 12 or more beats; unsteady gait; great sleepiness; and chills and heat, followed by profuse perspiration" (Millspaugh, in Pammel 1911).

In India, L. serriola is sometimes used for its leaves and sap, as a sedative, hypnotic, and expectorant (Nadkarni 1976). Likewise, in Indo-China the latex of L. indica is used as a narcotic sedative. In Papua New Guinea, the seeds of L. indica are chewed alone as a betel nut substitute [see **Areca**] by the Kukukuku (Paijmans ed. 1976; Perry & Metzger 1980). In n. Thailand, L. sativa seeds are eaten by hill-tribe shamans, to gain the cooperation of spirits when attempting to heal intestinal pains [see also **Petroselinum**] (Anderson 1993).

Culinary types of lettuce common on western tables have had most of their medicinal properties bred out of them to make them more tender and less bitter, and hence more palatable. These properties are concentrated in the milky sap or latex of the herb. Wild lettuce latex has long been used to adulterate opium from **Papaver** somniferum, and by the late 1700's it was in common use in its own right in European medicine, as a sedative relaxant (Von Bibra 1855). In medicine, the dried latex extract of wild lettuce has been known as 'lactucarium'. There were two main varieties used, French lactucarium [derived from L. sativa var. capitata], and German lactucarium [lactucarium germanicum; derived from L. virosa] (Budavari et al. ed. 1989; Felter & Lloyd 1898).

Several decades ago, it began a small 'counterculture' resurgence of use, with 'lettuce opium' being sold in health stores and through 'underground' magazines. However, much of this product appears to have been of low quality [made from garden lettuce] and was not satisfying to heroin addicts, who were used to 'harder stuff' (pers. comms.).

Lactuca spp. latex is collected when the plant is in flower, or just before. The tops of the plant are cut off with a sharp blade, and the latex collected and scraped off to be dried; this latex is milky-white and bitter, and in a couple of days dries to a light-brown colour. After a rest of 1-2 days or more, the plant can be cut again, a little lower on the stem, and this process continued until no more latex is yielded. The latex may then be smoked or decocted in the same manner as opium (pers. obs.). For internal medicinal use, the suggested dose of lactucarium is 0.3-1.3g (Felter & Lloyd 1898). Giorgio Samorini recently found latex of L. serriola [presumably taken orally] to be sedative and analgesic at a dose of 1g, but stimulating at doses of 2-3g. Samorini attributed these stimulant effects to the tropane alkaloids possibly present [see below] (Lorenzi 2005). Alternately, leaves and roots may be smoked for a weak effect, or the whole plant can be heated in water for up to 8hrs before being strained and reduced to a gum (Miller 1985). L. virosa is generally said to be the most potent, with L. canadensis var. elongata and L. altissima also held in high regard. L. sativa and L. serriola, when allowed to grow to maturity, are still active, but much less potent (Cribb 1981; Felter & Lloyd 1898).

The most important active components of Lactuca spp. are sesquiterpene lactones concentrated in the latex, such as *lactucin* and lactucopicrin [lactupicrin, intybin], which are very bitter (Sessa et al. 2000). These active principles reside mainly in the water-soluble portion of the latex; this portion, as well as pure *lactucin* and lactucopicrin, shows CNS-depressant activity in animals. Lactucopicrin is less toxic than *lactucin* [see *Chemical Index*], with an oral LD50 in mice of 12-20mg/g (Forst 1941). Although the presence of traces of *hyoscyamine* and *morphine* has been reported [see below], this is strongly doubted, largely on the grounds that these or similar compounds have not been detected elsewhere in the Compositae.

L. indica has yielded β-amyrenyl acetate, germanicyl acetate, taraxasteryl acetate, α-lactucerol, β-amyrin, β-sitosterol, stigmasterol and an unidentified aliphatic alcohol (Hui & Lee 1971).

L. sativa fresh aerial parts have yielded [w/w] 0.0002% lactucopicrin, 0.0001% *lactucin*, 0.00015% 11β,13-dihydro-*lactucin*, 0.0025% 3β-OH-11β,13-dihydro-acanthospermolide, 0.0005% 3β-14-dihydroxy-11β,13-dihydrocostunolide, 0.0017% β-sitosterol, 0.0005% β-sitosterol glucoside, 0.02% lupeol, 0.013% lupeyl acetate (Mahmoud et al. 1986), vitamin A, vitamin B1, vitamin C, vitamin E, vitamin K and traces of an essential oil (Watt & Breyer-Brandwijk 1962). Up to 0.02% of a mydriatic alkaloid was isolated from the flowering plant, identified as *hyoscyamine* (Felter & Lloyd 1898). Traces of *morphine* [2-10ng/g] have also been found in lettuce (Hazum et al. 1981). The latex has also yielded 10.26% rubber (Watt & Breyer-Brandwijk 1962). Latex from L. sativa cv. 'Diana' and cv. 'Benita' was shown to contain mostly lactucopicrin-15-oxalate, as well as lactucopicrin, *lactucin*, *lactucin*-15-oxalate, 8-deoxylactucin-15-oxalate, 15-deoxylactucin-8-sulfate, 11,13-dihydro-8-deoxylactucin-15-glycoside [jacquinellin glycoside], 15-p-OH-phenylacetyl-*lactucin*-8-sulfate and 2,3,4-tri-O-(4-OH-phenylacetyl)glucopyranose. The cultivars 'Capitan', 'Cobham Green', and 'Salinas' have similar chemical profiles to 'Diana' (Sessa et al. 2000). Seeds of L. sativa cv. 'Grand Rapids' yielded [as % of sterol fraction] 52% β-sitosterol, 14% campesterol, 12% stigmasterol, 12% stigmast-7-en-3β-ol, 6% Δ7-avenasterol and 4% Δ5-avenasterol (Knights & Middleditch 1972).

L. serriola latex has been found to contain *lactucin*, *lactucin*-15-oxalate, 8-deoxylactucin-8-sulfate, 15-p-OH-phenylacetyl-*lactucin*-8-sulfate, lactucopicrin, lactucopicrin oxalate, and 2,3,4-tri-O-(4-OH-phenylacetyl)-glucopyranose and homologues (Sessa et al. 2000). L. serriola leaf [harv. Jan.] from Brisbane, Queensland [Australia], tested positive for alkaloids; roots only gave a weak positive in one test. Herbage from Yarraman, Qld. [harv. Oct.] also gave positive tests, except for one sample, which was a very young plant (Webb 1949).

L. virosa latex has yielded α-lactucerin [lactucone, taraxasterol acetate], β-lactucerin, c.50% α-lactucerol [taraxasterol, pyrethrol, saussurol], *lactucin* [c.0.2% of plant], *lactucin*-15-oxalate, 15-deoxylactucin-8-sulfate, 8-deoxylactucin-15-oxalate, lactucopicrin, lactucopicrin oxalate, jacquinellin glycoside, germanicol, β-amyrin, mannitol and inositol (Bauer & Brunner 1939; Bauer & Schub 1929; Budavari et al. ed. 1989; Forst 1941; Schenck & Graf 1937; Sessa et al. 2000; Simpson 1944). Up to 0.02% of a mydriatic alkaloid was isolated from the plant, identified as *hyoscyamine*; however, no *hyoscyamine* was found in samples of German or English lactucarium (Felter & Lloyd 1898). The fresh latex has yielded neo-*lactucin*, which was proposed to be a possible precursor, converting to *lactucin* during the drying of the latex (Bauer & Brunner 1937).

Lactuca virosa is an annual or biennial herb; roots foetid; stems usually solitary, erect, to 2m, branched, glabrous or setose below. Leaves obovate-oblong, dentate to pinnatifid with wide lobes, spinulose on midrib beneath, lateral veins on underside smooth. Inflorescence a long, pyramidal panicle; capitula with c.15 florets; involucre cylindrical; bracts in several rows, with appressed auricles; corolla ligulate, ligules pale yellow; stamens 5, epipetalous. Ovary inferior, unilocular; ovule solitary, basal, anatropous; style solitary, with 2 stigmatic branches. Achenes 6-10mm long, body elliptical, compressed, narrowly winged, rugose, 5-ribbed on one side, blackish, beaked, beak as long as body, lighter in colour; pappus of 2 equal rows of simple hairs.

In dry, sandy or stony places; s., w. & c. Europe, also cultivated, and naturalised as a weed in many areas over the world (Tutin et al. ed. 1964-1980).

L. virosa and L. serriola have frequently been confused, due to the fact that they both exist in various forms which can overlap in appearance. When bruised or broken, L. virosa can be distinguished by its 'opium poppy-like' smell [**Papaver** somniferum]; L. serriola has a smell closer to that of L. sativa. Fresh achenes of L. virosa are a strong purplish or maroon in colour; fresh achenes of L. serriola are smaller, and olive-grey in colour (Oswald 2000).

LAGGERA

(Compositae/Asteraceae)

Laggera alata *(D. Don.) Sch.-Bip. ex Oliv.* **(L. angustifolia** *Hayata*; **L. heudelotii** *C.D. Adams*; **Blumea alata** *(D. Don.) DC.*; **B. heudelotii** *(C.D. Adams) Lisowski*; **Conyza alata** *Roxb.*; **Erigeron alatum** *D. Don.*; **Inula exsiccata** *H. Lév.*; **Vernonia alata** *F. Heyne ex DC.***)** – anriandro

The leaf of this shrubby African herb is smoked as a 'narcotic' by the Bapunu and Bavungu of Gabon (Watt 1967). The herb is strongly aromatic, with a sweet thymol-like odour. It is also eaten as a vegetable in parts of Nigeria, and in other parts of Africa it is used as a disinfectant, and to treat rheumatic pain, fevers, and pneumonia. In TCM, it is an ingredient in an ointment used to apply to skin tumours (Onayade et al. 1990). In Tanganyika, the related L. brevipes is used to treat 'sexual disorders'; in other areas of s.e. Africa, a decoction of the plant is given to a woman after childbirth (Watt & Breyer-Brandwijk 1962).

L. alata growing wild in Nigeria [harv. August] yielded an essential oil containing 44% 2,5-dimethoxy-p-cymene, 16% sabinene, 12% sesquiterpenes, 3% 6-OH-carvotanacetone and 2% 4-OH-carvotanacetone-7-O-angelate (Onayade et al. 1990); 5-desoxylongilobol has also been found in the plant (Buckingham et al. ed. 1994). Another study, using material from Madagascar, obtained 0.476% essential oil from aerial parts, containing eudismane sesquiterpenes [7-epi-pseudoeudesmol, 7-epi-β-eudesmol, 7-epi-α-eudesmol and isointermedeol], juniper *camphor*, β-dihydroagarofuran and β-selinene (Raharivelomanana et al. 1998).

Laggera alata is a strongly aromatic erect woody herb up to 3m or more tall. Leaves alternate, round-sided, broad-obtuse, venation clearly visible; stem leaves broadly oblong-elliptic and obtuse; leaves in the inflorescence elliptic-lanceolate; stem and undersurface of leaves puberulous; stem-wings c.3mm broad. Capitula 1cm or more diam., numerous, usually more than 20 in a spreading paniculate inflorescence; florets usually mauve in numerous heads c.1.3cm long; involucral bracts puberulous; calyx epigynous, reduced to a pappus of persistent or caducous hairs/bristles; corolla sympetalous, 4-5-fid, disc-florets actinomorphic, filiform, ligulate or rarely bilabiate, ray florets zygomorphic; stamens 5, rarely 4, epipetalous; filaments free; anther base not tailed. Ovary inferior, 1-locular, 1-ovuled; ovule erect from the base; style arms clavate without an apical appendage. Pappus bristles numerous; achene sessile, sometimes beaked.

Guinea, Sierra Leone, Liberia, Ghana, Nigeria, British Cameroons, Madagascar [highlands, e. coast], w. coast of Africa (Hutchinson & Dalziel 1954-1972).

LAGOCHILUS

(Labiatae/Lamiaceae)

Lagochilus ferganensis *Ikramov*
Lagochilus gypsaceus *Vved.*
Lagochilus inebrians *Bunge* – inebriating mint, intoxicating lagochilus
Lagochilus proskorjakovii *Ikramov*
Lagochilus setulosus *Vved.* **(L. hirtus** *Lapin***)**
Lagochilus spp. – lagochilus

In the Steppes of Turkestan, central Asia, the shrub L. inebrians is well known to the Uzbek, Turkmen, Tartar and Tajik, who have used it for centuries. The fruiting tops, leaves and stems are collected in October, and flowers are discarded. The herb is bundled and hung to dry in the house during winter; its strength is said to increase on drying, as does its aroma. For use, it is boiled or infused with water, sugar and honey to make a strong tea that acts as a sedative, hypotensive and antispasmodic, with no undesirable side-effects. This 'standard tea' [a.k.a. '5-10% extract'] is prepared by taking a pre-warmed teapot, filling to 1/3 with leaves and flowers, pouring in boiling water to the top, then covering and leaving wrapped in a tea cosy to infuse for 8-10hrs; this may keep for 2-3 days in a fridge. Modernly, it has been used in Russia as a haemostatic, and to treat nervous disorders, skin disorders, glaucoma and allergies. However, due to the current scarcity of the plant, and lack of organised cultivation efforts, any use today would be of synthetic derivatives or of related species. For example, L. ferganensis, L. gypsaceus, L. proskorjakovii and L. setulosus have the same properties as L. inebrians (Emboden 1979a; Schultes 1966; Turney 2004; Tyler 1966).

The psychotropic effects of L. inebrians are thought to stem largely from its content of lagochiline (Abramov et al. 1960; Pulatova 1960), an epoxylabdane or grindelane diterpene alcohol, sometimes referred to as an alkaloid in the older literature [such as Akopov 1954a] (Chizhov et al. 1969; Tyler 1966). Lagochiline has sedative effects, but is not very soluble in water or organic solvents. Two derivatives of lagochiline, lagochiline tetraacetate and lagochilidine [inebrine, a synthetic derivative], have similar sedative properties, but are more readily soluble, and were thus considered better candidates for potential medicinal use than lagochiline (Abramov 1959). Lagochiline acetate has shown sedative activity in humans at a dose of 30mg, and was hypotensive in dogs; like lagochiline, it is also haemostatic [see below] (Asliddinov 1958).

L. gypsaceus has a similar chemical composition to L. inebrians [see below] (Radchenko 1964), and has the same pharmacological properties (Turney 2004).

L. hirsutissimus has yielded 1.2% lagochiline (Sharipova et al. 1974), and the diterpene lactone lagochirzidin (Nurmatova et al. 1980).

L. inebrians has yielded lagochiline [lagochilin; 15.67% in resin, in one analysis], lagochiline tetraacetate, lagochiline 3-monoacetate, 3 diacetates of lagochiline, vulgarol [a labdane diterpenoid], and the alkaloid stachydrine [0.2%] (Abramov 1957; Abramov & Yaparova 1964; Islamov et al. 1978, 1981a, 1981b; Pulatova & Khazanovich 1964). At the beginning of the growing season, 1% lagochiline and 3% lagochiline tetraacetate were found; during full growth, this was reversed to yield 3% lagochiline and 1% lagochiline tetraacetate (Abramov & Yaparova 1964). Compared to wild plants, cultivated plants yielded 20% more lagochiline, as well as higher levels of tannins, and lower levels of carotene (Abramov et al. 1960).

L. pubescens has yielded lagochiline, and 8 acetyl-derivatives of lagochiline (Mavlankulova et al. 1978).

L. seravschanicus did not contain any detectable lagochiline (Radchenko 1964).

L. setulosus has yielded 0.608% stachydrine (Pulatova & Khazanovich 1964), lagochiline, tannins, resins, essential oil, ascorbic acid, carotene, and sugars. It has been suggested as a medicinal substitute for L. inebrians, due to their very similar chemical compositions (Pulatova 1960; Turney 2004).

A range of Lagochilus spp. were studied and all found to contain coumarins [0.3-2.5%], lipids [4.25-8.3%] and tannins [2.0-3.3%] (Sharipova et al. 1974). Members of the genus have also yielded new grindelane-derived diterpenoids (Zainutdinov et al. 1976). Extracts of Lagochilus spp. [given s.c.] were antispasmodic in frogs and rats, antagonising spasms induced by *camphor*, *caffeine*, picrotoxin, and *strychnine* (Akopov 1954b). Extracts or infusions of Lagochilus spp., as well as lagochiline, showed haemostatic activity (Akopov 1954a). An infusion of L. inebrians [old and possibly stale dried herb] was compared to chamomile [see **Anthemis and Matricaria**] in effect; also, the aroma of the dried flowers [which more or less lack aroma when fresh and growing, unlike the leaves] was compared to an intermediate between chamomile and hops [see **Humulus**] (Turney 2004, pers. comm.).

Lagochilus inebrians is a perennial herb, 25-40cm tall; stems numerous, woody at base, simple or branched, densely leafy and densely long-haired, the hairs horizontally spreading, 1-3-jointed, interspersed with numerous capitate sessile glandular hairs. Leaves broad-ovate in outline, 3-5-parted, the lobes broad-ovate, rounded or toothed, cuneate at base, both sides covered with scattered 1-2-jointed spreading hairs and glands; petioles densely beset with 2-3-jointed spreading hairs, the lower 1.5-2cm, the upper dilated, 2-5mm long. Inflorescence semiverticils 4-6-flowered; bracts firm, reclinate, trigonous, subulate, covered with long 2-3-jointed spreading and sessile capitate glandular hairs; calyx tubular-campanulate-infundibular, calyx teeth recurved, broad-ovate or broadly triangular, 5-6mm long, spiny-pointed, the spine 1-1.5mm long, calyx tube covered with short 1-2-jointed thick hairs interspersed with sparse 3-5-jointed slender and numerous sessile capitate-glandular hairs; corolla pale pink, as long to 1.5 times as long as calyx, bilabiate, the tube with a ring of hairs near base; upper lip oblong, erect, flat, densely hairy outside, notched at apex, with 2 lobes; lower lip oblong, 3-lobed, with short straight lateral lobes, middle lobe larger, deeply bifid; stamens 4, as long as or shorter than corolla, the filaments glabrous or pubescent at base; anthers approximate, hirsute; style lobes equal. Seeds sharply trigonous, truncate at apex. Fl. Jun.-Aug.

Submontane plains and low foothills, on pebble-beds and fluviatile outwash, gravelly slopes, in wormwood-grass and wormwood forb associations [see **Artemisia**]; endemic to central Asia, described from Samarkand area (Shishkin ed. 1987) and Nuratau, the only places it has been found. Endangered; wild-harvest and export are prohibited. Difficult to cultivate, and seeds remain viable for only c.1yr; does not root from cuttings. Plant seeds where they are to grow, not too close together, 1-1.5cm deep if sown in autumn or 1.5-2cm deep if sown in spring; seed may require scarification. Sprouts c.6 months later, with 25-40% germination rate. Soil in native range is poor, dry, fine-grained and slightly clayey, and should be ploughed before cultivation; temperatures range from -15°C at night in winter, to over 45°C in summer days; direct sun all day. Roots like to grow deeply [although aerial parts grow slowly and remain short], so cultivation in pots might not be ideal (Turney 2004); however, this extra root growth may reflect the arid climate in which the plant grows, hence if grown in pots with some minimal watering, preferably from a tray underneath [plants don't like it too damp], the roots might not need the extra depth (pers. obs.).

LANCEA

(Scrophulariaceae)

Lancea tibetica *Hook. f. et Thomson* – depgul, Tibetan Lancea

This common Tibetan herb is used to manufacture an intoxicant in Ladakh, India, known as 'berzeatsink'. To prepare it, the roots are dried and roasted over a fire, before being powdered and mixed with tobacco [see **Nicotiana**]. The mixture is then either smoked, or drunk with milk. The effects are said to consist of a strong stimulation, which 'activates' the person consuming it (Navchoo & Buth 1990).

Nothings appears to be known of the chemistry of this species.

Lancea tibetica is a small, glabrous herb; stem very short, to 2.5-10.2cm; rootstock slender, horizontal, creeping. Leaves rosulate, or opposite on stem, 2.5-8.9cm long, obtuse or subacute, narrowed into a ½-amplexicaul petiole 0.6-2.54cm long, rather coriaceous, sometimes very obscurely toothed. Flowers in a very short terminal few-flowered raceme, sunk amongst the leaves; pedicels very short, bracteate, bracts lanceolate; calyx campanulate, 5-fid, lobes acute; corolla 1.9-2.5cm long, blue, tube dilated above; upper lip suberect, concave, 2-lobed; lower large, spreading, 3-lobed, hairy within, palate 2-convex; stamens didynamous, subexserted; anther cells diverging; style filiform; stigma 2-lamellate. Fruit globose, indehiscent, exserted, pea-sized, hardly fleshy. Seeds brown, numerous, small, subglobose, testa thin. Extremely variable in size and luxuriance. Fl. Aug.

In sandy and moist places, often closely appressed to the ground; alpine Himalaya and w. Tibet, India from Kashmir to Sikkim, 7620-12190m (Hooker 1857, 1954-1961).

LATUA

(Solanaceae)

Latua pubiflora *(Grisebach) Baillon* **(L. pubiflora** *(Gris.) Phil.***; L. venenosa** *R.A. Philippi***; Lycioplesium pubiflorum** *Gris.***)** – latué, latúe, latuy, latue-hue, árbol de los brujos ['sorcerer's tree'], palo mato ['tree that kills'], palo de bruja

This feared shrub is used by Mapuche-Huilliche shamans ['machi'] of s. Chile as their most important shamanic plant [see also **Datura**, **Desfontainia**, **Lobelia** and Ovidia pillopillo in *Endnotes*]. It is believed by shamans to give strength, good luck, curing properties and shamanic knowledge if respected, and harvested with appropriate prayers and offerings. It is also used by witches or 'black shamans' ['kalku'] to kill or otherwise harm people. Its use is usually kept very secret, and details are generally not shared with outsiders. Most 'ordinary' locals will attest that only witches use latué. The bark of stems or young shoots ['with plenty of sap'] is taken as an infusion or decoction, drunk during the night in small amounts at 20-30min. intervals. Actual doses of the herb have unfortunately not been disclosed by native informants. The leaves, or juice pressings from the leaves mixed with water or wine, are also sometimes used. Some say the fresh fruits are also equally intoxicating, but they have not tested positive for the tropane alkaloids found in the rest of the plant [the seeds however, have – see below]. The effects of the intoxication are similar to those of **Atropa**, **Brugmansia** or **Datura**, and the plant is sometimes given maliciously to poison others. Shamans are knowledgeable about appropriate doses for use of this plant, either to cure or to drive one insane, but they are reluctant to divulge such information. During the experience [which may last up to 36hrs or more], the shaman is said to perform 4-6 hours of dancing in a circle rigidly, with rhythmic stomping, and chanting of variations on the word 'latué'. Tobacco [see **Nicotiana**] is smoked throughout [perhaps instead **Lobelia** tupa?]. In curing rituals, there may be intermittent praying and attempts to drive out evil spirits from the patient [which sometimes involves slapping the patient with branches of **Cestrum** parqui]. The plant is sometimes thrown on a fire with other herbs [such as **Drimys** winteri (see **Canella**, **Drimys**) bark, Fabiana imbricata foliage (see *Endnotes*), **Cestrum** parqui leaves, **Ilex** paraguariensis foliage] to repel evil spirits and negative emotions (Mohl ed. 1858; Plowman et al. 1971; Rätsch 2001; Schleiffer ed. 1973; Schultes 1979; Schultes & Hofmann 1980).

L. pubiflora is also used in Mapuche initiations of pubescent boys and girls, after a days fast. A beverage is prepared by village elders from the juice of the fresh leaves and branches, collected in the early morning. This is drunk in two stages before the initiate is tied to a tree until the effects wear off, after which the initiate is believed to have "died and is born again to a new life" (Rätsch 2001).

In the past, Chileans used juice from L. pubiflora and **Drimys** winteri to poison fish. Medicinally, it may be applied externally as a bath or alcoholic tincture [sometimes with other herbs] to treat rheumatism. Fruits may be applied directly for this purpose, and infusions made from the leaves and fruit have been used as a sedative. Taken in small doses, the plant is believed to give strength (Rätsch 2001). L. pubiflora has reputedly been used as an aphrodisiac and an ingredient in love potions (Plowman et al. 1971). One psychonaut found the smoked leaves provided him with "a very pleasant physical effect with aphrodisiacal sensations" and compared the accompanying "spiritual relaxation and associative thinking" to the effects of **Brugmansia**. It was warned that not more than 1g be smoked at a time (Rätsch 2001). I have also found the leaves, when smoked in small amounts, to give effective short-term relief of mild asthma. These experiments were prompted by the known use of **Datura** leaves for the same purpose (pers. obs.).

Accidental poisonings sometimes occur, as the plant resembles another, known as 'tayu' [see below], which is decocted to treat shock and pain. Such poisonings are remedied by administration of **Solanum** nigrum ['hierba mora'], an Oxalis sp. ['culle'] and/or Raphithamnus spinosus ['espino negro'] fruit. In the case of S. nigrum, the plant is decocted and drunk during an 8 day fast, during which time the decoction is also applied externally [head, neck and back] as a compress. L. pubiflora is reputed to be able to cause death, though such deaths rarely occur (Plowman et al. 1971), probably due to the respect accorded to the plant and the centuries of accumulated knowledge regarding safe use (pers. obs.), or to the local fear of the properties of the plant (Rätsch 2001).

L. pubiflora leaves have yielded 0.07-0.185% alkaloids [70-86% *atropine*, 14-30% *hyoscine*]; stems yielded 0.24-0.496% alkaloids [87-92% *atropine*, 8-13% *hyoscine*]; seeds yielded 0.09% alkaloids [86% *atropine*, 14% *hyoscine*] (Plowman et al. 1971).

Latua pubiflora is a shrub or small tree 2-10m tall, with 1-several main trunks 3-25cm diam., spreading up and outwards from base; bark thin, streaked with corky, longitudinal fissures, becoming rough, reddish to greyish-brown; branches smooth, grey, with spines; branchlets cylindrical, current growth yellow-brown pubescent, glabrescent; spines erect, arising from axils as modified branches, rigid, to 2cm long, usually subtended by a small leaf, with 1-2 minute cataphylls near apex. Leaves alternate, fascicled on short shoots or scattered on long shoots, simple, narrowly-elliptic to oblong lanceolate, apex acuminate, margin entire to erose-serrate, base attenuate, 3.5-12 x 1.5-4cm, pilose, glabrescent; stipules absent. Flowers pendulous; peduncle solitary, axillary, 1-flowered, 5-9(-20)mm long, tomentose, with series of overlapping bud-scales at base, scales ciliate, ovate, c.2mm long; calyx inferior, gamosepalous, 5-partite, campanulate, persistent, accrescent, 8-10mm long, rugulose with tomentose pubescence, pale green to purplish, lobes valvate, acute, triangular, erect, c.3mm long, calyx in fruit 11-16mm long, splitting irregularly; corolla much larger than calyx, gamopetalous, 5-partite, regular, elongate-urceolate, inflated, 3.5-4cm long, 1.5cm diam. at middle, densely pilose without, magenta to red-violet, lobes short, trilobate, recurved, c.5mm long with induplicate-valvate aestivation; stamens 5, inserted at base of corolla; filaments variable in length, slightly exceeding corolla, filiform, 3-4cm long, adnate for 8mm, base pilose, glabrous above, bright pink; anthers bilocular, elliptic, longitudinally dehiscent, 2mm long, brownish. Ovary ovoid, base gibbous, bilocular, with numerous anatropous ovules attached on axile placenta; style filiform, equalling corolla, 3cm long, pink; stigma short, semicircular, slightly bilobulate, bright green. Fruit a fleshy berry, globose, 2cm diam., apiculate, pale green to yellow; seeds numerous, somewhat reniform or irregular, often flattened ventrally, 2mm diam., albuminous, testa thick, reticulate-pitted, dark brown to black. Fl. from Oct.-Jul., depending on climate; fr. Feb.-Mar.

In wet coastal mountain forest, pastures and roadsides, mostly 300-900m; Chile, from Valdivia Province s. to Chiloé Province.

Propagate from green branch cuttings, or from seed. Prefers mild, rainy climate [but not too wet]; may need protection from frost. Although it often grows relatively in the open, plants grown in shady spots produce larger leaves (Rätsch 2001; pers. obs.). Although Rätsch (2001) stated that "Up to now, it has never been cultivated or spread by man in any other place", L. pubiflora has been available in s.e. Australia for many years as an exotic ornamental shrub, although still very uncommon (pers. obs.).

Rätsch (2001) noted that two forms of this species [the only member of its genus] are distinguished by the Mapuche. The 'male' form is +-

thornless, but the 'female' form is thorny; it is the 'female' form said to bear the magical properties associated with L. pubiflora (Rätsch 2001). Sometimes confused with Dasyphyllum diacanthoides [Flotowia diacanthioides] or 'tayu', a medicinal plant from the same region (Plowman et al. 1971). However, since this plant is a member of the Compositae, this confusion should not occur when the plants are in flower (pers. obs.).

LAURUS

(Lauraceae)

Laurus azorica *(Seub.) J. Franco* **(L. canariensis** *Webb et Berth, non Willd.***; Persea azorica** *Seub.***)** – loireiro, loureiro, louro

Laurus nobilis *L.* – bay laurel, bay tree, sweet bay, laurel, Grecian laurel, lorbeer

The bay laurel holds a rather noble place in European history, and was used as a drug by cultures as early as the Mesopotamians. It has long been used to dispel evil spirits. The Greeks identified it with Apollo, the god of prophecy, poetry and healing. The herb is also dedicated to Apollo's son, Aesculapius, god of medicine. The oracular priestesses at Delphi [the 'Pythia'] were reputed by some researchers to have chewed and inhaled the smoke from the leaves of the bay [which the roof of the Delphi temple was made of], as well as other psychotropic herbs [such as **Hyoscyamus**] to communicate with Apollo (Bremness 1988; Cunningham 1994; Duke 1983; Rätsch 1992). A recent hypothesis which received much publicity suggested that the Pythia may have instead been inhaling hydrocarbon gases [such as ethylene] emitted from bedrock fissures of underground springs at the site (Ball 2001; Reese 2001). However, the evidence used to support this scenario has been comprehensively discredited (Lehoux 2007) [which did not receive the same publicity!].

Bay was also sometimes an ingredient of Greek wines [see *Methods of Ingestion*]. To the Romans, it symbolised wisdom and glory, and was woven into wreaths to crown victorious athletes or other social achievers of the time. The Romans burned their sacrifices together with bay and **Juniperus**. For many years, it was used to treat a wide variety of diseases including plague, and the fruits and leaves have been used to treat hysteria. Bay is considered narcotic, nervine, stimulant, antiseptic, digestive, balsamic, carminative, antitussive and antirheumatic. Today, it is mostly used for culinary purposes in small amounts, particularly in bouquet garni, marinades, soups and stews. The wood is used to smoke meat and cheese, and the essential oil is sometimes used as a flavouring in liqueurs (Bremness 1988, 1994; Duke 1983; Mabey et al. ed. 1990; Rätsch 1992). The essential oil of L. nobilis should not be confused with 'bay oil', which derives from **Pimenta**.

L. azorica leaf essential oil comprised 12.7% α-*pinene*, 10.3% 1,8-cineole, 0.5% *methyleugenol*, *eugenol*, *elemicin* and other compounds, in one study (Hokwerda et al. 1982). L. azorica collected from the Azores yielded 0.3-0.7% essential oil from leaves [consisting of 15-37% α-*pinene*, 9-18% β-*pinene*, 12-31% 1,8-cineole, and 2.2-14.6% trans-cinnamyl acetate as the major components, with traces of *methyleugenol*, trans-iso-*eugenol*, ledol (see **Ledum**), and many others], and 0.4-0.9% from berries [consisting of 27-45% trans-β-ocimene, 9-16% cis-β-ocimene, 12-22% α-*pinene*, and 7-13% β-*pinene* as the major components, with traces of many others] (Pedro et al. 2001).

L. nobilis leaves may yield 1-3% essential oil, comprised of c.38.6% *eugenol*, 0.3% *estragole*, acetyl-*eugenol*, 2.1-7.7% *methyleugenol*, 30-50% 1,8-cineole, 11% chavicol, 31.6% myrcene, and small amounts of *pinene*, limonene, linalool, neral, α-terpineol, geranyl acetate, geraniol and β-phellandrene. Leaves also contain the sesquiterpene lactones costunolide, artemorin, dehydrocostus lactone, verlotorin, santamarine, reynosin, zaluzanin D, 3α-acetoxyeudesma-1,4(15),11(13)-trien-12,6α-olide, and 3-oxoeudesma-1,4,11(13)-trien-12,6α-olide; as well as palmitic acid, lauric acid, oleic acid and linoleic acid. Some of the sesquiterpene lactones inhibit ethanol absorption, and have α-methylene-γ-butyrolactone [α-methylene-GBL] moieties [see *GHB* in *Chemical Index*] (Chiej 1984; El-Feraly & Benigni 1980; Hokwerda et al. 1982; Lawless 1995; Mabey et al. ed. 1990; Schermerhorn et al. ed. 1957-1974; Yoshikawa, M. et al. 2000).

Laurus nobilis is a dioecious shrub or small tree 2-20m tall, with slender glabrous twigs. Leaves 5-10 x 2-4(-7.5)cm, narrowly oblong-lanceolate, acute or acuminate, entire, glabrous, alternate, smooth, leathery, glossy on upper side, opaque on the lower, deep green, veins prominent, among which the numerous oleiferous glands are clearly visible against the light; petiole very short. Flowers actinomorphic, small, yellowish-green; inflorescence subsessile; male flowers with 6-8 stamens, all or most with 2 glands at base; anthers opening by 2 valves, introrse; perianth deeply 4-lobed; female flowers with 2-4 staminodes; ovary superior, 1-celled; style simple; stigma present. Fruit a berry, 10-15mm, ovoid, blackish when ripe.

Mediterranean region, cultivated elsewhere and naturalised in some places (Chiej 1984; Tutin et al. ed. 1964-1980). Grows best in full sun with wind protection in a rich, moist, well drained soil. Cultivate from 10cm stem cuttings or by layering in late summer; plant cuttings in heated propagator with high humidity, if in a cold climate. Gather in summer (pers. comms.).

LEDUM

(Ericaceae)

Ledum groenlandicum *Oeder* **(L. latifolium** *Aiton***; L. palustre ssp. groenlandicum** *(Oeder) Hultén***)** – labrador tea, la dee muskat

Ledum hypoleucum *Kom.*

Ledum palustre *L.* – wild rosemary, marsh rosemary, crystal tea ledum, Dutch myrte, porst, sumpforst, tannenporst, kienporst, mottenkraut, wanzenkraut, bauerkraut, senkura, senkia, synkiu, bagul'nik, puyasmes, makum

'Labrador tea' [L. groenlandicum] was used by the Kwakiutl and Salish of w. Canada, who steeped the leaves to make an intoxicating tea. The leaves also expel catarrh and treat colds, and a tea of them is used in Alaska to relieve colds and hangovers (Bremness 1994; Festi & Samorini 1996; Ott 1993). It has similar medicinal and psychotropic properties to L. palustre [see below], but is generally less potent (Buhner 1998). When smoked, the leaves act as a pleasant stimulant (Zombiebowl pers. comm.).

The Tungus of n. Siberia [including the Nannay, Udegay, Ulk and Orocci] use L. hypoleucum and L. palustre as inebriants, by heating the dried leaves in a frying pan and inhaling the fumes – the effects were said to be stupefying and analgesic (Brekhman & Sam 1967). It has been reported that the root was sometimes chewed at the same time as inhaling the fumes of the smouldering foliage. Ainu shamans use a salted tea of 'spruce', L. palustre and 'mint' [Mentha spp. – see *Endnotes*] during their shamanic curing rituals; the plant alone was used to treat dysmenorrhoea. Leaves, flowers, and/or seeds of L. palustre were once widely used in Europe in beer brewing, often with Myrica gale [see *Methods of Ingestion*, *Endnotes*]. The beer thus prepared was known as 'gruitbier' or 'gruebsing'. The Swedish Vikings were known to consume it in public festivities. L. palustre has been demonstrated to synergise with alcohol, and produce a fuller intoxication more quickly than would either taken alone. Its consumption has been suggested to have been productive of the Berserkers' rage, which is a matter of debate. Alone, the herb has effects similar to alcohol, as well as causing muscle cramps, later paralysis, and strong digestive tract stimulation (Buhner 1998; Festi & Samorini 1996; Rätsch 1992).

In n.w. Europe, L. palustre was used as an ingredient of a magic potion also containing 'hemlock' [see **Conium**], 'henbane' [see **Hyoscyamus**], 'asa-foetida' [see **Ferula**], 'saffron' [see **Crocus**], 'poppy' seeds [see **Papaver**], 'mandrake' [see **Mandragora**], a **Solanum** sp. and an Aloe sp. [see *Endnotes*]. Medicinally, L. palustre is used today as an expectorant, galactagogue, emmenagogue, diuretic, antidiabetic, abortive, antiparasitic and whooping cough treatment (Buhner 1998; Festi & Samorini 1996).

L. palustre has been suspected of producing toxic ericolin-containing honeys; however there is no evidence for the occurrence of this compound in the plant (Ott 1993).

The essential oil is believed to be the psychoactive component of Ledum spp., the activity of which has so far been mainly attributed to the sesquiterpene alcohol ledol ['ledum *camphor*'], one of the major constituents. In humans and other animals, ledol produces initial CNS-excitation, sometimes with convulsive activity and palpitations, accompanied by inebriation; later, paralysis may occur. Its effects are somewhat similar to those of *camphor*. Usually in humans the toxic symptoms only arise with larger doses, which may induce miscarriage (Buhner 1998; Festi & Samorini 1996).

L. groenlandicum foliage yielded 0.035% essential oil, containing small amounts of phenols, aldehydes, sesquiterpenes and azulene, as well as ledol (Lynn et al. 1926).

L. hypoleucum essential oil yielded 2.2% ledol [it was not made clear whether this was as % of oil, or % of plant material] (Festi & Samorini 1996).

L. palustre var. palustre yielded 0.5-1% essential oil, with 1-2.5% ledol [see comment for L. hypoleucum], as well as palustrol, myrtenal, myrcene, *estragole*, alloaromadendrene, lepadol, lepalene, isopinocamphone, germacrone, aesculetin, umbelliferone, *scopoletin*, fraxetin, hyperoside, quercetin, sterols and aliphatic monoterpenes. Aerial parts also yield coumarin glycosides – palustroside, fraxine and esculine (Buckingham et al. ed. 1994; Festi & Samorini 1996; Tattje & Bos 1981).

L. palustre var. macrophyllum essential oil has yielded 22.3% ledol [see comment for L. hypoleucum] (Festi & Samorini 1996).

Ledum palustre is an evergreen shrub, with stems up to 120cm, decumbent to erect; young twigs ferruginous-tomentose. Leaves alternate, shortly petiolate, 12-50 x 1.5-12mm, linear to elliptic-oblong, ferruginous-tomentose beneath, deflexed in winter, margins revolute. Flowers numerous, 5-merous, in terminal, umbel-like, +- corymbose racemes; pedicels 5-25mm, persistently glandular-verrucose and also often ferruginous-tomentose at first, erect in flower, deflexed in fruit; bracts scarious, decidu-

ous; bracteoles absent; sepals small, connate for most of their length; petals free, 4-8mm, obovate, white, patent; stamens (5-)8-10(-14); anthers without appendages. Ovary and capsule verrucose-glandular. Fruit a septicidal capsule; seeds with very loose testa.

In bogs, heaths and coniferous woods; n. & c. Europe, south to s. Germany, n.e. Austria and n. Ukraine, North America from Alaska south to Newfoundland (Tutin et al. ed. 1964-1980). Becoming very rare in Europe (Festi & Samorini 1996).

LEONOTIS

(Labiatae/Lamiaceae)

Leonotis dysophylla *Benth.* **(L. ocymifolia var. raineriana** *(Vis.) Iwarsson***)**

Leonotis leonotis *R. Br.* **(L. ovata** *Spreng.***)** – lion's ear, klipdagga, knoppiesdagga

Leonotis leonurus *(L.) R. Br.* **(Phlomis leonurus** *L.***)** – lion's tail, lion's ear, wild dagga, red dagga, klipdagga, dagga dagga, twalainoyani, minaret flower

Leonotis mollis *Benth.* – balm of gilead [usually applied to the unrelated Populus x candicans]

Leonotis nepetaefolia *R. Br.* **(L. kwebensis** *N.E. Br.***; L. nepetifolia** *(L.) W.T. Aiton***; Phlomis nepetaefolia** *L.***)** – lion's ear, Christmas candlestick, chandelier, cordão de São Francisco, molinillo

L. leonurus is sometimes used as a smoking herb by the Hottentot of S. Africa, when **Cannabis** or tobacco [see **Nicotiana**] are not available. The shoots and immature flower buds are picked, dried and smoked, or a resin may be scraped from the leaves and smoked with tobacco. It has also been used for recreational purposes by the Kaffirs, as well as white farmers, and its 'narcotic' properties are known in the Belgian Congo. Nama tribesmen used to chew a wad of the powdered leaf to produce the desired effects. Decoctions of the plant have been used medicinally, treating skin eruptions, haemmorrhoids, flu, coughs and colds, indigestion, headache, jaundice, partial paralysis, epilepsy and 'cardiac asthma', also acting as a purgative, anthelmintic and emmenagogue. L. leonotis is used in the same way as L. leonurus. The Suto sometimes smoke L. mollis with tobacco. Europeans in southern Africa sometimes use L. dysophylla as a nerve tonic, and L. nepetaefolia as an antispasmodic. L. microphylla is also known as 'wild dagga', 'knopdagga' and 'klipdagga' (Emboden 1979a; Watt 1967; Watt & Breyer-Brandwijk 1932, 1962), suggesting a similar usage. However, some doubt that Leonotis spp. are psychoactive at all. To support this doubt, De Smet (1998) cited an earlier researcher who noticed no effects after smoking 'several successive pipefuls' of L. leonurus. This is in conflict with many modern anecdotal reports of success [eg. see below], though it is possible that some people simply do not respond much to this drug (pers. obs.). One friend suggested from her observations that in general, women are more affected by it than men (Baill pers. comm.).

It should be said that the taste of the plant and its smoke is rather sickly and bitter [perhaps due to the bitter compound marrubiin – see below], a fact acknowledged by the Hottentot. Most people simply don't find it worth the bother, except mixed with other psychoactive herbs to mask the taste. The effect of smoking L. leonurus is rather mild for most people, though some do enjoy it for producing a light, 'playful' high. In practice it may be difficult to obtain resin by scraping the plant directly [as was mentioned above] (pers. comms.; pers. obs.). Observations by growers in New South Wales [Australia] indicate that the plant only produces useful quantities of resin in hot, dry climates, preferably over 40°C. Some claim that resin is only produced in the leaves, with larger and thicker leaves bearing more resin (Torsten pers. comm.) – however, sometimes the flower buds are sticky and thus appear to contain resin. The plant may be hand-rubbed to acquire small amounts of resin in a similar way to making hashish by the rubbing technique [see **Cannabis**]. It may be more desirable to make an extract for smoking purposes. One person described the effects of a dried alcohol extract as "like having a (small) cone [of **Cannabis**] and a (small) line of speed [some variety of *amphetamine*] at the same time. Lasts only about half an hour". Another person obtained a 'crystalline' green powder from sun-drying a liquid extract made by simply passing fresh flower buds through an electric juicer. The smoke from this extract was reportedly quite active and lacked most of the bad taste of the smoked herb (pers. comms.; pers. obs.).

L. dysophylla leaves have yielded 0.44% 8β-OH-marrubiin (Kaplan et al. 1970).

L. leonotis leaves have yielded 0.47% leonitin, a grindelane diterpenoid (Eagle et al. 1978).

L. leonurus has yielded 0.4% marrubiin, premarrubiins I & II, 0.5% compound X and 0.5% compound Y; the leaf may contain up to 19.8% resin (Rastogi & Mehrotra ed. 1990-1993; Watt & Breyer-Brandwijk 1962).

L. nepetaefolia leaves [from Trinidad] have yielded labdane diterpenoids, including nepetaefolin [major component], methoxynepetaefolin, nepetaefolinol, nepetaefuran, nepetaefuranol, leonotin, and leonotinin. Indian plants yielded nepetaefolinol as the major component, and also contained dilactone (Blount & Manchand 1980); 8β-OH-marrubiin (Kaplan et al. 1970) and the coumarin 4,6,7-trimethoxy-5-methylchromen-2-one have also been found in this species (Rastogi & Mehrotra ed. 1990-1993). Plants from Puerto Rico have shown antitumour activity (Blount & Manchand 1980).

None of the diterpenoids found in Leonotis spp. have been shown to be psychoactive, though it would seem that neither have they been adequately studied in this regard.

Leonotis leonurus is a perennial shrub to 2m tall; branches densely hairy, hairs both short and long, simple and multicellular, mostly antrorse. Leaves opposite, green, lanceolate to narrow-elliptic, sparsely hairy, 5-8 x 1-1.5cm, apex subacute, base tapering into petiole, margins irregularly toothed; petiole 3-10mm long. Inflorescence dense whorled clusters of 12 or more flowers per axil; calyx 8-10-veined, funnel-shaped, 8-10-toothed, mouth slightly oblique, tube 10-15mm long, densely shortly hairy, lobes to 1mm long, shortly and broad-triangular, +- mucronate; corolla 30-55mm long, bright orange, 2-lipped, lower lip 3-lobed, upper lip concave, longer than lower; stamens 4, ascending upper lip of corolla; anther loculi divergent. Ovary deeply 4-lobed; style gynobasic; stigma reduced to a tiny tooth. Mericarps +- smooth. Fl. all year.

Native to S. Africa; a garden escapee in coastal areas of Victoria, New South Wales and Western Australia [Australia]. Common in cultivation (Harden ed. 1990-1993).

Propagate these attractive plants from seed in winter, or from cuttings in spring. Provide with full sun, watering deeply and infrequently. Very hardy in Melbourne, Australia (pers. obs.).

LEONURUS

(Labiatae/Lamiaceae)

Leonurus cardiaca *L.* – common motherwort, lion's ear

Leonurus heterophyllus *Sweet* **(L. artemisia** *(Lour.) S.Y. Hu***)** – chong wei, i-mu-tsao, yi-mu-cao, yet-mo-juo

Leonurus sibiricus *L.* – Siberian motherwort, marihuanilla, honeyweed, i-mu-tsao, yi-mu-cao

'Motherworts' have long been used for their relaxing and therapeutic properties. Culpepper stated "there is no better herb to take melancholy vapours from the heart, to strengthen it, and make a merry, cheerful, blithe soul." Some early herbals also recommended it against 'wicked spirits' (Ody 1993). L. cardiaca is used to relieve anxiety in new mothers. It is sedative, calms tachycardia, lowers blood pressure, treats menstrual pain and irregularity, contracts the uterus after birth, reduces muscle spasms and reduces blood fat levels (Bremness 1994; Chevallier 1996; Mabey et al. ed. 1990; Pendell 1995; Polunin & Robbins 1992).

L. heterophyllus and L. sibiricus are often used interchangeably in

TCM – they are considered pungent, bitter and cold in energetics, with an affinity for the liver and heart meridians. They have the same gynaecologic applications as L. cardiaca, and are used [in a 15-60g deoction] to stimulate circulation and respiration, cause vasodilation, clear clots and disperse phlegm. The seeds, known as 'huang wei zi', have similar uses to the herb, as well as brightening tired or sore eyes (Bremness 1994; Hsu et al. 1986; Huang 1993; Reid 1995), and acting as a diuretic and aphrodisiac, increasing sperm count (Perry & Metzger 1980).

Since at least 1918, L. sibiricus has been smoked in Malaya when **Cannabis** was not available. In some areas of Chiapas, Mexico, it is known as 'marihuanilla', and is smoked for its sedative effect. It is also used in a tincture to treat rheumatic fever (Diaz 1979; Emboden 1979a). The effects of Leonurus spp., smoked in large joints, are somewhat similar to those of smoked **Cannabis** leaf (pers. comms.; pers. obs.). Dried, powdered leaves and flowering tops of L. sibiricus [c.500mg or ¼tsp for a starting dose] may be taken orally with fruit juice for mild psychotropic effects lasting 2-3hrs; blending with **Cannabis** and/or **Tagetes** is reported to enhance the effects (Lazar 2002).

L. cardiaca has yielded 0.0068% of the guanidine alkaloid leonurine when flowering [diuretic, stimulates skeletal muscle, followed by neuromuscular depression], 0.055% stachydrine, leocardin, 0.001% of the labdane diterpene 10-acetoxypregaleopsin, the iridoid glucosides leonuride [ajugoside] and ajugol, flavonoids [such as marrubiin (see **Leonotis**), rutin, quinqueloside, quercitrin, isoquercitrin, hyperoside, genkwanin, 5,4'-dihydroxy-7-methoxyflavone, *apigenin*-derivatives and kaempferol-3-O-D-glucoside] and vitamin A (Buckingham et al. ed. 1994; Gulubov & Chervenkova 1971; Huang 1993; Kartnig et al. 1985; Ody 1993; Papanov et al. 1998a, 1998b; Rastogi & Mehrotra ed. 1990-1993; Schermerhorn et al. ed. 1957-1974).

L. heterophyllus has yielded 0.01% leonurine, stachydrine, leonuridine, leonurinine, lauric acid, oleic acid, vitamin A and fatty oils (Hsu et al. 1986; Huang 1993).

L. sibiricus has yielded 0.02-0.04% leonurine, stachydrine, leonuridine, leonurinine, cycloleonurinin, leosibirin, isoleosibirin, leosibiricin, rutin, arginine, stachyose, 4-guanidino-1-butan-ol, 4-guanidinobutyric acid, 12,13-epoxyoleic acid, palmitoleic acid, linoleic acid, oleic acid, eicosanoic acid, benzoic acid, lauric acid, sterol and vitamin A (Buckingham et al. ed. 1994; Hsu et al. 1986; Rastogi & Mehrotra ed. 1990-1993).

Leonurus sibiricus is an erect annual or biennial herb to 180cm tall; stems obtusely quadrangular, furrowed, usually softly retrorse-pubescent. Leaves 3.8-10cm long, deeply 3[or more]-parted, palmatipartite with linear incised segments, glabrous or nearly so above, pale and +- pubescent on the veins beneath, upper floral leaves often entire; nerves strong below; petioles up to 5cm long. Inflorescence of axillary spiked whorls; bracts subulate, ½-fully as long as the calyx tube; calyx 6-8mm long, turbinate, glabrous or slightly pubescent, 5-lobed, lobes spinescent from a triangular base, tube weakly 10-nerved, 5mm long; corolla pink-reddish, to 13mm long, tube roughly equalling the limb, annulate within, upper lip obovate, galeate, entire, pubescent, lower lip roughly equalling the upper, 3-lobed, the middle lobe subcordate, the 2 lateral lobes smaller, rounded; stamens 4; anthers conniving, cells transverse. Nutlets 2.5mm long.

Waste places; tropical Asia, plains of India, Africa, America (Gleason 1952; Kirtikar & Basu 1980), naturalised weed in Australia [N.S.W.] (Hnatiuk 1990).

LEPTACTINIA

(Rubiaceae)

Leptactinia densiflora *Hook. f.* – karo-karoundé, nami, wata, tangboruku

The leaves of this African shrub contain an essential oil, which is used in perfumery. Its wood might be useful in craft [such as for making musical instruments, snuff boxes, hairpins and combs], as is the wood from L. senegambica (Burkill 1985-1997; Usher 1974). This plant is of greater interest here due to its chemistry.

L. densiflora leaves have yielded 0.5% *leptaflorine* [tetrahydroharmine], which was first found in this plant (Paris & Caiment-Le Blond 1955); roots have yielded 0.18% crude alkaloids, including *tetrahydroharman* (Paris et al. 1957). The root bark has also yielded 2% catechuic tannin, and a small amount of flavones. Flower essential oil contains c.32% phenolic acids. Trunk bark and root bark of L. senegambica have also tested positive for alkaloids (Burkill 1985-1997).

Leptactinia densiflora is a large, bushy shrub; branchlets densely or sparingly pilose, or nearly glabrous. Leaves broadly elliptic to obovate, obtuse or cuneate at base, +- acuminate at apex, more than 7.5-20 x 3-11cm, with 7-10 main lateral nerves on each side of the midrib, usually with long weak hairs and tufts of shorter hairs by the midrib and nerves beneath; petioles more than 5mm long. Inflorescence a terminal corymb; white fragrant tubular flowers 2.3-7.6cm long, velvety outside, in dense heads; calyx lobes contorted in bud, 1.3-3cm long; corolla tube (2-)4-8(-10.5)cm, lobes (1.2-)1.8-3(-3.5)cm long; anther cells not divided into compartments. Ovary 1-2-celled; ovules several to numerous; style included in corolla tube, with 2 recurved spreading arms. Fruits black, ribbed and wrinkled, 1.3cm diam., crowned by the long calyx.

Sierra Leone, Liberia, Ivory Coast, Ghana, s. Nigeria (Hutchinson & Dalziel 1954-1972).

LESPEDEZA

(Leguminosae/Fabaceae)

Lespedeza bicolor *Turcz.* – bicolor Lespedeza, bush clover

Lespedeza bicolor var. japonica *Nakai* – bicolor Lespedeza, bush clover, wild stem, hu chih tzu

Over much of the world, Lespedeza spp. are used as a protein-supplement forage for stock animals, and for green manure, as well as being grown to prevent soil erosion (Allen & Allen 1981). L. bicolor var. japonica is reportedly used in Brazil in a similar way to 'jurema' [see **Mimosa**] (Der Marderosian 1967; Watt 1967). In N. America, L. bicolor is used as an analgesic, as is L. capitata (Ott 1993). The Kiowa give a leaf tea of L. capitata as a tonic for the sick, and the Omaha and Ponca used the herb as a 'moxa' [see **Artemisia**] for neuralgia and rheumatism (Kindscher 1992).

Recently, red autumn leaves of L. bicolor [cultivated in US] were reported to be useful as a component of an ayahuasca analogue [see *Methods of Ingestion*]; c.30g or more of these leaves, with an MAOI, was sufficient to produce the desired effects (Ringworm pers. comm.).

L. bicolor var. japonica from Japan has yielded *tryptamine* alkaloids [0.068-0.106% crude alkaloids from leaf, 0.206% from root bark]. Leaves contained *DMT* [major alkaloid – 0.25% in one test], *5-methoxy-DMT*, *bufotenine*, and 0.035% *lespedamine* [1-methoxy-*DMT*]; root-bark contains these alkaloids in greater amounts, as well as *DMT* N-oxide and *5-methoxy-DMT* N-oxide (Goto et al. 1958; Morimoto & Matsumoto 1966; Morimoto & Oshio 1965). Independent TLC-analysis of L. bicolor var. bicolor has found alkaloids to be in greater concentration in the seeds; no alkaloids were detected in foliage of the 1st year's growth (Trout ed. 1997d). In a broad alkaloid screening, L. bicolor roots [from US, harv. Sep.] tested negative for alkaloids, and seeds tested positive only in preliminary tests; the confirmation tests were negative (Fong et al. 1972). Leaves also contain the carbohydrate d-pinitol; unripe seeds contain the amino acid canavanine [see **Canavalia**], as well as orientin, homoorientin, quercetin, isoquercetin, kaempferol [MAOI (Sloley et al. 2000)], trifolin, and 6 other flavonoids (Glyzin et al. 1971; International... 1994).

L. capitata has yielded a great array of flavonoid glycosides [including kaempferitrin and iso-orientin], as well as the alkanes n-pentacosane, n-hentriacontane, n-hexacosane and n-tritriacontane (Linard et al. 1982; Tin-Wa et al. 1969). In a broad alkaloid screening, root, stem, leaf and fruit tested negative (Fong et al. 1972).

L. cuneata leaves have yielded the C-glycosylflavones isoorientin, isovitexin, vicenin-2, lucenin-2, and the C-glycosylflavonoid 6,8-di-C-pentosyl-*apigenin* [a feeding stimulant for larvae of Eurema hecabe mandarina, a butterfly which uses this plant as its host] (Numata et al. 1980).

L. cyrtobotyra root bark has yielded isoflavanones [lespedeol A, lespedeol B] and pterocarpans [lespein, lespedezin]; stem bark yielded chalcones [lespeol, xanthoangelol]; heartwood yielded isoflavonoids [daidzein, dalbergioidin, genistein, haginins A-D, lespedeol C, 3,9-dihydroxypterocarp-6a-en, 2-(2,4-dihydroxyphenyl)-6-OH-benzofuran], as well as isoliquiritigenin (Miyase et al. 1980, 1981), which has shown MAOI properties (Pan et al. 2000).

Canavanine has also been found in L. macrocarpa, L. sericea and L. tomentosa (Bell et al. 1978); alkaloids were not found in leaves and stems [harv. Mar.-Jul.] of L. hirta, L. sericea, L. striata, or L. stipulacea growing in New Zealand (White 1951).

Lespedeza bicolor is an erect shrub to 1m, woody at base; stems stout and erect. Leaves mostly trifoliate; leaflets ovate, rounded or emarginate at tip, petioluled, pinnately veined; stipules linear or ovate-lanceolate, awl-shaped, setaceous, persistent. Flowers small, purple, in conspicuous clustered racemes; 2 kinds of flowers – petaliferous (papilionaceous) and apetalous, the apetalous fertile; peduncles 1-3cm long; bracts linear, small, subtending each pedicel, persistent; pedicels often 2-3 together, long and slender, bearing 1 or 4 persistent bracteoles at base of calyx; calyx campanulate, cylindric, 5-lobed, acuminate but not setaceous, calyx teeth ovate-lanceolate; standard oblong-obovate, clawed; wings oblong, slightly curved, clawed; keel petals obovate, incurved; stamens diadelphous, grouped 9 and 1; anthers uniform. Ovary sessile or stalked, 1-ovuled; style filiform, incurved; stigma small, terminal. Pod oval-orbicular, sessile or short-stalked, compressed, reticulate, tipped with remnant style, indehiscent; seed 1, flat, rounded. Fl. Jul.-Sep., fr. Oct.

In brushland; n. China, Manchuria, Japan and Hawaii.

L. bicolor var. rosea is found in the US (Allen & Allen 1981; Steward 1958).

Cultivate from seed; scarification is beneficial, but seed damages easily, and clean seed should not need it; may be inoculated with bean inocu-

lant, but can germinate and grow without; sow early spring, c.6mm deep, germinates 1-3 weeks. Grow in full sun, almost any soil; drought resistant (pers. comm.).

LICARIA

(Lauraceae)

Licaria cannella *(Meisn.) Kosterm.* **(Aydendron cannella** *Meisn.***)**
Licaria puchury-major *(Mart.) Kosterm.* **(Acrodiclidium puchury-major** *Mez.***; Nectandra puchury-major** *Nees***; Ocotea puchury-major** *Mart.***)** – pixuri, puchuri, puchury, puchery, puchyry, picheri

The seeds of L. puchury-major, known as 'puchuri', are widely used in Brazil as a sedative tranquilliser, and to treat intestinal disorders. A dose is prepared by taking one seed [weighing c.4-5g], powdering it, and infusing in 70-100ml boiling water, in a wrapped, sealed container. This preparation is referred to as 'abafado' (Carlini et al. 1983). The seeds are readily harvested from the rainforest floor as they strongly resist decomposition, and can thus be easily picked out from other rotting vegetable matter (Himejima & Kubo 1992).

L. aritu [also from Brazil] contains the neolignans licarin-A and licarin-B in the wood; licarin-A is almost identical to dehydrodiiso-*eugenol*, except for its differing optical activity (Aiba et al. 1973).

L. cannella [again from Brazil] has yielded *elemicin*, *dillapiole*, sitosterol and neolignans [canellins A-C], all from the trunk wood (Giesbrecht et al. 1974).

L. puchury-major seed essential oil [yield 1.8%] is rich in phenylpropenes – 36-51.3% *safrole*, 3.3-14% *eugenol*, 2.9% *methyleugenol*, and *anethole*; as well as 25% 1,8-cineole, 5.4% eucalyptol, 8.9% lauric acid, 8.6% α-terpineol, 4-terpineol, geraniol, limonene, γ-terpinene, linalool, caryophyllene, and lauric acid. Essential oil from the leaves contained 21.7% *safrole*, 1.7% *eugenol*, 47.6% eucalyptol and 11.7% α-terpineol; branchwood essential oil contained 20.1% *safrole*, 61% *eugenol*, 10.8% eucalyptol and 6.8% α-terpineol. The non-essential oil fraction of an aqueous seed preparation showed depressant activities in mice [administered i.p.] different to those caused by the less potent essential oil fraction (Carlini et al. 1983; Da Silva et al. 1973; Himejima & Kubo 1992).

Licaria puchury-major is a tree with straight branchlets, glabrous, bark very aromatic. Leaves sparse to subopposite, glabrous, elliptic, +-120 x 55mm, base obtuse to subacute, apex shortly caudate-acuminate, loosely prominently reticulate on both sides, especially beneath; petioles to c.20mm long. Inflorescence axillary, (sub)few-flowered, racemose-paniculate, base subfasciculate-divided, moderately tomentellous, inflorescence-leaves short, pedicels barely present; flowers tomentellous, 4mm long; perianth tube largest, ellipsoid, apex not constricted, lobes long, 4, scale-shaped, ovate, obtusely acute. Male parts in 2 exterior perianthiform series, sterile, perianth lobes subequal in 2 exterior series, foliaceous; 1/3 of biglandulose base fertile, 1/4 entirely abortive; filaments introrse, thick, fleshy, glabrous, free, apex not constricted; anthers 2, shortly separate, introrse, apex obtuse. Ovary subsuperior, glabrous, ellipsoid; style very short, conical, terete, gradually attenuate, glabrous; stigma slightly obtuse. Berry totally included in cupule when immature, adult oval, cupule doubly high, mostly c.5cm long; cupule large, thick, rugulose, sub-saucer-shaped, obscurely double-marginate.

In forests; n.w. provinces of Brazil, upper Amazon, near Tabatinga, Rio Negro (Garke & Urban 1889).

LIMONIA

(Rutaceae)

Limonia acidissima *L.* **(L. crenulata** *Correa***; Feronia elephantum** *Correa***; F. limonia** *(L.) Sw.***; Schinus limonia** *L.***)** – elephant apple, wood apple, monkey fruit, curd fruit, citron des mois, kapitthah, velagapandu, bela, katbel, kaith, kavita

In India, this plant has a variety of medicinal applications. The leaves treat epilepsy; the root is purgative, diaphoretic, and treats colic; and the fruits treat indigestion and persistent fevers, and prevent contagion of smallpox. The fruit is also considered tonic, and an antidote to various poisons (Kirtikar & Basu 1980; Nadkarni 1976). In Thailand, the fruit juice is used as a yellow ink, and a yellow powder made from the stems [called 'tanaka'] is used as a cosmetic face paint. A water soluble gum from the tree ['feronia gum', or 'velampisini'] is used in the manufacture of glue, varnish and water paints. The tree is also cultivated for its aromatic fruit, which may be eaten raw or made into a variety of beverages and desserts (Usher 1974; Zarga 1986).

L. acidissima fruit has yielded acidissiminol, acidissiminin epoxide and N-benzoyl-*tyramine* [see **Casimiroa**] (Ghosh et al. 1991). Root bark has yielded the coumarin dihydrosuberenol (Ghosin et al. 1982). Stem bark has yielded 0.045% *DMT*, 0.0027% N-acetyl-*N-methyltryptamine*, 0.0035% 2-methyl-THβC, 0.0004% 3-formylindole, 0.0027% tanakine, 0.003% tanakamine, 0.00025% tembamide, 0.0005% N-(p-OH-β-phenethyl)-p-OH-cinnamide, 0.004% 4-MeO-2-quinolone, 0.001% 4-MeO-1-methyl-2-quinolone, 0.0025% 4,8-dimethoxy-2-quinolone [edulitine], 0.0003% physcion [a laxative anthraquinone], 0.0017% syringaresinol [a cytotoxic lignan], and limonoids [0.0007% acidissimin, 0.0017% obacunone, limonin and methyl-deacetylnominilate]. The plant has also yielded other coumarins, including umbelliferone, geranyl umbelliferone, marmesin, xanthotoxine, luvangetin, suberosin, epoxysuberosin, suberenol, crenulin and crenulatin; as well as β-sitosterol and lupeol (MacLeod et al. 1989; Zarga 1986); leaf essential oil contains *estragole* (Harborne & Baxter ed. 1993).

Limonia acidissima is a spiny, glabrous shrub or small tree; spines sharp, 1.2-2.5cm long. Leaves alternate, pinnate, 2.5-10cm long; leaflets in 2-4 pairs, 2.5-5 x 1.2-2.5cm, trapezoid-ovate, obtuse, rarely acute, notched at apex, crenulate, glabrous, base cuneate; petiole and rachis jointed, the former narrowly, the latter very broadly winged; joints of rachis obovate-oblong, crenulate. Flowers in umbelliform, often leafy racemes; peduncles 2-3 together from axils of fallen leaves; pedicels slender; calyx small, glandular, lobes 4, broadly ovate, acute; petals 4, glandular, imbricate, 6mm long, elliptic-oblong; stamens 8, free, subequal; filaments linear-subulate; anthers cordate or linear-oblong; disc stipitiform. Ovary papillose, 4-celled; ovules 1-2 in each cell; style stout; stigma obtuse or capitate. Berry c.1.2cm diam., globose, 1-4 seeded, very acidic; seeds embedded in mucilage.

W. & s. India, Punjab, n.w. Himalaya, Simla, Kumaon, Bihar, Bengal, Assam, Burma, Siam, Cambodia, Laos, Yunnan, Malaya, Java (Kirtikar & Basu 1980).

LOBELIA

(Campanulaceae/Lobeliaceae)

Lobelia alata *Labill.* – angled lobelia
Lobelia cardinalis *L.* **(Dortmannia cardinalis** *(L.) Kuntze***)** – cardinal flower, common red lobelia
Lobelia chinensis *Lour.* **(L. caespitosa** *Blume***; L. campanuloides** *Thunb.***; L. erinus** *Thunb.***; L. radicans** *Thunb.***)** – ban bian lian
Lobelia deckenii *(Asch.) Hemsl.* – Tanganyika lobelia, giant lobelia
Lobelia excelsa *Bonpland*
Lobelia inflata *L.* – Indian tobacco, wild tobacco, lobelia, poke weed, emetic weed, asthma weed, gagroot
Lobelia laxiflora *Kunth* **(Tupa laxiflora** *(Kunth) Planch. et Oerst.***)** – chilpanxóchitl
Lobelia pyramidalis *Wall.* – rato phul ['red flower'], deu nigalo ['bamboo of the gods']
Lobelia quadrangularis *R. Br.* – jarrinymawu ['cave dweller']
Lobelia syphilitica *L.* – blue cardinal flower, giant lobelia
Lobelia spicata *Lam.*
Lobelia tupa *L.* – tupa, tabaco del diablo
Lobelia spp.

L. inflata is used as a medicine and ritual smoking herb by many native North American groups. Although today in herbal medicine many consider it too toxic to use, low doses can be used safely with care and in moderation. The Cherokee use it to break tobacco addiction [see **Nicotiana**], to treat asthma and sore throat, and as an emetic; it is also applied as a poultice to sores and aches. The Cherokee also use L. spicata to treat shaking and trembling. The Crow used L. inflata ritually, and the Mesquakie and Pawnee used it in love magic. The Penescot used it to induce sweating and vomiting, to drive out evil spirits. It may be smoked to improve mental clarity and relax the body, as well as to treat asthma and bronchitis. The plant is also taken internally as a decoction, though it is potentially more toxic via this route (Bremness 1994; Hamel & Chiltoskey 1975; Hutchens 1973; Kindscher & Hurlburt 1998; Ott 1993; Rätsch 1992). In more recent times, L. inflata has been explored as a mild psychotrope in smoking mixtures amongst curious psychonauts (Rätsch 1990; Siegel 1976).

The Cherokee also use L. cardinalis and L. syphilitica interchangeably – a root tea treats worms and stomach troubles, and a leaf tea treats fever, rheumatism, colds and sores. L. cardinalis is also used as an antispasmodic, and acts as a nervine. These two species are also used by the Mesquakie in love magic. The Iroquois use L. cardinalis as a kind of panacea, and often mix it with other ingredients to strengthen their effects; they consider it to protect against witchcraft, treat depression, and render one attractive to the opposite sex. They also use a root decoction of L. syphilitica to treat syphilis, fluid retention, and diarrhoea [in small doses for the latter]. The powdered root was put in the bed of quarrelling couples to rekindle their love. In Mexico, L. laxiflora root is used as a respiratory stimulant and anti-spasmodic, and has *lobeline*-like effects [see below]. In the Chilean highlands, the Mapuche smoke L. tupa ['tobacco of the devil'] to produce a narcotic or even visionary stupor. The Mapuche also press the milky sap from the leaves or roots, to apply externally to headache and toothache (Bremness 1994; Emboden 1979a; Hamel & Chiltoskey 1975; Heffern

1974; Rätsch 1992). Other reports of Mapuche shamans using tobacco [either smoked, snuffed or chewed] as one of their most important 'narcotic' plants during curing ceremonies (eg. see Plowman et al. 1971) most likely also refer to L. tupa, rather than **Nicotiana** (pers. obs.).

In TCM, L. chinensis leaves and stems are used as a hypotensive, diuretic, respiratory stimulant, antibacterial, and to stimulate bile secretion (Huang 1993). They may be used also for similar effects to other species such as L. inflata (pers. obs.). In India, L. excelsa is smoked by poor people. L. nicotianifolia is used to treat asthma, scorpion stings, and as an antiseptic, but it is more commonly used as a poison – as little as 1 drachm [1.8g] of the dried leaves is said to produce death (Chopra et al. 1965). In Nepal, L. pyramidalis may sometimes be used to transform water into 'amrita' (Müller-Ebeling et al. 2002). In northern Australia, the Ngarinyman chew dried L. quadrangularis as a 'bush tobacco' [see **Nicotiana**]; nowadays, it is often used mixed with commercially-available chewing-tobacco, and some ash made from the bark of Eucalyptus camaldulensis (Smith et al. 1993). In S. Africa, L. pinifolia root is used as a diuretic, and to treat rheumatism, gout, and skin diseases; it is also credited with stimulant and diaphoretic properties (Watt & Breyer-Brandwijk 1962). The giant L. gibberoa bears a latex, with a smell described as 'nauseating', which can cause violent emesis from ingestion of very small quantities (Watt & Breyer-Brandwijk 1962).

Lobelia spp. all seem to have similar chemistry and properties. Common to the genus is the alkaloid *lobeline*, which has a *nicotine*-like action, with only 1/5th-1/20th of the potency. The herbs are either smoked, steeped in water [1 tab. herb or more to 1 pint of water] or lightly decocted. The tea has an acrid taste which may cause prickling sensations in the mouth and throat, and smoking can cause headache. The effects, at low doses, are a short-lived mild stimulation, euphoria, and relaxation. Higher doses are more narcotic, and may be accompanied by nausea, vomiting, sweating, trembling, paralysis, pain, hypothermia, diarrhoea, dilated pupils, incoordination, confusion, and rapid or irregular pulse. Severe cases of poisoning may result in convulsions, coma and death from respiratory paralysis (Foster & Caras 1994; Huang 1993; Turner & Szczawinski 1991; pers. obs.). Grubber (1973) claimed that the seeds are the most potent part of these plants.

L. alata gave a positive result in an alkaloid screening (CSIRO 1990); when smoked, it had similar effects to L. cardinalis or L. inflata (Torsten pers. comm.).

L. cardinalis has yielded 0.71% *lobeline*, as well as lobelanidine and 2 unidentified alkaloids (Krochmal et al. 1972b)

L. deckenii has yielded *lobeline* (Watt & Breyer-Brandwijk 1962).

L. inflata [consisting of flowering and fruiting aerial parts] has yielded 0.36-2.38% *lobeline* (Krochmal et al. 1972a), as well as lobelinine, lobelanine, lobelanidine, isolobinine, meso-lobanine, meso-lobelanidine, isolobilanidine, lelobanidine, norlelobanidine, lobetidine, lobinanidine, lobinine, allosedamine, norallosedamine, sedinine, lobetyol, lobetyolin, 8-ethylnorlobelol, (+)-8-phenylnorlobelol, 8,10-diethyllobelidiol, 3-OH-3-phenylpropanoic acid, 8-methyl-10-ethyllobelidiol, and 8-methyl-10-phenyl-lobelidiol (Bruneton 1995; Buckingham et al. ed. 1994; Krochmal et al. 1972b; Morton 1977; Rastogi & Mehrotra ed. 1990-1993). *Lobeline* content was, on average, highest in cultivated plants, though one wild plant analysed gave the highest yield reported [2.38%]. Cultivated plants also tended to be larger than wild plants (Krochmal et al. 1972a).

L. portoricensis leaves [from flowering plants] yielded c.1.25% alkaloids, with a *lobeline*-like alkaloid, portoricin, as the major component; in animals, portoricin acted as a respiratory stimulant and anticholinergic (Meléndez et al. 1967).

L. puberula has yielded c.1% *lobeline*, as well as lobelanidine and 2 unidentified alkaloids (Krochmal et al. 1972b).

L. purpurascens from Queensland, Australia [harv. Mar. & Nov.] tested strongly positive for alkaloids (Webb 1949), and contains *lobeline*. The plant is strongly emetic (Cribb & Cribb 1981).

L. syphilitica has yielded 0.49% *lobeline*, as well as lobelanidine, and 2 unidentified compounds, one of them an alkaloid (Krochmal et al. 1972b).

Lobelia inflata is an erect herb, stems usually branched, villous, up to 1m tall. Leaves alternate, exstipulate, sessile or subsessile, ovate-oblong to oblong-obovate, 5-8 x 1.5-3.5cm, obtuse or acute, +- serrate, usually pubescent. Racemes terminating the branches, 10-20cm long; lower bracts foliaceous, the upper gradually reduced; pedicels 3-8mm long, glabrous or puberulent, bracteolate at base; flowers 7-10mm long, irregular, epigynous, gamopetalous, 5-merous; sepals linear, 3-5mm long; corolla blue or white, split to base along dorsal side, 2-lipped, 2 lobes of upper lip usually erect, the lower lip pubescent, with 3 spreading lobes; stamens 5, inserted at very base of corolla, alternate with corolla lobes, +- protruding through the cleft corolla, shorter than or exceeding corolla tube; anthers united into a tube around style, usually coloured, lower 2 bearded at apex. Ovary 2-celled; hypanthium much inflated in fruit. Fruit a capsule, opening apically; seeds many. Fl. Jul.-Oct.

Open woods in moist or dry soil, sometimes a weed of gardens or lawns; eastern US (Gleason 1952).

Sow seed where they are to grow early in spring, after the last frosts; in very cold areas, start inside in flats. Sprinkle seed on ground and rake lightly. Enjoys plenty of sun, and adequate [but not excessive] water; does not respond well to high-humidity conditions. Harvest when in flower (Krochmal et al. 1972a; Torsten pers. comm.).

LOLIUM including some ACREMONIUM endophytes

(Gramineae/Poaceae)

Lolium perenne *L.* **(L. brasilianum** *Nees***; L. canadense** *Bernh. ex Rouville***; L. marschallii** *Steven***; L. multiflorum** *Lam.***)** – perennial rye grass

Lolium temulentum *L.* **(L. arvense** *With.***; L. giganteum** *Roem. et Schult.***; L. maximum** *Willd.***; L. speciosum** *Stev. ex M. Bieb.***; Craepalia temulenta** *(L.) Schrank***)** – darnel, bearded darnel, drake, drunken rye grass, thyaros ['plant of frenzy'], aira, eaver, ivray ['inebriating'], cizana, borrachuela ['drunkenness'], taumellolch ['delirium grass'], cheat, cockle, zawan, tares, zizanion

(Clavicipitaceae/Balansiae)

Acremonium lolii *Latch., Christensen et Samuels* **(Neotyphoideum lolii** *(Latch et al.) Glenn et al.***)**

Acremonium spp.

'Darnel' [L. temulentum] has an age-old reputation for causing intoxications in both humans and animals, though some crops are non-toxic. People throughout history have occasionally become intoxicated by darnel grains baked into bread, or from the barley in beer-brewing being contaminated with darnel. Such contaminated barley is said to produce a beer that is "very intoxicating" and "unusually and even dangerously heady". Three different recipes for witch's flying potions contain darnel in their ingredients. Rumour has it that in Lebanon, a mystic group living in the mountains make a water infusion of darnel, to induce "religious ecstasy". In the Chiquian valley of Peru, L. temulentum seeds are known as 'cizana', and are added to the fermented chicha brew [see *Methods of Ingestion*] to increase its intoxicating potency. In the Canary Islands, darnel is used as a tranquilliser (Bacon 1995; Duke 1983; Gardner & Bennetts 1956; Ott 1993; Samorini 2001). L. temulentum infected with ergot [see **Claviceps**] was suggested as a possible ingredient in the Eleusinian kykeon (Wasson et al. 1978). The 'zizanion' referred to in the Bible [Matthew 13] as a weed of wheat plantations has been translated as 'tares', 'darnel' or simply 'weed', and is believed by many researchers to represent L. temulentum, though another weed of wheat fields, Cephalaria syriaca, has also been proposed as a possible identity. Both also share the name 'zawan' in Jordan and Syria (Musselman 2000).

Consumption of L. temulentum seed can cause dizziness, headache, tremor, weakness, gastrointestinal disturbance, and a delirious state accompanied by visual and auditory phenomena. Toxic doses may cause convulsions, paralysis and even death, though death in humans is very rare. L. perenne can cause similar symptoms; it also has detergent, oestrogenic, antigangrene, antiperiodic and sometimes antibiotic actions, also relieving diarrhoea. In animals, symptoms may include incoordination, head shaking, and collapse, effects which are only temporary. Seeds of these two grasses are not life-threatening in moderate amounts (Cheeke 1995; Chopra et al. 1965; Duke 1983; Gallagher et al. 1984; Gardner & Bennetts 1956; Pammel 1911; Watt & Breyer-Brandwijk 1962). However, some state that Lolium spp. have 'no pharmacological activity' themselves, and that any psychotropic effects experienced would be due to infection of the grasses by **Claviceps** ergot, or other endophytes with which they are frequently infected [see below] (Wasson et al. 1978; Samorini 2001).

Intoxicating properties of darnel are most likely due to compounds formed by the fungi living symbiotically in most examples of L. temulentum, long believed to be an Acremonium sp. Recently, strains of Neotyphoideum occultans have been isolated from specimens of L. temulentum. Neotyphoideum spp. are asexual forms of Epichloë spp., closely related to Acremonium spp. L. perenne, which is toxic to livestock [causing 'rye-grass staggers'], supports the endophyte Acremonium lolii [now regarded as Neotyphoideum lolii]. These fungi have a protective rather than a deleterious effect on the grass they inhabit. The loline alkaloids [see below] were long believed to be formed by the host grass in response to endophyte infection (Casabuono & Pomilio 1997; Freeman & Ward 1902; Moon et al. 2000); however, it now appears that these compounds can also be produced by the endophytes themselves [see **Festuca**] (Blankenship et al. 2001). For more discussion of Acremonium, Epichloë, and Neotyphoideum endophytes, see **Stipa** and **Festuca**.

In Western Australia, L. rigidum ['annual ryegrass', 'Wimmera ryegrass'] is a prominent pasture grass, and has caused poisoning in stock animals. Symptoms may be noted within 2 days to 12 weeks after feeding on the grass. "The disease is characterised by staggering and convulsions and affected animals collapse, convulse for some minutes then may regain their feet and stagger away with a stiff-legged 'rocking horse' gait".

These symptoms are most noted when animals are disturbed or forced to move, and although they often recover after a few minutes of apparent intoxication, a mortality rate of up to 53% in sheep and 45% in cattle has been recorded. Toxicity is believed to be due to infection by nematodes [Auguina lollii] which hitch a ride on the growing plant, later eating into developing flowers, where they develop into adult worms and lay their eggs. The nematode is host to a yellow, slimy bacteria [a Corynebacterium sp.], which develops fully in the flowering plant, often killing the nematode in the process. It is uncertain which organism is the cause of the toxicity (Pearce et al. 1974).

L. cuneatum has yielded loline, norloline, N-methylloline, N-formylloline, N-formylnorloline and N-acetylloline (Petroski et al. 1989).

L. perenne has yielded *harman* and *norharman* (Allen & Holmstedt 1980). When infected with Acremonium lolii it has yielded 0.0005-0.004% peramine [a pyrrolopyrazine alkaloid; insect feeding deterrent, tremorgen], perloline [mildly toxic, but rapidly destroyed metabolically after administration], 0.0005-0.001% lolitrems A, B, C, D and E [indole isoprenoid diterpenoids; tremorgens], paxilline [precursor to lolitrem B], 13-desoxypaxilline, paspaline [an indole-diterpenoid], terpendole M [an indole-diterpenoid; tremorgen], lolitriol, α-paxitriol and 0.0005% ergovaline [reduces prolactin levels]. Lolitrem B content is highest in leaf sheaths, and lowest in blades of A. lolii-infected plants. **Penicillium** spp. yielding tremorgens such as janthitrem B have been found growing on decaying plant matter in L. perenne pastures, and may complicate the observed toxicology amongst stock animals (Bush & Jeffreys 1975; Cheeke 1995; Gallagher et al. 1984; Gatenby et al. 1999; Porter 1995; Rowan et al. 1986; Watt & Breyer-Brandwijk 1962). As L. multiflorum, it has yielded octopamine, and the *phenethylamine*-conjugate annuloline (Lundstrom 1989); the roots of germinating seedlings have yielded annuloline, between the 6th and 14th day (O'Donovan & Horan 1971). It is often infected by strains of the endophyte Neotyphoideum occultans (Moon et al. 2000).

L. temulentum caryopses have yielded 0.11% alkaloids, with 0.05% loline, 0.06% temuline [narcotic, mydriatic], temulentic acid and temulentine [a decomposition product of the former – both can produce vomiting and paralysis of the brain, spinal cord and heart nerves]. Stems, leaves and peduncles have yielded 0.019% alkaloids, consisting of 0.003% perloline, 11-β-OH-gibberellin A, fructose and fructosan (Buckingham et al. ed. 1994; Chopra et al. 1965; Dannhardt & Steindl 1985; Ott 1993; Pammel 1911; Watt & Breyer-Brandwijk 1962).

Lolium perenne is a caespitose perennial grass, similar in habit to L. temulentum; culms green to straw-coloured. Leaf blade plicate when young, 3-20 x 0.2-0.6cm. Spikes 4-30cm long, stiff, slender to somewhat stout; spikelets 7-20mm long, 4-14-flowered, elliptic to obovate-elliptic in lateral view; superior glume shorter than the rest of the spikelet, 5-7-nerved, narrowly lanceolate, apex usually obtuse, smooth; lemmas 5-7mm long, 5-nerved, muticous, imbricate, obovate-oblong or oblong, apex acute to subobtuse; paleas with scaberulous keels; anthers 3-4mm long; caryopsis c.4.5mm long (Exell & Wild ed. 1960).

Introduced over much of the temperate world; a weed in all states of Australia (Parsons & Cuthbertson 1992).

The fungus **Acremonium lolii** is identified by the presence of septate, intercellular, infrequently branched hyphae running longitudinally in the leaf-sheaths; conidia ellipsoid to reniform, 5-7µm long, produced simply on slender conidiophores; it is also found in the grain, and is quite variable in its characteristics.

L. perenne is also sometimes host to the seed-transmissible Gliocladium-like and Phialophora-like fungi, most often in cosymbiosis with Acremonium spp.; these have penicillate conidiophores (Christensen et al. 1991, 1993; Siegel et al. 1995). It has also recently been found to sometimes be host to Tilletia walkeri, which can also infect other Lolium spp. T. walkeri has tuberculate teliospores, and the surface of the exospore is made up of incomplete cerebriform ridges (Castlebury & Carris 1999). Freeman & Ward (1902) gave a detailed description of the growth of the Acremonium sp. endophyte of L. temulentum, the fungus still being unidentified at that time.

LONCHOCARPUS

(Leguminosae/Fabaceae)

Lonchocarpus violaceus *Benth.* **(L. benthamianus** *Pittier***; L. longistylus** *Pittier***; L. violaceus** *(Jacq.) Kunth. ex DC.***; L. violaceus** *Oliv.***)** – balché, lancepod, greenheart, savonette, savonette le ba, savonette petite feuille

The 'balché' tree has long been cultivated and held sacred by the Maya of Yucatan [Mexico], n. Guatemala, and British Honduras, who use it to prepare a ritual beverage of the same name. It is consumed communally in times of need, to re-establish links with the gods [who gave the balché ritual to the Mayan ancestors], or sometimes for almost any reason that can be thought of off-hand [as with the Lacandon Maya]. The brew was once taken rectally as an enema, but today is usually only consumed orally. The beverage is prepared in a specially-made canoe, which is sometimes made from the balché tree itself. Water is added to the canoe; wild honey [which usually may not be consumed for more trivial purposes] is then dissolved in the water to a ratio ranging from 1:1 to 2:1 [water:honey]. Old, used pieces of balché bark, probably harbouring yeast colonies, are crushed and added, along with fresh bark strips, and sometimes root, equivalent to 4 strips each c.33cm long per brew [it was not noted how many people this would serve]. This mixture is then fermented for 3-6 days, with a final alcohol content of 1-5%. Incantations are uttered throughout the early stages of preparation, calling in the spirits of toxic plants and creatures of the jungle, some of which may also be added to fortify the brew [see *Methods of Ingestion*].

Before group consumption in a ritual circle, the 'soul' of balché is offered to each of the gods in turn in a palm-leaf cup [or other appropriate vessel], held up to the heavens. A conch-shell is sounded, which invites everyone to attend the circle to drink. All are served an equal amount from a central pot, and all drink simultaneously. Over the next few hours, 17 litres or more may be consumed by each person, with frequent vomiting, urinating and defecating to make room for more. Effects, which manifest quickly, consist of euphoria, feelings of good-will, sharpened perceptions, muscle relaxation, emesis, and purging, followed finally by a deep sleep. There is said to be little subsequent hangover. Apparently, even after drinking large quantities, one does not feel drunk, despite the alcohol content, due to a modification of action from the balché bark. When made with 'kava' [see **Piper 2**] in place of L. violaceus, the effects are very similar (De Lima et al. 1977; Montgomery pers. comm.; Rätsch 1990, 1992; Rätsch pers. comm.).

It should also be noted that in Yucatan, a stingless bee collects honey from **Turbina** corymbosa; this honey is said to be quite inebriating (Ott 1998a). It is not known whether the wild honeys used for preparing balché similarly bear psychoactive constituents from such a source.

In Central and South America, the roots of some Lonchocarpus spp. [such as L. nicou (L. floribundus) and L. densiflorus] are thrown into water as a fish poison. In Brazil L. urucu is used for this purpose, but it is the leaves and stems which are valued, rather than the root. The use of these plants in stupefying fish is due to their rotenone content [up to 20% in L. nicou dry root]. Species high in rotenone have a thick, abundant latex. Rotenone is a neurotoxin which is generally considered non-toxic to mammals (Allen & Allen 1981; Prance 1972; Usher 1974). However, recent animal studies have implicated rotenone [i.v.] in causing some symptoms of Parkinson's disease, with chronic exposure (Butcher 2000; Greenamyre et al. 1999). Canavanine [see **Canavalia**] has been found in some Lonchocarpus spp., such as L. bussei, L. capassa, L. cyanescens, L. eriocalyx, L. laxiflorus and L. neisii (Bell et al. 1978).

L. violaceus root bark has yielded 16% of a raw extract, containing prenyl-stilbenes called longistylines [similar to *kawain* from kava – see **Piper 2**], and rotenone; the root has yielded 1.4% longistyline A, 0.3% longistyline B, 1.3% longistyline C and 0.7% longistyline D. All of the longistylines have antibacterial properties (De Lima et al. 1977; Monache et al. 1977; Rätsch 1992), but their potential psychoactive properties seem to be uninvestigated. Seeds have also yielded the peptide enduracididine and traces of 4-OH-arginine, as well as the alkaloids 2-amino-4,5-dihydro-1H-imidazole-4-acetic acid, and 3,4-dihydroxy-2,5-bis(OH-methyl)pyrrolidine (International… 1994).

Lonchocarpus violaceus is a small, glabrous tree. Leaves alternate, imparipinnate; leaflets in 3-5 pairs, ovate, translucent-dotted, to 8.9cm long, dark green above. Flowers numerous in axillary racemes to c.25cm long; bracts small, caducous; bracteoles 2; calyx truncate, lobes short or obsolete, 2 uppermost ones longer and connate; petals whitish outside, pale purple or pinkish inside, standard orbicular-obovate, with 2 basal ears, wings oblique-oblong, clawed, eared, slightly adherent to the keel above the claw, keel obtuse, eared, clawed; stamens 10, 1 of them separated at the base but united above with the other 9; anthers versatile. Ovary silky-pubescent, 2-many-ovuled; style incurved, filiform; stigma small, terminal. Fruit a flat, indehiscent leguminous pod, lanceolate, membranous or leathery, to 5.9cm long and half as wide, 1-seeded; seeds round, flat or kidney-shaped.

S.e. Mexico, Guatemala, British Honduras, West Indies, Colombia, Venezuela, Zimbabwe; cultivated as an ornamental (Allen & Allen 1981; Bailey & Bailey 1976).

LOPHANTHERA

(Malpighiaceae)

Lophanthera lactescens *Ducke*

This tree has been reported to be used as a source-plant in some S. American ayahuasca brews, in place of **Banisteriopsis** caapi (Schultes 1986). It is also drunk as a therapeutic tea in the Amazon, reputed to have febrifugal properties (Ribeiro & Machado 1947). L. pendula leaves are used as a strong diuretic in the upper Rio Negro region of Brazil (Schultes & Raffauf 1990).

L. lactescens leaves have yielded lophanterine, an alkaloid of unknown structure [has an extremely bitter taste, and febrifugal properties] (Ribeiro & Machado 1947); (4R,6α,7α,15β,16β,18β,21β,22α)-6,7,15,16,24-pentaacetoxy-22-carbomethoxy-21,22-epoxy-18-OH-27,30-bisnor-3,4-seco-1,20(29)-friedeladien-3,4-olide has also been found in the plant (Buckingham et al. ed. 1994).

Lophanthera lactescens is a tree up to 15m high, young parts with bitter white latex; adult branches glabrous. Leaves opposite, generally 20-30 x 8-14cm, above applanate-canaliculate, sparingly pilose, at length glabrous, obovate, base cuneate-attenuate, apex obtuse or subrotundate, plane, membranaceous, on both sides glabrous and shiny; petiole 2-2.5cm long, moderately robust; stipules connate in petioles, 1-1.5cm long, base robust, triangular, apex subulate, rarely shortly bi-fid, appressed pilose, margin villose, soon glabrate. Inflorescence a raceme, usually to 50cm long, reddish-pubescent, lateral branching alternate, dense, numerous, commonly biflowered; flowers c.1.25cm diam.; bracts and bracteoles ovate-lanceolate, to 1.5mm long, bracteoles moderately large, terminating in a long stipe; calyx 5-partite, 10-glandulose; sepals ovate-lanceolate, acute; petals golden-yellow, oblong-obovate, clawed, margin revolute, c.6mm long; stamens 10, all fertile; filaments bearing hairs, united with stamen at base; anthers 1.5-2mm long, glabrous. Ovary triloculer; locules oblong, lateral exterior appendiculate, cristiform, verrucose, decurrent near base; styles 3, ventrifixed, subulate, acute. Fruit a capsule c.5mm long, tricoccous, carpophore lacking, slowly loculicidal; seeds subglobose, testa crustaceous.

Habitat near rivers, not on flooded land, in old-growth secondary forest; near middle Tapajos river, Pará river, Brazil (Ducke 1925; Engler & Niedenzu 1928; Fridericus & De Martius ed. 1965-1975).

LOPHOPHORA

(Cactaceae)

Lophophora diffusa *(Croizat) H. Bravo* **(L. echinata** *Croizat* **var. diffusa** *Croizat***; Anhalonium williamsii** *Rümpler***; A. williamsii** *(Lemaire) Lemaire***)**

Lophophora fricii *Haberm.* – possibly hikuri walula saeliame, or jíkuli huálala saeliami ['hikuri of great authority']

Lophophora jourdaniana *Haberm.* **(Anhalonium jourdanianum** *Lewin***; Echinocactus jourdanianus** *Rebut ex Maas***)**

Lophophora williamsii *(Lemaire) J. Coulter* **(Anhalonium lewinii** *Hennings***; Ariocarpus williamsii** *Voss***; Echinocactus williamsii** *Lem. ex Salm-Dyck***; Mammillaria williamsii** *J. Coulter***)** – peyote, peyotl, pellote, hikuli, hikuri, jículi, jículi huanamé, huanamé, wanamé, xicori, pejoriseni, azee, ho, makan, beyo, walena, joutouri, kamba, nezats, hunka, challote, mescal buttons, muscale buttons, devil's root, diabolic root, dry whiskey, Indian dope, white mule, good medicine

Lophophora williamsii var. caespitosa *Ito* **(L. caespitosa** *Fric ex Roeder***)** – kobuki-ubadama

'Peyote', L. williamsii, has been used as a ritual entheogen for at least 3,000yrs. The Aztecs used it as a remedy for many ailments in low doses, such as rheumatism, headaches and fever; in higher doses it was used by shamanic priests as a magical plant for divination, and was considered one of the most important entheogens. It was also consumed in water, possibly with pulqué brewed from Agave spp. [see *Methods of Ingestion*], at ritual celebrations. It was eaten by Tarahumara runners to give endurance and speed, and warriors sometimes wore the dried plant as an amulet to give 'superhuman strength' and protection. As well as L. williamsii ['hikuri', 'hikuri huanamé'], the Tarahumara used a great variety of medicinal and magical cacti [eg. see also **Mammillaria**]. M.S. Smith (2000) has suggested the 'hikuri walula saeliame' ['hikuri of great authority'] known to the Tarahumara might have been L. fricii.

With the coming of the Spanish conquest, peyote was one of the first 'demonic' plants noticed by the invaders, and its users were persecuted and driven into hiding. Today, it is still widely used by the Huichol, to whom it is the most important entheogenic link with the great spirit 'Hikuri', which is also their name for the cactus, and for the deer, all of which are synonymous in the Huichol cosmology. Once a year, they make a pilgrimage [of which there are lengthy descriptions in some of the references below] to their sacred collecting ground, 'Wirikuta', the mythic place of origin, where Hikuri and the 'Kakauyarixi' [the divine ancestors of the Huichol] dwell. The trek is led by a shaman who is in touch with Hikuri, and is preceded by a ritual of confession of the sexual histories of all present. No one is permitted to show anger or jealousy; a knot is tied in a cord for each confession, before it is burnt in the fire in a rite of purification. The members of the procession take with them only tobacco [see **Nicotiana**], water and tortillas for provisions. Once the 'hunt' for peyote begins at Wirikuta, the first plant sighted is surrounded with arrows fired to mark the 4 cardinal points around the plant; all present cry, pray and make offerings of tobacco-gourds, while the shaman pushes the 'spirit of the dying deer' back into the plant with his prayer-arrow. The plant is then respectfully sliced off at ground level with a sharp knife, and small pieces of the 'button' are distributed for all to chew. Later, the hunt begins in earnest, with buttons being harvested with true love, and apologies made for removing them from their home. The day concludes with an all-night peyote session, and the next day the group leaves for home, with the year's peyote supply [both for their own people, and for trade with other peyote-using groups who have no pilgrimage] (Anderson 1996; Bravo 1937; Bye 1979b; Diaz 1979; Furst 1976; Kloesel 1958; Rätsch 1992; Schaefer 1995; Schultes 1937a, 1937b; Schultes & Hofmann 1980, 1992; Wasson 1963).

By the beginning of the 1870's, peyote use had begun to spread north as journeys into Mexico by native American peoples brought back news of its lofty virtues. In the US, indigenous people had begun to be confined in reservations, and many were losing their cultural identity and heritage, and most importantly, their spirituality. The Kiowa and Comanche were the first to start the spread of peyote, adapting its use to the needs of modern 'Indians', as an effort to return cultural pride and a connection with the great spirit; many other men had an important part in the spread of this movement. In 1918, the Native American Church was officially formed to protect the right of native people to use peyote, which was by then illegal in the US. They held out against massive pressure from local government and church groups, and continue to be a major church today; peyote use is still illegal in the US for non-native users, and even the legal use by church members still faces regular uncertainties in circumstances where local law enforcement officers are less than sympathetic. Church members usually live by a code of ethics known as the 'peyote road', including the practice of honesty, love, sharing, care of the family, self-reliance, and abstinence from alcohol – this last point is sometimes loosely adhered to, but it is generally held that alcohol should never be drunk with peyote. It has been said that "a peyote lesson can be as gentle as a baby, or as harsh as your lack of respect." Peyote also enjoys medicinal uses, besides being 'medicine for the spirit' – it acts as an effective tonic stimulant, topical analgesic, antirheumatic, antipyretic, haemostatic, antibiotic and antiseptic; the juice can also be applied to wounds, forming a flexible scab which holds the wound together, speeding the healing process (Anderson 1996; Bye 1979b; Farnsworth 1968; McCleary et al. 1960; Mount 1993; Ott 1993; Schultes 1937a, 1937b, 1969c; Stafford 1992).

Many readers will expect a description of an 'authentic' peyote ceremony; however, each group has their own variations. For greater detail on different practices, see the references listed. Below is a broad summarisation of some of the elements involved in Plains Indians practices.

The ceremony is presided over by the 'Roadman', who is aided by the 'Chief drummer' [keeps up the drumbeat all night on a water-drum], 'Fire chief' [attends the fire, tends the sick, watches the door], and 'Cedar man' [uses cedar incense to revive the disoriented; see **Juniperus**]. They erect the meeting place for the ceremony, which is often a tipi with a fireplace in the middle; a crescent-moon shaped altar is set up, on which is later placed a large peyote specimen ['father peyote'] on a bed of **Artemisia** ['sagebrush']. Ritual paraphernalia [such as a gourd-rattle, incense, eagle feathers etc.] is arranged in preparation. The ceremony begins just after dark. When the father peyote is placed on the altar, informalities cease and the ceremony has begun. Tobacco cigarettes are rolled in corn-husks and passed around; tobacco is smoked throughout the night. Prayers are offered, incense is burnt, participants 'smudge' themselves with smouldering bunches of **Artemisia** ['smudge sticks'] and the bag of peyote is passed around for all to consume several buttons. More peyote may be eaten at any time through the night as needed. Those who become ill leave the tipi to vomit and are 'smudged' by the Cedar man before re-entering. At midnight, the Roadman leaves the tipi and blows his eagle-bone whistle to the four corners of the earth. The ceremony continues until dawn, when a 'peyote woman' enters the tipi and distributes water and basic food. At the conclusion, the participants join the tribe for a communal meal, after the ritual paraphernalia has been packed away and the area cleaned (Anderson 1996; Schultes 1937a; Schultes & Hofmann 1992).

Today, the non-traditional gathering of peyote in the wild has severely diminished its natural distribution, and diverted supplies from traditional groups who require it for their spiritual practices. Peyote is now endangered in the wild [due to over-collection, ploughing up of habitat, and landowners barring access to their properties for legitimate collection], and should only be collected from specimens cultivated from seed or cuttings (Anderson 1995). Traditional harvest time [for best psychological effect, and least somatic side-effects] is December to April or mid-May; some experienced users say January and February are the best times. At other times of the year, the tetrahydroisoquinolines [THIQs] are found in greater proportion to *mescaline* and related phenethylamines. The plant is harvested by slicing level with the ground, or preferably just above ground level, leaving some green growth; this latter method ensures the best chance of regeneration. This above-ground portion is known as the peyote button, and is often dried – a dried button c.2-3cm diam. constitutes one 'button-unit' for dose calculation when no scales are available. The root is preferably dusted with charcoal or sulphur dust and allowed to form a dry callus, and left in the ground to regenerate. Many new heads will sprout from the root in time, if it survives. Peyote buttons may be taken fresh or dried, and may be chewed, or decocted and drunk. The white

tufts of hair are usually plucked out before chewing. Some traditional groups press the fresh plants on a metate, collecting the juice and mixing it with water for consumption. The cactus is extremely bitter in taste, and nausea and vomiting often develop early in the experience [many native users believe the degree of vomiting is associated with impurities of body and spirit]. Some say it is best to consume it slowly over a period of time, to lessen the shock to the system [a method of questionable validity, according to some – see **Trichocereus**]. A good technique of chewing is to chew the button up with the front teeth, tossing the smaller pieces to the back of the mouth to be swallowed. Effects begin to be felt in 1-3hrs, and are similar to those of *mescaline* alone; however, the experience is qualitatively different due to the many other active compounds present. Duration is up to 12hrs or more (Mount 1993; Schultes & Hofmann 1980, 1992; Stafford 1992; Trout & Friends 1999; pers. comms.).

The effects of L. diffusa, which is low in *mescaline* but fairly rich in THIQs, differ greatly, bearing more similarity to anticholinergic hallucinogens, in some reports. Effects may include "clumsiness, confusion, general malaise and prolonged diaphoresis…two individuals described pleasant effects characterised by tranquillity and mental clarity accompanied by visual and especially auditory images" (Diaz 1979). Another individual ingested 20 buttons of L. diffusa, which had been decocted in aguardienté liquor, and reported a **Datura**-like experience (http://www.lycaeum.org/drugs/trip.report/view_report.cgi?RowID=246).

Phenethylamine will, in most cases, here be abbreviated to PEA.

L. diffusa has yielded 0.9% alkaloids [w/w, whole plant], mostly *pellotine* [1.997-2.213%; over 90% of total alkaloids], with traces of *mescaline* [0.006-0.03%; c.1% of total alkaloids], as well as [given as % of total alkaloids] the isoquinolines isopellotine, O-methylpellotine, 5% anhalamine [6,7-dimethoxy-8-OH-THIQ; claimed to have physiological activity similar to *mescaline*], 3.8% *anhalonidine* [6,7-dimethoxy-8-OH-1-methyl-THIQ], 0.6% anhalinine [6,7,8-trimethoxy-THIQ; similar effects to anhalamine], 0.7% O-methylanhalinine, 0.1% anhalidine, 0.1% anhalonine [6-MeO-1-methyl-7,8-methylenedioxy-THIQ; excitant in animals], 0.1% lophophorine [1,2-dimethyl-6-MeO-7,8-methylenedioxy-THIQ; excitant in animals; in humans, 20mg has caused headache, vasodilation, hot flushing, nausea, and slowed pulse, effects lasting c.40 min.]; and *phenethylamines* – 0.1% *tyramine*, 0.1% N-methyltyramine, 0.5% *hordenine* and 0.1% N-methylmescaline (Bruhn & Holmstedt 1974; Kloesel 1958; Shulgin & Shulgin 1997; Starha 1997; Trout & Friends 1999).

A sample identified as L. diffusa var. koehresii yielded [as % of total alkaloids] 86.27-90.51% *pellotine*, 4.42-5.06% anhalamine, 2.63-4.27% *anhalonidine*, 0.97-1.67% *mescaline*, and lesser amounts of *hordenine*, anhalinine, anhalonine, anhalidine, O-methylanhalidine, O-methyl-*pellotine*, lophophorine, N-methylmescaline, 3,5-dimethoxy-4-OH-*PEA*, N-methyl-*DMPEA*, *tyramine* and N-methyltyramine (Štarha & Kuchyna 1996). A specimen identified as L. echinata yielded [w/w] 0.003% *mescaline* (Siniscalco 1983).

L. fricii yielded 1.607-2.031% *pellotine*, c.0.014% *mescaline*, and [as % of total alkaloids] 24.9-25.9% *anhalonidine*, 2.2-2.7% anhalinine, 1.9-2.3% O-methylanhalinine, 1% anhalidine, and lesser amounts of *tyramine*, N-methyltyramine, *hordenine*, N-methylmescaline, anhalamine, anhalonine and lophophorine.

L. jourdaniana yielded 0.585-0.795% *mescaline* [31% of total alkaloids in one test], 0.621-0.799% *pellotine* [17.8% of total alkaloids in one test], and [as % of total alkaloids] 20.1% *anhalonidine*, 3.2% N-methylmescaline, 2.9% *hordenine*, 3.1% anhalidine, 1.7% anhalamine, 1.1% anhalonine, 1.4% lophophorine, and lesser amounts of *tyramine*, N-methyltyramine, anhalinine and O-methylanhalinine (Štarha 1997).

L. williamsii has yielded 0.4[w/w, whole plant]/0.93[w/w]-8.86% alkaloids; roots have yielded 0.2% alkaloids [w/w] (Bruhn & Holmstedt 1974). *Mescaline* is the major component in mature plants, and content averages at 1% [though up to 6% has been found], or 15-30% of the total alkaloids; as well as [as % of total alkaloids] 0.74-17% *pellotine*, isopellotine, O-methylpellotine, 0.5-5% lophophorine, peyophorine [2-ethyl-6-MeO-1-methyl-7,8-methylenedioxy-THIQ], 0.1-8% anhalamine, 1,2-deyhdroanhalamine, N-formylanhalamine, N-acetylanhalamine, isoanhalamine, 0.001-10% anhalidine, isoanhalidine, 0.01-0.5% anhalinine, 0.5% O-methylanhalinine, N-formylanhalinine, 0.5-3% anhalonine, N-formylanhalonine, N-acetylanhalonine, 5-14% *anhalonidine*, isoanhalonidine, O-methylanhalonidine, N-formylanhalonidine, N-formyl-O-methylanhalonidine, 1,2-dehydroanhalonidine, 1,2-dehydroanhalidinium quaternary salt, 1,2-dehydropellotinium quaternary salt, peyotine iodide quaternary salt, anhalotine iodide, peyoxylic acid, O-methylpeyoxylic acid, peyoruvic acid, peyoglutam, mescalotam, peyotine iodide, and lophotine iodide; the other major group of alkaloids present are the *phenethylamine*s, of which *mescaline* is a part – as well as 0.5-1% *tyramine*, 0.5-1% N-methyltyramine, 5-8% *hordenine* [anhaline, peyocactin – an antibiotic; mostly in roots], *dopamine*, epinine, 3-MeO-*tyramine* [homovanilylamine], 3-MeO-N-methyltyramine, N,N-dimethyl-3-MeO-*tyramine*, 3,4-dimethoxy-phenethylamine [*DMPEA*], 3,4-dihydroxy-5-MeO-*PEA*, 5% 3-OH-4,5-dimethoxy-*PEA* [3-demethylmescaline; unstable, absent in old material], 4,5-dimethoxy-N-formyl-3-OH-*PEA*, N-acetyl-4,5-dimethoxy-3-OH-*PEA*, 4,5-dimethoxy-3-OH-N-methyl-*PEA*, 3-demethyl-trichocereine, 3% N-methylmescaline, N-formylmescaline, N-acetylmescaline, *mescaline* succinamide, *mescaline* malimide, *mescaline* maleimide, *mescaline* citrimide and *mescaline* isocitrimide lactone; peyoglunal, peyonine, N-(3,4,5-trimethoxyphenethyl)*glycine*, N-(3,4,5-trimethoxyphenethyl)alanine and *choline* have also been found (Anderson 1996; Bruhn & Holmstedt 1974; Crosby & McLaughlin 1973; Gennaro et al. 1996; Kapadia & Fayez 1970; Kapadia et al. 1968; Kloesel 1958; Lundstrom 1989; McCleary et al. 1960; McLaughlin & Paul 1966; Shulgin 1973; Shulgin & Shulgin 1997; Siniscalco 1983; Štarha 1997; Todd 1969). 'Buttons' may lose 89% water on drying (Bruhn & Holmstedt 1974). Younger plants yield lower levels of alkaloids (Gennaro et al. 1996), as do cultivated plants receiving plenty of water (pers. comm.). Recently, methanol extracts of L. williamsii have been found to have some anti-tumour and immune stimulant activities (Franco-Molina et al. 2003).

L. williamsii var. caespitosa has yielded 0.616-0.786% *mescaline*, 0.205-0.396% *pellotine*, 0.029% *anhalonidine*, 0.146% anhalidine, anhalamine and lophophorine, as well as betaine derivatives – 0.036% anhalotine [3,4-dihydro-8-OH-6,7-dimethoxy-2-methylisoquinolinium inner salt], peyotine [3,4-dihydro-8-OH-6,7-dimethoxy-1,2-dimethylisoquinolinium inner salt], 0.022% 3,4-dihydro-8-OH-6,7-dimethoxyisoquinolinium inner salt, and 0.0036% 3,4-dihydro-8-OH-6,7-dimethoxy-1-methylisoquinolinium inner salt (Fujita et al. 1972; Štarha 1997).

Lophophora williamsii is a cactus, stems solitary to numerous, glaucous-green to bluish-green, depressed-globose to depressed-cylindroid, mound-like, mature plants to 2.5-7.5cm high or more (I have seen a specimen clumping to 25cm high), 5-10cm diam.; ribs mostly c.8-12; younger tubercles at apex bulging, to 5mm high, the older ones flattening out as stem enlarges, irregularly-hexagonal, to 25mm diam.; areoles 2-4mm diam., typically 12-25mm apart, during the first year of growth in mature plants bearing a dense tuft of white, +- silky hairs to 7-10mm long, later in a compact cylindroid tuft with ends broken off; spines none (seedlings with a few weak, bristle-like spines). Flower apical, 12-25mm diam., 12-30mm long; sepaloids with greenish middles and pink margins, the largest narrowly oblanceolate, 9-15mm long, to 3mm wide, strongly cuspidate, acute, margin entire; petaloids pink in middles, pale to nearly white at margins, the largest oblanceolate, 12-15 x c.4mm, acute and cuspidate, entire; filaments pale, c.2mm long; anthers yellow, 1-1.4mm long; style white, tinged with pinkish, to 9 x 1-1.5mm; stigmas 5, 2 x c.1mm, thin and flattened; ovary in anthesis turbinate, 3-4.5mm long, smooth, not scaly, surrounded by hairs to 12mm long. Fruit red, walls thin and transparent, fleshy at maturity, elongate, clavate or nearly cylindroid, enlarged gradually upwards, 12-20 x c.3-5mm; seeds densely papillate, 1.25mm long, c.1mm wide, 0.8mm thick.

In limestone or partly limestone soil in hills, alluvial fans, and desert flats, 150-1200m; Chihuahuan Desert, Rio Grande Plain, Texas, n. Mexico (Benson 1982; pers. obs.).

L. williamsii var. caespitosa refers to specimens with several stems arising from the one root; however, this is not an unusual feature and the plant is otherwise the same as L. williamsii (Anderson 1996), though often sold as L. caespitosa in the horticultural trade (pers. obs.).

Most botanists accept two species of Lophophora – L. diffusa and L. williamsii [some believe the genus consists of only the latter], L. diffusa differing mainly from L. williamsii with its yellowish-green skin, indistinct or absent ribs, and whitish to yellowish-white flowers. It also has a smaller, more southern distribution [state of Querétaro, Mexico], and is distinguished by its alkaloid profile [see above]. L. fricii and L. jourdaniana are two putative classifications which some argue belong with L. williamsii. L. fricii differs from typical L. williamsii with its many distinguished ribs, grey-green skin, 'carmine-red' flowers, and seeds with a coarse coat and compressed V-shaped hilum. The type specimen was collected near San Pedro, Coahuila [Mexico]. The material studied under this name has an alkaloid profile more similar to that of L. diffusa, than to that of L. williamsii. L. jourdaniana is said to differ from L. williamsii with small, persistent spines on young areoles, and having a rose-violet perianth, pistil and filaments (Anderson 1996).

Lophophora spp. are very slow-growing – L. williamsii may take 50 years to reach maturity. It can be cultivated from cuttings or seed. Seeds are collected with tweezers from the old flowers, and should be kept dry and in the dark until planted. Germinate as for other cacti; seeds may germinate in 3-7 days. Cuttings of buttons root best in spring, and once the cut has dried over, are simply planted on the ground on which they are to grow. They will grow much faster if grafted to a small **Trichocereus** spp. stock of a similar diameter. A soil mixture should preferably use crushed limestone, coarse sand, and desert topsoil blended with rotted leaves and rabbit manure. Cuttings will grow in commercial cactus potting mix, but to this should be added gypsum or dolomite lime, and organic fertiliser once roots have formed and new growth is obvious. Soil analyses of peyote's natural habitat indicate "limestone in origin, with pH 7.9-8.3. More than 150ppm calcium, at least 6ppm magnesium, no more than 3ppm phosphorous, strong carbonates and no more than trace amounts of NH3." Water plants as often as the soil dries out, but keep on the dry side; too much is worse than none at all. Withhold water in late autumn and winter, when cacti are in dormancy. Cool, damp conditions will rot

the plant; it can tolerate temperatures as low as 5°C [sometimes even less, if not for extended periods and if the plants are healthy and robust]. Gradually expose seedlings to sunlight; in temperate climates, peyote may be able to deal with full sunlight for part of the day; in hotter, sunnier climates, plants require more dappled shade (Mount 1993; pers. obs.).

LUPINUS

(Leguminosae/Fabaceae)

Lupinus angustifolius *L.* – narrow-leaved lupin, blue lupin, lupino azul
Lupinus hirsutus *L.* **(L. pilosus** *L.***)** – agriolupino
Lupinus nootkatensis *Donn ex Sims* **(L. perennis ssp. nootkatensis** *(Donn ex Sims) L. Phillips***)**
Lupinus spp. – lupins, lupines

In ancient Greece, lupins were considered a magical and healing food. L. hirsutus is thought to be the Thermos referred to by Dioscorides, which was used in folk medicine as an antidiabetic and emmolient. Pilgrims to the death oracle of Acheron in ancient Greece consumed large amounts of L. angustifolius or L. hirsutus seeds, in order to come into contact with spirits of the dead; due to their toxic nature, it would seem likely that some of them stayed with the dead (Rätsch 1992; Souleles 1990)! However, there are relatively non-toxic varieties of L. angustifolius known as 'sweet lupin', which have non-bitter, edible seeds, and low alkaloid content throughout the plant. Presumably, such non-toxic varieties would have been those consumed by the Greeks. For years grown as food for stock animals, the seeds are now becoming more accepted as a protein-rich food for humans (Brooke et al. 1996). This may change now that non-alkaloidal toxins have been found in the seeds (Rahman 2000).

In N. America, the Tlingit and Kwakiutl ingested L. nootkatensis roots to produce an intoxication. Animals grazing on the plants often develop intoxication, sometimes leading to death or illness; pregnant animals can give birth to deformed young. Two different forms of stock poisoning have been noted – 'European lupinosis', with symptoms including depression, loss of appetite, jaundice and liver damage; and 'American lupin poisoning', causing staggering, convulsions, respiratory depression, dyspnoea and frothing at the mouth. The latter syndrome has been attributed to the alkaloids present in the plants; the former syndrome generally appears after prolonged feeding on lupin fodder (Gardner & Bennetts 1956; Keeler 1975; Lipp 1995; Pammel 1911).

Roasting the seeds of some species can remove toxins, and they may then be ground and used as a coffee substitute [see **Coffea**] (Bremness 1994; Chiej 1984). In parts of South America, a preparation known as 'wilka tarwi' or 'bilca tauri' was once taken both orally and rectally as a purgative which gave health and strength for battle. 'Wilka' is a derivation of 'villca', a term often applied to some **Anadenanthera** spp. 'Tauri' is the name for the seeds of L. mutabilis, which are not known to be psychoactive. It is not known whether Lupinus spp. seeds were used in this preparation (Torres 2001; Trout ed. 1998).

The genus name comes from the Latin 'lupus', or 'wolf', apparently referring to the notion that lupins take over the land and ruin its productivity – a strange belief, as lupins, like many other legumes, fix nitrogen and phosphorous in the soil and make a good green manure, as well as absorbing excess toxins from the soil. For this latter reason, lupins were planted around Chernobyl after the infamous disaster there (Allen & Allen 1981; Bremness 1994). Today, lupins are commonly grown as ornamental garden plants. Although not all species contain toxic principles, most do; the most toxic parts are generally the seeds and pods, as well as young leaves and stems in spring. Ingestion can induce nervousness and excitability, followed by depression; symptoms of severe poisoning may include nausea, abdominal pain, vomiting, dizziness, salivation, headache, and slowed heartbeat and respiration; death can occur, but is rare. As mentioned above, Lupinus spp. are also sometimes responsible for poisoning stock animals (Foster & Caras 1994; Keeler 1975; Turner & Szczawinski 1991), and some N. American species rich in anagyrine [such as L. sericeus] are teratogenic to cattle (Bruneton 1995; Keeler 1975).

The safest mode of use is probably to smoke the dried herbage [collected at flowering], or dried, ground seed pods (pers. obs.). One adventurous person consumed c.150ml of a 'lupin seed' decoction as an enema, on two separate occasions, and experienced "malaise, unpleasant sensations in the head, dimness of vision, palpebral heaviness, dizziness, mental excitation, and laryngeal and pharyngeal constriction" (Felter & Lloyd 1898).

Lupinus spp. predominantly contain quinolizidine alkaloids, some of which affect *acetylcholine* receptors. Of these, some [such as lupanine] are active mainly at nicotinic *acetylcholine* receptors, and others [such as angustifoline, multiflorine, sparteine (CNS depressant), 3β-OH-lupanine and 13α-tigloyloxylupanine] act mainly at muscarinic *acetylcholine* receptors (Nucifora & Malone 1971; Schmeller et al. 1994).

L. angustifolius alkaloids accumulate in the leaves and stems, until flowering and fruiting, with highest alkaloid concentrations ending up in the ripe seeds. Seeds [from bitter varieties] have yielded up to 2% alkaloids, including lupanine [c.44% of alkaloids; lupanine is known to be a CNS depressant, hypotensive, antiarrhythmic and hypoglycaemic], 13-OH-lupanine [c.38% of alkaloids], α-isolupanine [c.1% of alkaloids], and angustifoline [c.16% of alkaloids]; sparteine, isoangustifoline, dehydroangustifoline, multiflorine [CNS depressant] and tetrahydrorhombifoline are also found in the seeds. Seeds of sweet varieties have yielded 0.04-0.21% alkaloids; they are characterised by containing much less lupanine, 13-OH-lupanine, and angustifoline, though sparteine, isolupanine, and isoangustifoline levels are not significantly different to those in seeds of bitter varieties. *Gramine*, wighteone, orobol, lupinic acid, angustones A-C, N-γ-glutamyltyrosine, and flavonoids such as genistein [MAOI (Hatano et al. 1991)] have also been found in the plant (Brooke et al. 1996; Buckingham et al. ed. 1994; Christiansen et al. 1997; Harborne & Baxter ed. 1993; Harborne et al. ed. 1971; Henry 1939; International… 1994; Nucifora & Malone 1971; White 1943c). The seeds also contain toxic polypeptides, which interfere with protein synthesis in the liver (Rahman 2000). When plants were water-deprived during vegetative growth, alkaloid yields increased in two sweet varieties [0.094% and 0.192%] and one bitter variety [2.55%]; similar drought stress during flowering and fruiting produced mixed results (Christiansen et al. 1997).

L. hartwegii, L. hispanicus, and L. luteus have been found to contain *gramine* (Leete 1975); seeds of L. luteus tested positive for HCN (Watt & Breyer-Brandwijk 1962).

Other toxic species contain a similar array of alkaloids, and may have broadly similar effects.

Lupinus angustifolius is an erect annual herb to 1.5m tall, much-branched; stems pubescent with appressed or spreading hairs. Leaves alternate, palmately compound, 5-9-foliolate, petiolate; leaflets linear to linear-spathulate, 1.2-3.5cm x 2-5mm, apex obtuse, upper surface glabrous, lower surface sparsely silky to villous; stipules fused to petiole, subulate; stipels absent. Inflorescence of terminal pedunculate racemes 5-20cm long, flowers pedicellate, unscented; pedicel 2-4mm long; peduncle 1-3cm long; bracts caducous; bracteoles usually fused to calyx base; calyx 7-8mm long, deeply 2-lipped, upper lip 2-toothed to entire, lower lip entire or shallowly 2-3-lobed; corolla 11-15mm, blue, often tinged with purple, standard +- circular, ovate or oblong, equal to wings and keel, wings connate at apex, enveloping keel, keel incurved, apex dark and beaked; stamens monadelphous; anthers alternately long and basifixed, and short and dorsifixed. Ovary sessile; ovules 2 or more; style glabrous, incurved. Pod 35-55mm long, shortly hairy, oblong, 2-valved, dehiscent, +- flat, +- constricted between seeds, beak +- filiform; seeds 4-6, ovoid, 5-7mm long, smooth, brownish with white or brown markings, hilum sunken, aril not present. Fl. spring.

Native to Mediterranean and s. Europe; cultivated, widely naturalised [eg. in Australia – e. and s.w. New South Wales, Queensland, Western Australia, Tasmania] (Harden ed. 1990-1993).

LYCOPERDON and SCLERODERMA

(Lycoperdaceae)

Lycoperdon gigantea *Batsch ex Pers.* **(Calvatia gigantea** *(Batsch ex Pers.) Lloyd***; Langermannia gigantea** *(Batsch ex Pers.) Rostk.***; Lasiophaera gigantea** *(Batsch ex Pers.) Smarda***)** – giant puffball, ma bo
Lycoperdon hiemale *Vitt.* **(L. depressum** *Bon.***; Vascellum pratense** *(Pers.) Kriesel***; V. depressum** *(Bon.) Smarda***)** – bolita de tierra, euesco de lobo, afgeplatte stuifzwam, wiesenstäubling, angsröksvamp
Lycoperdon marginatum *Vitt.* **(L. candidum** *Pers.***; L. cruciatum** *Rostkovius***)** – gi'i sawa, hongo de primera classe, bolita de conejo, ternerita dellano
Lycoperdon mixtecorum *Heim* **(L. qudenii** *Bottom.***; Vascellum qudenii** *(Bottomley) Ponce de León***)** – gi'i wa
Lycoperdon pedicellatum *Peck non Batsch* **(L. caudatum** *Schröt.***)** – hakamaatuhkelo, kärröksvamp
Lycoperdon pyriforme *Schaeff. ex Pers.* **(L. cupricolor** *Lloyd***; L. globosepiriforme** *Lloyd***; L. serotinum** *Bon.***)** – stump puffball
Lycoperdon spp. – puffballs
Scleroderma bulla *Heim* **(S. hydrometrica** *(Pers.) Heim* **var. maculata** *(Patouill.) Heim***)** – putka
Scleroderma citrinum *Pers.* **(S. aurantium** *Vaill. ex Pers.***; S. vulgare** *Hornemann***)** – common earthball, poison puffball, pigskin
Scleroderma verrucosum *Bull. ex Pers.* **(Lycoperdon verrucosum** *Bull.***)** – scaly earthball, warted devil's snuffbox
Scleroderma spp. – puffballs, purple-fleshed puffballs, earthballs

Mixtec shamans of Mexico have been reported to use L. marginatum and L. mixtecorum as shamanic drugs. The latter ['first class mushroom'] is preferred over the former ['second class mushroom'], which smells like faeces. A pair of the puffballs are consumed to enter a dream-like state, in which echoes and voices speak to the shaman regarding what s/he needs to know. Other Lycoperdon spp. may also be used by the Mixtec. An unidentified Lycoperdon sp. ['kalamoto', 'pata de perro' ('dog's paw')] is

used by malicious sorcerers amongst the Tarahumara, in order to make people sick or to approach someone without being seen. Lycoperdon spp. are also important to shamans in Mendocino County, California. Puffball spores have been known to act as a 'chloroform-like' anaesthetic and narcotic when inhaled, though inhalation of the spores can cause serious lung inflammation ['lycoperdonosis'] (Diaz 1979; Emboden 1979a; Heim 1963b; Ott 1993; Schaecter 1997; Schultes & Hofmann 1980). Some native Americans use puffball spores to apply to wounds, due to their astringent properties (Hamel & Chiltoskey 1975). Plains Indians have been reported to have strung puffballs like beads on 'shamanic necklaces' (Morgan 1995), though in at least some cases, this has been a confusion with carved sporophores of Haploporus odorus and/or Fomitopsis officinalis [see *Endnotes*] (Blanchette 1997; Blanchette et al. 1992). In Chile, the Mapuche possibly use an unidentified Lycoperdon sp. ['pëtremquilquil', meaning 'tobacco of Chuncho' (a human-headed shamanic bird) or 'powder of the devil'] for shamanic transformation and flight. In Colombia, Kogi shamans reportedly use a "bluish puffball" and other fungi for their psychoactivity (Rätsch 1998).

The Germans have a wide variety of colloquial names for Lycoperdon spp., all with the prefix 'hexen' ['hexenbeutel', 'hexenei', 'hexenfurz', 'hexenmehl', 'hexenpilz', 'hexenpüsters', 'hexenschiss', 'hexenschwam', 'hexenstaub'], pointing to possible use by witches in the past (De Vries 1991). L. pyriforme may have been used by Basque witches. In one person, the species provoked a 'short-acting narcosis', taking effect 30-60min after consumption of about 7 specimens (Morgan 1995). There is one report of a person who consumed roughly 20-30 young specimens of English origin, sliced and fried in olive oil, followed by a spicy meal. Gastric disturbances were experienced after 2 hours, followed later by mild stimulation. Sleep followed with very intense dreaming, which frequently interrupted sleep. During waking periods auditory and colour perception were enhanced. A hangover was experienced for several days after the meal (theobromus pers. comm.). 'Narcotic' effects have also been reported from meals of Lycoperdon spp. in the US (Ott 1993), such as L. hiemale and L. pedicellatum (Rätsch 1998).

L. gigantea [now usually known as Calvatia gigantea] is used in TCM to treat tonsillitis and sore throat, and the spores are used as a topical haemostatic. The dried fungi are used in a dose of 1.5-6g, wrapped in cheesecloth and boiled in water for 20-30 minutes. The spores have shown some antibacterial activity, and both fruiting bodies and spores have shown some antitumour activity (Hobbs 1995). In England, puffballs such as this species have also been used as haemostatics and tinder. A tincture [25% strength] has been used as a sedative to treat 'nervous affections' (Grieve 1931).

Scleroderma bulla is known by the Santals of Orissa, India, as 'putka', and they collect it when it breaks through the ground, to be eaten as food. If it is not eaten shortly after harvesting, it develops a 'cadaver-like' odour. Though the Santals do not have any known sacred uses for this fungus, their name for it signifies that it is 'animate', or has a soul, and they do not attribute this property to any other members of the plant kingdom. Putka is thought to be synonymous with 'putika', a substitute for soma that is no longer used. As a soma-substitute, putika was not consumed, however. It was used as an admixture to the clay used to make the mahavira vessels, which were placed in the fire for the Pravargya sacrifice, a symbolic ritual of meaning too complex to enter into here. This sacrifice was a late addition to the Vedic Soma sacrifice. Putika may have even been the mysterious last meal of the Buddha [see also **Amanita**]. L. pusillum was reported by one Santal person to be an example of 'rote-putka' [rote = toad or frog], though this may simply be a term applied to all similar puffballs. The Santal recognise two other forms of putka, 'hor putka' ['man putka'] and 'seta putka' ['dog putka'], which are thought to be different growth-stages of the same species [S. bulla] (Wasson 1968; Wasson et al. 1986).

Scleroderma spp., purple-fleshed puffballs, have occasionally been used as truffle-substitutes or adulterants. Although sometimes considered edible [particularly when sliced and well-cooked], they have been known to cause severe gastric upset and, occasionally, psychotropic symptoms. S. citrinum from Europe has been reported to result in "a feeling of uneasiness, vomiting, perspiration, and unconsciousness" when eaten, though in small amounts, it has been used for its "pleasant aromatic taste" as a truffle-substitute (Stevenson & Benjamin 1961). S. citrinum is also considered psychoactive. Half of one small specimen, eaten, has caused a deep sleep lasting 2hrs [c.15min. after consumption], followed by a restless period, with strongly dilated pupils and visual disturbances, in one psychonaut (Morgan 1995). S. cepa has caused a poisoning in one man in the US, who took a bite from a fresh specimen, having read that 'all puffballs' are edible. The first symptoms were noted within 30 min., with gastric pains followed by weakness, nausea, muscular rigidity, and a tingling sensation over the body; 45 min. after ingestion, stomach cramps and profuse sweating were noted. After vomiting, symptoms quickly subsided, and the next day no lingering effects were present (Stevenson & Benjamin 1961). S. verrucosum has also caused gastric upset after consumption (Ott 1993), and has been reported to be psychoactive (Rätsch 1998).

Biossays by several Western researchers with the Mixtec species [L. marginatum and L. mixtecorum], as well as 8 others identified by an indigenous informant, did not result in any psychoactive effects, though some caused gastric distress (Heim 1963b; Ott 1993). Lycoperdon spp. are generally considered edible when young, before any yellowing has begun and with the interiors still white [note – the interior flesh of many Scleroderma spp. is purplish] (Benedict 1972; Phillips 1981).

The chemistry of the Lycoperdon spp. is still unknown. The spores of L. gigantea, however, have been analysed and found to contain calvacin, ergosterol, urea, amino acids and lipids (Hobbs 1995).

S. citrinum has yielded tentative indole compounds, as well as fumaric acid, linoleic acid, palmitic acid, mannitol, glycerol, glucose, fructose, maltose, ergosterol, ergosterol peroxide, 9(11)-dehydroergosterol peroxide, (23S)-lanosta-8,24-diene-3β,23-diol, and a mixture of triglycerides (Nikonorow et al. 1967; Vrkoč et al. 1976).

Lycoperdon mixtecorum has a body 2-3cm diam., subglobose, slightly flattened, abruptly constricted into a short peduncle 3-4mm long; exterior surface not echinulate but densely cobbled-pustuliform, light tan in colour; interior silky, papyraceous, smooth, straw-coloured. Peridial envelope yellowish-brown mixed with orange, covered with whitish chevelure at base. Opercule ragged. Gleba loosely spongy, grey-tawny to slightly violet, capillitium filaments straight, irregular, 2-6μ long. Sterile base slightly developed, lemon-yellow to almost orange, cellules relatively large, 2-3mm, radially oriented. Spores brownish tawny with subtle violet tinge, spherical, 7.8-10μ including sculpturing, muricate-winged, presenting 5 distinct membranes covered with mesh of incomplete, unequal, pale threads.

On ground in light forest and pastures, 2000m and above; Oaxaca, Mexico, south around San Miguel (Schultes & Hofmann 1980, 1992).

When hunting for puffballs, it is important to remember that some species may resemble fruiting bodies of toxic **Amanita** spp. in the unopened 'egg' stage.

LYCOPODIUM and related genera

(Lycopodiaceae)

Lycopodium affine *Grev. et Hook. non. Bory* **(L. blepharodes** *Maxon***; Huperzia affinis** *Trevis***; H. blepharodes** *(Maxon) Holub***; Urostachys affinis** *(Grev. et Hook.) Nessel***; U. blepharodes** *(Maxon) Herter***; U. involutus** *Herter ex Nessel***)** – condorillo

Lycopodium clavatum *L.* **(L. aristatum** *Humb. et Bonpl. ex Willd.***; L. eriostachys** *Fée***; L. piliferum** *Raddi***; L. preslii** *Grev. et Hook.***; L. serpens** *C. Presl.***; L. trichiatum var. desvauxianum** *Spring.***; L. trichophyllum** *Desv.***; Lepidotis clavata** *(L.) P. Beauv.***)** – stag's horn clubmoss, snake moss, wolf claw, devil's claw, devil ash, spirit herb, keulenbärlapp, hexenkraut ['witch herb'], hexenmehl [referring to spores – 'witch flour'], hexenmoos, hexenstaub, hexenstupp, hexentanz, drudenkraut ['druid herb'], druid foot, druid flour, ground pine, running pine, vegetable sulphur, moriri-wa-mafika, boriba-bo-boholo, shen jin cao, trencilla verde, lahare jhyau, nagbeli, melam mendo

Lycopodium complanatum *L.* **(Diphasiastrum complanatum** *(L.) Holub***; Diphasium complanatum** *(L.) Rothm.***; Lepidotis complanata** *(L.) P. Beauv.***; Stachygynandrum complanatum** *(L.) C. Presl.***)**

Lycopodium flabelliforme *(Fernald) Blanch.* **(L. complanatum var. flabelliforme** *Fernald***; L. digitatum** *Dill.***; Diphasiastrum digitatum** *(Dill.) Holub***)**

Lycopodium gnidioides *L. f.* **(L. flagelliforme** *Schrad.***; L. funiculosum** *Lam.***; L. pinifolium** *Kaulf.***; Huperzia gnidioides** *(L. f.) Trevis***; Trichomanes bradei** *H. Christ.***; T. diaphanum** *Kunth***; Urostachys gnidioides** *(L. f.) Herter ex Nessel***; Vandenboschia diaphana** *(Kunth) Copel.***)** – tsilaky

Lycopodium lucidulum *Michx.* **(Huperzia lucidula** *(Michx.) Trevis***; Urostachys lucidulus** *(Michx.) Nessel***)**

Lycopodium magellanicum *(P. Beauv.) Sw.* **(L. clavatum var. fastigiatum** *(R. Br.) Benth.***; L. clavatum var. magellanicum** *(P. Beauv.) Hook.***; L. fastigiatum** *R. Br.***; L. pichinchense** *Hook.***; L. spurium** *Willd.***; Austrolycopodium magellanicum** *(P. Beauv.) Holub***; Lepidotis magellanica** *P. Beauv.***)** – condoro, trencilla del lago ['trencilla ('small plait') of the lake'], mountain clubmoss

Lycopodium obscurum *L.* **(L. dendroideum fo. strictum** *Milde***; L. obscurum fo. strictum** *Nakai ex H. Hara***)**

Lycopodium pallescens *C. Presl.* **(L. cordifolium** *Hort. ex Spring***; L. cuspidatum** *Link***; Selaginella albo-marginata** *Fée ex Foum***; S. avilae** *Klotzsch ex Kunze***; S. cuspidata** *(Link) Link***; S. densifolia** *Klotzsch***; S. dentifolia** *Klotzsch ex Aberle***; S. elongata** *G. Schneider***; S. emiliana** *Bull***; S. incana** *Spring***; S. nidus-avis** *Ezcurdia***; S. pallescens** *(C. Presl.) Spring***; S. reticulata** *Klotzsch***; S. sulcangula** *Spring***)** – moss fern, false arbor-vitae fern, sweat plant, njule

Lycopodium phlegmaria *L.* **(Huperzia phlegmaria** *(L.) Rothm.***; Lepidotis phlegmaria** *(L.) P. Beauv.***; Phlegmariurus phlegmaria** *(L.) Holub***; Urostachys phlegmaria** *(L.) Herter ex Nessel***)** – tasselled clubmoss, common tassel fern, coarse tassel fern

Lycopodium reflexum *Lam.* **(L. bifidum** *Humb. et Bonpl. ex Willd.***; L. eversum** *Poir***; L. reflexum** *Willd.***; L. reflexum var. densifolium** *Baker***; L. reversum** *C. Presl.***; L. squarrosum** *Sw. non Forst***; Huperzia reflexa** *(Lam.) Rothm.***; H. reflexa** *(Lam.) Trevis***; Plananthus reflexus** *(Lam.) P. Beauv.***; Urostachys reflexum** *(Lam.) Herter***)** – condoro

Lycopodium rupestre *L.* **(Bryodesma rupestre** *(L.) Soják***; Selaginella rupestris** *(L.) Spring.***; Stachygynandrum rupestre** *(L.) P. Beauv.***)** – rock spikemoss, wild turnip, hodzo

Lycopodium sabinaefolium *Willd.* **(Diphasiastrum sabinifolium** *(Willd.) Holub***)**

Lycopodium saururus *Lam.* **(L. andinum** *Rosenst.***; L. crassum** *Humb. et Bonpl. ex Willd.***; Huperzia saururus** *(Lam.) Trevis***; Urostachys saururus** *(Lam.) Herter***)** – condór misha, hierba del condór

Lycopodium selago *L.* **(Huperzia selago** *(L.) Bernh. ex Schrank et Mart.***; Plananthus selago** *(L.) P. Beauv.***; Urostachys selago** *(L.) Herter***)** – wolf's foot clubmoss, hexenkraut, devil clover, selago, fir selago, tannenbärlapp, bärlappgewächs, heckenysop, agwo, otuen, ude

Lycopodium serpens *Desv.* **(L. plumosum** *Lunan***; Lycopodioides serpens** *(Desv.) Kuntze***; Selaginella argentea** *Veitch***; S. brittoniorum** *Hieron.***; S. jamaicensis** *Hort. ex A. Br.***; S. mutabilis** *Hort. ex A. Br.***; S. scalariformis** *Spring***; S. serpens** *(Poir.) Spring***; S. variabilis** *(Hook.) Hort. ex A. Br.***; S. varians** *Hort. ex A. Br.***)** – snake Selaginella, agwo elili

Lycopodium serratum *Thunb. ex Murr.* **(L. sargassifolium** *Liebm.***; Huperzia serrata** *(Thunb. ex Murr.) Rothm.***; H. serrata** *(Thunb. ex Murr.) Trevis***; Urostachys serratus** *(Thunb. ex Murr.) Herter***)** – quian ceng ta, weipo

Lycopodium squarrosum *G. Forst.* **(Huperzia squarrosa** *(Forst.) Rothm.***; H. squarrosa** *(L.) Trevis***; Phlegmariurus squarrosus** *(Forst.) Löve et Löve***; Plananthus squarrosa** *(Sw.) P. Beauv.***; Urostachys squarrosus** *(Forst.) Herter***)** – water tassel, water tassel fern, rock tassel fern, yeng yeng madep

Lycopodium tetragonum *Hook. et Grev.* **(L. catharticum** *Hook.***; Huperzia tetragona** *(Hook. et Grev.) Trevis***; Urostachys tetragonus** *(Hook. et Grev.) Nessel***)** – condorillo de quatro filos

Lycopodium tristachyum *Pursh* **(Diphasiastrum tristachyum** *(Pursh) Holub***; Diphasium tristachyum** *(Pursh) Rothm.***)**

Lycopodium spp., Huperzia spp. (probably also **Copodium spp., Diphasiastrum spp., Diphasium spp., Lepidotis spp., Lycopodiastrum spp., Lycopodiella spp., Palhinhaea spp., Phlegmariurus spp., Phylloglossum spp., Plananthus spp., Selaginella spp., Selago spp.** and **Urostachys spp.**, which have been classified in **Lycopodium** by some authors**)** – clubmoss, condor plant, cóndor, condoro, condorillo, hierba de condorillo, cóndor purga, hornamo lirio, hornamo loro, huaminga, huaminga misha, huaminga oso ['bear huaminga'], trenza amarilla ['yellow braid'], trenza shimbe, bärlapp

The club mosses, a group of very similar plants distributed over much of the world, are quite obscure when it comes to their psychoactive properties. L. clavatum is probably the most widely used for medicinal purposes – as well as being an antispasmodic sedative, it has been used to treat kidney diseases and urinary disorders, lung diseases [such as bronchitis], skin diseases, constipation and rheumatism, and is an emmenagogue, demulcent, emetic and diuretic. Its spores are used for dusting pills. Blackfoot Indians inhaled the spores to stop nose-bleeds, and dusted them on cuts to staunch bleeding. The Chinese decoct it to treat disorders of the nervous system, arthritis and muscular rigidity. Its spores, 'explosive' when lit, have been added to fireworks and used in theatrical lighting. Some of the Germanic common names of this and other Lycopodium spp., involving the prefix 'hexen' or 'druden', may betray a past knowledge of psychotropic properties and related magical use. L. cernuum is used in broadly similar ways to L. clavatum, as well as being used as a charm in Surinam (Ansari et al. 1979; Bremness 1994; De Vries 1991; Huang 1993; Samorini & Festi 1999; Watt & Breyer-Brandwijk 1962). In Nepal, L. clavatum, L. cernuum, L. hamiltonii, L. serratum and L. subulifolium are associated with Vishnu, and are used as garlands in religious celebrations and for honoured guests. They are believed to give protection from witches (Müller-Ebeling et al. 2002; Rätsch 1998).

L. gnidioides is shade-dried and smoked in Madagascar, to bring about "ebriety accompanied by oneiric hallucinations similar to those produced by Indian hemp [**Cannabis**]" (Boiteau 1967; Samorini & Festi 1999). The Suto of southern Africa smoke L. clavatum with L. rupestre to relieve headaches (Watt & Breyer-Brandwijk 1932, 1962). L. rupestre [now generally known as Selaginella rupestris (Selaginellaceae)] is used in local folk medicine in India to treat epilepsy, and the smoke of the leaves apparently has a 'narcotic' effect (Chakravarthy et al. 1981). The Jindwes of Zambia prepare an ointment from the powdered rhizome, to treat venereal sores (Watt & Breyer-Brandwijk 1932). In s. Nigeria, L. pallescens [now generally known as Selaginella pallescens] rhizomes are infused and drunk to relieve insomnia; the crushed leaves are applied externally for rheumatism. In the same region, L. serpens [now generally known as Selaginella serpens] is cultivated near houses to repel evil spirits (Nwosu 2002). In Colombia and Ecuador, unidentified Selaginella spp. are added to a 'curare' arrow poison for killing birds, made also from Schoenobiblus peruvianus (Schultes & Raffauf 1990).

L. selago, which is widespread in the northern hemisphere, was an important herb used by the Druids as a protective amulet. Its collection was governed by special ritual, similar to that used for collecting mistletoe [see *Endnotes*]. The herb was so revered, it was sometimes referred to as 'God's gift'; in Wales today, the herb is still known as 'Gras Duw', or 'God's grace' (Rätsch 1998). In s. Nigeria, the plant is hung on doors to repel evil spirits (Nwosu 2002). Emboden referred to its 'narcotic' properties, stating that 3 stems, each a few inches long, induce a mild hypnotic state, while 8 will result in a stupor or coma (Emboden 1979a). It is capable of causing vomiting, dizziness, collapse and unconsciousness (Rätsch 1998).

A Lycopodium sp. known as 'condorillo' was reported to sometimes be brewed with 'San Pedro' [**Trichocereus** pachanoi] and **Brugmansia** arborea, in Peru (De Rios 1977). Further investigation has shown that in north Peru, Lycopodium spp. are commonly known by names derived from the word 'condór', such as 'condoro' and 'condorillo'. L. affine, L. reflexum, L. saururus and L. tetragonum are other species known to be consumed with San Pedro. When L. saururus ['condór misha'] or other Lycopodium spp. are taken with San Pedro, the plant spirit appears to the shaman as a condor. This spirit may undertake journeys, counteract harmful charms, retrieve the lost 'shadow soul' of patients, and perform other duties on behalf of the shaman. One researcher was told by a herb seller in Trujillo [Peru] that 'trenza shimbe', a herb resembling 'condór misha', improves the 'visionary view' when taken with San Pedro. Rätsch was also told by a herb seller in a Chiclayo [Peru] 'witches market' that 'condoro', a plant appearing to be L. magellanicum, is a 'hallucinogen', particularly if taken with San Pedro (Rätsch 1998). L. reflexum is also said to be used magically against "ritual witchcrafts". In n.e. Peru, two unidentified Huperzia spp. ['cabello del bosque' and 'huaminga'] are used medicinally, the former as a hair tonic and the latter as a strong purgative and vermifuge (De Feo 2003).

In Russia, L. annotinum is decocted as a contraceptive (Brondegnard 1973). L. serratum is used in TCM to treat memory deficits in the aged, and *huperzine A* isolated from the herb has been used to treat Alzheimer's Disease and myasthenia gravis (Liu et al. 1986; Tang et al. 1994). At Mt. Hagen, Papua New Guinea, it is used as a laxative which 'disperses the spell of death' (Stopp 1963).

The Australasian L. phlegmaria has been reputed in Queensland [Australia] to have aphrodisiac properties (Bailey 1880). The dried herb is psychoactive smoked in small amounts in a water-pipe, producing a short-lived **Cannabis**-like high. The dried herb seems to lose potency after a few months of storage (pers. exp.). Nkopo villagers from Papua New Guinea rub L. squarrosum on their bodies in order to enter a sleep-like state, in which it is hoped a bush spirit will come and give the person a song endowed with spiritual significance, which must be learnt as soon as one awakens (Schmid 1991).

A friend ingested a decoction made from 4tsp dried L. squarrosum, simmered in 1 cup of water for 5min., and steeped for a further 10min; half of the decoction was drunk, the other half drunk 1hr later. The brew had a strong fishy odour, but was easy to drink. Initially, a "subtle dreamy ambience" was felt, accompanied by mild nausea and diarrhoea, and a hot forehead; he also reported a "sort of watery pressure in the head". Several bouts of vomiting, of varying intensity, ensued over the first few hours. Mild visual distortions were observed in the reflection of light from curved glass or moving water, and the "surfaces of things smoodged a bit...Everything became a tinge Escheresque" [in reference to the famous artwork of M.C. Escher]. He reported a "blobby sort of trippiness, like [a] big soft forcefield holding energy into myself...Unfortunately concern about keeping still to prevent nausea increasing, and about the amount of poisoning [felt a tinge of pain in right kidney], were predominant over the trippy impact. Slight nausea and trippiness still present 12hrs later. The high seemed like when you trip during a heavy flu, and also like mugwort" [**Artemisia** vulgaris] (Wonderfeel pers. comm. 1998).

The genus Lycopodium contains a unique class of alkaloids related to the quinolizidines. Most of them have in common $C_{16}N$, $C_{16}N_2$, or $C_{27}N_3$ in their chemical formulae (MacLean 1985). Some of these alkaloids have shown pressor effects in animals, as well as causing uterine contractions and paralysis (Manske 1955). Nervous system paralysis has only been demonstrated in frogs; in mammals, however, clavatine, clavatoxine, and lycopodine have been shown experimentally to act as respiratory stimulants (Watt & Breyer-Brandwijk 1962). *Huperzine A* [selagine] and huperzine B have been found in some species. These alkaloids act as potent inhibitors of the enzyme acetylcholinesterase [AChE; see *Influencing Endogenous Chemistry*] (Ayer et al. 1989; Liu et al. 1986; Tang et al. 1994), with *huperzine A* also antagonising NMDA receptors (Zhang & Hu 2001). Other Lycopodium alkaloids have shown similar activity, though none as potently as the *huperzine*s, according to Tori et al. (2000), who refer to Ayer et al. (1994) and Liu et al. (1986), neither of which discuss the AChE-inhibitory activity of any alkaloids other than the *huperzine*s. Some

species also contain traces of *nicotine* (Manske 1955). The presence of flavonoids is widespread in the Lycopodiaceae. Types normally encountered in this family are mostly flavone O-glycosides, and occasionally C-glycosylflavones (Richardson 1989).

L. annotinum has yielded *nicotine*, annotine [Lycopodium alkaloid L11], annotinine [Lycopodium alkaloid L7], acrifoline [Lycopodium alkaloid L27], O-acetylacrifoline, fawcettiine, lofoline, acetyllofoline, lycodine, lyconnotine, lycopodine, isolycopodine, lycodoline [Lycopodium alkaloid L8], obscurine, and Lycopodium alkaloids L9 and L10 (Ma et al. 1998; MacLean 1968; Manske 1955).

L. cernuum has yielded 0.06-0.07% alkaloids (Braekman et al. 1974); others found 0.01% crude bases, consisting mostly of cernuine. Also found are c.0.00001% *nicotine*, *huperzine* B, lycodoline, lucidioline, lycopodine, lyconnotine, annotinine and 0.002% lycocernuine [Lycopodium alkaloid L33] (Ma et al. 1998; Marion & Manske 1948), as well as *apigenin* C-glycosides (Richardson 1989).

L. clavatum has yielded 0.1-0.42% alkaloids. The main base present was lycopodine [c.60% of total alkaloids]; also found were traces of *nicotine*, and Lycopodium alkaloids L13 [an isomer of lycopodine], L18 and L19. Clavatine and clavatoxine were found in European plants, but were not detected in plants from Canada. Therefore, on a chemotaxonomic basis, it is believed that the specimens of this species found in Europe and North America represent differing continental varieties (Braekman et al. 1974; Marion & Manske 1944b). The clavatine content isolated by some workers was actually a complex of 3 alkaloids, consisting of the 'true' clavatine [12%], lycopodine [83%] and clavatoxine [3%] (Watt & Breyer-Brandwijk 1962). The flavonoid *apigenin*-4'-O-(2",6"-di-O-p-coumaryl-β-D-glucopyranoside) has also been found (Ansari et al. 1979), as has 48% of a fixed oil, and methylamine (Huang 1993), which, if found in L. squarrosum, may explain the 'fishy' odour of the latter herb when decocted.

L. complanatum has yielded mostly lycopodine, as well as 0.012% complanatine [as the perchlorate], obscurine, Lycopodium alkaloids L2-L5 and 0.0002% *nicotine* (Manske & Marion 1942).

L. flabelliforme has also been shown to yield *nicotine*, as well as complanatine, obscurine, lycopodine and Lycopodium alkaloids L2-L5 (Manske 1955).

L. gnidioides has yielded anhydrolycodoline, gnidioidine, lucidioline, lycoclavine, lycognidine, gnidine, gnidinine, gnidioidine and *huperzine A* (MacLean 1985).

L. lucidulum has yielded 0.23% ether-soluble bases, mostly lycopodine, as well as *nicotine*, lucidine A, lucidine B, lucidulinone, oxolucidine A, and Lycopodium alkaloids L13, L20, L21, L22, L23, L24 and L25 (Manske & Marion 1946; Tori et al. 2000).

L. magellanicum has yielded lycopodine, acetyl-dihydrolycopodine, lycodine, N-methyllycodine, clavolonine, fawcettiine, acetylfawcettiine, deacetylfawcettiine, magellanine, 5-dehydromagellanine, magellaninone, α-obscurine (Loyola et al. 1979; MacLean 1985), α-onocerin and α-onocerin diformate (Loyola et al. 1982); as L. fastigiatum, it has yielded lycopodine, dihydrolycopodine, acetyl-dihydrolycopodine, lycodine, lycodoline, anhydrolycodoline, lycoflexine, clavolonine, flabelliformine, fastigiatine, des-N-methylfastigiatine, α-obscurine and an unknown alkaloid (Gerard & MacLean 1986).

L. obscurum has yielded annotinine, lycodoline, α-obscurine, β-obscurine and *nicotine* (Willaman & Li 1970).

L. paniculatum has yielded lycopodine, dihydrolycopodine, acetyl-dihydrolycopodine, lycoclavine, deacetyllycoclavine, paniculatine, paniculine [7α-OH-acetyl-dihydrolycopodine], deacetylpaniculine, anhydrodeacetylpaniculine and flabellidine (Morales et al. 1979).

L. phlegmaria has yielded lycodoline, anhydrolycodoline, lycopodine, gnidioidine, lucidioline, lycophlegmine, lycophlegmarine, phlegmarine, N-methylphlegmarine, N,N-dimethylphlegmarine, lycoflexine, fawcettidine, epihydrofawcettidine, 8-deoxyserratinidine and 8-deoxy-13-dehydroserratinine (Buckingham et al. ed. 1994; Ma et al. 1998; MacLean 1985; Manske 1955).

L. rupestre has yielded the biflavonoid amentoflavone. The amentoflavone component of the plant was assayed in rodents, but did not show any apparent behavioural effects on the central nervous system; antispasmodic activity was observed (Chakravarthy et al. 1981). Amentoflavone is a potent ligand of brain BZ-receptors (Nielsen et al. 1988).

L. sabinaefolium has yielded 0.2% crude bases, including 0.11% lycopodine, 0.00006% *nicotine*, and Lycopodium alkaloids L13 and L26 (Marion & Manske 1946).

L. saururus has yielded 0.19-0.48% alkaloids (Braekman et al. 1974), including *huperzine A*, lycopodine, dihydrolycopodine, lycodoline, anydrolycodoline, clavolonine, fawcettiine, acetylfawcettiine, pillijanine, saururine, saururidine, sauroxine and Lycopodium alkaloid LS14 (MacLean 1985; Manske 1955).

L. selago has yielded 0.587% crude alkaloids, including 0.018-0.086% *huperzine A*, lycodoline, 0.0058% isolycodoline [pseudoselagine], 12-epilycodoline, lycopodine, 6α-OH-lycopodine, obscurine, 6β-OH-*huperzine A* and acrifoline (Ayer et al. 1989; Buckingham et al. ed. 1994; Rastogi & Mehrotra ed. 1990-1993).

L. serratum has yielded *huperzine*s A [0.001%] and B, lycopodine, lycodine, lycodoline, lucidioline [0.00015%], serratine, serratinine [0.00005%] and serratinidine (Bruneton 1995; Ma et al. 1998; Willaman & Li 1970; Zhou et al. 1993).

L. squarrosum has yielded *huperzine* B, lycopodine, lycodoline and lucidioline (Ma et al. 1998).

L. tristachyum has yielded lycopodine as the major alkaloid, as well as *nicotine*, and Lycopodium alkaloids L13, L14, and L15 (Braekman et al. 1974; Marion & Manske 1944a).

*Huperzine*s A & B are widespread in this family, as are related Lycopodium alkaloids (Ma et al. 1998).

Lycopodium phlegmaria is an epiphytic plant, rarely lithophytic or terrestrial; stems isotomously branched, branches aggregated, tufted, erect at first, becoming pendulous, branched several times, 35-90cm long; sterile portion (incl. leaves) 1.5-3cm diam.; roots in a single basal tuft, sometimes branches rooting near tips or along prostrate shoots. Leaves densely spirally arranged, coriaceous, stiff, angled at 50-70° to axis, lanceolate, attenuate, entire, shortly petiolate, twisted at base, 5-20 x 2-5mm, deep green. Transition from sterile to sporogenous zone abrupt; sporogenous zone 2-30cm x 1-2.5mm, 1-many times forked; sporophylls identical to vegetative leaves or reduced, persisting after sporangial dehiscence, ovate, acute, rounded or keeled, decussate, appressed, 1-2.5 x 1-1.5mm; sporangia ½ length of (or slightly longer than) sporophylls, axillary, reniform, isovalvate, shortly stalked; spores foveolate-fossulate.

Widespread in rainforest, usually epiphytically, sometimes on mossy rocks and banks in humus accumulations, 60-600m; Australia, tropical Africa, Asia, and Pacific; in Aust. restricted to n.e. & e.c. Qld, also cultivated (Chinnock 1998).

Plants of the Lycopodiaceae grow in a range of habitats, generally in damp or humid areas. Many of the tropical species grow epiphytically on trees in rain forest or cloud forest. Many species also grow terrestrially, on substrates ranging from disturbed soil, clay soil, sandy or peaty depressions, in rocky or gravelly places, or amongst shrubs. One exception to the requirement for continuous moisture is the African L. carolinianum, which grows in areas that are seasonally dry, and survives these periods due to its large tubers (Tryon & Tryon 1982).

Whilst some species can be easy to grow in cultivation [such as L. phlegmaria, L. proliferum, L. scariosum], others can prove difficult. For example, L. cernuum is difficult to transplant successfully, yet will grow easily once established. L. serpentinum, 'bog club-moss', will only grow well in a permanently humid environment. Another species, L. deuterodensum, is said to be "impossible to grow". Of the species which can be cultivated successfully, a coarse, well-drained soil mix is recommended, and should be kept damp, but not excessively so. Watering may be preferred by aerial misting, rather than through the roots, for semi-tropical species such as L. phlegmaria and L. squarrosum. New wire hanging baskets should be used with caution, as galvanising compounds in the metal can damage the stems and cause rot if they come into direct contact with the plant. Specimens should be situated in a protected position; these plants respond poorly to disturbance and require protection from wind and sun. In nontropical areas, a glasshouse may be required. Some species require heat in order to survive (Jones & Clemesha 1976; pers. comms.).

LYGODIUM

(Schizaeaceae/Lygodiaceae)

Lygodium venestum *Swartz* **(L. mexicanum** *Presl.***)** – rami, tchai, tchai del monte

This fern is used by the Culina and Sharanahua of Peru as an ayahuasca additive [see **Banisteriopsis**], said to increase the strength of the brew. The amount added by the Culina is a handful of the leaves. A bioassay of a Sharanahua ayahuasca brew containing this fern [as well as **Banisteriopsis** caapi and **Psychotria** viridis] resulted in strong physical side effects ["nausea, pain in the muscles, accompanied by compulsive and uncontrollable movements (swaying, hand moving), a feeling of coldness"], as well as feelings of anguish, accompanying the effects more typical of ayahuasca brewed with **Psychotria**. It was not known by the researcher involved if the Sharanahua also experience these adverse effects. Incidentally, the name 'rami' is the Sharanahua name for a "shining blue veil" which may sometimes be seen in the early stages of an ayahuasca experience (McKenna et al. 1995; Pinkley 1969; Rivier & Lindgren 1972; Schultes 1972). The Huastec Maya of Mexico use the same plant as a treatment for insanity or psychological disorders (Ott 1993).

In China, the whole plant of L. japonicum ['Japanese climbing fern'] is used in doses of 15-60g as 'ching-sha-teng' or 'jing-sha-deng' ['gold sand vine'] to treat delirium, high fever, pneumonia, coughing with blood, toothache, hepatitis, and gonorrhoea. It also acts as a sedative. The spores ['hai-chin-sha' or 'hai-jin-sha'] are used in a dose of 6-12g to treat urinary disorders (Chin & Keng 1990; Hsu et al. 1986). In s. Nigeria, L. flexuosum ['agbiligbi', 'usehe'] leaves are infused and taken to treat infertility in women (Nwosu 2002).

Chemistry of ferns is quite obscure, though this genus is known to yield aliphatic and triterpene hydrocarbons (Schultes & Raffauf 1990). L. venestum contains compounds with antifertility actions (McKenna et al. 1995), and L. japonicum contains flavonoids (Hsu et al. 1986).

Lygodium venestum is a terrestrial fern; stem short to long-creeping, slender, frequently branched, protostelic, bearing short trichomes and few to many fibrous roots. Leaves partially dimorphic, fertile portions with marginal lobes, or somewhat contracted and wholly fertile, sometimes with a different architecture than the sterile, close or rather widely spaced, c.1-10m or more, climbing, widely alternately pinnate, glabrous to somewhat pubescent, pinnae short-stalked, pseudodichotomously branched with an arrested bud in the axil; each primary pinna-branch pinnate, veins free, the pinnules stalked, except sometimes near the apex of the primary branch; sterile pinnules lobed or pinnate, palmately lobed at base. Sporangia borne separately on marginal lobes of a pinna-segment or on a wholly fertile segment, each covered by a laminar outgrowth (flange); spores tetrahedral-globose, trilete, the laesurae c.3/4 the radius, surface with spherical deposition, the distal face often verrucate and the proximal one with a prominent ridge connecting the ends of the laesurae, or rugose to reticulate.

In open forest, especially along borders where the climbing leaves can reach well-lit situations, sometimes in rainforests, but more commonly in gallery forest, shrubby savannahs or along borders of streams or river banks, frequently in disturbed spots; Central & S. America (Tryon & Tryon 1982).

MACROPIPER

(Piperaceae)

Macropiper excelsum ssp. excelsum *(Forst. f.) Miq.* **(Piper excelsum** *Forst. f.***)** – pepper tree, kawakawa, 'Maori kava'
Macropiper excelsum ssp. peltatum *Gardner*
Macropiper excelsum ssp. psittacorum *(Endl.) Laing* **(M. excelsum var. majus** *(Cheesem.) Allan comb. nov.***; Piper excelsum var. major** *Cheesem.***; P. psittacorum** *Endl.***)**
Macropiper latifolium *(L. f.) Miq.* – false kava

M. excelsum was thought to have been adopted by the Maoris of the north island of New Zealand about 1,000yrs ago, due to its apparent similarity to the 'true kava', **Piper** methysticum [see **Piper 2**], which is also known as 'kawakawa' or 'kavakava'. A beverage of this name was prepared from the roots and leaves, and used in religious rites. The root has been used to treat urinary disorders, and the leaf and bark treated gonorrhoea, stomach pain and toothache, also acting as an anthelmintic. Leaves could also be infused as a tonic, or applied topically to swelling or rheumatism. The fruits were considered to have the most potent properties, but were used less often. The plant acts as a stimulant and aphrodisiac, and slightly excites the salivary glands, kidneys and bowels. New Zealand Parliament banned shamanic practices in 1907, and partially for this reason, further knowledge regarding the past use of magical plants in New Zealand remains obscure (Bock 2001; Brooker et al. 1987).

Today, M. excelsum is cultivated, and the dried leaf is sold in teabags by some New Zealand herbalists. The apparently "insipid" tea is said to "clear the head, cleanse the body and produce a feeling of wellbeing and relaxation without drowsiness" (Low et al. ed. 1994).

M. excelsum leaf has yielded 0.1% essential oil, which consisted of 41.3% *myristicin*, 3.1% *elemicin*, and lesser amounts of *pinene*, phellandrene, aromadendrene and cadinene (Bock 2001); leaf has also yielded the lignans (+)-excelsin, (+)-epiexcelsin, (+)-demethoxyexcelsin and (+)-diayangambin (Russell & Fenemore 1973).

M. latifolium essential oil contains predominantly β-*asarone* (Lebot et al. 1992). The leaves are peppery to the taste and only slightly numbing; the root bark has a "VERY hot taste", and has numbing properties stronger than those of 'true' kava [see **Piper 2**] (Torsten pers. comm. 2001).

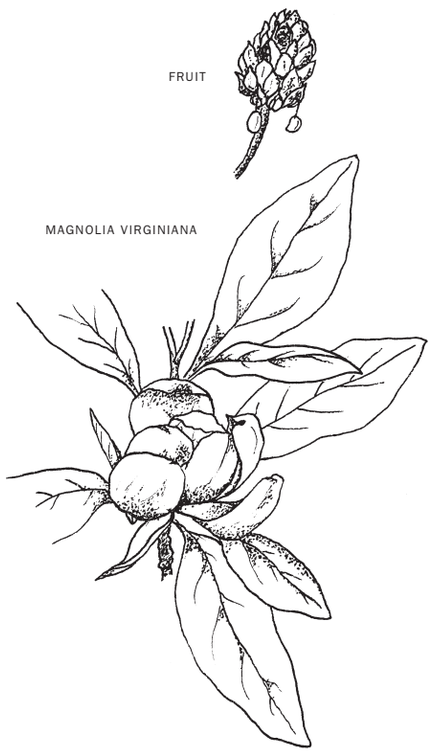
Macropiper excelsum ssp. excelsum is an aromatic shrub or tree to 6m tall; branches +- zig-zagging, jointed and swollen at nodes, dark. Leaves opposite or alternate, entire, subcoriaceous, dark- to yellowish-green, 5-10 x 6-12cm, broad-ovate to suborbicular, cordate at base, sinus narrow to open, rather abruptly narrowed to obtuse at apex, 5-7(-9)-subpalmately nerved; petiole 1-4cm long; stipules adnate. Flowers minute, sessile, very close-set, in axillary, unisexual, bracteated spikes; spikes solitary or paired, 2-8cm long on peduncles +- 1cm long; bract orbicular-peltate; male with 2(-3) stamens; anthers 2-celled, cells distinct. Female with 3(-4) stigmas; ovary superior, 1-celled; ovule 1, basal. Fruit a small drupe, very close-set, 2-3mm diam., +- angled; exocarp succulent, yellow to orange, broadly obovoid. Fl. & fr. all year.

Lowland forest; north island, south island s. to Banks Peninsula and Okarito, also on Chatham Island.

M. excelsum ssp. psittacorum differs by having leaves 10-16 x 11-20cm, 9-nerved; spikes up to c.15cm long (Allan 1961). Kermadec Is., Lord Howe Is., Norfolk Is., Three Kings, Poor Knights, Little Barrier, Tiritiri, Mayor Is., and other small islands off the coast of New Zealand's north island (Allan 1961; Bock 2001).

MAGNOLIA

(Magnoliaceae)



Magnolia biondii *Pamp.* **(M. aulacosperma** *Rehder et Wilson***; M. biondii fo. purpurascens** *Law et Gao***; M. conspicua var. fargesii** *Finet et Gagnep.***; M. denudata var. fargesii** *(Finet et Gagnep.) Pamp.***; M. fargesii** *(Finet et Gagnep.) W.C. Cheng***)** – xin yi hua
Magnolia dealbata *Zucc.* **(M. macrophylla var. dealbata** *(Zucc.) D.L. Johnson***)** – elexochitl
Magnolia denudata *Desr.* **(M. conspicua** *Salisb.***; M. heptapetala** *(Buc'hoz) Dandy***; M. obovata var. denudata** *(Desr.) DC.***; M. yulan** *Desv.***; Lassonia heptapetala** *Buc'hoz***)** – xin yi hua
Magnolia kobus *DC.* **(M. praecocissima** *Koidz.***; M. tomentosa** *Thunb.***; Buergeria obovata** *Sieb. et Zucc.***; Yulania kobus** *(DC.) Spach***)** – kobushi
Magnolia liliflora *Desr.* **(M. quinquepeta** *(Buc'hoz) Dandy***; Lassonia quinquepeta** *Buc'hoz***)** – xin yi hua
Magnolia officinalis *Rehder et E.H. Wilson* **(M. biloba** *(Rehder et Wilson) Cheng***; M. officinalis ssp. biloba** *(Rehder et Wilson) Cheng et Law***; M. officinalis var. biloba** *Rehder et Wilson***; M. officinalis var. pubescens** *C.Y. Yeng***)** – Chinese magnolia, chuan how-pow, hou po
Magnolia salicifolia *Maxim.* – tamushiba

Magnolia tripetala *L.* **(M. umbrella** *Lamarck***)**
Magnolia virginiana *L.* **(M. australis** *Ashe***; M. australis var. parva** *(Ashe) Ashe***; M. fragrans** *Raf.***; M. glauca** *(L.) L.***; M. glauca var. longifolia** *Pursh***; M. glauca var. pumila** *Nutt.***; M. virginiana ssp. australis** *(Sarg.) Murray***; M. virginiana var. australis** *Sarg.***; M. virginiana var. glauca** *L.***; M. virginiana var. parva** *Ashe***)** – sweet bay, swamp bay, white bay, white laurel, red laurel, sweet Magnolia, swamp sassafras, beaver tree

These Magnolia spp., large trees with splendid flowers, have similar medicinal and intoxicating properties, generally as aromatic tonic stimulants or narcotics.

M. dealbata has been proposed to have been the Aztec inebriant 'poyomatli' (Diaz 1979), yet it is likely that the true identity of poyomatli will never be known with certainty. The Cherokee use M. acuminata and M. macrophylla as analgesics (Hamel & Chiltoskey 1975). The Rappahannock snuff leaves and bark of M. virginiana as a 'mild dope' (Ott 1993). The odour of the flowers of this species has, on occasion, caused fainting and difficulty in breathing [presumably with over-exposure]. The bark of M. tripetala has been chewed as a tobacco substitute [see **Nicotiana**] by at least one person, who thus succeeded in breaking his tobacco habit. In N. America, the barks of Magnolia spp. [harv. spring and summer] were once widely used as bitter tonics, with diaphoretic and possibly antiperiodic effects, though they are rarely used any more in western medicine (Felter & Lloyd 1898).

M. officinalis is revered in TCM for its bark [dose – 6-10g], which is a tonic aphrodisiac, and is used to treat neurosis, colds, coughs, vomiting, asthma, diarrhoea, peptic ulcers and stomach spasms. Its antiseptic properties are effective against typhus, malaria and salmonella; the bark also has a muscle-tranquillising component (Bremness 1994; Chin & Keng 1990; Keys 1976; Watanabe et al. 1983). M. salicifolia flower buds ['shin-i'] are used in Japan to treat headache and nasal congestion (Watanabe et al. 1981). An extract of the bark from M. obovata [closely related to M. denudata] has shown sedative effects in mice (Macrae & Towers 1984a).

M. biondii, M. denudata and M. liliflora flower buds, used in TCM, contain *eugenol*, *safrole*, *estragole* and *anethole*. Leaves yielded salicifoline [3-OH-4-MeO-N,N,N-trimethyl-*phenethylamine*] and the aporphine magnocurarine. M. liliflora is said to be incompatible with **Acorus** gramineus (Huang 1993; Keys 1976; Tomita & Nakano 1957).

M. grandiflora bark has yielded candicine [4-OH-N,N,N-trimethyl-*phenethylamine*], salicifoline and the aporphine magnoflorine [thalictrine] (Tomita & Nakano 1957); wood has yielded N-nor-*nuciferine*, anonaine, anolobine and liriodenine; leaves yielded only anonaine and liriodenine (Tomita & Kozuka 1967).

M. kobus bark has yielded [w/w] 0.214% salicifoline (Tomita & Nakano 1952b).

M. obovata bark has yielded magnocurarine (Tomita & Nakano 1957), as well as neolignans similar to those in **Virola** spp. (Macrae & Towers 1984a).

M. officinalis bark has yielded the neolignan derivatives magnolol and honokiol, which caused sedation, ataxia and muscle relaxation in mice, in doses of 50-500mg/kg [i.p.] (Watanabe et al. 1983); honokiol also stimulated K+-evoked *acetylcholine* release in rat hippocampus (Tsai et al. 1995).

M. salicifolia bark yielded [w/w] 0.016% salicifoline, as well as magnocurarine (Tomita & Nakano 1952a, 1957); flower buds yielded the benzyltetrahydroisoquinolines d-coclaurine [sedative; inhibits *dopamine* uptake in rat iris] and d-reticuline [sedative] (Watanabe et al. 1981); leaves and small branches yielded an essential oil containing 73% *anethole*, 7% anisaldehyde, 1.3% 1,8-cineole, 3% hydrocarbon and traces of *citral* (Matsuura & Watanabe 1953).

M. sprengeri has yielded N,N-dimethyl-3-MeO-*tyramine* (Lundstrom 1989).

M. stellata bark has yielded salicifoline (Tomita & Nakano 1957).

M. virginiana leaves have yielded the neolignans magnolol, MeO-hinikol and biphenyl ether. Flowers yielded 1.16% 4,4'-diallyl-2,3'-dihydroxybiphenyl ether, 0.11% 3,5'-diallyl-2',4-dihydroxybiphenyl, 1.66% 5,5'-diallyl-2,2'-dihydroxybiphenyl and 0.42% 3,5'-diallyl-2'-OH-4-MeO-biphenyl (Chandra & Nair 1995). In a broad alkaloid screening, stem and leaf tested positive (Fong et al. 1972).

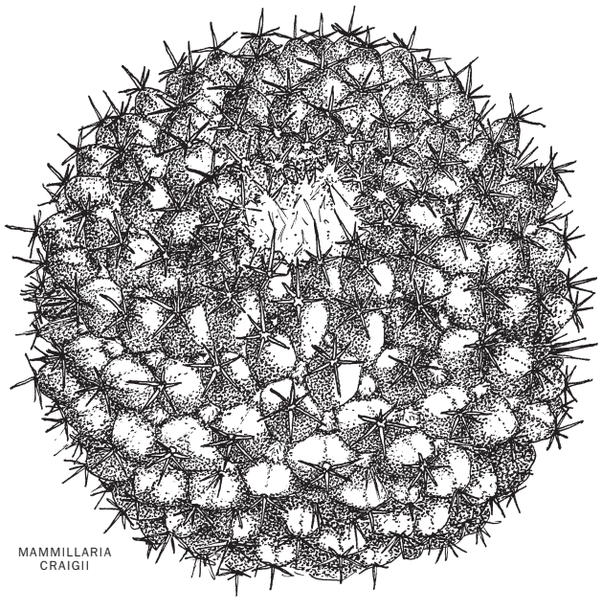
Aporphine alkaloids are common in the genus Magnolia – including nor-*nuciferine*, asimilobine, anonaine, glaucine, norglaucine, oxoglaucine, obovanine, liriodenine, lanuginosine, norushinsunine, N-methyllindcarpine and N,N-dimethyllindcarpine (Guinaudeau et al. 1975).

Magnolia virginiana is a tall shrub or slender tree to 20m tall. Leaves scattered on the twigs, coriaceous, deciduous in north, evergreen in south, oblong to elliptic or sometimes oblanceolate, 8-15cm long, 1/3-1/2 as wide, obtuse, base acute to broadly rounded, strongly glaucous and finely pubescent beneath; stipules completely encircle stem at base of leaf, early deciduous, leaving a scar. Flowers fragrant, white, subglobose, c.5cm diam., or in age more widely expanded; perianth of 9-15 similar or scarcely differentiated segments in 3-5 circles; petals 9-12, coriaceous, obovate, concave, 3-5cm long, forming a subglobose flower; stamens many, spirally arranged; pistils many, spirally arranged, on an elongate receptacle, ripening into red or brown cone-like fruits; anthers introrse. Ovaries separately dehiscent at maturity, exposing the seeds; ovules 1-2 in each ovary. Seeds remaining attached by slender threads for some time after dehiscence. Fl. May-Jul.

Wet woods and margins of swamps; e. Massachusetts, Long Island, New Jersey to Texas and Arkansas, mostly on the coastal plain, but extending inland to Pennsylvania (Gleason 1952).

MAMMILLARIA [including Dolicothele]

(Cactaceae)


MAMMILLARIA CRAIGII

Mammillaria craigii *Lindsay* – peyote de San Pedro, wichurí, wichuríki, witkulíki, biznaga
Mammillaria elongata *DC.* **(M. intertexta** *DC.***; M. subcrocea** *DC.***; M. tenuis** *DC.***; Echinocactus densus** *Steud.***; Neomammillaria elongata** *(DC.) Br. et R.***)** – golden star
Mammillaria grahamii *Engelmann* **var. oliviae** *(Orcutt) Benson* – híkuli, híkuri, peyote
Mammillaria heyderi *Mühl.* **(Cactus heyderi** *Kuntze***; Neomammillaria heyderi** *(Mühl.) Br. et R.***)** – wichurí, wichuríki, witkulíki, biznaga, biznaga de chililos
Mammillaria longimamma *DC.* **(Dolicothele longimamma** *(DC.) Br. et R.***)** – peyotillo, peyote
Mammillaria pectinifera *(Ruempler) Weber* **(Pelecyphora pectinata** *B. Stein***; Solisia pectinata** *(B. Stein) Br. et R.***)** – peyotillo, peyote, cochinito ['little pig']
Mammillaria senilis *Lodd.* **(Cactus senilis** *Kuntze***; Mamillopsis senilis** *(Lodd.) Weber***)** – cabeza de viejo ['head of the old'], chilito, biznaga de chililos
Mammillaria sphaerica *Dietr.* **(Dolicothele sphaerica** *(Dietr.) Br. et R.***)**
Mammillaria surculosa *Böed.* **(Dolicothele surculosa** *(Böed.) Buxb.***)**
Mammillaria uberiformis *(Zucc.) Br. et R.* **(M. longimamma var. uberiformis** *(Zucc.) D.R. Hunt***; Dolicothele uberiformis** *(Zucc.) Br. et R.***)**

Carl Lumholtz reported early last century that amongst the Tarahumara of n. Mexico, "High mental qualities are ascribed especially to all species of Mammillaria and Echinocactus." Plants from these genera were also mentioned by Bravo as being very important in religious rites, known as 'comitl', 'metzollin', and/or 'huiztnahuac'. Some of these plants known under the latter name were considered to be incarnations of Tlaloc (Bravo 1937; Schultes 1967a). Unfortunately, it is unclear exactly which Echinocactus spp. [see *Endnotes*] Lumholtz was referring to, and **Lophophora** williamsii was once classified as an Echinocactus.

The Tarahumara once used M. craigii and/or M. heyderi for their medicinal and psychoactive properties [some believe these to be synonymous species; some keep them separate but say that the Tarahuamara plant is actually M. craigii and not M. heyderi]. The plants are both feared and held in high regard, and must be harvested respectfully. M. craigii/M. heyderi has been used to treat headaches, earaches and deafness, by inserting the juice of the cut, despined and roasted cactus into the ear. The centre of the plant is rich in a white latex. This plant was claimed to be ingested as a stimulant for runners, and so that a shaman could "locate witch-

es and wizards by clearing his vision". The despined tops of the plants are reputed to be the most effective, and when consumed, have been claimed to send one into a sleep in which brilliantly coloured visions and shamanic voyages are experienced – or, if the consumer is not properly prepared for the experience, "it will drive him crazy". The edible fruits ['chilitos'] are enjoyed locally (Bruhn 1973; Bruhn & Bruhn 1973; Bye 1979b). M. grahamii var. oliviae is reputed by the Tarahumara to have the same effects as decribed for M. craigii, and it was ritually consumed by the shaman with other participants (Bye 1979b).

M. longimamma and M. pectinifera have also been known as 'peyote' and 'peyotillo' [see **Lophophora**] (Schultes 1937a, 1937b), though it is not known whether they have been used ritually. M. senilis has been said to be sacred to the Tarahumara, due to the respect displayed toward the plant (Bruhn 1973; Bruhn & Bruhn 1973; Bye 1979b). M. senilis might represent the 'híkuli rosapara' mentioned under **Epithelantha** (Bye 1979b). The Seri of Sonora use M. microcarpa and M. sheldoni medicinally, in common with the Tarahumara use of M. craigii/M. heyderi – the juice from the vascular bundle is given as ear drops to treat earache (Felger & Moser 1974).

M. craigii has been found to be psychoactive in human bioassays. For each person, one whole plant including the root [the 'button' being c.10cm diam., 5cm tall] was decocted and drunk; the residue was also eaten. The psychonauts who consumed this experienced a pleasant 'trip', which was compared qualitatively to a mixture of *mescaline* and MDMA (Torsten pers. comm.). Another psychonaut smoked the dried latex of this species, mixed with **Cannabis**; subjectively, the effects were compared to a combination of smoked **Salvia** divinorum and **Cannabis** (Anon. 1998). There appears to be no published chemical analysis of this species.

M. elongata yielded less than 0.004% alkaloids – 0.0009% synephrine, 0.0005% *hordenine*, and traces of β-O-methylsynephrine, *tyramine* and N-methyl-*tyramine* (West & McLaughlin 1973).

M. heyderi has yielded 0.01-0.05% alkaloids [w/w], mostly N-methyl-*DMPEA*, with smaller amounts of an unidentified alkaloid (Bruhn & Bruhn 1973). The latex was smoked with **Cannabis** as above, but no effects were noted that could not be attributed to the **Cannabis** (Anon. 1998).

M. longimamma has yielded 0.43% d,l-synephrine, as well as 0.012% *normacromerine*, 0.00037% longimammine [may = longimammidine], 0.0019% longimammosine [6-OH-THIQ], 0.0019% longimammidine [8-OH-2-methyl-THIQ], 0.0028% longimammatine [6-MeO-THIQ], 0.0008% longimammamine [4,8-dihydroxy-2-methyl-THIQ] and ubine [N,N-dimethyl-β-OH-*phenethylamine*]; as well as 10.5% lipids (Kruger et al. 1977; Ranieri & McLaughlin 1975, 1976a).

M. meiacantha [= M. runyonii *(Br. et R.) Boed.*] contains an unidentified alkaloid, 0.114% acetovanillone, 0.0069% mammillarol [a triterpene] and 0.0043% ACI-9 [a steroid] (Dominguez & Pugliese 1967).

M. pectinifera has yielded 0.01-0.05% alkaloids, mostly *hordenine*, with lesser amounts of N-methyl-*tyramine* and an unidentified alkaloid (Bruhn & Bruhn 1973).

M. sphaerica has yielded [w/w] 0.0033% synephrine, 0.0038% β-O-ethyl-synephrine, 0.0155% N-methyl-*tyramine*, 0.0411% N-methyl-*phenethylamine* and 0.65% dolicotheline [N-isovaleryl-*histamine*] (Dingerdissen & McLaughlin 1973a; Dingerdissen et al. 1973). Doping with isocaproic acid caused the plant to produce N-isocaproyl-*histamine*; doping with 4(5)-aminomethylimidazole caused production of 4(5)-[N-iso-valerylaminomethyl]imidazole (Rosenberg & Paul 1973).

M. surculosa has yielded [w/w] 0.134% N-methyl-*tyramine*, 0.25% N-methyl-*phenethylamine*, 0.017% synephrine, 0.178% *hordenine*, traces of dolicotheline and an unknown imidazole (Dingerdissen & McLaughlin 1973b).

M. uberiformis has yielded synephrine, longimammine, longimammatine, uberine [5-MeO-7-OH-2-methyl-THIQ], *normacromerine*, N-methyl-*DMPEA*, N-methyl-4-MeO-*phenethylamine*, N,N-dimethyl-β-OH-*phenethylamine*, N-methyl-*tyramine* and *hordenine* (Kruger et al. 1977; Ranieri & McLaughlin 1976b).

Mammillaria craigii is a simple cactus, branching dichotomously, with a sunken, woolly apex; roots fibrous. Tubercles closely set in 13 and 21 spirals, firm in texture, light yellowish grey-green, 4-sided, sharply angled to tip, 6-7mm long, 9-10mm wide at base, with milky sap; areoles oval, 2mm long, sunken, with abundant light tan wool persisting for some time; axils with a little white wool in flowering area, but no bristles; central spines (1-)2(-3), 10-20mm long, lower longest, all slender acicular, stiff, smooth, nearly straight, upper slightly recurved, all slightly enlarged at base, brownish-golden, slightly divergent dorsally and ventrally from porrect; radial spines 7-8, 4-12mm long, upper 3 shorter, lower longest, all fine acicular, straight, smooth, mostly stiff to semiflexuous, base slightly enlarged, brownish-golden, markedly ascending. Flowers campanulate, somewhat lateral, 15-20mm long, 10-15mm wide; outer perianth segments 15, very pale greenish below, brownish-pink above, linear, tip obtuse, margins serrate and slightly ciliate; inner perianth segments deep pink, darker mid-line ventrally, linear-spatulate, tip obtuse to emarginate, margins mostly entire, sometimes serrate at tip; filaments cream to yellow to pink above; anthers sulphur-yellow; style yellow to very pale pink above; stigma lobes 7, greenish-yellow, 3mm long, slightly overtop anthers. Fruit red, clavate, 12 x 8mm, with dried perianth persisting; seeds light brown, glossy, curved pyriform with lateral hilum near base, faintly reticulate, 1 x 0.4mm. Fl. Feb.-Mar., open for 2-3 days.

In leaf mold in crevices of rocks, partial shade, in mountainous habitat c.1800m; s.w. Chihuahua, s.e. Sonora [Mexico] (Craig 1945).

MANDRAGORA

(Solanaceae)

Mandragora autumnalis *Bert.* **(M. femina** *Gersault***; M. microcarpa** *Bertol.***; M. officinalis** *Moris***; M. officinarum** *Bert. non L.***)** – mandrake, autumn mandrake, black mandrake, female mandragora, morion

Mandragora caulescens *C.B. Clarke* **(Anisodus caulescens** *(C.B. Clarke) Diels***)**

Mandragora officinarum *L.* **(M. acaulis** *Gaert.***; M. mas** *Dod.***; M. neglecta** *G. Don.***; M. officinalis** *Mill. non Moris***; M. praecox** *Sweet***; M. vernalis** *Bert.***)** – mandrake, spring mandrake, mandragora, male mandragora, mandagloire, devil's apple, love apple, circeium, merdomgia, isterung, ebrewi sanam, segken ['dog-dug'], atzmann, yabrouh, hunguruk koku, tuphac el sheitan, putrada, lakshmana, alraun, hexenkraut, galgemannlein ['little gallows man'], thjofarot

Mandragora turcomanica *Mizgir.*

Mandragora spp. – mandrake, main de gloire, madagfoire

Mandrake is an ancient and mysterious magical herb, surrounded by mythology and archaic beliefs. It has drawn reverence for its sometimes anthropomorphic root [with the powers of imagination factored in to the equation], said to contain a spirit that would kill the digger of the plant with its screams. Many rituals arose to deal with this supposed problem, and safely harvest the root, mostly involving the use of an unwitting dog to pull up the root, and 'sacrifice itself' with its supposed subsequent death. The root was not generally consumed, but instead kept as a good-luck amulet. Often the more anthropomorphic roots were dressed in tiny clothes and cared for [as 'alraun' – 'elf-whisper'], with the attendant belief that failure to do so would bring disastrous misfortune.

The ancient Greeks used it in wine as an aphrodisiac, stupefacient, and surgical anaesthetic. Dioscorides referred to a variety of mandrake which was particularly potent, known as 'morion', which may have been M. autumnalis. It was commonly believed in many areas that mandrake fruits could enable an infertile woman to bear a child. Mandrake fruit [as 'dudaïm' in original texts] is said to have been used by Rachel in the Bible [Genesis 30:14-15] to help her conceive. The plant was also used in wine or beer [see *Methods of Ingestion*] by the ancient Egyptians as an aphrodisiac and stupefacient. In legend, Ra used a beer fortified with mandrake and human blood to placate the ravening lion-goddess Sekhmet, and turn her [after a long sleep] into the love-goddess Hathor (Emboden 1979a; Duke 1983; Rätsch 1990, 1992; theobromus pers. comm.; Thompson 1968; Zohary 1982). M. turcomanica has been suggested as a potential candidate for the identity of 'haoma', and perhaps also 'soma' [see **Peganum**, **Amanita**], though this is based on scanty evidence (Ott 1998b).

By the Middle Ages, knowledge of the properties of mandrake had spread to practitioners of magic and herbalism in Europe and China. The plant has been an ingredient in witches potions and 'flying ointments'. Even today in Romania, the ritual collection and use of mandrake as a magical aphrodisiac continues, and the Bedouins of Israel hold it sacred. Near Mt. Lebanon, the fruits are known as 'baidh ul-jinn' ['eggs of genii'], alluding to knowledge of the properties of the plant. In Sikkim, the root of M. caulescens is reportedly used in 'magic rites'. In Armenia, the smoke from burning mandrake is inhaled to cure insanity. In India, M. officinarum root, as 'lakshmana' [see also **Calonyction**], is regarded as an aphrodisiac and 'promoter of conception'. As long as the mandrake has been sought after for its properties, various plants with anthropomorphic roots, or with roots carved or otherwise manipulated to replicate an approximation of human form, have been sold to the unwitting as true mandrake. Some of these plants have included Allium victoralis, Bryonia dioica ['bryony'], Podophyllum pentatum ['American mandrake', 'mayapple'] and others, which are known as 'false mandrakes' (Duke 1983; Emboden 1979a; Jackson & Berry 1979; Mehra 1979; Rätsch 1990, 1992; Schultes & Hofmann 1992; Thompson 1968).

In the late 15th century, mandrake became an ingredient in a general anaesthetic devised by an early surgeon, Hugo of Lucca. His mixture, which was soaked into a sponge for use ['spongia somnifera'], contained mandrake leaf-juice, opium [see **Papaver**], hemlock [see **Conium**], henbane [see **Hyoscyamus**], unripe mulberry juice [see **Morus**], forest mulberry, wood ivy, water lettuce, lettuce seeds [see **Lactuca**], water hemlock seeds [Cicuta sp.; see **Conium**] and dock seeds (Thompson 1968).

Some antidotes for mandrake poisoning have been suggested in the past, however we do not know whether they are effective. One of these consisted of wormwood [see **Artemisia**], rue [Ruta graveolens – see *Endnotes*], scordium, mustard [see **Brassica**], oregano [Origanum sp. –

see *Endnotes*] and castor [Ricinus sp.], taken with vinegar and wine [see *Methods of Ingestion*] (Thompson 1968).

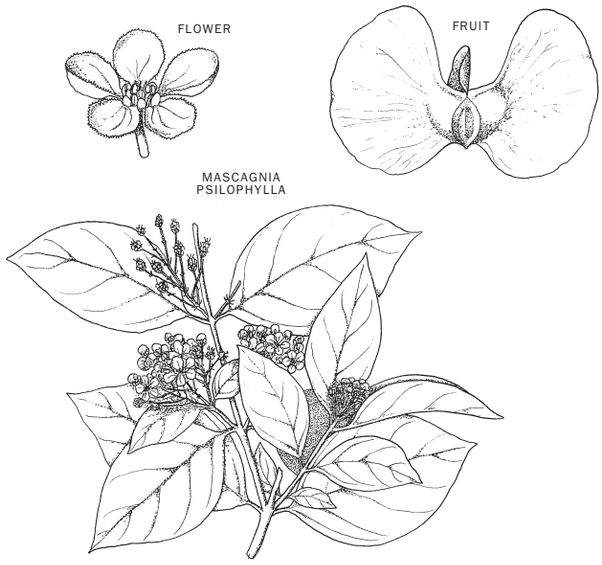
M. officinarum and M. autumnalis [and probably the whole genus] are potently psychoactive plants, and attempted use as an aphrodisiac should be with very small doses. Their alkaloid composition appears to be virtually identical. Highest alkaloid concentrations are reported to be in the roots and fruits; roots have yielded 0.1-0.4% alkaloids, mostly *hyoscyamine*, as well as *hyoscine*, apo-*atropine*, belladonnine and traces of cuscohygrine [mandragorine; present in larger amounts in fresh roots]; 3α-tigloyloxytropane, 3,6-ditigloyloxytropane, β-methylesculetin [in fruits], sitosterol, rhamnose, glucose, fructose and sucrose have also been found in the plant (Evans 1979; Hesse 1901; Jackson & Berry 1973, 1979; Schultes & Hofmann 1980; Thoms & Wentzel 1901). M. autumnalis has been found to contain calystegines B2 and B3 in the leaves, and calystegines A3, B1, B2, and B3 in the roots [see **Convolvulus**] (Bekkouche et al. 2001).

Mandragora officinarum is a perennial herb with a stout, erect, often bifid and anthropomorphic fleshy taproot; acaulescent or with a very short stem. Leaves simple, in a dense basal rosette, petiolate, ovate to ovate-lanceolate, entire, undulate, sparsely villous on veins at least when young. Flowers hermaphrodite, solitary, axillary; pedicels usually shorter than leaves; calyx slightly accrescent, much shorter than berry, campanulate, 5-lobed; corolla campanulate, with 5 narrowly triangular lobes, plicate between the lobes, persistent, not more than 2.5cm, greenish-white; stamens 5, subexserted, inserted in lower ½ of corolla-tube, alternating with lobes; filaments villous below; anthers dorsifixed. Ovary superior, usually with 2 loculi, surrounded at base by glandular disc; style simple; stigma capitate. Fruit a globose yellow berry, becoming unilocular by the obliteration of the septum; seeds usually numerous.

N. Italy, w. Yugoslavia (Tutin et al. ed. 1964-1980), other Mediterranean countries, to North Africa.

MASCAGNIA

(Malpighiaceae)



Mascagnia glandulifera *Cuatrecasas*

Mascagnia psilophylla var. antifebrilis *(Griseb.) Nied.* **(M. psilophylla var. peruviana** *Nied.***; Banisteria antifebrilis** *Griseb.***; Cabi paraensis** *Ducke***; Callaeum antefebrile** *(Griseb.) Johnson***)** – cabí, caapueira, hayawasca, bejuco de las calenturas ['vine for fever'], shillinto

The bush M. psilophylla var. antifebrilis is reported to be used as an ayahuasca additive [see **Banisteriopsis**] in Peru, though in at least one case identification may have been in error due to a mixed collection. As Cabi paraensis, it has been reported to be used in the same way as **Banisteriopsis** near the mouth of the Amazon. When added to ayahuasca, the plant is used in order to treat difficult cases of typhus or fever. The root is used alone to treat fevers, and is taken in a cold water infusion as a vermifuge (Bristol 1966; Luna & Amaringo 1991; Schultes 1957, 1966; Schultes & Raffauf 1990). In the middle Aporis, the crushed, boiled leaves of M. glandulifera are applied as a poultice to boils and other infections (Schultes 1950). It is also suspected of being used as a yajé source-plant, in place of **Banisteriopsis** (Trout ed. 1998 – see Harv. Bot. Mus. Leaf. 26(5):177-197 [1978]).

In Brazil, Mascagnia spp. [known as 'cipó-prata'] sometimes cause fatal intoxications in cattle, with 0.5-2kg/100kg causing sudden death due to cardiac arrest (Pott & Alfonso 2000).

M. psilophylla var. antifebrilis leaves and twigs have yielded *harmine* (Mors & Zaltzman 1955).

Mascagnia psilophylla var. antifebrilis is a shrubby bush, to 5m, scrambling or climbing, branches pale brown or hoary white, to c.0.5cm diam., internodes 2-7(-13)cm long. Leaves to 3cm long, caudate-acuminate, base acute to obtuse, often narrow or inaequilateral, ovate to elliptic to subrotundate, membranaceous-chartaceous, upper side smooth, underside with 4-5 prominent primary nerves, secondary nerves parallel, slightly raised, areolate and near upper margin base spotted on both sides with 1-2 wide glands; petiole slightly puberulous, to 2cm long, sometimes below apex bi-glandulose; stipules gland-like or tubercule-like, attached on both sides at base of petiole, scarcely 4mm high. Umbels axillary, numerous, arranged in large panicles; peduncle 3-7mm long, pedicels mostly twice as long; bracts ovate, c.1.25mm, bracteoles cordate-rotund to reniform, semiamplexicaul, 1.5-2mm long; flowers 1.5cm diam.; sepals orbicular, with 8 glands, 1.5-2.25mm long; petals 5, spathulate, acute, base glandulose-fimbriate, 5-7mm diam., unguis recurved, 2mm long; anthers orbicular, 1mm diam. Style mostly sericeous, 2, posterior recurved-divergent, anterior somewhat shortly suberect. Fruit a samara, subglabrate, leathery, 3-winged; nut subglobose, 0.7-0.75cm long, areole widely ovate; lateral flange margin slightly sinuate.

Peru [Pueblo Nuevo; Tarapoto, Dep. Loreto] (Engler & Niedenzu 1928).

MAYTENUS

(Celastraceae)

Maytenus chuchuhuasha *Raymond-Hamet et Colas* **(M. krukovii** *A.C. Sm.***)** – xuxuá, chuchuhuasi, chuchuhuasha

Maytenus ilicifolia *(Schrader) Planch.* – espinheira santa, kangorosa

Maytenus laevis *Reissek* **(M. ebenifolia** *Reiss.***; M. jauaensis** *Steyerm.***)** – chuchuhuasi, chuchuhuasca, chuchuhuasha, chuchuguache, chuchuguaza, coemeni

Maytenus spp. are valued as treatments for rheumatism in the Amazon, particularly in Peru and Colombia. M. laevis is used by some Peruvian shamans as an ayahuasca additive, and is taken by Lamisto apprentice shamans a few weeks after taking ayahuasca [see **Banisteriopsis**]. It may also be taken under diet as a plant teacher and tonic medicine. Besides treating rheumatism, it offers protection against cold (Bear & Vasquez 2000; Luna 1984; McKenna et al. 1995; Schultes & Raffauf 1990). Extracts of the root bark have shown antitumour effects. The medicinal alcohol infusion of the bark is commonly referred to as 'chuchuhuasha' or similar names (González, J.G. et al. 1982). M. laevis is used medicinally by the Siona, particularly those who have become urbanised, where the bark is soaked in aguardienté overnight, and drunk as a painkiller for rheumatism and arthritis. Jungle Siona prefer to boil a 5cm trunk segment in 2 litres of water, reducing its quantity by half; a small cup of the decoction is drunk 3 times a day. It has the reputation of being a strong stimulant (Schultes & Raffauf 1990). As M. krukovii, M. chuchuhuasha is used in Brazil to treat skin cancer (Shirota et al. 1996). It has been suggested that M. krukovii, M. laevis and M. macrocarpa are the same species (Jones 1995), but I am seeking confirmation of this.

M. ilicifolia is used as an aphrodisiac in southern Brazil (Mors & Rizzini 1966). In Paraguay, its rhizome is decocted as an abortifacient, and to treat amenorrhoea, ulcers and cancer. The leaf is sometimes used to adulterate 'maté' [see **Ilex**] (Basualdo et al. 1995). In Argentina, it is used as an antiasthmatic, antiseptic, vulnerary and sialogogue [promotes salivation] (Zhu et al. 1998).

In TCM, the fruit, bark, and rhizome from M. buchananii, M. conterliflories, M. hookeri and/or M. serrata are now used [as 'mei deng mu'] in treating cancer. They must be used in small doses, due to toxic side effects such as diarrhoea, nausea, vomiting and liver toxicity (Huang 1993).

M. chuchuhuasha has yielded small amounts [<0.002%, w/w] of the triterpene dimers xuxuarine Eβ, isoxuxuarines Aα & Aβ, 7,8-dihydroxuxuarine Aα and 7,8-dihydroisoxuxuarine Aα (Shirota et al. 1997). As M. krukovii, it has been claimed to contain d-cathine [*norpseudoephedrine*] and d-*cathinone*, strong CNS-stimulants [see **Catha**] (Harborne & Baxter ed. 1993; Smith 1939), but I can find no primary reference for this, and the claim needs verification. Dried stem bark has also yielded 0.019% mayteine and 0.0015% 6-benzoyl-6-deacetylmayteine [sesquiterpene-pyridine alkaloids] (Sekar et al. 1995), as well as 0.05% of the triterpenes krukovines A-E (Shirota et al. 1996).

M. ilicifolia has yielded triterpenoids, triterpenoid dimers, oligo-nicotinated sesquiterpene polyesters and 3 glucosides [ilicifolinosides A-C] (Zhu et al. 1998).

M. laevis bark has been found to contain the phenoldienones tingenone and 22-OH-tingenone, as well as 4'-methyl-(-)-epigallocatechin and Ouratea-proanthocyanidins A & B (González, J.G. et al. 1982); bark also yielded sesquiterpene-pyridine alkaloids – ebenifoline E-1, euonine, euonymine, euojaponine, euojaponine I, laevisines A & B, mayteine and

wilforine (Piacente et al. 1999).

M. senegalensis has yielded triterpenes and sterols, and has shown antitumour activity in mice (Tin-Wa et al. 1971).

An unidentified Maytenus sp. from the Rio Ica in Brazil is used locally as a diuretic, and yielded 0.85% *caffeine* from its arils (Schultes & Raffauf 1990).

Maytenus chuchuhuasha is a glabrous tree to 28m tall; branches terete, slightly flattened when young, slender, soon ash-grey. Petioles rugose, narrowly winged or conspicuously grooved longitudinally, 6-9mm long; leaves coriaceous when dry, olive-green or dark brown, oblong-elliptic or obovate-elliptic, 9-14(-18)cm long, 3.5-5(-7)cm wide, base attenuate and in petiole decurrent, apex acuminate (acumine to 10mm long, appearing obtuse), margin mildly revolute and superne above crenate-serrate, midrib prominent on both sides, lateral nerves 7-9 paired, adscending, near margins anastomose, on upper side immersed and obscure, on under side slightly raised, minor veins obscure. Inflorescence axillary, glomerules 4-5mm diameter; flowers sessile to subsessile (pedicel c.0.5mm long), numerous (50 or more per inflorescence), bracts minute; calyx cupuliform, sepals deltoid, subacute, 0.8-1mm long, c.0.6mm wide, towards apex minutely glandulose-fimbriate; petals imbricate, oblong-deltoid, 0.8-1.2mm long, c.0.8mm wide, apex obtuse to rotundate; filaments minute, 0.2mm long, apex angustate; anthers deltoid-ovoid, c.0.5mm long and wide, base deeply cordate, apex minute mucronulate. Disc slightly fleshy, c.1.2mm diameter, margin undulate; ovary immersed in disc; style thick, c.0.4mm long, inconspicuously lobed. Fruit an oblong-obovoid coriaceous capsule, c.20mm long, 14mm wide, bivalved, pericarp 1-1.5mm thick.

Brazil [near mouth of Rio Embira, basin of Rio Jura, Amazonia; between Rio Madeira and Rio Capana].

Closely resembles M. laurina of the Rio Negro; differs in smooth upper leaf with immersed nerves, as M. laurina has nerves sharply impressed above (Smith 1939).

MELICOPE

(Rutaceae)

Melicope erythrococca *Benth.*
Melicope leptococca *(Baillon) Guillaumin* **(Evodia leptococca** *Baillon***)**

I have found no ethnobotanical uses for these plants; however, their chemistry is of interest.

M. erythrococca bark from Yarraman, Queensland [Australia], harvested in October, tested positive for alkaloids (Webb 1949). The bark has a 'tingling taste', and produced excitation in frogs, followed by paralysis of the spinal cord and death. "The active principle is apparently a protoplasmic poison, 'destroying every part of the animal economy'" (Hurst 1942). The plant also yields an essential oil containing *elemicin* (Shaw et al. comp. 1959).

M. fareana leaf and bark from Boonjie, Queensland [harv. Aug.] tested strongly positive for alkaloids (Webb 1949). The bark has yielded lupeol, the furoquinoline alkaloid acronycidine [4,5,7,8-tetramethoxyfuro[2,3-b]quinoline], and the acridines melicopine, melicopicine [1,2,3,4-tetramethoxy-10-methylacridone] and melicopidine [N-methyl-1,4-dimethoxy-2,3-methylenedioxy-9(10H)-acridone]; leaves have yielded these last 3 alkaloids, as well as the furoquinoline *skimmianine* (Shaw et al. comp. 1959).

M. leptococca aerial parts yielded 0.61% alkaloids [following figures as % of total alkaloids] — 35% *5-methoxy-DMT* [*5-MeO-DMT*], 5% *5-MeO-DMT* N-oxide, 4% 2-methyl-*pinoline*, 10% acronydine, 7% melicopicine, 3% melicopidine, 30% kokusaginine [see **Dutaillyea**], 1% acronycine [acronine; 3,12-dihydro-6-MeO-3,3,12-trimethyl-7H-pyrano[2,3-c]acridin-7-one], 2% acronycidine and 1% dimethylaminoacetyl-3-methoxy-5-indole [the ketone analogue of *5-MeO-DMT*] (Skaltsounis et al. 1983); the plant has also yielded acronidine (Buckingham et al. ed. 1994).

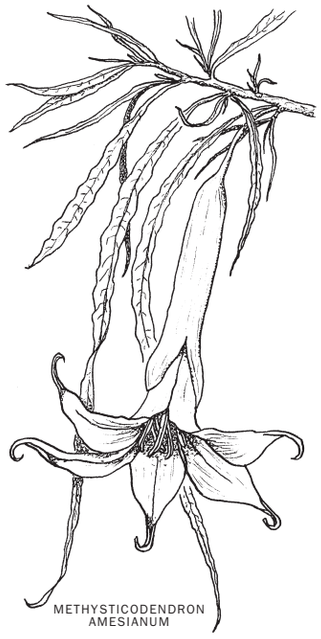
M. leratii aerial parts yielded 0.33% alkaloids, including *skimmianine*, melicopidine, xanthevodine and 1,2,3-trimethoxy-10-methylacridan-9-one (Ahond et al. 1978).

M. neurococca leaf and bark [harv. Nov.] from Pine Mt., Queensland [Australia] tested weakly positive for alkaloids (Webb 1949).

Melicope leptococca is a small bushy shrub growing at higher elevations of Mt Boulinda, New Caledonia (Shulgin & Shulgin 1997). I have not personally managed to obtain the source for its description, which was reported to be found in Bull. Mus. Hist. Nat. Paris 1920, xxvi. 175. However, an overseas friend who did locate this reference found that it did not contain any description, merely a note that Evodia leptococca had been re-named as M. leptococca; from what could be understood from this French article, the description of E. leptococca seemed to exist only in an unpublished manuscript.

METHYSTICODENDRON

(Solanaceae)



Methysticodendron amesianum *Schultes* **(Brugmansia amesianum** *(Schult.) D'Arcy***; Datura candida** *(Pers.) Saff.* **cv. 'culebra'** *Bristol***)** – culebra, culebra borrachero ['intoxicant of the snake'], metskwai borrachero ['intoxicant of the jaguar'], mits-kway borrachero, mutscuai borrachero, kin-de borrachero, goon'-ssi-an borrachero

This tree, closely related to **Brugmansia** spp. [generally considered a mutant **Brugmansia** cultivar], is occasionally used by Inga and Kamsá shamans of the Colombian Sibundoy as a hallucinogen. Its common names are indicative of its properties. It is considered very strong, stronger than **Brugmansia**, and is only taken in very difficult cases of divination. The effects may last 2-4 days, with much of that period spent in an apparent comatose state. In small doses, it is given to novice shamans to impart its teachings. For consumption, up to 6 of the leaves are collected within an hour of intended use, crushed, and infused in cold water for ½ hour. Just before consumption, the infusion is lightly heated [never boiled] and stirred, before being strained, and drunk over a 2-3 hour period. It is taken only on a waning moon phase. The plant is also used medicinally. Leaves and flowers are heated in water and applied externally to tumours and rheumatic swellings; a similar decoction may be used as a bath to treat persistent fever and chills (Bristol 1969; Davis 1996; Schultes 1955b; Schultes & Raffauf 1990; Uscategui 1959). Incidentally, Bristol (1969) doubted the shamanic use of M. amesianum, as he was unable to uncover any such use in the Sibundoy valley. In any case, Schultes (1955b) noted that only several shamans in each tribe know how to use the plant.

M. amesianum leaves and stems have yielded 0.3% alkaloids [leaves alone yielded 0.55%], consisting of *hyoscine* [80% of total alkaloids; 53-60% in leaves alone], norhyoscine, apohyoscine, *atropine*, noratropine, *hyoscyamine*, meteloidine and oscine (Bristol et al. 1969; Pachter & Hopkinson 1960).

Methysticodendron amesianum is a tree to 8m tall or more; leaves narrowly linear-ligulate, membranaceous, apex acuminate, base attenuate, margin undulate, 20-26 x 1.3-2cm, central nerve robust. Flowers 23-28cm long, apex in anthesis 10-13cm diam., usually solitary; calyx tubular, spathaceous, membranaceous; corolla very deeply lobose, divided to 3/5-4/5 of its length, lobes 5, apices long-acuminate, tube wholly enclosed within calyx; stamen filaments c.5cm long, 2mm diam. at base; anthers 2.7-3cm long, 3-4mm diam. Ovary subcylindric, 1.5cm long, 0.5cm diam., with 3 conduplicate carpels, the walls of which fuse c.1/3 of the way down to form a trilocular syncarp; ovules apical, ovule cavity somewhat open at apex, exposing the ovules; styles 3, free, concave, c.9cm x 2.5mm, with undivided stigmatic areas; stigma 2-lobed, 1-1.5cm, decurrent, papillose; appendages usually homologous with styles, but shorter, accompanied by 2 knob-shaped, clavate or subulate style-like projections. Fruits unarmed, smooth, indehiscent, fusiform, c.15cm long.

In cold, damp, high-altitude forests; Sibundoy Valley, Colombia (Schultes 1955b).

MICHELIA

(Magnoliaceae)

Michelia champaca *L.* **(M. blumei** *Steud.***; M. euonymoides** *Burm. f.***; M. pilifera** *Bakh. f.***; M. pubinervia** *Blume***; M. rufinervis** *Blume***; M. suaveolens** *Pers.***; M. tsiampacca** *Blume***; M. velutina** *Blume***; Magnolia champaca** *Baill. ex Pierre***; Ma. membranacea** *P. Parm.***; Sampacca suaveolens** *(Pers.) Kuntze***; S. velutina** *Kuntze***; Talauma villosa fo. celebica** *Miq.***)** – yellow champaca, true champaca, champa, champáka, sampáka, champákang-pulá

Michelia longifolia *Blume* **(M. x alba** *DC.***; Sampacca longifolia** *(Blume) Kuntze***)** – white champaca

Michelia montana *Blume* – chempaka

The dark brown wood of M. montana is lightweight and durable, and is thus used in construction of bridges and houses. Its aromatic bark is used in n. India as a bitter tonic for fevers. The related M. champaca is used for fevers in the same way; its leaves are also used as food for silkworms [see also **Morus**, *Endnotes*]. In Thailand its flowers are used as a perfume. In India, the flowers are used as a stimulant, tonic, purgative and carminative. Also in India, a water maceration of the leaves is used as an eye wash to clear the vision. When anointed with 'ghee' [clarified butter] and sprinkled with 'cumin' [Cuminum cyminum] seed powder, the leaves are applied to the head to relieve "puerperal mania, delirium and maniacal excitement". The flowers of the tree yield an essential oil known as 'champaca oil'. For this purpose, flowers must be processed quickly after harvesting, as they quickly lose their fragrance. The Himalayan M. excelsa and M. kisopa are said to have the same properties as M. champaca. M. fuscata [M. figo] from China is also used for the banana-scented essential oil [see **Musa**] in its flowers (Brooks 1911; Dutta et al. 1987; Nadkarni 1976; Usher 1974; West & Brown 1920).

M. alba has yielded the *phenethylamine* alkaloid salicifoline [see also **Magnolia**] (Smith 1977a).

M. champaca flowers have yielded c.0.2-0.37% essential oil, containing iso-*eugenol*, cineole, phenylethyl alcohol, benzyl alcohol, benzaldehyde, benzoic acid and acetic acid (Brooks 1911; West & Brown 1920).

M. longifolia flowers have yielded 0.0125% essential oil, containing *methyleugenol*, linalool and a methylethylacetic acid ester (Brooks 1911).

M. montana leaf essential oil [0.95% yield] contained mostly [75%] *safrole*; trunk bark essential oil [0.36% yield] contained mostly [76%] 'sarisan' [*asaricin*] (Dutta et al. 1987). Another analysis of leaf essential oil [plants from Assam, India] found 81.8% *asaricin* and 13% *safrole* (Van Genderen et al. 1999).

Michelia montana is a glabrous tree c.6-9m tall. Leaves thinly coriaceous, obovate, narrowed at both ends, dark green, 15.2-19cm long, 10.2cm wide, nerves 12 pairs; petioles 1.9cm long. Flowers white, fragrant, 3.8cm across, solitary in axillary or terminal peduncle 1.3cm long; sepals and petals 8, oblanceolate or lanceolate-acute, in 3 or more rows; stamens 18-24; pistils 3-4; carpophore stalked, carpels usually many, spirally arranged on an elongated axis, free; anthers introrse, long, narrow. Ovules 2 or more. Follicles woody, usually 1, subglobular pyriform, 7.6cm long, walls 1.3cm thick, in a lax or dense spike dehiscing dorsally; seeds 4-5.

In mountains, rare; Himalaya, Java (Ridley 1923).

Cultivate from seed or cuttings. Trees flower abundantly from the fourth year; collect flowers from mid-June to mid-October (Brooks 1911).

MIMOSA

(Leguminosae/Mimosaceae)

Mimosa acutistipula var. acutistipula *Benth.* – jurema preta ['black jurema']

Mimosa arenosa var. arenosa *(Willd.) Poiret* **(M. malacocentra** *(Mart.) Benth.***; M. xantholasia** *Benth.***; Acacia arenosa** *Willd.***; A. malacocentra** *Mart.***)** – jurema, jurema branca ['white jurema'], calumbi, calumbi branco, calumbi preto, calango cego, amorosa

Mimosa burgonia *Aubl.* – jurema branca, jurema marginada

Mimosa ophthalmocentra *Mart. ex Benth.* – jurema, jurema preta, jurema branca, jureminha, calumbi preto, calumbi vermello

Mimosa pigra *L.* **(M. asperata** *L.***; M. berlandieri** *A. Gray ex Torr.***; M. brasiliensis** *Niederl.***; M. canescens** *Willd.***; M. ciliata** *Willd.***; M. hispida** *Willd.***; M. pellita** *Humb. et Bonpl. ex Willd.***; M. polyacantha** *Willd.***)** – sensitive du Senegal, mimosa rebarbatif, sa she, gajanje

Mimosa polydactyla *Humb. et Bonpl. ex Willd.* **(M. hexaphylla** *Salzm. ex Benth.***)** – amor dormedo ['sleeping love'], vergonsosa

Mimosa pudica *L.* **(M. balansae** *Micheli***; M. hispidula** *Kunth***; M. tetrandra** *Humb. et Bonpl. ex Willd.***; M. unijuga** *Duchass. et Walp.***)** – common sensitive plant, dormideira ['soporific'], dormilona ['sleepy one'], espina dormilona, duermidillo ['little soporific'], jurema branca, muigin, guaring, sleeping grass, punyosisa, honte, morivini, daven kagat-kaget, dedinnaru, dorme dorme, huya-huya, malu-malu, hanxiou-cao, ajalikalika, shame bush, shame lady

Mimosa scabrella *Benth.* **(M. bracaatinga** *Höhne***)** – abaracaatinga, bracaatinga, paracaatinga

Mimosa somnians *Humb. et Bonpl. ex Willd.* **(M. acutiflora** *Benth.***; M. palpitans** *Humb. et Bonpl. ex Willd.***; M. podocarpa** *Benth.***; M. quadrijuga** *Salzm. ex Benth.***; M. somniculosa** *Kunth***; M. tobagensis** *Urb.***)** – dormideira, dormilona

Mimosa tenuiflora *(Willd.) Poir., non Benth.* **(M. cabrera** *Karsten***; M. hostilis** *(Martius) Benth.***; M. limana** *Rizzini***; M. maracasensis** *Harms***; M. nigra** *Huber nom. nud.***; Acacia hostilis** *Mart.***; A. tenuiflora** *Willd.***)** – jurema, jurema preta, cabrera, cuji cabrera, calumbi, carbonal, tepescohuite, urban ginseng

Mimosa verrucosa *Benth.* – jurema, jurema branca, jurema mansa ['gentle jurema'], jurema preta, caatinga

M. tenuiflora, and to a lesser degree M. verrucosa. were once used extensively in n.e. Brazil [by groups such as the Kariri, Tusha, Fulnio, Pankaruru, Acroa, Guege, Atanaye and Pimenteria] to prepare a ritual entheogenic drink known as 'vinho de jurema', or 'ajucá'. The spirit with which the drink brings the consumers into contact is also called Jurema. It is still prepared and consumed today, but existing only on a limited basis. The common use of M. verrucosa preparations have been observed to often be inactive as psychedelics, seemingly acting as placebos. Some groups, however, such as the Kariri-Shoko, do prepare a psychoactive drink from M. verrucosa, though they say it is 'gentle', and 'does not drive one crazy' like 'jurema preta', M. tenuiflora. Effects are said to be much more subtle than those of M. tenuiflora, and to manifest days later in dreams. Apparently, M. ophthalmocentra is also used as a jurema; it also has medicinal uses, as an antiseptic and antiinflammatory. The festival of the drink, attended by those entitled to do so, is usually held at night in the middle of the forest. The root of the tree is scraped clean and washed free of dirt, before being beaten to a pulp between two stones. The pulp is added to a vessel of water, in which it is hand-kneaded until the liquid turns red and frothy; the froth and the root pulp are strained out, and the drink is ready [others have said it is boiled for a long time in the water, though this is probably in error]. The leader of the ceremony lights a tubular pipe made from the root, and inhales the smoke to blow over the drink in the form of a cross. The vessel is placed on a leaf mat and all present sit around in a circle. A spiritual mood prevails as the drink is served to each person. Remaining liquid is poured into a special pit, and singing and music fill the air throughout, while jurema root pipes are passed around. The participants are filled with the spirit of Jurema, and receive glorious visions which strengthen their lives (Batista & De Almeida 1997; Da Mota 1997; De Lima 1946; Emboden 1979a; Lowie 1946; Ott 1993).

Several other Mimosa spp. are known as types of 'jurema' or 'jurema branca', and might be used as such, including M. arenosa var. arenosa, M. burgonia, and M. pudica; M. acutistipula var. acutistipula is also known as 'jurema preta' (Ott pers. comm.; Ott 1997/1998; Queiroz 2000). See also **Acacia**, **Pithecellobium**.

As 'tepescohuite', powdered bark of M. tenuiflora has been used in Mexico to treat burns and prevent inflammation. The same common name and medicinal application are referred to M. tenuefolia by Dominguez et al. (1989), which is probably in error. These authors also gave M. cabrera as a synonym, which is a known synonym for M. tenuiflora, as well as claiming the plant is in the subfamily Fabaceae, which it is not [as listed above, Mimosa spp. are placed in the Mimosaceae].

Mimosa spp. root paste was apparently popular with Latin American girls, smeared on the soles of the feet as an aphrodisiac (Rätsch 1992). The Tarahumara of n. Mexico use the crushed roots of M. dysocarpa ['karároa' or 'garáowa'] to stupefy fish (Pennington 1958).

M. pudica [whose leaves fold down when touched] is cultivated as a soporific in Veracruz, Mexico, and its roots are also used to regulate menstruation. In Panama, the Guaymi infuse the ground stem for arthritis; in Guatemala it is decocted to treat urinary infections. The Mayans of Belize use it as a soporific, as did the Aztecs, who used the root juice. In India, the root is considered aphrodisiac, and is used to treat epilepsy (Nadkarni 1976; Ott 1993). In Ecuador, the leaves are put into pillows to treat insomnia amongst the young and the elderly (Schultes & Raffauf 1990). The Chami say that if taken in strong doses, the plant can cause insanity (Duke & Vasquez 1994). In Senegal and Trinidad, a leaf or root infusion is taken as a calming, soporific drink. In Senegal, the root in decoction is given as a sexual stimulant to aged men (Burkill 1985-1997). In Vietnam, the herb is used as a hypnotic tranquilliser (Ott 1993), and a root decoction is used amongst the Hmong of the 'Golden Triangle' in Thailand to treat shock and fainting due to spirits (Anderson 1993). In TCM, the dried stem is decocted in doses of 5-7g as a tranquilliser to treat neurosis, 'trauma wounds' and haemoptysis [it should also be avoided by pregnant women] (Huang 1993). In Nepal, M. rubicaulis flowers ['bokshi ghans' ('witch's flowers')] are an ingredient [along with three types of chilli - see **Capsicum**] in one recipe for 'bokshi dhup', an incense used to protect against the evil influence of witches (Müller-Ebeling et al. 2002).

The foliage and twigs [or whole plant] of M. pudica have been both smoked and infused as an obscure psychotropic drug by experimenters in the US, reportedly producing distortions of spatial orientation, feelings of expanding and contracting gravity, and mild visual effects (pers. comm.). After personal experimentation, I can confirm the plant is psychoactive, but these reports seem to be exaggerated. It should be noted that overdose of the root-extract is purgative, and may even cause coma and death (Burkill 1985-1997).

M. somnians ['dormilona'] may be used as a soporific in Panama. In El Salvador, guerillas smoke a Mimosa sp. they call 'dormilona' when they have no **Cannabis**, and a tea of dried leaves is said to have the strongest effects (Ott 1993). In parts of the Amazon, M. polydactyla flowers are infused as a nervine sedative (Duke & Vasquez 1994). In Gabon, the Bwiti administer eye-drops of a root-extract of M. pigra and other plants to initiates, so that they may 'see that which is hidden' [see **Tabernanthe**]. In Tanganyika, a leaf infusion is taken to make one invisible for war; it is also given to chickens, so that they may become invisible to hawks (Burkill 1985-1997). The root is used as an aphrodisiac, but it has a calming effect on some people (Watt & Breyer-Brandwijk 1962).

Due to its rich *DMT*-content [see below], the root bark of M. tenuiflora has, in recent years, been widely used in preparation of ayahuasca analogues, with suggested doses ranging from 8-15g root bark, in addition to MAOI [see *Methods of Ingestion*]. Addition of honey to such brews is recommended, to counteract the astringency of the bark decoction. M. tenuiflora bark used in ayahuasca analogues is often reported to cause much more nausea and vomiting than other admixtures, such as **Psychotria** or **Diplopterys** (Trout ed. 1998; pers. comms.).

It has recently been found that 25g of such root bark is active alone for some people, kneaded in a cold-water infusion, supporting the original ethnobotanical reports of jurema use. Many people have assumed that the use of jurema was once accompanied by some form of plant-based MAOI [and sometimes it is - see **Passiflora**], and further assumed that the knowledge of this admixture had been lost, the jurema-drinkers continuing the practice in a symbolic imitation of past rites. When used in this way, the pounded or shredded root bark is prepared simply by kneading in cold, neutral water and leaving to soak twice, for 30 minutes each time, before pressing out and consuming the liquid. The psychoactivity of this plant, taken alone, is thought to be due to the additional presence of *DMT*-conjugates which are not substrates to MAO, surviving into the brain, where they are rendered active (Ott pers. comm.; Ott 1997/1998). The eventual isolation of one such new alkaloid is discussed below. It should be mentioned that some others trying to self-duplicate this example have perceived no psychoactivity with the dose suggested, though definite somatic sensations from the *DMT* in the body were felt. Other have had definite mild *DMT*-like central and somatic effects from 35-45g of root bark, with effects lasting from 20 minutes to 2 hours (pers. comms.).

Besides indole alkaloids, some Mimosa spp. contain the water-soluble amino acid mimosine [leucinine, leucenol, α-amino-3-OH-1(4H)-pyridinepropanoic acid] (Buckingham et al. ed. 1994; Budavari et al. ed. 1989), which is toxic to animals. It causes hair-loss in horses, sheep and pigs, but ruminants are able to detoxify it and remain unaffected. Other effects include weight loss, malaise, cataracts and infertility. It is teratogenic in rats, and inhibits DNA synthesis (Harborne & Baxter ed. 1993; Keeler 1975). Caution should obviously be exercised when consuming crude preparations, due to the unknown human toxicity of mimosine.

M. ophthalmocentra roots yielded 3% tertiary alkaloids; 1.6% *DMT*, 0.0012% *N-methyltryptamine* [NMT] and 0.0065% *hordenine* were isolated. The various fractions of the extract were tested on rats [i.p.] at each stage of the extraction process; only fractions containing *DMT* or *NMT* were shown to cause serotonergic effects thought to reflect "hallucinogenic activity". These extracts appear to act at 5-HT2 receptors (Batista et al. 1999). Stem bark also yielded the same alkaloids (Batista & De Almeida 1997).

M. pigra leaf has yielded mimosine; some tests of leaves have been negative for the presence of alkaloids (Burkill 1985-1997; Watt & Breyer-Brandwijk 1962); stem bark has yielded triterpenoid saponins (Englert et al. 1995); seeds were shown to contain 4-OH-pipecolic acid and willardiin [willardiine] (Krauss & Reinbothe 1973).

M. polydactyla twigs, leaves and pods were independently analysed by TLC, and tentatively observed to contain small amounts of *DMT*, *NMT* and *5-methoxy-DMT* [5-MeO-DMT] (Trout ed. 1998).

M. pudica stems contain the amino acid mimosine and the glycoside mimoside; the pulvinus contains crocetin [see **Crocus**] (International...1994; Tiwari & Spenser 1965); and the primary pulvinus and petiole contain *norepinephrine* [0.00006-0.00035% in 2-yr old plants] (Applewhite 1973). Independent TLC tests have shown the possible presence of *DMT* in the seeds, and also in roots and leaves of 2nd year plants; possible *5-MeO-DMT* was also found in aerial parts and roots of seedlings and 15 month old plants [harv. Nov.], with higher amounts in the roots (Trout ed. 1997d). The water-extract of the roots has been shown to inhibit the lethality, enzyme activity, and muscle toxicity of **Naja** kaouthia venom (Mahanta & Mukherjee 2001), and the hyaluronidase and protease activities of **Naja** naja, Echis carinatus and Vipera russelii venoms (Girish et al. 2004). Seeds of M. pudica var. hispida were shown to contain small amounts of pipecolic acid (Krauss & Reinbothe 1973).

M. scabrella bark has yielded less than 0.0357% *DMT*, as well as *NMT*, *tryptamine* and 2-methyl-THβC (De Moraes et al. 1990). It is interesting to note that this tropical/subtropical species has been found to grow well in Newcastle-upon-Tyne, n. England (Trout ed. 1998).

M. somnians [whole plant] yielded 0.026% *tryptamine* and 0.029% *NMT* [harv. summer, Panama] (Gupta et al. 1979), as well as *DMT*, *bufotenine*, *5-MeO-DMT* and 5-MeO-*NMT* (Shulgin & Shulgin 1997), though these latter claims might be in error (Trout ed. 1997d).

M. tenuiflora root has yielded 0.57% *DMT* [though this may have actually used the root bark]. An earlier study found 0.51% 'nigerine' in root bark (Pachter et al. 1959), which is thought to have been an impure mixture of *DMT*, and possibly *DMT* N-oxide and other compounds. Another early study found 0.98% 'nigerine', in root bark from the same location [Arcoverde, Pernambuco (Brazil)]. In unpublished research, one sample of Brazilian root bark from Alhandra, Paraíba was shown to contain c.11% *DMT*! The jurema beverage made from this material contained 7.46mg/ml *DMT*, though the doses used traditionally are not known. Bioassays [in ayahuasca analogues] of some commercially available Mexican M. tenuiflora root bark indicates approximate concentrations of 1% *DMT* (Ott 1997/1998). Similar yields have been obtained by independent psychonauts, through alkaloid extraction (pers. comms.). A more recent analysis of micro-propagated trees found [as percentages from Jan./Jun. harvests] stem bark to contain *DMT* [0.35/0.11], *tryptamine* [0.0022/0.0071] and *tryptophan* [0.0021/0]; leaves to contain *DMT* [0.01/0.09], *serotonin* [0.009/0], *tryptamine* [0.0037/0.0074] and *tryptophan* [0.00215/0]; and flowers to contain *DMT* [0.03/0], *tryptamine* [0.0075/0] and *tryptophan* [0.0007/0] (Nicasio et al. 2005). Independent TLC analysis of commercially-obtained root bark [originating from Mexico] found 4 strong bands corresponding to *DMT*, possibly *N-methyltryptamine*, and two other unidentified compounds (Trout ed. 1997-1998). Stem bark has yielded 0.03% *DMT* and 0.001% *serotonin*, though the sample had been subjected to high temperatures before the extraction process (Meckes-Lozoya et al. 1990); also found are terpenoids [mimonosides A-C] which have been shown to activate and prolong cell multiplication for about 10 days (Bruneton 1995; Jiang et al. 1991). Stem bark from Oaxaca [Mexico] recently yielded 0.11% [w/w] yuremamine, an unstable alkaloid with an indole nucleus; it is thought that yuremamine may be immune to metabolism by MAO, and might even be an MAOI, contributing to the activity of jurema beverages (Vespäläinen et al. 2005); others believe it may have *DMT*-like psychoactivity in its own right (pers. comms.). Callus cultures from the cotyledons and hypocotyl have yielded 0.037-0.069% *DMT* (Villareal et al. 1993). As M. tenuefolia [probably a confusion with M. tenuiflora – see above], small branches have yielded 2 chalcones, kukulkanins A [0.014%] & B [0.028%] (Dominguez et al. 1989).

M. verrucosa has been claimed to contain *DMT* (Ott 1993; Smith 1977b), and this may well be the case, but chemical analyses seem to be lacking.

Mimosa tenuiflora is an often prickly shrub or tree 2-5m tall with stiff, knotty, fuscous-livid or blackish branches, erratically armed with thorns 2-10mm from a swollen pediment; branchlets and foliage puberulent, +- resinous or viscid with soft hairs 0.1-0.3mm and minute glands; stipules deltate to triangular-acuminate, (0.5-)1-2.5mm, deciduous. Leaf stalks (2-)2.5-6.5(-9.5)cm, the petiole incl. livid pulvinus 7-14mm, the longer interpinnal segments (3-)4-9(-11)mm, the ventral groove interrupted between pinnae by a spicule 0.3-1mm; pinnae usually 4-7(-11), decrescent proximally, the rachis of longer ones (2-)2.5-5(-5.5)cm, the longer interfoliar segments 1-2.2(-2.5)mm; leaflets glabrous or finely puberulent, often minutely ciliolate, dorsally sprinkled with glands, leaflets of longer pinnae (15-)17-33(-40)-jugate, decrescent only near ends of rachis, linear-oblong, obtuse or minutely apiculate, the longer ones (3.5-)4-8 x 1-1.6mm, faintly 2-nerved dorsally, upper face veinless. Flower spikes from axils of fully expanded or already fallen leaves, solitary or sometimes geminate, subsessile, appearing as dense cylindric catkins c.5-10 x 2-3mm, axis becoming 4-10cm, loosely spicate; bracts cuneate-spatulate, 0.6-1mm, apex dilated and hooded, dorsally puberulent; flower buds oblong-obovoid, minutely glandular-papillate distally; flowers 4-merous, 8-androus, some often staminate; calyx turbinate-campanulate, 0.75-1mm, 4-angled by prominent ribs leading to the very short, cucullately incurved, dorsally puberulent lobes; corolla turbinate, 2.1-3.1mm, whitish or greenish-white, lobes 0.7-1.6mm, ovate, incurved, apex callous; filaments white, free, longer ones exserted, 3-4mm. Ovary grey-pilosulous laterally and glandular-verruculose. Pods narrowly oblong or oblong-elliptic, when well-fertilised 25-50 x 6-8.5mm, 4-6 seeded, body cuneately contracted at base to a slender stipe 2-4mm long, the shallowly undulate replum 0.3-0.5mm wide, valves viscid with glands, when ripe breaking into articles c.6-8mm long. Seeds roughly obovate-subcordate, 4-4.5 x 3.3mm, dull brown.

In brush-woodland, sometimes sandstone outcrops, sometimes forming weedy thickets in pastures along highways; usually up to 500m, but has been found up to 900m; n.e. Brazil [lat. 4-15°S], Venezuela, Guajira

Peninsula of n.e. Colombia, El Salvador, Honduras, lowlands of Oaxaca and Chiapas [Mexico] (Barneby 1991).

MIRABILIS

(Nyctaginaceae)

Mirabilis jalapa *L.* **(Nyctago jalapa** *(L.) DC.***)** – marvel of Peru

Mirabilis multiflora *(Torr.) A. Gray* **(Oxybaphus multiflorus** *Torr.***; Quamoclidion multiflora** *(Torr.) Torr. ex A. Gray***)** – desert 4-o'clock, Colorado 4-o'clock, wild south-western 4-o'clock, so'ksi, so'kya, maravilla, tsédédéèh

Mirabilis nyctaginea *(Michx.) MacMill.* **(Allionia nyctaginea** *Michx.***; Oxybaphus nyctagineus** *(Michx.) Sweet***)** – pretty by night

M. multiflora is used by the Hopi of N. America, whose shamans chew the root to induce visions, and help expel evil spirits from a patient. In smaller doses, it is chewed to treat stomach ailments. The Navajo smoke it with other herbs which make up the 'coyote chant' mixture. The Zuni powder the root and bake it into bread as an anorexic. It has the potential to be dangerous with careless use, and its use as a shamanic plant is often kept a secret to outsiders (Bluefeather pers. comm. 1996; Emboden 1979a; Ott 1993; Winter 1998).

The related M. jalapa is a very common garden plant, the root being a strong purgative and diuretic. It is said to have aphrodisiac properties, also treating urinary infection, scabies, eczema, inflammation, poor circulation and tonsillitis. At night, the flower scent is said to be stupefying. A leaf poultice may be applied to abscesses, and the leaves are eaten as a vegetable in Nepal. In China and Japan, women use the powdered seed as a cosmetic (Bremness 1994; Watt & Breyer-Brandwijk 1962). Yoruba men use the leaves to increase their virility (Verger 1995). The Hmong of n. Thailand use its roots as a stimulant, tonic, aphrodisiac, diuretic and post-partum treatment (Anderson 1993). M. jalapa root and seeds have caused poisoning in children, the symptoms consisting of acute stomach pain, vomiting and diarrhoea (Hamel & Chiltoskey 1975; Watt & Breyer-Brandwijk 1962).

The Cherokee use M. nyctaginea as a fly poison, and a poultice for boils (Hamel & Chiltoskey 1975). An unidentified Mirabilis sp. from South America bears the common name 'huillko', possibly derived from 'huillca' or 'villca', names applied to **Anadenanthera** spp. (Trout ed. 1998).

A dose of 28-57g [c.1-2 ounces] M. multiflora root [dry] is capable of inducing a state of 'gaeity and hyperactivity' lasting 30-60 minutes, followed by a period of 'befuddlement' (Ott 1993). Another user of the plant reported that at this dose "Its effects are more of a 'happy-go-lucky' type of 'feel-good' inebriant, than a profound psychoptic like *mescaline* or LSD[...]30 to 90 minutes after ingesting, one experiences merriment, light heartedness, and a tendency to laugh or giggle[...]after a couple of hours these effects are followed by muscular lethargy, slurred speech, blurred vision, and eventually it aids in restful sleep." One of his friends who tried the same dose vomited after 20 minutes, and did not experience any effects. The fresh root has a slightly sweet, peppery taste, and numbs the mouth when chewed (Hambly 2000).

M. himalaica roots have yielded daucosterol, N-pentacosanosyl-β-D-glucopyranosyl-(1-1')-phytosphingosine, N-hexacosanosyl-β-D-glucopyranosyl-(1-1')-phytosphingosine, syringaresinol-4'-O-β-D-monoglucoside, 2,3-dihydroxypropyl-(Z,Z)-9,12-octadecadienate, β-sitosterol, and oleanolic acid (Zhang et al. 1997).

M. jalapa has yielded trigonelline, indicaxanthin, miraxanthins I-IV, oxymethylanthraquinone and a resin (Buckingham et al. ed. 1994; Schermerhorn et al. ed. 1957-1974; Watt & Breyer-Brandwijk 1962).

The chemical contents of M. multiflora and M. nyctaginea appear to be unknown.

Mirabilis multiflora is a perennial herb from a long, pithy root 30-60cm long; stems erect to spreading or decumbent, 30-60cm long, forming clumps to 1m diam., usually stout, densely leafy, glaucous, pubescent, often viscid to glabrate, branches ascending. Leaves opposite, 3-7.5cm x 15-75mm, broadly ovate to reniform-orbicular or ovate-oblong, cordate or rounded at base, acute to rounded and apiculate at apex, thick and succulent, glabrous to pubescent, often glandular; petioles slender or stout, c.½ as long as leaf blade or shorter. Peduncles slender or stout, 0.5-6cm long; inflorescences solitary in axils and cymose at ends of branches, leaves of inflorescence reduced; involucres 15-35mm long, campanulate, usually 6-8 flowered, glabrous to glandular-puberulent or short-villous and viscid, green or tinged red; involucral lobes 5, equalling or shorter than tube, ovate-orbicular to triangular, rounded and apiculate to very acute; perianth 2-6cm long, trumpet-shaped, rose-coloured to violet or purplish-red, shallowly 5-lobed, glabrous or glandular-puberulent outside, the tube 4-7mm thick, expanding into a shallowly-lobed limb 2-3cm across; stamens 5, equalling perianth or slightly exserted; filaments filiform, incurved, united into a fleshy cup at base; anthers dorsifixed near base, didymous, opening by lateral slits. Ovary included in perianth-tube, 1-celled, membranous. Anthocarp 6-10mm long, conspicuously 5-angled or 5-ribbed, oval, obtuse at each end, smooth or slightly furrowed at base, dark brown to nearly black, glabrous; seed filling the pericarp to which the testa adheres. Fl. spring-autumn.

Dry slopes and plains, gypseous hills, on granite, rocky and sandy soils, limestone areas; from Colorado and s. Utah, south to Texas, Arizona, New Mexico and Mexico (Correll & Johnston 1970).

Sow seeds where they are to grow, spaced at least 35cm apart; can take several weeks to sprout. Prefers loose, dry, sandy desert-type soil, dug very deep to allow large root production. In colder climates, dig roots up and store them in winter. Harvest roots in autumn; dig up carefully, as they break easily, and can be quite large. Very drought- and cold-hardy when established. Can remain dormant for long periods (Grubber 1973; Hambly 2000). These plants have great weedy potential once established due to the difficulty in removing them permanently, as their roots may divide underground and regenerate from small pieces (pers. comms.).

MITCHELLA

(Rubiaceae)

Mitchella repens *L.* – partridge berry, checkerberry, deerberry, oneberry, squaw vine, hive vine, winter clover

The Menomini of N. America commonly use M. repens in the form of a berry or leaf infusion, to treat insomnia. It reputedly acts as a strong CNS-depressant and hypnotic (Emboden 1979a). The Cherokee use it as a diuretic and diaphoretic, as well as to relieve period pain, facilitate childbirth, and treat hives, dropsy, diarrhoea and uterine disorders. The berries have also been eaten as food (Hamel & Chiltoskey 1975), and may be used to treat dysentery (Hutchens 1973) and diarrhoea. A salve made from the plant has been useful as an application to sore nipples. The whole plant also has astringent and uterotonic properties (Felter & Lloyd 1898).

M. repens has been poorly studied chemically; the herb has been shown to contain saponins, and no observable essential oil (Felter & Lloyd 1898).

Mitchella repens is a creeping evergreen herb; stems rooting at the nodes, 10-30cm long, forming mats. Leaves evergreen, petioled, round-ovate, 1-2cm long. Flowers mostly terminal, paired, their hypanthia united, the common peduncle shorter than the subtending leaves; corolla funnel-form, white, 10-14mm long, with an elongate tube and (3-)4(-6) short spreading or recurved lobes, villous on inner face; stamens usually as many as corolla lobes; anthers 4, narrowly oblong, 2-celled, dehiscing longitudinally. Ovary 4-celled, with a single ovule in each cell; stigmas 4, slender. Fruit a twin berry, scarlet, composed of the ripened hypanthia and ovaries of the two flowers, 5-8mm diam., crowned with the short sepals, persistent through the winter, edible but insipid; 8-seeded. Fl. May-Jul.

Common in dry or moist woods; Nova Scotia to Ontario and Minnesota, south to Florida and Texas.

Forms with completely confluent corollas and white berries are M. repens forma leucocarpa (Gleason 1952).

MITRAGYNA

(Rubiaceae)

Mitragyna africana *Korth.*

Mitragyna ciliata *Aubrév. et Pellegr.* **(Hallea ledermannii** *(K. Krause) Verdc.***)** – poplar, abura, bahia

Mitragyna inermis *(Willd.) O. Kuntze* **(M. africana** *(Willd.) O. Kuntze, non. Korth.?***; Uncaria inermis** *Willd.***)** – false abura, pied d'éléphant, tsina ['cow tree'], dumo, koli

Mitragyna parvifolia *(Roxb.) Korth.* **(Nauclea parvifolia** *Roxb.***)**

Mitragyna speciosa *Korth.* – kratom, gratom, kutum, mambog, biak

Mitragyna stipulosa *(DC.) O. Kuntze* **(Hallea stipulosa** *(DC.) Leroy***; Nauclea stipulosa** *DC.***)** – African linden, false opepe [opepe = Nauclea diderrichii – see *Endnotes*], abura, bahia, uwem, subaha

Mitragyna spp.

The leaves of M. speciosa ['kratom'] are used as an opium substitute [see **Papaver**] in parts of s.e. Asia, particularly Siam, Thailand, Malaysia, Burma and Assam [India]. The leaves may be chewed fresh, smoked when dried, made into a tea [using up to c.9g leaf], or processed into a thick syrup called 'mambog' [used in a dose of c.0.4g], which may be smoked or otherwise consumed. By any route, its use is considered to be habit-forming. Sometimes, leaves are added to quids of 'betel nut' [see **Areca**] for chewing, to enhance the effect. Mambog may also be mixed with the powdered leaf of Licuala paludosa ['swamp fan palm'], and smoked in bamboo pipes. Kratom has also been used as a stimulant to reduce fatigue and appetite. It has been used in Thai folk medicine as a stimulant and analgesic, and to treat diarrhoea, fever, wounds [as a poultice], and opiate withdrawal, the latter in combination with M. parvifolia leaves (Emboden

1979a; Jansen & Prast 1988; Macko et al. 1972; Perry & Metzger 1980; Rätsch 1992, 1998; Schultes 1966; Tyler 1966). Kratom is highly illegal in any form today in Thailand; possession of the drug can lead one to a death sentence (pers. comms.). In Indo-China, M. parvifolia leaves are used as an appetite-stimulant (Perry & Metzger 1980).

In Mali, the Bambara of the Dyidé religion once used a leaf infusion of M. africana as a possibly entheogenic sacrament and initiatory agent. The practice was suppressed in the 1940's, but may remain 'undergound' (De Smet 1998; Trout & Friends 1999, citing Imperato, P.J. 1977. African Folk Medicine [York Press, Baltimore]). In Senegal, twigs, bark, and roots of M. inermis are decocted [the liquid being drunk as well as bathed in] to treat mental disturbances. Tandanké hunters clean their guns with a leaf-macerate as a magical act to help guide them to a deer suitable for killing. In Congo, a bark infusion of M. stipulosa is given to treat insanity, and in Ghana and Gabon, it treats sterility. In Ivory Coast, it is used to relieve stiffness, stomach-ache, poor eyesight, and to ease childbirth. The Yoruba believe the plant has powers of protection, and pray to it before a journey. In Liberia and Nigeria, leaves of M. stipulosa and M. ciliata are used as wrappers for 'kola nuts' [see **Cola**]. Several Mitragyna spp. are used in construction for their quality wood, such as M. macrophylla ['West African mahogany'] and M. stipulosa ['African linden' (see **Tilia**)] from Sierra Leone; the roots of the former treat stomach complaints, and the leaves of the latter treat coughs and fever (Burkill 1985-1997; Usher 1974).

The effect of M. speciosa has been described as being like "chewing coca [see **Erythroxylum**] and smoking opium simultaneously" (Jansen & Prast 1988), or even as "a pleasant reverie comparable to[...]**Psilocybe** or a small dose of LSD" (Emboden 1979a). These claims are not particularly accurate, however, despite their frequent repetition. Stimulant effects are observed with low doses of kratom, resembling the stimulation from *yohimbine* or *ibogaine* [low doses of the latter!], whilst higher doses reveal opium-like effects (Torsten pers. comm. 2001). Acute overdose can cause vomiting, vertigo, stupor, numbness and muscle-twitches. Extended, excessive use is said to result in emaciation, dark lips, dry skin, and constipation, as well as some of the above symptoms (Emboden 1979a; Jansen & Prast 1988; Rätsch 1992; Tyler 1966); some of these effects are perhaps more likely due to the lifestyle of a habitual drug-user in poverty, rather than entirely the effects of the plant.

Several leaves or more may be smoked or chewed, with effects being felt by 5-10 minutes (Jansen & Prast 1988). The effects have been described as emotionally blunting, inducing indifference. I found the leaves [from a small plant, c.2 years old, cultivated in Melbourne, Australia], smoked through a water pipe, to have pleasant effects similar to those induced by smoking **Vinca** major leaves (pers. obs.). Some people report very mild 'psychedelic' effects. Cessation of heavy, regular use gives rise to a withdrawal syndrome with symptoms including severe mood swings, jerky movement, runny nose and body aches (Jansen & Prast 1988). One psychonaut, who chewed kratom daily for 6 months, reported withdrawal effects that were much milder than opiate-withdrawal. He also did not agree with previous reports that the herb is highly addictive; he reported that it was not "any more habit-forming than *caffeine* or commonly prescribed SSRI anti-depressants". A synergy with **Cannabis** was noted, but he did not feel kratom was psychedelic, although causing "some level of closed-eye visuals". In lower doses [2-3 leaves; 1-1.5g] anxiolytic, anti-depressant, analgesic, and mild stimulant effects were noted; the stimulant effect was unlike that from other stimulants, and was described as more of a "mental clarifier". Higher doses [>3g] caused mild agitation, an itchy nose, constipation and *codeine*-like effects, sometimes with nausea and vomiting. Contrary to earlier reports, this psychonaut refuted any similarity to coca other than a numbing of the mouth. The leaf is effective either fresh or dried, though in the latter form it is more often made into a tea, which is not subjectively as strong as the chewed leaf. Lastly, this psychonaut was told by several kratom-users that the effects could be stopped within 5 minutes, by drinking lemon [see **Citrus**] or tamarind juice, though sugar would make the effects more severe (Wogg 2000).

Mitragyna spp. contain a variety of *mitragynine*- and *mitraphylline*-type alkaloids [indoles and oxindoles, respectively] with CNS-depressant and hypnotic-tranquillising effects, as well as other related indoles. M. speciosa is the only species known to contain *mitragynine*, believed to be the most important psychoactive alkaloid in Mitragyna spp., the others exerting only weak or no CNS effects.

The leaf of M. speciosa has a different action to pure *mitragynine*, and the other alkaloids clearly contribute in synergy to produce the full effects. In early experiments in which *mitragynine* was given to five men, it was found that the leaves were more effective than their equivalent *mitragynine*-content alone (Jansen & Prast 1988; Wogg 2000).

M. ciliata has yielded rhynchophylline, isorhynchophylline [see **Uncaria**], rhynchociline, ciliaphylline, rotundifoline and isorotundifoline (Shellard & Alam 1968).

M. inermis leaves have yielded mitraciliatine, speciogynine, rotundifoline, isorotundifoline, rhynchophylline, isorhynchophylline, speciophylline and uncarine F; stem bark and root bark yielded the same compounds, with the exclusion of mitraciliatine and speciogynine (Shellard 1983). Plants from Ghana yielded rhynchociline, rhynchophylline, isorhynchophylline, rotundifoline and isorotundifoline (Shellard & Alam 1968).

M. parvifolia from varying locations in s.e. Asia has yielded rhynchophylline, isorhynchophylline, rotundifoline, isorotundifoline, pteropodine, isopteropodine, speciophylline, *mitraphylline*, isomitraphylline and uncarine F (Shellard & Alam 1968).

M. speciosa leaves have yielded at least 22 indole and oxindole alkaloids; young, large leaves contain highest levels of alkaloids [0.46-0.5%], of which 66% may be *mitragynine* and 7.5% speciofoline, as well as [with values as % of whole leaf] *mitraphylline* [0.046%], isomitraphylline [0.0034%], 3-dehydromitragynine [0.0036% w/w], speciophylline [0.00052%], speciogynine [0.0061%], speciociliatine [0.00157%], mitraciliatine [0.0032%], *ajmalicine* [0.0019%], corynantheidine [0.0037%], paynantheine [0.0035% dry, to 0.005% w/w] and 7-α-OH-7H-*mitragynine*; leaves also contain (-)-epicatechin. Some trees do not yield *mitraphylline*-type alkaloids. Bark has yielded 0.26% alkaloids (Beckett et al. 1965, 1966a, 1966b; Hartley et al. 1973; Henry 1939; Houghton & Said 1986; Ponglux et al. 1994). Leaves of young trees yielded predominantly isocorynantheidine, isopaynantheine, mitraciliatine and speciogynine (Shellard et al. 1979). The tree has also yielded the alkaloids specionoxeine and isospecionoxeine (Saxton 1973).

M. stipulosa leaves have yielded *mitraphylline*, rhynchophylline, isorhynchophylline, rotundifoline, isorotundifoline, hirsutine, and traces of corynoxeine and isocorynoxeine (Shellard 1983; Shellard & Alam 1968); the plant has also reportedly yielded *yohimbine* (Rätsch 1998).

Alkaloidal yield and composition of Mitragyna spp. may vary at different times of year, and with plants grown in different habitats (Shellard & Alam 1968).

Mitragyna speciosa is a large tree 12-15m tall, trunk 60-90cm thick; young stems or twigs rectangular in internodal cross-section, in section 1-3 x 2-5mm, the shorter sides deeply grooved, the longer sides flat or slightly concave, all covered with thick dark brown cork bearing many oval or rounded lenticels. Young stems each bear 10-12 leaves in opposite, decussate pairs; leaves simple, membranous, ovate, slightly obovate, ovate-lanceolate or oblong, margin entire, apex acuminate, base obtuse, rounded, truncate or slightly cordate, glabrous on upper side, 10-17 x 5-10cm, distinct pinnate venation, most prominent on underside, 10-16 pairs of nerves, emerging from midrib acutely at 55-70°, angle decreasing near apex, they continue +- straight until nearing the margin, where they curve upwards and run parallel to the margin, fine reticulate venation between nerves, roughly parallel to each other, midrib and nerves pale brown to reddish-brown, elevated and slightly pubescent beneath, mostly where veins and nerves meet; petioles 3-5cm x 1.5mm, cylindrical, flattened or grooved on upper side, dull and rough, sometimes finely striated; 2 stipules subtending each pair of leaves, attached just above petioles, at right-angles to leaves, one slightly larger than the other (before young shoots emerge the two are closely adpressed and the margin of the larger stipule folds over that of the smaller one), oblong-lanceolate, to 5cm long, 2.5cm wide, yellowish-brown to reddish-brown when dried, with c.9 parallel ribs, glabrous, with 2-3 rows of elongated brown protuberances at base of upper surface, which secrete a sticky transparent substance when young. Flowers sessile, in globose, solitary or panicled heads c.30mm diam. mixed with spathulate, claviform paleaceous bracts (c.40 surrounding each floret); heads 3, one very shortly peduncled between two on the ends of long branches c.5cm long, 2.5cm thick in flower, deep yellow; peduncle with 2 petioled leafy bracts near tip; receptacle spherical, c.5mm diam., golden-brownish, clothed in long hairs; calyx conoid, gamosepalous, 5 sepals united more than ¾ of length, lobes and basal part golden, central part pale, lobe margins golden-brownish, sepals glabrous, oblong, rounded at lobes, c.2mm long, plano-convex, with prominent midribs, margin lobes ciliate; corolla 9-10mm long, gamopetalous, funnel-shaped, tube long and c.1mm diam., a ring of hairs in mouth, 5 petals joined more than ½ their length, +- linear, but widening towards lobes, with prominent midribs, golden to golden-brownish, lobes c. 4 x 1mm, tapering to a blunt point and thickened at tip, at right angles to tube, inner surface of corolla with abundant pale golden trichomes; stamens 5, c.3mm long, epipetalous, with long trichomes, alternating with corolla lobes, inserted near mouth of tube; anthers free, lanceolate, cordate, 2-lobed, colourless or pale grey, except for central golden region where filament joins the connective, c.1.8mm long, tapering to blunt point at base, lobes dehiscing lengthwise; filament dorsifixed, versatile, joined to anthers c.1/3 its length from base. Ovary c.1.5mm long, 1mm diam. at top, inferior, 2-celled, with ridges over the vascular bundles, +- angular in outline; ovules numerous, minute, pale golden, attached to axile placenta in overlapping patterns; style simple, slender, solid, cylindrical, widening slightly towards base, c.15mm long, extending c.4.5mm beyond corolla, golden, paler near base; stigma conical, apex blunt and rounded, fleshy, dark brown, c.1.5mm long, with c.10 flat, equal sides on surface, bases of which form slightly rounded lobes. Fruit head dark brown, globose, c.35mm diam., with c.90 fruits; fruits slightly flattened, ellipsoidal capsules, c.10mm long, 4mm wide at middle, topped with disc-like structure with a hard brown rim (remnant of calyx), sunken in centre, upper half of fruit with 10 prominent ridges, base surrounded by overlapping bracte-

oles with long basal hairs (bracteoles fall off at dehiscence), fruit bilocular, dehiscing longitudinally; seeds numerous, small, winged, fusiform, golden, central region darker than wings, attached to dark brown, striated placenta in overlapping pattern.

In swampy ground, open country, apparently rare in wild; Malay Peninsula [Kwal Berr, Perak, Ulu Bubong], Thailand (Beckett et al. 1965; Ridley 1923; Shellard & Lees 1965; Shellard & Walker 1969), Burma, Assam [India] (Emboden 1979a), Borneo and Papua New Guinea (Rätsch 1998).

It has been reported that this species exists in at least 2 forms or 'strains', some of which may be inactive (Torsten pers. comm. 2000). Wogg reported one with red veins on the leaves [as described above], which caused a "relaxed alertness" when chewed, and one with green veins, which was subjectively more potent according to some psychonauts (Wogg 2000). The colour difference of the leaf-veins may simply be due to nutritional factors.

To complicate matters, seeds of other Mitragyna spp. are sometimes sold as M. speciosa (Torsten pers. comm. 2001).

MOMORDICA and MONODORA

(Cucurbitaceae)

Momordica balsamina *L.* **(M. involucrata** *E. Meyer ex Sonder***; M. schinzii** *Cogn.***)** – balsam apple, balsamina, mokha

Momordica charantia *L.* **(M. chinensis** *Spreng.***; M. elegans** *Salisb.***; M. indica** *L.***; M. operculata** *Vell.***; M. sinensis** *Spreng.***; Cucumis argyi** *H. Lév.***; Sicyos fauriei** *H. Lév.***)** – ngoko bi-ai-kâi, shushavi, karela, cundeamor, African cucumber, bitter cucumber, bitter gourd, bitter melon, maiden apple, balsam pear, carilla fruit, cerassee, luo han guo

(Myristicaceae)

Monodora myristica *(Gaertn.) Dunal* **(M. borealis** *S. Elliott***; M. claessensii** *De Wild.***; M. grandiflora** *Benth.***; Annona myristica** *Gaertn.***)** – pebe, lubushi, owere, hikoma, medjok, mendak, nding, Calabassan nutmeg

Natives of Bassa, central Cameroon [Africa] may sometimes wish to contact the 'bisime', or water-spirits. To do this, one must visit the local curer, who administers a plant known as 'ngoko bi ai kâi' [believed to be Momordica charantia]. A preparation from the plant is both consumed and rubbed into the skin. It is presumed that psychotropic effects result, in which one sees, and may converse with, the bisime. To break off this contact, one again visits the curer, who gives another plant to be rubbed on the body. Two such antidotes have been mentioned, known by the Duala as 'mandai' or 'mandassi' [unidentified], and 'pebe', which is a name that has been applied to Monodora myristica. This latter antidote is also known to the Bassa as 'hikoma', as 'medjok' or 'mendak' to the Bamileké, and 'nding' to the Ewondo. Wagner suggested the possibility that pebe may, in this case, refer to another Myristicaceous plant, even **Myristica** fragrans itself (Wagner 1991). Unfortunately, the English summary accompanying Wagner's 1991 article confused the relationships of the plants discussed. The error has persisted for English-speakers since Ott (1993) repeated the assertion that M. myristica was possibly used to contact the water-spirits, with M. charantia used to break the contact.

Monodora myristica fruits have been used as a stimulant and nutmeg substitute [see **Myristica**], 'Calabassan nutmeg'. The aroma of the fruit is said to be similar to that of true nutmeg, but less fragrant. Central African pygmies sometimes use the seeds as a 'reconstituant', heart-tonic, and remedy for headaches and fever (Grime 1976; Wagner 1991). To treat headache, they may be chewed and rubbed on the forehead; the chewed root also relieves toothache (Bremness 1994).

Momordica charantia is much cultivated in India for its edible young fruits, which are pickled before consumption. As a food the fruit is "very bitter and has to be steeped in salt water, then well boiled and squeezed, and therefore, the removal of the upper skin, as also scraping away ridges and tubercles where bitterness is concentrated, makes the fruit more palatable" (Nadkarni 1976). Medicinally, M. charantia is used widely. In India, the fruit is considered stimulant, tonic, laxative and emetic, and "dissipates melancholia". The seeds are also used in Ayurvedic medicine, as an analgesic for gout and rheumatism, and to treat diabetes mellitus and liver disorders. The seeds and leaves of M. charantia are known to be a strong purgative and emetic; this action can be so violent, that a child has been reported to have died from it. The leaf and root have also been used to treat epilepsy, earache, fever, gout, and roundworm. In Tanganyika, the fruit pulp is used to repel or poison ants, weevils and moths. This plant and its relatives are used medicinally in parts of Africa, Asia, the Americas, and the Caribbean (Biswas et al. 1991; Chopra et al. 1965; Dale & Greenway 1961; Nadkarni 1976; Watt & Breyer-Brandwijk 1962). In TCM, the dried ripe fruit ['luo han guo'] of M. charantia (friendly pers. comm.) and/or M. grosvenori are used as an expectorant and to treat symptoms of colds (Huang 1993).

In the Philippines, M. charantia has been used to make an arrow-poison (Watt & Breyer-Brandwijk 1962). The root of M. charantia has been used as an aphrodisiac in Mexico (Heffern 1974; Jiu 1966). A hot water extract of the root has been taken as an aphrodisiac in parts of Africa; a tincture of the root is also believed to have aphrodisiac properties in Brazil. In Ivory Coast, the leaf juice is added to palm wine [see *Methods of Ingestion*] as an aphrodisiac. In Cuba, an extract of the whole plant is used by women to treat sterility. Strangely, all parts of the plant are also widely used to prevent pregnancy by early abortion. In Jamaica, the plant is infused to make a 'bush tea' [see **Camellia**]. The whole plant has also been taken in large amounts to treat diabetes (Ross 1999).

Momordica balsamina has been reported to cause feelings of lightness and appearance of 'fog' before the eyes (Wagner 1991). It has been used as an ingredient in arrow-poisons. The fruit of this species is widely considered to be very toxic, though as with M. charantia, it is edible after preparation. M. involucrata and M. foetida runners are infused or decocted by the Zulu as a sedative for an irritable stomach (Chopra et al. 1965; Watt & Breyer-Brandwijk 1962). In India, M. cochinchinensis and M. dioica are also considered to be stimulants, and M. cymbalaria is used as an abortifacient (Nadkarni 1976). Some other 'wild cucumbers' may be psychoactive – see also Echinocystis lobata in *Endnotes*.

Momordica charantia leaves have yielded 0.038% monoridicine, cucurbitane triterpenes called momordicines and momordicosides, *GABA*, a fixed oil, an essential oil, a glucoside, resins, and vitamins A & C. An extract of the leaf is antibiotic, antibacterial and insecticidal. Leaf juice showed antifertility effects in female mice. A hot water extract of unspecified parts given orally to pregnant rats inhibited foetal development. Seed has yielded 32-35% of a fixed oil with purgative properties, which consists of stearic acid, α-oleostearic acid, oleic acid and linoleic acid; as well as being high in saponins. Unripe fruit juice showed antifertility effects in male rats, and an extract of the fruit had antispermatogenic effects in various animals. Ethanol extracts of fresh fruit and leaves [given i.p.] showed CNS-depressant activity in mice. Ethanol extract of the root [given i.v.] acted as a uterine stimulant on non-pregnant guinea-pig uterus (Chopra et al. 1965; Durand et al. 1962; Fatope et al. 1990; Ross 1999; Watt & Breyer-Brandwijk 1962). Fruit, seeds and tissue cultures contain polypeptide-p, which has strong hypoglycaemic activity (Khanna et al. 1981); perhaps this effect has a role in the psychopharmacology of the plant [see **Oplopanax**]. This species has been well-studied chemically, and has yielded too many compounds to list here. Many of the compounds found in this plant are cucurbitacins [see **Desfontainia**]. A useful overview may be found in Ross (1999).

Monodora myristica seed oil has yielded mainly phellandrene, as well as cineol, limonene and myristicol (Schermerhorn et al. ed. 1957-1974; Schimmel & Co. 1904); the plant has also yielded monodoro-indole and isomonodoro-indole (Buckingham et al ed. 1994). Schermerhorn et al. (ed. 1957-1974) also listed the essential oil as containing *eugenol*, benzaldehyde, cinnamaldehyde, a ketone and an alcohol, but this appears to be a poor reading of their reference, Schimmel & Co. (1904), which does not report those chemicals in this species.

Monodora tenuifolia stems have yielded aporphine alkaloids, including anonaine, liriodenine, stepharine, magnoflorine iodide, sparsiflorine, N,O-diacetylanolobine and N,O,O-triacetyllaurelliptine (Spiff et al. 1984); leaves have yielded 2.5-3% alkaloids, 60% of which was laurelliptine (Djakoure et al. 1980). The plant has also yielded 6-(3'-methylbuta-1',3'-dienyl)-indole (Husson 1985).

Momordica charantia is an annual trailing or climbing herb, pubescent, sometimes glabrescent. Leaves palmately 5-7-lobed, the segments again lobulate or sinuate-dentate, 3-10cm long, toothed, glabrous or pubescent; petiole 3-5cm long; tendrils simple. Male flowers usually solitary, on stalk 0.5-8cm long; bract 2cm long, towards base or near the middle of flowering stalk; female flowers solitary, on a stalk 0.2-5cm long, usually smaller than males; bract 2cm long, sometimes absent; hypanthium shallow; petals 5, free, 1-3 with incurved scales inside at base, white or yellow; stamens 3; anthers free or fused; disc absent; females with 0 or 3 staminodes. Ovules numerous; stigmas 3, 2-lobed. Fruit fleshy, ovoid, 3-12cm long, with longitudinal ridges and warts, orange to red, dehiscing irregularly by 3 valves, exposing the seeds in sticky pulp hanging from the face of each valve; seeds few to many, ovate, sculptured, c.10mm long.

Cameroon; scattered throughout tropics of both hemispheres; naturalised in parts of coastal Queensland and Northern Territory [Australia] (Chopra et al. 1965; Cribb & Cribb 1987; Harden ed. 1990-1993).

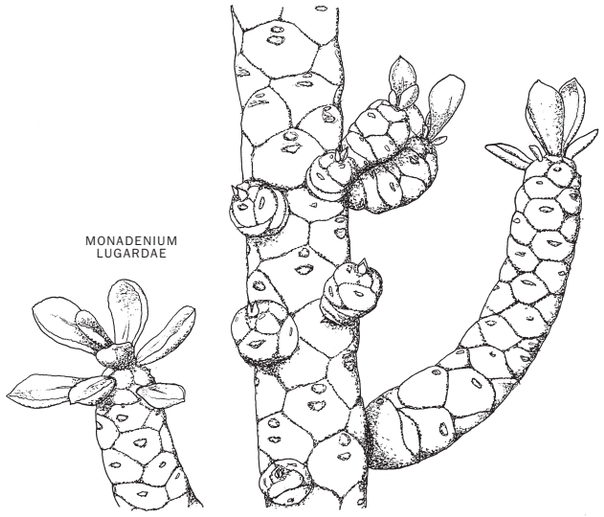
Monodora myristica is a deciduous forest tree to c.24m tall, casting heavy shade when in full leaf; bark grey, vertically corrugated, ridges distinctly rounded; slash brown, vaguely layered. Leaves glaucous, paler below than above, obovate-elliptic, to 61 x 20cm (usually not more than 20 x 6.3cm on flowering shoots), apex obtusely acuminate, base rounded with minute, characteristic, upward-directed auricles where the lamina joins the petiole, lateral nerves 12-20 pairs, prominent beneath; petiole thick, purplish, 1.3cm long. Flowers large, handsome, 10-13cm across, borne singly on short flowering branches; stalks slender, up to 20.3cm long with an ovate leafy crispate bract up to 2.5cm long in upper ½ (the stalk is re-

ally a modified branch), deciduous if the flower is not fertilised, thickening and becoming woody if it is; sepals 3, green with reddish spots, crispate, lanceolate, 2.5-3.8cm long; petals 6 in 2 series, outer petals ovate-lanceolate, to 10cm long, crispate, greenish-yellow spotted with purple-red and brown, inner petals broadly ovate, much shorter than the outer, not crispate, greenish-white with purple-brown spots, the lamina +- distinctly auricled at base, the auricles incurved, pilose; carpels whorled and united forming a 1-celled ovary with parietal placentation. Fruit smooth, green, spherical, becoming woody, c.15-18cm diam., containing numerous edible seeds, 2.5cm long, embedded in a fragrant pulp.

In riparian forest; Kenya, Cameroon (Dale & Greenway 1961).

MONADENIUM

(Euphorbiaceae)



Monadenium lugardae *N.E. Br.* – tshulu, mhlebe, mahumula

This succulent plant, sometimes cultivated as an ornamental, has been used by shamans [‘sangomas’] in the Piet Rief region of Eastern Transvaal, Africa. A piece of the root is chewed and swallowed, in order to produce visions for the purpose of prophesy. It is known to produce delirium and hallucinations with an adequate dose, though it is also said to have been lethal on occasion (De Smet 1996; Emboden 1979a; Watt & Breyer-Brandwijk 1962).

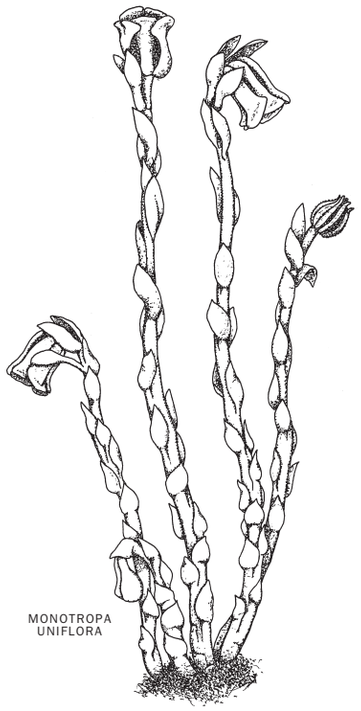
M. lugardae contains a latex with insecticidal activity, as well as an unidentified alkaloid (De Smet 1996). As with other latex-bearing plants [such as other Euphorbiaceae and many Apocynaceae], care should be taken not to bring the latex into contact with the eyes.

Monadenium lugardae is a monoecious dwarf perennial succulent, with tuberous rhizomes and milky latex. Succulent stems simple or branched at base, 10-60 x 1.5-3cm, cylindrical, glabrous, with rhomboidal or hexagonal tessellations; leaves simple, alternate, fleshy, crowded in a small terminal tuft or spaced along upper part of stem, spathulate to obovate, 1.5-9 x 0.5-4cm, margin crisped serrulate towards apex, attenuate, obtuse or subacute, subsessile, soon deciduous and leaving prominent leaf scars. Flowers greenish, in cyathia of 3 nodding involucres, arranged in solitary, axillary cymes, in uppermost leaf axils, once-forked; peduncles short, stout, 2-6mm long; involucre bracteate, cup-like, open on one side to below the middle, truncate at summit and bearing a continuous gland around its top margin, as long as the inner series of 5 membranaceous, fringe-toothed lobes, or longer; stamens 1-several. Ovary 3-celled, superior, triangular, with 2 rows of serrated wings on each ridge, becoming long-exserted on a recurved stalk. Fruit a 3-angled capsule with 2 minute, crisped-toothed wings down each angle, splitting into 3 1-seeded sections.

Arid plains and open places; s.e. Africa (Bailey & Bailey 1976; Jacobsen 1960).

MONOTROPA

(Ericaceae)



Monotropa uniflora *L.* **(Hypopitys uniflora** *(L.) Crantz***)** – pipe plant, Indian pipe, ghost pipe, ink pipe, wood snowdrop, ice plant, corpse plant, fit root, bird’s nest, xawiska, ova ova

M. uniflora is an eerily beautiful herb, with many interesting common names related to its appearance. The name ‘pipe plant’ is related to the shape of the flowers. It may be called ‘ghost pipe’ both because of its ‘ghostly’ appearance, and the fact that the plant is so delicate when fresh that it may dissolve or melt away on handling, hinting at the ethereal nature of ghosts and also explaining a probable origin of the name ‘ice plant’ (Felter & Lloyd 1898; pers. obs.).

The roots of this rare herb were used by the Cherokee to treat epilepsy and convulsions; its diluted juice was also used as a wash for sore eyes, and the crushed plant was applied externally to bunions and warts (Hamel & Chiltoskey 1975). Other native American tribes used it in a similar way, to overcome ‘nervous irritability’ and spasms. The Winnebago use it as a smudge-stick to revive someone who has fainted (Kindscher & Hurlburt 1998). In 19th century N. America, the plant was popular as an opium substitute [see **Papaver**], and was not recorded to have any negative side-effects. The root acts as a sedative, nervine, antispasmodic, diaphoretic, and tonic, and is generally used in doses of 2-4g. It soon fell into disuse, probably because of its scarcity. M. uniflora is now considered endangered (Emboden 1979a; Felter & Lloyd 1898), and should be lightly harvested if at all, for the sake of conservation. Other Monotropa spp. may have similar properties and should be explored as substitutes.

M. hypopitys has yielded the iridoid lactone glycoside monotropein, and monotropitoside [gaultherin, a methyl-salicylate derivative – see **Gaultheria**].

M. uniflora has yielded [w/w] 0.0087% monotropein, as well as ursolic acid, p-coumaric acid and β-sitosterol (Bobbitt et al. 1966). Early studies suggested that the plant contains andromedotoxin [see Rhododendron spp. in *Endnotes*] (Felter & Lloyd 1898), though this has not been verified and may have been in error.

Monotropa uniflora is a fleshy herb with a cold, waxy texture, turning black when touched or on drying; stems 10-20cm tall, usually solitary, commonly pure waxy white, rarely pink or reddish, beset with small scale-like leaves; parasitic on soil fungi. Nodding flower solitary, odourless, 10-17mm long, same colour as stem; sepals often none, or 2-5; corolla urceolate or broadly tubular; petals 4-5, distinct, all or some saccate at base, broadly oblong, slightly widened distally; stamens 8 or 10, filaments slender, pubescent; anthers transverse, opening by 2 clefts across the top. Ovary superior, 4-5-celled; style short, thick, longer than ovary; stigma glabrous, broad, peltate and umbilicate. Fruit a loculicidal capsule, erect, ovoid to subglobose. Fl. Jun.-Aug.

Rich woods in leaf mold, especially in beech and maple forests; Newfoundland to Washington, south to Florida, California and Central America; also in east Asia (Emboden 1979a; Gleason 1952). The root is harvested from Sep.-Oct., dried, and pulverised for storage in airtight

sealed containers (Felter & Lloyd 1898).

MORUS

(Moraceae)

Morus alba *L.* **(M. intermedia** *Perr.***; M. tatarica** *L.***)** – white mulberry, sang shen, toola, kambilipuch
Morus nigra *L.* – black mulberry, shetuta, shetura, tuta
Morus rubra *L.* – red mulberry, American mulberry
Morus spp. – mulberry trees

'Mulberry' is associated with the Roman fertility and nature goddess Diana, and has been used magically to make wands and to protect the garden from lightning (Bremness 1994; Cunningham 1994). In the 1500's, M. nigra was used extensively in medicine. The berries were a remedy to stop inflammation and bleeding, the bark for toothache, and the leaves as an antidote for snakebite and aconite poisoning [Aconitum spp. – see *Endnotes*]. In Europe, a leaf extract has been used to stimulate insulin production in diabetics. M. alba fruit is still used in TCM as a yin tonic to nourish the 'vital essence', and as a gentle laxative. Branches and twigs ['sang zhi'] are analgesic, diuretic, and treat rheumatism and high blood pressure; they are tranquillising in mice. Root bark ['sang bai' or 'sang bai pi'] is a sedative expectorant. The leaves ['sang ye'] are used for headaches, colds, fevers and sore throats (Huang 1993; Hsu et al. 1986; Ody 1993). Extracts of M. alba leaves have shown some antioxidant and free-radical scavenging activity (Doi et al. 2001).

Apparently, Baluchi warriors once carried M. alba berries to eat before battle, "to give them stomach for the fight" (Nadkarni 1976). Uncooked leaves and young twigs of Morus spp., as well as unripe berries, accompanying latex, and water used to cook young leaves, are reported to cause CNS stimulation, possibly with mild hallucinations, as well as headache and gastric upset (Bremness 1994; Brill & Dean 1994; Ody 1993). One book reported that "the primary hallucination is that you're so sick you're going to die. However, you'll probably recover" (Brill & Dean 1994)! Some psychonauts, using what may have been M. rubra, have reported relaxing and numbing effects from eating 20-40 unripe berries [still green]; "deliriant" effects were attributed to higher doses [c.60 berries] (R.D. 2001). Animal intoxications have also been reported. In Victoria [Australia], ducks have been observed becoming so inebriated from eating fallen mulberries, that they were "almost toppled by the wind". The writer and illustrator Beatrix Potter also recorded the results of feeding her pet rabbit a cup of mulberry seeds – "the consequence being that when I wanted to draw him the next morning he was partially intoxicated and wholly unmanageable" (Smullen 1989)!

The dried fruits of both M. alba and M. nigra [and jam from M. nigra] have been commercially available, as the fresh fruit is prone to bruising and does not travel well. The ripe fruits of both species are edible, though M. nigra fruit is often considered more delicious (theobromus pers. comm.). Some people may get contact dermatitis from the leaf (Blackwell 1990), which is grown as food for silkworms [Bombyx mori – see *Endnotes*] – the thick sap is said to give strength to the silk filaments (Bremness 1994).

Mistletoes [see *Endnotes*] sometimes grow on Morus spp., and in China they have been used medicinally. These include Viscum album var. coloratum ['hu chi sheng', 'pei chi sheng'], V. liquidambaricolum ['pien chi sheng'], Loranthus parasiticus ['sang chi sheng', 'kuang chi sheng'], L. yadoriki ['shih chi sheng'], and Scurrula ritozanensis ['tai wan chi sheng']. Collectively, they are referred to as 'sang chi sheng' or 'liu chi sheng', and are used to treat arthralgia, lumbago, stiff back, pain in muscles and tendons, vaginal bleeding in pregnancy, and other disorders, in a dose of 9-16g. They have shown hypotensive, diuretic, antibacterial, antiviral and blood-cholesterol lowering effects (Hsu et al. 1986).

M. alba root bark, fruits, and leaves have yielded a variety of alkaloids, including [as % of each part, respectively] 1-deoxynojirimycin [DNJ; a piperidine alkaloid][0.165, 0.084, 0.069], 2-O-α-D-galactopyranosyl-1-deoxynojirimycin [0.0017, 0.014, 0.03], traces of other nojirimycin-derivatives, calystegine B1 [0.00016, 0, 0], calystegine B2 [0.00083, 0.0012, 0.0026], fagomine [0.0021, 0.0018, 0.0185], and traces of other fagomine-derivatives, D-arabinitol-derivatives, 1,4-dideoxy-1,4-imino-D-ribitol and (2R,3R,4R)-2-OH-methyl-3,4-dihydroxypyrrolidine-N-propionamide. Calystegine C1 has also been found in the root bark, and the fruits yielded 2 new dihydroxynortropanes – 4-O-α-D-galactopyranosyl-calystegine B2 [0.001%] and 3β,6β-dihydroxynortropane [see **Convolvulus**] (Asano et al. 2001). The leaves have also yielded astragalin, skimmin, scopolin, isoquercitrin, roseoside, benzyl D-glucopyranoside, 2 new prenylflavanes and a glycoside (Doi et al. 2001); stems, bark and roots have also yielded morin [inhibits enzyme functions], dihydromorin, maclurin, mulberrin, cyclomulberrin, mulberrochromene, cyclomulberrochromene, 2,4,4',6-tetrahydroxybenzophenone and dihydrokaempferol [kaempferol itself is an MAOI (Sloley et al. 2000)]. A water extract of the bark had a hypotensive action in rabbits [i.v.] which was blocked by *atropine* (Huang 1993; Rastogi & Mehrotra ed. 1990-1993). Root bark showed sedative, anticonvulsant, hypotensive, analgesic, antitussive, diuretic, cathartic and antioedema activity in animals (Yamatake et al. 1976).

M. alba cv. 'Ichinose' yielded, from the reddish-violet powder of the root bark surface, 2-arylbenzofuran derivatives [including mulberrofuran M] and stilbene derivatives (Hano et al. 1986).

M. nigra root bark contains the prenylflavonoid morusin as a major component; morusin has shown analgesic effects in mice [i.p.] (De Souzaa et al. 2000b).

Morus sp. root bark [as the Chinese drug 'sang bai pi'] yielded mulberrofurans K [0.0005%], N [0.00039%] & O [0.0075%] (Hano et al. 1985).

Leaves of unspecified Morus spp. were shown to contain tyrosine, *phenylalanine*, *choline*, *glycine*, valine, *aspartic acid*, leucine, alanine, proline, guanine, adenine, histidine, arginine, lysine, trigonelline and hypoxanthine (Katayama 1917).

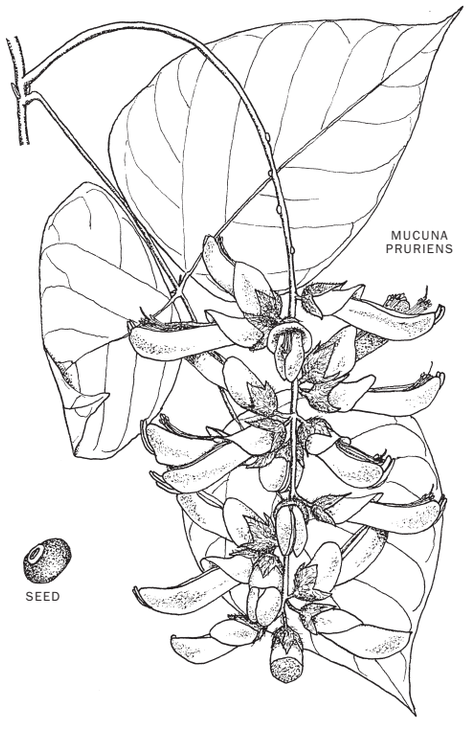
Morus spp. have also been found to contain albafuran A, albanol A [hypotensive], moracin A, kuwanone G, kuwanone H [hypotensive], mulberrofuran A, 5,7-dihydroxychromone and paeonol [anxiolytic] (Harborne & Baxter ed. 1993). The silkworms that feed on Morus spp. accumulate large amounts of some of the alkaloids of these plants (Asano et al. 2001) – see *Endnotes* for more discussion on Bombyx mori.

Morus alba is a deciduous tree to 15m tall; bark orange-brown. Leaves rotund in outline, up to 20 x 12cm, serrate, often irregularly 3- or more lobed, acute or short acuminate, often cordate at base, glabrous or nearly so on both sides, or sparsely pubescent with white spreading hairs along the veins underneath. Flowers in cylindric catkins, males longer and more loosely flowered; calyx deeply 4-parted; stamens 4; style deeply 2-parted. Fruit a short, cylindric berry cluster, white, pink or purple to almost black, composed of juicy, accrescent but not coherent calyces, each containing a small seed-like achene, with the remains of the style protruding.

Native to e. Asia [hill slopes of n. China], long cultivated in Europe and N. America; often escaped on roadsides, in vacant land and open woods (Coombes 1992; Gleason 1952).

MUCUNA

(Leguminosae/Fabaceae)



Mucuna argyrophylla *Standl.* – tecalate
Mucuna monosperma *DC.* – negro bean, mothikunile, thelu-kodi
Mucuna pruriens *(L.) DC.* **(M. aterrima** *(Piper et Tracy) Holland***; M. esquirolii** *H. Lév.***; M. prurita** *Hook.***; M. prurita** *Wight***; Dolichos pruriens** *L.***; Stizolobium pruriens** *(L.) Medik.***)** – cowitch, cowhage, buffalo bean, hellfire bean, itchy bean, fogarate, gratey, pica pica, pois-velu, pois-gratter, goncha, guru, chanda, kaochir, adhyanda, atmagupta, kiwach, kaunch, feijao macaco
Mucuna pruriens var. utilis *(Wight) Burck* **(M. capitata** *Wight et Arn.***; M. deeringiana** *(Bort) Merr.***; M. utilis** *Wight***; Stizolobium hassjoo** *Piper et Tracy***)** – velvet bean, Bengal bean, Mauritius bean, Portuguese coffee, cafe Brazilii, kafé go bouwo

M. pruriens has an interesting history of use, and contains some interesting compounds. Its seeds are an ingredient of some Haitian zombi potions, perhaps due to the irritating stinging hairs covering the seed pods [M. pruriens var. utilis is a variety with velvety hairs and no sting]. The Cuna of Panama use the seed as an aphrodisiac, a use shared in Brazil [in the form of water or alcohol extracts], where it also serves as a nerve tonic. In Nepal, it is a remedy for 'disorders of the nervous system' (Davis 1988a; Ott 1993; Ross 1999).

The plant is probably most widely used in India. There, the leaf is employed to treat headache and is considered aphrodisiac, tonic, anthelmintic, antiinflammatory and blood-cleansing. The bitter-sweet seed has similar uses, and also treats biliousness, ulcers, gonorrhoea, gout, and scorpion-stings [for which it is said to be ineffective]. The seeds are also a prominent aphrodisiac, sexual tonic, and nerve tonic, and have been used as an expectorant and abortifacient. A seed decoction has been given to children as an anthelmintic, though fatal overdoses have sometimes been reported. The root is a purgative, emmenagogue and uterine-stimulant used to treat dysentery, delirium in fevers, and elephantiasis. In Chota-Nagpur, the smoke of the root is used to accelerate delivery and lessen pain in childbirth (Ghosal et al. 1970a; Kirtikar & Basu 1980; Nadkarni 1976; Ross 1999; Watt & Breyer-Brandwijk 1962).

The seeds were once used in Hindu medicine as an aphrodisiac, combined in equal parts with **Tribulus** terrestris fruits to make a dose of c.1.8g, with sugar and milk. When you examine the chemistry of these two plants, this preparation taken in larger doses could perhaps represent an ancient 'ayahuasca analogue' of sorts [see *Methods of Ingestion*], though the potential toxicity of large levels of *L-DOPA* with MAO-inhibition might be of concern [also, the MAOI activity of **Tribulus** is currently in doubt]. M. pruriens seed is also an ingredient in an Indian compound medication for general debility, in equal parts with *camphor* [see **Cinnamomum**], 'mace' [see **Myristica**], **Argyreia** nervosa, **Acorus** calamus and sugar – the dose of the powder is c.650mg (Dutt 1989; Nadkarni 1976).

As a note of interest, in Mozambique in 1989, an outbreak of "acute toxic psychosis" occurred during a time of famine and extreme hardship, when locals subsisted almost entirely on improperly-cooked M. pruriens seed (Infante et al. 1990). As in other parts of the world where this species occurs, the seeds have been decocted and taken as an aphrodisiac in Mozambique, Madagascar [as a milk decoction – 120g seed per 1 litre of milk] and Guinea-Bissau (Ross 1999). In Mexico, M. argyrophylla seeds are used as an aphrodisiac (Jiu 1966).

There exists a modern anonymous report of mild psychoactive effects from smoking M. pruriens leaf ['1 cigarette-sized joint']. These effects were much more prominent when 2 similar cigarettes were smoked after having consumed 3g **Peganum** harmala seed – which "produced throbbing in the head accompanied by coloured geometric patterns…Pulsating coloured patterns spiralling around me, a strong urge to lie down. Very mellow and detached" (DeKorne ed. 1996).

M. monosperma seed is decocted in India as a sedative and expectorant (Usher 1974). In the Congo, twigs of M. poggei are used to stupefy fish; M. flagellipes is also used there to make an arrow poison. In Java, M. jonghuniana seeds are worn as a charm against diseases. Seeds of M. gigantea are considered edible in Malaysia (Davis 1988a; Usher 1974). The Nkopo of Papua New Guinea use a Mucuna sp. ['soal'] in rituals to promote hunting success (Schmid 1991).

Some Mucuna spp. have fruits that are covered with tiny trichomes, which may penetrate the skin and release irritating compounds that cause intense itching, burning and blistering. They contain *serotonin*, which causes *histamine* release. Their action is destroyed by boiling or drying (Allen & Allen 1981; Bowden et al. 1954; Watt & Breyer-Brandwijk 1962). In some parts of Africa, such fruit trichomes [usually referred to simply as 'stinging hairs'] have been used as a homicidal poison (De Smet 1998). Mature seeds of Mucuna spp. often contain large amounts of *L-DOPA* – besides those mentioned below, M. holtonii yielded 6.7% and M. urens 5.2%, with two unidentified species from Georgia [US] and Japan yielding 3.1% and 4.4%, respectively (Daxenbichler et al. 1971).

M. gigantea growing in Queensland, Australia, tested alkaloid-positive in the seeds [harv. Jan.]; leaf material gave a weak-positive in one test (Webb 1949).

M. pruriens seed [both ripe and unripe] and pod contain *DMT*, *DMT* N-oxide, *5-methoxy-DMT*, *bufotenine*, an unidentified β-carboline, an unidentified 5-oxyindole-3-alkylamine and an unidentified indole-3-alkylamine; seeds also contain *choline*, *L-DOPA* [c.1.5% w/w], 1,2,3,4-tetrahydro-6,7-dihydroxy-3-isoquinoline carboxylic acid, 0.025% mucunine and 0.055% mucunadine [two uncharacterised alkaloids, which might be identical to some of the above], as well as an oil containing β-sitosterol, myristic acid, palmitic acid, stearic acid, arachidic acid, oleic acid, linoleic acid and linolenic acid. Leaf [fresh] yielded 0.0064% *DMT*, 0.003% *DMT* N-oxide, 0.0025% *5-methoxy-DMT*, 0.011% *bufotenine*, 0.046% unidentified indole-3-alkylamine, the other two unidentified compounds above, and *choline*. Root also yielded these compounds (Damodaran & Ramaswamy 1937; Ghosal et al. 1970a, 1970b; Mehta & Majumdar 1946; Santra & Majumdar 1954). The stem-leaf has also reportedly yielded isoharmine [6-MeO-*harman*] (Ghosal 1972), an MAOI (Shulgin & Shulgin 1997). The trichomes of the seed pods have yielded 0.015% *serotonin* (Bowden et al. 1954). *Nicotine* [small amounts], mucuadine, mucuadinine, mucuadininine, prurienidine [vasodilator, hypotensive], prurienine [vasodilator, hypotensive, stimulates intestinal peristalsis], prurieninine [similar activity to prurienine] (Majumdar & Paul 1955; Majumdar & Zalani 1954) and Mucuna Pruriens bases P, Q, R, S and X were reported from unspecified parts (Rakhit & Majumdar 1958). As later work has not reported these uncharacterised alkaloids, perhaps they [not including *nicotine*] are identical with the known indole alkaloids mentioned above.

In an Indian study, the total indole alkaloids from M. pruriens [whole plant] produced marked behavioural changes in rats, seemingly indicating 'hallucinogenic' and stimulant activity (Rastogi & Mehrotra ed. 1990-1993). Hypoglycaemic effects have also been demonstrated in rats, from an ethanol/water [1:1] extract of the seeds; teratogenic effects in pregnant rats were also demonstrated [administered intragastrically], though a water extract of the seeds, tested in the same fashion, showed no embryotoxic effects. Ethanol/water [1:1] extract of seeds and roots showed antispasmodic activity against *acetylcholine*- and *histamine*-induced spasms, in guinea pig ileum. In humans, an extract of the dried whole plant taken regularly was shown to increase sperm count and sperm motility. Seeds with *L-DOPA* content of c.4.5-5.5%, taken orally at 15-40g, had antiparkinson activity in humans (Ross 1999).

M. pruriens var. utilis has not been found to contain indole alkaloids, but may not have been analysed for such compounds. Stems and leaves contain *L-DOPA*; leaflets have yielded the flavonoids cajanol, dalbergioidin, genistein [MAOI (Hatano et al. 1991)], 2'-OH-genistein, kievitone, maackiain and medicarpin; seed pods have yielded stizolamine, (1'S,2'R)-neopterin, isoxanthopterin, and 2-amino-6-(hydroxymethyl)-4-(1H)-pteridinone; seeds have yielded 2.3-5% *L-DOPA*, stizolamine, 1,2,3,4-tetrahydro-6,7-dihydroxy-3-isoquinoline carboxylic acid and 1,2,3,4-tetrahydro-6,7-dihydroxy-1-methyl-3-isoquinolinecarboxylic acid; and epicotyl sap has yielded stizolobic acid and stizolobinic acid [see **Amanita**] (Daxenbichler et al. 1971; International... 1994).

Mucuna pruriens is an annual twining shrub; branches slender, +-hairy at first, later glabrescent. Leaves pinnately 3-foliate; petioles 6.3-11.3cm long, appressedly silky; stipules deciduous, lanceolate, 5mm long; stipels minute; leaflets membranous, 7.5-12.5 x 5-7.5cm, terminal leaflets slightly smaller, rhomboid-ovate, base cuneate, lateral leaflets with truncate base, very inaequilateral, lower side greatly dilated, apex subacute, mucronate, pubescent above, densely clothed with silvery-grey hairs beneath. Flowers solitary or 2-3 together along a slender silky rachis, large, purple or greenish, in elongate 6-30-flowered racemes 15-30cm long, axillary or lateral on old branches or on stems; pedicels 3-6mm long, hairy; bracts 1.2cm long, lanceolate, hairy, caducous; bracteoles 8mm long, hairy, caducous; calyx 1cm long, silky, with few irritant bristles; tube campanulate, upper teeth completely connate into a triangular lip equalling the tube, lateral teeth lanceolate and as long as tube, and lower tooth lanceolate and slightly longer; corolla much exserted, 2.5-3.7cm long, purple; standard c.½ the length of the wings and keel, auricled at base; keel slightly incurved; stamens diadelphous; anthers dimorphous, the longer basifixed, the shorter ovate or bearded. Ovary sessile, villous, 2- to many-ovuled. Pods 5-7.5 x c.1.2cm, turgid, with a longitudinal rib running the length of each valve, falcately curved on both ends (somewhat S-shaped), densely clothed with persistent irritant bristles which are at first pale brown, later steel grey. Seeds 5-6, small.

Cosmopolitan in the tropics, often cultivated (Kirtikar & Basu 1980); India, China, Philippines, Taiwan, Australia [Qld], Caribbean, Central America, Brazil, Surinam, Venezuela, US, Africa, Madagascar, Mauritius (International... 1994).

MUSA

(Musaceae)

Musa sapientum *L.* **(M. paradisiaca** *L.***)** – banana, kadali, mochaka, vasha, gemeiner pisang

Musa spp. – banana palms, banana trees, plantains

The banana tree is used in modern voodoo rites to represent the gods, due in part to its hermaphroditic flowers. In Hawaii and Tahiti, the banana tree was used extensively in religious ceremonies – the fruit as an offering, the leaves to cover the altar, and the stalk as a representation of man. Until 1919, Hawaiian women were forbidden to eat bananas by threat of death. The tree is believed to increase fertility, and the stem and fruit have been used to treat general debility, asthma, stomach disorders and throat infections. The leaves are used as a poultice for wounds, and as a food wrapping for cooking. The Chewa of Africa use the stem juice to relieve toothache, and in Durban, S. Africa, the juice of black stems is taken diluted with water to sober up an intoxicated person. In India, the root, in a cold infusion, is similarly taken to sober up a drunk person; children who have overdosed on opium [see **Papaver**] are given the bark and leaf juice with ghee as a purgative. The leaves are sometimes used in country

areas as wrappers for bidi cigarettes [see **Datura**, **Nicotiana**]. Banana fruit has also been used as a remedy for diarrhoea and abdominal inflammations, as well as inhibiting the growth of some fungi and bacteria (Cunningham 1994; Nadkarni 1976; Wagner et al. 1990; Watt & Breyer-Brandwijk 1962). The Nkopo of Papua New Guinea use M. sapientum ['golda'] as a paste with other plants, in rituals to achieve harmony with natural forces (Schmid 1991).

Many will remember the banana-smoking 'craze' of the mid-late 1960's, when it was claimed that smoking a concentrated and dried water extract of ripe inner-peel scrapings, or the dried scrapings themselves, would result in a **Cannabis**-like 'high' due to the mythical psychedelic claimed to be contained within, 'bananadine'. In San Francisco, one man even started a business ['Mellow Yellow Co.'] to sell 14g portions of baked banana peel scrapings, and to give away the fruit flesh to 'underfed hippies'. This strange fad is often thought to have originated from the 1966 UK hit by Donovan, 'Mellow Yellow', with lyrics such as "electrical banana is gonna be a sudden craze" (Krikorian 1968; McCarthy 1971; Moore 1967; Weil 1969).

The idea of smoking banana peels may have actually originated with the Berkeley psychedelic band Country Joe & the Fish under amusing circumstances. I will give the story in some detail, for the sake of clarifying an 'urban myth'. As related by ['Country'] Joe McDonald – "our drummer, Gary 'Chicken' Hirsch, said he had just figured out that banana peels have qualities similar to marijuana. His theory was that if you dried out a banana peel and smoked the white pulp on the underside, you would get high. At that time, the band was living on peanut-butter-and-banana sandwiches. All the ingredients were cheap. We were just throwing the peels away, so this sounded like a great idea." At this point, the band was preparing to play a gig in Vancouver, and used the oven in a nearby 'psychedelic shop' to dry out their banana peels at low heat while they prepared for the show. Here enters the complication – the stage roadies were in possession of a jar of water dosed with a large quantity of LSD, which they offered to share with the band. Having taken several helpings and played the first set, by the time the banana peels were dry enough to smoke, their subjective judgement of the effects [or lack of] was understandably impaired. After more LSD, and another set, the band members returned to smoke more banana peels, this time convinced that they worked. McDonald – "We started puffing the banana joints and looking at each other and saying, 'Man, this shit is really working! I'm getting really ripped! This stuff is incredible!' Afterward, we went all over Vancouver telling people that bananas get you high. We returned to the Bay Area and almost immediately played a benefit to legalise marijuana. At that event, we passed out 500 banana joints and told everybody that bananas get you high." A few days later, bananas were almost impossible to find in the area, and newspaper headings proclaimed the 'New Hippie Craze'. It wasn't until 3 months later that McDonald remembered the LSD that had been involved, and thought [in his own words] "Ah, that explains everything!" (Perry & Miles 1997).

In experience, a large amount is usually required to be smoked, and the material does not burn easily; effects, though quite mild and short-acting, could well be explained away as carbon monoxide intoxication (pers. comms.). It should be borne in mind, though, that Musa spp. contain a wide array of neurotransmitters and related substances which might contribute to any psychoactive effects when concentrated and smoked, if they were able to survive combustion and cross the blood-brain barrier via this route.

M. sapientum fruit contains *5-hydroxytryptophan*, *serotonin* [% as found in hard green; ripe; over-ripe fruits, respectively – outer peel (0.0074; 0.0096; 0.016), inner peel (0.0013; 0.0038; 0.017), pulp (0.0024; 0.0036; 0.0035)], 0.0065% *tyramine* [0.0029% in fruit peel in one study, 0.0003% in leaf], 0.07% *dopamine* [ripe fruit – 0.02-0.074% in peel, 0.0022-0.005% in pulp], *norepinephrine* [ripe fruit – 0.0017-0.0084% in peel, 0.00014-0.0006% in pulp], *phenethylamine* and *histamine*, as well as the THIQ *salsolinol* [in ripe fruit – traces to 0.027% in peel, traces to 0.004 in pulp], which was found here for the first time in plant matter (Duncan et al. 1984; Riggin et al. 1976; Udenfriend et al. 1959; Watt & Breyer-Brandwijk 1962; Wheaton & Stewart 1970), and up to 0.000074% 1-methyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid (Herraiz 1999); peel also has yielded 0.0036% cycloartane triterpenes (Akihisa et al. 1998), and the fruit contains vitamin A, B complex vitamins, vitamin E, vitamin G, potassium, sugars and malic acid (Watt & Breyer-Brandwijk 1962). The mysterious psychoactive alkaloid 'bananadine', which has been claimed in some underground literature [such as 'The Anarchist's Cook Book'] to be the active 'psychedelic' in banana peels, is a complete fabrication.

Musa sapientum is a polymorphic plant 2-10m tall, with clear sap; pseudostems (the stem is composed of the overlapping bases of the leaves) variously coloured, 1-6m long, 15-40cm diam. at base. Leaves usually 8-20, glaucous, blades 100-400 x 30-80cm, entire, becoming torn in strips by the wind; petioles 30-100cm long. Inflorescences spreading apart, fruiting axis curved, 80-250cm long, 4-8cm diam.; female flowers few to c.20, 5-9cm long, inflated, producing thick, jelly-like nectar; male flowers numerous, 3-6cm long, narrow, compactly arranged beneath leathery red-purple bracts. Fruit of variable appearance, elongate-cylindrical, straight to strongly curved, 3-40 x 2-8cm, apex and base tapered, rounded or blunt, skin thin and tender to tough and leathery, yellow, green or red, flesh starchy to sweet, white, yellowish or orange, often seedless.

Cultivated in tropical areas from eastern India throughout s.e. Asia to the Solomon Islands and n.e. Australia, as well as the West Indies, Central America, Hawaii, Fiji, and w. & s. Africa. Naturalised in many of the countries in which it grows. Cultivated bananas are sterile hybrids bearing edible seedless fruits, mostly derived from M. sapientum (Harrison et al. 1985; Wagner et al. 1990).

MYCENA [including Gerronema]

(Agaricaceae/Tricholomataceae)

Mycena amicta *(Fries) Quélet*
Mycena cyanescens *Velenovsky*
Mycena cyanorrhiza *Quélet*
Mycena epipterygia *(Scop. ex Fr.) Gray*
Mycena pachyderma *Kühner*
Mycena pelianthina *(Fr.) Quél.*
Mycena pura *(Pers. ex Fr.) Kummer* – lilac Mycena, clean Mycena, pure Mycena, amethyst agaric
Mycena splendidipes *Peck* **(M. epipterygia var. splendidipes** *(Peck) M. Geest.***)**
Mycena subcaerulea *(Peck) Sacc.*
Gerronema fibula *(Bull. ex Fr.) Singer* **(Mycena fibula** *(Bull. ex Fr.) Kühn.***; Omphalina fibula** *(Bull. ex Fr.) Kummer***; Rickenella fibula** *(Bull. ex Fr.) Raith.***)** – orange nail fungus
Gerronema setipes *(Fr. ex Fr.) Singer* **(G. swartzii** *(Fr. ex Fr.) Kriesel***; Mycena swartzii** *(Fr. ex Fr.) A.H. Smith***; Omphalina swartzii** *(Fr.) Quél.***; Rickenella setipes** *(Fr.) Raith.***; R. swartzii** *(Fr.) Kuyp.***)**

These tiny mushrooms have gained some attention due to the bluing reaction of some species; also, a species tentatively identified as M. cyanorrhiza, as well as a Mycena sp. which was possibly M. amicta have been said to contain *psilocybin* and/or *psilocin* based on bioassays. These species, as well as M. cyanescens and M pura, sometimes show a blue bruising reaction, hinting at the possible presence of *psilocybin* and/or *psilocin* [see **Psilocybe**]. However, researchers have failed to find these tryptamines in the above mentioned species (Allen et al. 1992; Ott 1993; Stamets 1996). Also reported to blue at the base of the stem are M. pachyderma and M. subcaerulea (Breitenbach & Kranzlin 1991). Bluing in mushrooms is not necessarily related to the presence of *psilocybin* or *psilocin* [see **Boletus**], and human bioassay is not adequate to determine the chemical content of an unanalysed species.

Of these species, only M. pura has been reported to have caused 'poisonings' described as "in the narrow sense hallucinogenic" (Bresinsky & Besl 1989). Some regard this species with suspicion, when searching for edible fungi, though others claim that it is edible. In 1959, V.H. Etienne decided to find out, and consumed 40 fresh specimens of M. pura. An hour after ingestion, profuse sweating manifested, lasting for the next 3 hours. After 2 hours, there was mild nausea and colic, and marked salivation, leading into a semi-somnolent state in which Etienne experienced vivid, colourful, abstract visions. Sleep followed, and the next morning there were no side-effects noted other than mild fatigue. In 1961, R. Heim followed this up by ingesting 3.5g dry M. pura, though no effects were observed with this dose (Heim 1963b).

M. pelianthina is suspected of having toxic properties similar to those of M. pura. M. rosea has caused poisonings related to its muscarine content [see **Amanita**, *Neurochemistry*] (Bresinsky & Besl 1989). M. epipterygia and M. splendidipes have also been claimed to have 'narcotic' properties similar to those of M. pura (Norland 1976).

M. haematopus has yielded haematopodin, an indole-derived rose-coloured pigment with a chemical structure similar to dehydro-*bufotenine* [see **Arundo**, **Bufo**]; this species bleeds dark red when cut (Baumann et al. 1993).

M. metata has been shown to produce the inebriating solvent chloroform, which is released into soil-air (Hoekstra et al. 1998).

M. pura from Japan [harv. Sep.] yielded [w/w] 0.055% L-γ-methylene-*glutamic acid*, 0.0008% L-γ-ethylidene-*glutamic acid* and 0.009% L-γ-propylidene-*glutamic acid* (Hatanaka & Katayama 1975). These compounds might possibly be psychoactive. (2S,4R)-4-methyl-*glutamic acid* is a potent ligand at kainate receptors, (2S,4S)-4-methyl-*glutamic acid* is a potent ligand at 1α and 2 subtypes of *glutamic acid* receptors, and 4-methylene-*glutamic acid* is a potent non-selective ligand at kainate, AMPA, NMDA, and 1α and 2 subtypes of *glutamic acid* receptors [see *Neurochemistry*] (Bräuner-Osborne et al. 1997). Small levels of muscarines have been found, though 75-96% of this was present as epi-muscarine, which is apparently pharmacologically inactive (Bresinsky & Besl 1989; Stadelmann et al. 1976). Cultures have been shown to produce paraquinonic acid, a compound that may be useful in treating leukaemia (Clive et al. 2001).

M. pelianthina also contained small amounts of muscarines, entire-

ly present as epi-muscarine (Bresinsky & Besl 1989; Stadelmann et al. 1976).

The closely related Gerronema fibula and G. setipes [often misspelled as G. solipes] were shown to contain *psilocybin* and *tryptophan* (Gartz 1986b), though subsequent tests failed to duplicate this (Stijve & Kuyper 1988). Mycelial cultures of G. fibula have produced striatal D, a highly cytotoxic diterpenoid. Mycelial cultures of an unidentified N. American Gerronema sp. produced gerronemins A-F, biscatechols which also have cytotoxic properties (Silberborth et al. 2002).

Mycena cyanorrhiza has a cap 3-10mm across, hemispherical, campanulate, sometimes slightly indented in centre, surface dull, smooth and finely pubescent, striate almost to centre, light grey-whitish to grey-brownish; margin acute and slightly undulating regularly. Stem 10-20 x 0.2-1mm, cylindric, sometimes bent, surface finely pubescent, translucent grey-whitish, hollow, base sometimes slightly thickened and bulbous and an intense blue, tomentose, often attached to the substrate by fine anchor hyphae. Flesh membranous, taste and odour largely lacking. Gills white to grey-whitish, broad and ventricose, 10-12, with 1(-3) lamellulae between each, abruptly adnexed to almost free, edges white and sometimes peelable as an elastic thread. Spores elliptic, smooth, hyaline, with drops, 6-7.8 x 3-5µm, whitish. Fr. spring-autumn.

Usually gregarious, on dead wood or on bark of conifers; Europe. Uncommon (Breitenbach & Kranzlin 1991).

The European M. pura is also found in Australia in pine litter [Western Australia, New South Wales, Queensland], where it is "suspected of being slightly poisonous" (Shepherd & Totterdell 1988; Young, T. 1994).

MYRISTICA

(Myristicaceae)

Myristica argentea *Warb.* – New Guinea nutmeg, long nutmeg
Myristica fragrans *Houttyn* – nutmeg tree, jati-phalam, jaiphal, jaepatri, bushpala, sauz-bawwa, dzaa-ti, madashaunda ['narcotic fruit'], ram patri ['fruit of the gods'], jai patri
Myristica malabarica *Lamk.* – Malabar nutmeg, Bombay mace, kamuk, malati, kanagi
Myristica succedanea *Blume* – pala maba

Nutmeg, the seed of Myristica fragrans, and 'mace', the bright red arillus around the seed, are both common spices and powerful intoxicants. Originating in the East Indies, nutmeg had spread to Europe by at least the Middle Ages, initially via Arabian traders, and was a highly valued commodity in the lucrative spice trade [which actually catered for the demand for narcotics, aphrodisiacs and medicines, rather than culinary uses]. Often false nutmegs carved from wood would be sold as real nutmegs. For centuries, the Dutch ruthlessly monopolised its supply and distribution. The nut and its essential oil were well-known for their intoxicating properties, and have been used almost worldwide accordingly. Nutmeg became commonly used in Europe as a soporific, aphrodisiac and mild analgesic. It is apparently powdered and snuffed in some parts of Indonesia. The Malayans prescribe it for madness. In Tibet, it is inhaled, alone or with other herbs, to treat depression and other neurotic symptoms, anxiety, restlessness and palpitations. Kirati shamans of Nepal use it for shamanic travel, with 1 nutmeg being sufficient to 'fly'; it is also used as an offering. Some Hindus of w. India take it as an intoxicant, and it is given in small amounts as a hypnotic for 'irritable' children. It is much used in Indian medicine, and is sometimes substituted by M. malabarica, which is also a stimulant and nervine aphrodisiac. Its use is still sometimes apparent in prisons where no other drugs are available; its use by students, teenagers and older experimenters has also been documented (Clifford 1984; Emboden 1979a; Faguet & Rowland 1978; Lawless 1994; Müller-Ebeling et al. 2002; Nadkarni 1976; Siegel 1976; Weil 1965, 1967a, 1967b, 1969; Weil & Rosen 1983). The pickled bark of M. fragrans is known to induce sleep (theobromus pers. comm.).

The Nkopo of Papua New Guinea use what was tentatively identified as a Myristica sp. in their initiations (Schmid 1991). Interestingly, in India, birds-of-paradise have been observed "becoming so intoxicated from the mere whiff of nutmeg that they finished up lying prone with ants crawling all over them" (Smullen 1989)!

Medicinally, nutmeg in smaller amounts treats flatulence, nausea, indigestion, diarrhoea, and insomnia; it also stimulates the appetite, and is used sparingly in many sweet and savoury dishes. The essential oil is used in perfumes, soaps, hair oils, tobacco [see **Nicotiana**] and fumigants; the fixed oil, when freed of lingering essential oil ['nutmeg butter'] is used in skin creams (Bremness 1994; Nadkarni 1976; Tierra 1988). Nutmeg must be ground for use – this is preferably done when it is to be used, as ground nutmeg loses its essential oil content rather quickly (Weil 1967a).

Aromatherapists consider nutmeg essential oil to have analgesic, aphrodisiac, calming, 'elevating', euphoric, narcotic, nervine and heart tonic effects (Lawless 1994). Sedative and weak analgesic effects have been demonstrated in animals (Grover et al. 2002). In mice, nutmeg [various extracts given i.p.] has been found to produce anxiety (Sonavane et al. 2002). The nutmeg itself is stupefying in large doses, and can cause delirium, hallucinations, fainting, nausea, vomiting, severe abdominal pain, sweating, decreased body temperature and headache. Sometimes the toxic effects are exhibited during the inebriation, sometimes not until the next day; for a lucky few, not at all! Ground nutmeg is usually taken by swallowing 2-3 tablespoons [or 2-3 nutmegs] or more (pers. comms.; pers. obs.); doses of up to 80g ground nutmeg have been reported in medical literature (Stein et al. 2001). It is usually washed down with a liquid, as it doesn't dissolve in drinkable fluids. Blending the nutmeg into a cashew milkshake has been suggested as a good method, both for taste, and ease of ingestion. Effects may take up to 3-5 hours or more to manifest, lasting up to 12 hours. Responses may vary widely between individuals, and at different times, only partly due to chemical variation in the nutmegs. The side-effects stop most people from coming back, although some claim to obtain only positive effects and adopt it as a favourite substance (pers. obs.; pers. comms.; Faguet & Rowland 1978). Nutmeg may also be smoked [this is difficult and HOT] for a very mild effect (pers. obs.; pers. comm.). Anecdotal evidence suggests that smoking nutmeg may be extremely destructive to the lungs (pers. comm.).

The effects from whole ground nutmeg differ from those of nutmeg essential oil. Whole ground nutmeg, as noted above, can produce a variety of toxic effects in the doses required for psychoactivity. The essential oil appears to predominantly rely on *myristicin* and *safrole* content of the aromatic ether fraction for its psychoactivity [and perhaps also the other trace phenylpropenes – see below], and has been bioassayed in doses of up to 20ml, an amount much higher than would be found in a psychoactive dose of nutmeg. It appears that other compounds present in whole nutmeg contribute to the full spectrum of psychoactivity. Essential oils low in *myristicin* required much greater doses to reach the same level of effect; however, 20ml of one essential oil sample that was found to be low in both *myristicin* and *safrole*, taken internally, produced only the toxicity normally associated with whole ground nutmeg. Some of these toxic symptoms from the essential oil may be due to irritating effects from the terpene hydrocarbon fraction, which constitutes most of the essential oil. Humans given nutmeg devoid of essential oil experienced no psychoactivity (Shulgin et al. 1967; theobromus pers. comm.; Torsten pers. comm.).

The phenylpropenes found in the aromatic ether fraction of the essential oil have been thought to contribute to most of the psychoactivity [as mentioned above], presumably by partial or full conversion by the liver to their respective psychotropic *amphetamine* counterparts through amination, though this has not been demonstrated in humans [see *Chemical Index*]. These constituents seem to work synergistically, having relatively little activity on their own (Braun & Kalbhen 1973; Oswald et al. 1971b; Shulgin et al. 1967).

To obtain optimum positive effects from eating nutmeg, it is suggested to eat the dose on an empty stomach, following this with a carbohydrate-rich meal 1hr later. If using the essential oil, 10-15 drops may be taken orally, though some experience no effects consuming the oil directly. Massaging the essential oil into calf-muscles [if intending to dance or run] seems to result in particularly good effects. Muscle activity may stimulate the conversion of phenylpropenes in the essential oil to their *amphetamine* counterparts (Torsten pers. comm.); perhaps this is partly due to providing the oxidative conditions which may enhance the metabolic conversion (eg. see Braun & Kalbhen 1973). Consumption of large amounts of nutmeg has led to deaths in the past, due to "fatty degeneration of the liver" (Faguet & Rowland 1978). A later source claimed that there had been no reports of nutmeg fatality except for a recent case, in which the deceased had also taken flunitrazepam, possibly resulting in a dangerous interaction that might have caused the death (Stein et al. 2001).

M. argentea seeds give only a small yield of essential oil, of low quality, though this has not stopped them being sold in the spice trade.

M. canarica and M. malabarica seeds have been found to contain little essential oil, and yield mainly fats and myristic acid (Shulgin et al. 1967).

M. fragrans nuts [seeds] have yielded 5-15% essential oil, containing 3.86-12.78% *myristicin*, 0.02-2.36% *elemicin*, 0.11% isoelemicin, 0.3-3.42% *safrole*, 0.17% *eugenol*, 0.62% *methyleugenol*, 0.25% methoxyeugenol, 0.19% isoeugenol, 60-80% d-camphene, 8% dipentene, *pinene*, sabinene, geraniol, d-*borneol* and l-terpinol, as well as small residual amounts of fixed oil [2.87% myristic acid, 3.72% unidentified compounds]; and 25-40% fixed oil, consisting mainly of myristic acid, as well as trimyristin [anxiogen, apparently acting at least partly through *serotonin* and *GABA* receptors (Sonavane et al. 2002)], linoleic acid, oleic acid, and other minor constituents. The fixed oil may sometimes contain some additional essential oil in traces. The aril ['mace'] yields 4-14% essential oil of similar composition, with *myristicin* being the main phenylpropenoid constituent, and a high *safrole* content [c.1.9% of essential oil]; 1.57% malabaricone B and 0.53% malabaricone C [both antimicrobial] have also been found. Pericarp, minus aril and seed, has yielded 2-3% essential oil, containing 15.5% α-terpineol, 15.2% α-*pinene*, 13.5% terpinen-4-ol, 6.8% β-*pinene*, 4.5% isoeugenol, 1.5% *safrole*, 1% *myristicin*, 0.2% *elemicin*, 0.1% *methylisoeugenol*, 0.1% *borneol*, and many other constituents. Leaves have yielded c.1.5% essential oil, +- of the same composition as the seed (Budavari et

al. ed. 1989; Choo et al. 1999; Hall 1973; Morton 1977; Orabi et al. 1991; Shulgin et al. 1967; Weil 1967). Nutmeg and *myristicin* have a weak MAOI effect (Truitt 1967; Truitt et al. 1963). A remedy for nutmeg poisoning is administration of mineral or castor oil, followed by gastric lavage and demulcents (Turner & Szczawinski 1991).

M. succedeana has been used as a source for nutmeg essential oil where M. fragrans is not readily available, and has similar constituents (Shulgin et al. 1967).

Myristica fragrans is a tree up to 15(-18)m tall, spreading, dioecious (occ. monoecious), with superficial roots; bark grey. Leaves alternate, estipulate, short-petiolate, prominently pinnatinerved (8-11 pairs), glabrous, elliptic or oblanceolate, apex acuminate, base acute, dark green, shiny above, much paler beneath, 5-15 x 2-8cm, aromatic. Staminate and pistillate inflorescences similar, few-flowered (1-10 in staminate; 1-3 in pistillate), axillary umbellate cymes; peduncle up to 1.5cm long; flowers usually unisexual, v. rarely hermaphroditic, fragrant, yellow, waxy, fleshy, glabrous, apetalous; calyx campanulate, basally nectiferous, with 3 triangular lobes, acute, reflexed. Staminate flowers 6-7mm long; stamens 8-12; anthers adnate to central column and laterally connate to each other. Pistillate flowers up to 1cm long; ovary sessile, puberulent, 1-celled; stigma short, bifid. Fruits drupaceous, pyriform, or occasionally subglobose, nodding, yellowish, to 10cm long, longitudinally with circumferential groove along which yellow pericarp splits into 2 valves at maturity; seeds dark brown-purple, shiny, ovoid, 2-3cm long, enclosed in bright red or orange-red laciniate aril forming close network around seed.

Thought to be native to e. Malaysia; cultivated, little-known in the wild. There are about 6 races of this species with slightly differing characteristics (Schultes & Hofmann 1980).

Cultivated in the tropics, often interspersed with other tree species; prefers altitude below 750m [or up to 900m with wind protection], temps. of 10-35°C, 150-300cm average annual rainfall, and well-drained, loamy soil. Seeds lose viability quickly, and are preferably sown as soon as having been extracted from the fresh mature fruit and dried. Sow seeds in shaded raised beds [or in pots, 1 per pot], with micropylar end pointing upwards, 2.5cm deep and 12-30cm apart; water regularly. Most seeds germinate within 45-90 days. Pot out seedlings when 6 months old, and transfer to prepared ground when 1 year old. When transplanting, care must be taken not to damage the extensive root systems, particularly the tap root. Shade and water regularly for first few years of establishment. Mulching around the base of the plant with dead leaves, and fertilising with manure twice a year is advantageous. Trees bear fruit when 7 years old, with yields increasing until 20 years old; trees can remain productive of fruit for 70-80 years, and a single tree may produce 2,000-3,000 [or even up to 20,000] fruits per year. Having too many male plants in a plantation is considered undesirable; this is sometimes remedied by grafting female plants onto rootstocks of the males.

Fruits are usually harvested in the mornings, in June-October, though some report December-May as the preferred season; however, fruit may be produced all year. The fruits may take 6 months to ripen, from the time of pollination; when ripe, they split open to reveal the mace and nutmeg. The fruits are either harvested when freshly fallen to the ground, or while still on the tree, having just split open, with the aid of hooks on the end of poles. The pericarps are removed and discarded. The aril ['mace'] is removed from the seed, flattened between boards, and sun-dried separately over 10-15 days, becoming brittle; further drying over 6 weeks in total results in the amber-coloured mace of commerce. The seeds may take 4-8 weeks to dry properly, this being judged by the kernel [the 'nutmeg'] rattling inside the shell when shaken. The shell is cracked open with a mallet to remove the nutmeg (Ilyas 1978).

MYRTILLOCACTUS

(Cactaceae)

Myrtillocactus geometrizans *(Mart.) Cons.* **(Cereus geometrizans** *Mart.***; C. pugioniferus** *Lemaire***; C. gladiator** *Otto et Dietrich***)** – garambullo, padre nuestro, blue myrtle

This common Mexican cactus has acidic fruits known as 'garrambullas', which may be eaten either fresh or dried; they are often sold in local markets (Britton & Rose 1963; Bye 1979a).

M. geometrizans has been stated to contain *mescaline* (Shulgin & Shulgin 1997), though this appears to be in error. A stock of M. geometrizans that had been used to graft **Lophophora** williamsii yielded 0.3% *mescaline*, but otherwise none was found in the species (Siniscalco 1983). The *mescaline* that was detected may have originated from the location of the graft. In a broad alkaloid screening one sample tested positive for the presence of alkaloids, though another, which was flowering and fruiting, did not (Fong et al. 1972). An assay of the genus found no alkaloids, but detected triterpenes in all species. M. geometrizans yielded the triterpenes chichipegenin [0.62%], methyl-cochalate [0.25%], methyl-myrtillogenate [0.14%], longispinogenin [0.0025%] and cochalic acid (Djerassi et al. 1957), which might all be artefacts of the extraction process. It has been noted that Djerassi's screening method for detection of alkaloids may have been inadequate for the detection of *mescaline* and similar alkaloids (Trout pers. comm.).

Myrtillocactus geometrizans is a tree-like cactus, with a short definite trunk crowned by a large, much branched top; branches often a little curved, bluish-green, usually 5-6 ribbed, 6-10cm diam., very blue when young; ribs 2-3cm high, rounded; areoles 2-3cm apart; radial and central spines very different, almost filling the areoles; radial spines usually 5, rarely 8-9, usually short, 2-10(-30)mm long, +- turned backward, slightly flattened radially but swollen at base; central spine elongated, dagger-shaped, flattened laterally, 1-7cm long, sometimes 6mm wide. Flowers appearing from upper part of areole, 2.5-3.5cm wide, limb 3-4 times as long as tube; perianth segments oblong, 1.5cm long; stamens numerous, erect, exserted; fruit ellipsoid to subglobose, edible, purplish-bluish, 1-2cm long.

Very common on Mexican tableland; San Luis Potosi to Oaxaca (Britton & Rose 1963).

NAJA and OPHIOPHAGUS

(Elapidae)

Naja naja *L.* – Asian cobra, Indian cobra, spectacled cobra, common cobra, nulla pambu ['good snake'], nag, naga, nagara havu, nale pambo, moorkhan pambu, gokhura

Ophiophagus hannah *Cantor* – king cobra, royal cobra, nagaraja, krishna nagam, shankha chur

The generic name of the 'true' cobras [Naja spp.] is taken from the Nagas of Indian mythology, 'snake-deities' with the ability to give people special healing knowledge and other insights. An Indian myth tells of Mucilinga, king of the Nagas, who used his hood to shield Buddha from the sun's scorching rays when he fell asleep travelling in the desert. In thanks, Buddha blessed the serpent by touching two fingers to its neck, giving rise to the 'spectacles' on the cobra's hood (Bauchot ed. 1994). In Shirala, west-central India, local villagers believe that Shiva granted a favour to one of their ancient sages that the people would be protected from cobras, which are very common in the fields. These people see the cobra as an emblem of divinity and do not fear it – in return, the people are not harmed by these venomous but [normally] passive snakes (Miller, H. 1970). Cobras are also venerated as sacred in many other parts of India and Nepal, and numerous Hindu deities and ancient kings have been depicted with cobra hoods, or otherwise in association with cobras. As shamanic animals as well as deities, they [and other snakes] are associated with both death and renewal of life, and the links between worlds, as well as the kundalini serpent [see *Influencing Endogenous Chemistry*] (Deoras 1971; Müller-Ebeling et al. 2002).

Some saddhus and yogis in India smoke the dried venom glands or dried venom ['bis', 'vis' - names which apply to all poisons] of either N. naja or O. hannah, mixed with **Cannabis**, in order to enter a trance-like state for shamanic travel, or to gain 'shakti' [spiritual power]. **Cannabis** may also be planted on a freshly dead cobra [buried to ritual specifications] to result in very potent and visionary **Cannabis** flowers. Some adepts, including Ojha and Tharu shamans of Nepal, may even allow a cobra to bite them on the tongue or elsewhere for the same purpose; amongst the Ojha, a special mantra protects them from dangerous effects. Apparently all poisonous snake species may be used to aid shamanic travel (Müller-Ebeling et al. 2002; Rätsch 1992; Svoboda 1986).

A modern report exists of human experimentation with N. naja venom. The subject smoked a minute [ie. barely visible] amount of dried venom in a glass pipe. Effects manifested almost immediately, with confusion, delirium and 'irrational' behaviour, accompanied by immobility, increased body temperature, weak pulse and respiration, and a semi-comatose state. The subject experienced bizarre hallucinations and out-of-body sensations, and reverted to normal condition after 2 days (pers. comm.). Another report, this time of an unintentional ingestion, comes from herpetologist Carl Kauffeld, who was bitten by a large cobra. He reported a mild 'dopey' feeling with general weakening, followed by loss of alertness and a fuzzy 'darkening' around the visual field, and a feeling of being semiconscious. No swelling, burning or serious pain occurred (Mara 1993).

Today, purified and diluted cobra venom is sometimes used by doctors to treat arthritis pain (Bauchot ed. 1994) and epilepsy. In India, it has been said that "of all the stimulants, the fresh venom obtained from strong, young, black cobra is regarded as the most powerful, and its effects lasting more than those of other stimulants". Cobra venom has been taken orally in small doses by some people in India, to protect against poison and disease (Nadkarni 1976). In the past it has been used to treat leprosy (Müller-Ebeling et al. 2002). Poisonous snakes in general have been consumed in Arabic countries as a panacaea which reputedly makes one "invincible to wounds, bestows eternal youth, and allows you to understand the language of the animals" (Madejesky, in Müller-Ebeling et al. 2002).

The dry venom of N. naja consists of 90-92% proteins, and some salts. Each venom constituent is associated with a protein fraction, yielding a neurotoxin, hemolysin, cardiotoxin, cholinesterase, AChE, as well as var-

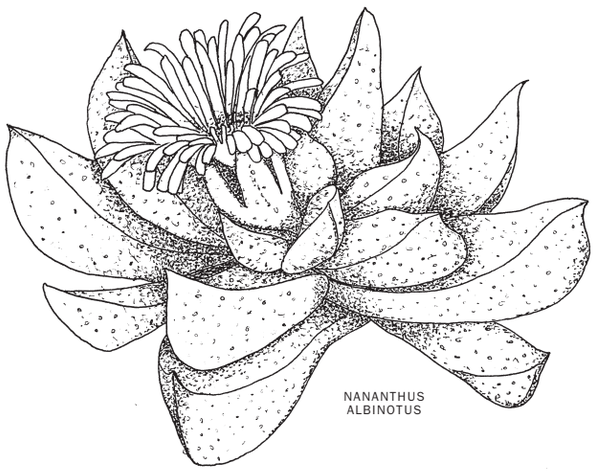
ious other enzymes and enzyme-inhibitors. The neurotoxins in N. naja venom are complex polypeptides, and are considered highly toxic. Cobra venom inhibits *acetylcholine* biosynthesis, and promotes high activity of the enzymes AChE, L-amino acid oxidase, alkaline phosphomonoesterase, phosphodiesterase and 5'-nucleotidase; low activity of the enzymes phospholipase A and hyaluronidase; and very low activity of protease enzymes (Bauchot ed. 1994; Ghosh & Chaudhuri 1968; Ohta et al. 1981; Tan, N.-H. et al. 1987). Venom obtained in winter is less toxic than venom obtained in summer. Cobras also yield less venom in captivity, though those allowed to roam outdoors produce more venom than those confined to cages or enclosures (Deoras 1971). In animals, "the venom produces initial stimulation of the higher parts of the brain followed by paralysis". Respiratory paralysis, in particular, is a real danger with the use of cobra venoms (Nadkarni 1976). In an 'average-sized' male human, 12mg of cobra venom may be lethal (Deoras 1971).

In the case of a cobra bite, the symptoms usually manifest within 1-4 hours, beginning with drooping eyelids and a feeling of sleepy intoxication; following symptoms may include respiratory difficulty, paralysis of eye muscles, increased salivation, weakness of neck and limbs, flaccid paralysis and coma. Some people experience convulsions, cardiac arrest or local tissue damage. Two sub-species known to cause such necrosis are N. naja ssp. kaouthia and N. naja ssp. leucodira [the Malayan cobra] (Russell 1983). However, with a lethal dose of venom, symptoms may be perceived from as little as 8 minutes after the bite (Deoras 1971). Heating a solution of cobra venom at 90°C for 30min. destroyed the cardiotoxic, haemolytic, and cholinesterase activity, without affecting the neurotoxicity (Devi 1968). In vitro, the neurotoxin could be markedly inactivated by application of sodium bisulfite, zinc, hydrochloric acid, ascorbic acid or cysteine (Ghosh & Chaudhuri 1968).

Naja naja is a slender snake with smooth scales, up to 2m long; varying from black or dark brown above, pale underneath, sometimes with black bands underneath; the typical variety [N. naja naja] is patterned with white spots and spectacles on the hood. Indian cobras are known for their ability to raise the body and spread their hood when threatened. They range through India to Sri Lanka and Pakistan, and there are many subspecies of N. naja in Asia. They shelter in a wide array of habitats, often near human habitation, though serious bites from cobras are rare. They feed on rodents and a variety of other small creatures (Mattison 1995; Mehrtens 1987).

NANANTHUS [including Rabiea]

(Aizoaceae/Mesembryanthemaceae)



Nananthus albinotus *(Haw.) L. Bol.* **(Aloinopsis albinota** *(Haw.) Schwant.***; Mesembryanthemum albinotum** *Haw.***; Rabiea albinota** *(Haw.) N.E. Br.***)** – s-keng keng

Nananthus aloides *(Haw.) Schwant.* **(N. aloides** *(Haw.) N.E. Br.***; Aloinopsis aloides** *(Haw.) Schwant.***; Mesembryanthemum aloides** *Haw.***)**

Nananthus difformis *L. Bol.* **(Rabiea difforme** *(L. Bol.) L. Bol.***)** – 'lizard keng'

'S-keng keng', N. albinotus, is said to be used by Griqua tribesmen of S. Africa as an intoxicant. They pulverise the whole, dried plant before adding it to their tobacco [see **Nicotiana**], either for smoking or snuffing – this addition is claimed to have powerful 'hallucinogenic' effects (Emboden 1979a). N. wilmaniae is known as a 'moervygie' or 'yeast mesemb', and may have been used in brewing 'khadi' mead [see **Delosperma**, *Methods of Ingestion*] (Hargreaves 1999). The root of N. aloides is edible, and is eaten by humans (Watt & Breyer-Brandwijk 1962).

N. difformis has been the subject of only a single human bioassay, that I am aware of. The psychonaut harvested 30g of the plant, 1 month after breaking dormancy, which was crushed in fruit juice and filtered. The consumed extract was reported to cause a degree of MAO-inhibition against *DMT*. The herb was also claimed to have yielded less than 1% of a "mixed harmala alkaloid hydrochloride". Further experimentation was hindered by lack of plant material (pers. comm.).

Chemistry of this genus is relatively unknown, except for independent TLC screening of several species [N. albinotus, N. aloides, N. aff. broomii, N. transvaalensis and Rabiea albipunctata (N. albipunctus)]. No alkaloids were detected, except in N. aloides harvested early Nov. [northern hemisphere], which showed faint bands for *DMT* and 2 other compounds (Trout ed. 1997a; Trout & Friends 1999).

Nananthus albinotus is a dwarf, caespitose, stemless succulent herb with fleshy rhizomes divided apically into short branches. Leaves 6-8, opposite, in dense rosettes, united basally, ascending to spreading, enclosing the internodes, often roughened by raised white or greenish flecky dots, greyish-green, to 3(-10) x 1cm, sabre-shaped, narrowed to an acute, recurved-mucronate apex, upper side flat, lower side rounded basally, keeled and laterally compressed apically, keel abruptly rounded to tip. Flowers solitary, nearly sessile, to (30-)38mm across; calyx 5-lobed, unequally or nearly equally; petals yellow, many, in 3-4 series; stamens many, in an erect columnar mass. Ovary inferior, 9-10 celled; stigmas 9-10. Fruit a capsule, expanding keels broadly winged, placental tubercles absent.

Dry open places; Cape Province, S. Africa [Cradock, Graaff Reinet, Middelburg].

Most growth occurs in summer. In cultivation, they require very tall or tubular pots with a sandy, stony, loamy soil (Bailey & Bailey 1976; Jacobsen 1960).

NARCISSUS

(Amaryllidaceae)

Narcissus jonquilla *L.* – jonquil, narcissus

Narcissus pallidulus *Graells* **(N. triandrus** *L. non Curt***)**

Narcissus poeticus *L.* **(N. pseudopoeticus** *Boutigny***)** – daffodil, poet's narcissus, narcissus

Narcissus pseudonarcissus *L.* **(N. cernuus** *Roth. non Bourg., non Salisb.***)** – King Alfred daffodil

Narcissus tazetta *L.* – buttercup narcissus

Narcissus spp. – daffodil

'Narcissus' is thought to derive from the Greek 'narkê' ['numbness' or 'torpor' – also the origin of the word 'narcotic'], due to the narcotic properties of the herbs (Liddell & Scott 1968). According to Greek legend, Narcissus was a young man who fell in love with his own reflection in the water, and died of unrequited love; narcissus plants grew where he died. To the Greeks, the daffodil represented death, and they planted it near their graveyards (Lawless 1994). It is thought that Persephone was picking daffodils [as 'narkissos'] when she was abducted by Hades, and it has been suggested that the bulb may have been the psychotropic agent used at the Lesser Mysteries of Eleusis [see **Claviceps**, **Amanita**, **Panaeolus**, **Pancratium**], which were associated with that mythical abduction (Samorini 2001). The Arabs considered Narcissus spp. to be aphrodisiac, and in a similar vein, some modern magicians use it to affect fertility. Along with oils of rose, sandalwood [see **Santalum**] and jasmine [see **Jasminum**], 'narcissus oil' is used to anoint the body before prayer in India. Also, the flowers were once used in France as an antispasmodic to treat hysteria and epilepsy (Cunningham 1994; Lawless 1994). N. tazetta bulbs have been taken in brandy as an aphrodisiac. This preparation was used with caution, due to its potency and toxicity (Duke 1983).

Narcissus oil, usually obtained from N. poeticus, but sometimes from other species, blends well with clove [see **Syzygium**], sandalwood, and ylang-ylang [see **Cananga**] essential oils. On its own, the scent is said to be aphrodisiac, hallucinogenic, hypnotic, 'inspiring', narcotic and sedating. One of the predominant effects has been described as a "heavy, dull sensation in the head". It should be used in moderation, as too much can cause headache and nausea (Lawless 1994). I received a report from an individual who ate 'several small pieces' of a daffodil bulb, and reported later feeling "like a flower", before being sick (Wonderfeel pers. comm.). There have been several reports of people consuming daffodil bulbs, mistaken for onions. Symptoms often develop rapidly after consumption, with vomiting, stomach cramps, lightheadedness, shivering, and sometimes diarrhoea. In all reports of human poisoning, there has been complete recovery after c.3 hrs – though this may not necessarily mean that higher doses could not be fatal. The aerial parts are less toxic than the bulbs, though they may cause a type of contact-dermatitis known as 'lily rash' (Litovitz & Fahey 1982).

Most horticultural daffodils are hybrids these days, but most probably have similar effects. The alkaloids found in some species, such as *galanthamine*, are known to strongly affect the cholinergic system by inhibiting AChE (Vasilenko & Tonkopii 1975).

N. bugei floral fragrance yielded mainly [54.7-64.4%] trans-β-oci-

mene, also containing *estragole* [3-3.8%], *methyleugenol* [0.2%], 1,3-dimethoxy-5-methylbenzene [11.4-25.9%], 1,4-dimethoxy-benzene [0-0.8%] and other compounds.

N. jonquilla floral fragrance has yielded 37.2-55.5% methylbenzoate, 0.8-2.1% benzylbenzoate, 1.6-3.9% methylcinnamate, 0.1-0.4% indole, 24.6-26.6% trans-β-ocimene and other compounds (Dobson et al. 1997).

N. pallidulus yielded traces [0.00313%] of the *mesembrine*-alkaloid mesembrenone [see **Sceletium**]; similar alkaloids have only rarely been found outside of the Aizoaceae. Others in the Amaryllidaceae of note are Crinum oliganthum, containing mesembrenol, and Hymenocallis arenicola, containing amisine (Bastida et al. 1989); H. americana leaf has yielded 0.0336% [w/w] *tyramine* (Wheaton & Stewart 1970).

N. poeticus has yielded astragalin, astragalin monobenzoate, lycorine [narcissine, galanthidine – toxic], *galanthamine*, galanthine, homolycorine, lycorenine, narcissidine, oduline, pancrasine, poetamine, poetaminine, poetaricine, poeticine, poetinatine, populin, narcimarkine and piscidic acid (Buckingham et al. ed. 1994; Martin 1987).

N. pseudonarcissus has yielded 0.026% *galanthamine*, lycorenine, 0.013% homolycorine, 0.002% 8-O-demethylhomolycorine, crinine, 0.001% narcidine, 0.005% narcissidine, 0.146% haemanthamine and 0.08% hippeastrine (Tojo 1991).

N. tazetta has yielded *galanthamine*, epigalanthamine, lycorine, homolycorine, pseudolycorine, des-methylhomolycorine, lycoramine, lycorenine, maritidine, O-methylmaritidine, tazettine, pretazettine, haemanthidine, pluviine and epipapyramine (Martin 1987).

Narcissus cultivars were screened for *galanthamine* content – yields averaged 0.005% ['Cheerfulness'], 0.007% ['Geranium'], 0.05% ['Mount Hood'] and 0.065% ['Ice follies'] (Moraes-Cerdeira et al. 1997b). 'Ice follies' was also analysed in more detail – alkaloid content was 0.197% in inner bulb scales, 0.148% in outer bulb scales, 0.461% in bulb basal plates, 0.224% in flowers, 0.259% in bulbils and 0.455% in leaves. Galanthamine was the dominant alkaloid [except in leaves and flowers, where it was overtaken by haemanthamine]; other alkaloids included lycorine, lycoramine, N-demethyllycoramine, caranine and hippeastrine (Moraes-Cerdeira et al. 1997a).

Narcissus poeticus is a glabrous, bulbous, scapose perennial herb; bulb 17-40 x 12-35mm. Leaves all basal, linear to lorate or oblanceolate, often distichous, 20-40cm x 5-13mm, flat, +- glaucous; scape 20-50cm, compressed. Spathe 30-50mm, scarious; pedicel 10-45mm; flowers fragrant, hermaphrodite, regular or slightly zygomorphic, solitary or in umbels of 2-15, subtended by a spathe of 1 usually scarious valve; bracteoles small or absent; hypanthial tube 20-30mm; perianth of 6 petaloid segments, arising from apex of ovary, or from hypanthial tube; segments 15-30 x 6-22mm, ovate, orbicular to oblanceolate-cuneate, white or pale cream; corona free from stamens, 1-2.5 x 8-14mm, discoid to very shortly cylindrical, yellow, with red or scarious margin, crenulate; stamens 6. Ovary inferior, 3-locular; stigma capitate or shortly 3-lobed. Fruit a capsule, ellipsoid to subglobose, pericarp dry. Fl. Jan.-Jun.

Mountain meadows; from east central France, south to central Spain, s. Italy and n.w. Greece (Tutin et al. ed. 1964-1980).

NELUMBO

(Nymphaeaceae/Nelumbonaceae)

Nelumbo lutea *(Willd.) Pers.* – American lotus

Nelumbo nucifera *Gaertn.* **(N. caspica** *(DC.) Fisch.***; N. komarovii** *Grossh.***; Nelumbium nuciferum** *Gaertn.***; Nelumbium speciosum** *Willd.***; Nymphaea nelumbo** *L.***)** – sacred lotus, Indian lotus, Egyptian lotus, pink water lily, lotus lily, Chinese water lily, aquaie, he ye, lian zi xin, lien zi, oujie, padma, pankaja, kanwal

Nelumbo spp. (Nelumbium spp.) – lotus, water lily [see also **Nymphaea**]

Asian cultures venerate the 'sacred lotus' [N. nucifera] as representing perfection, immortality and enlightenment. The growth habit of the plant is partly productive of these beliefs – the plant grows out of the mud on the river or lake bottom, rising through murky waters to flower in the sun well above water level, reminiscent of the quest towards spiritual perfection, and the ascending of the chakras. Fittingly, lotus flowers with varying numbers of petals are used to represent each of the 7 chakras. In India, the flower represents the feminine aspect of creation (Rätsch 1992). Recently, it has been stated to be the definitive identity of 'soma' [see **Amanita**] (McDonald 2004), though no doubt not everyone will agree.

In Ayurveda, N. nucifera seeds are considered aphrodisiac, body-strengthening, cardiotonic, sedative to the uterus, and astringent; they may be useful to allay vomiting and relieve burning sensations in the body. The anthers have similar properties, and the flower is considered good for the eyes, fever and biliousness, allaying coughs, thirst, skin eruptions and poisoning symptoms. Other plant parts again have similar uses in general, but varying from district to district. The leaves have been reported to be used as an antidote to poisonous fungi in east and south-east Asia. In China and Malaya, the rhizome fibre is used to restore health to those with nervous exhaustion (Kirtikar & Basu 1980; Nadkarni 1976; Perry & Metzger 1980); also in China, the leaves have been smoked with tobacco [see **Nicotiana**] (Cooke 1860). In China, the rhizomes are used as an arrowroot substitute in cooking, called 'oce fun', which is known to 'increase mental faculties and quiet the spirits' (Mukherjee et al. 1996).

All parts of the lotus are valued in TCM, particularly as a tonic. The rhizome, seeds and leaf are believed to slow the ageing process. The leaves, which are sometimes used to wrap foods for baking, act as a smooth muscle relaxant, antipyretic and refrigerant, treating symptoms associated with excessive summer heat, as well as stimulating the immune system and increasing vital energy. The stamens have been used to perfume tea [see **Camellia**], and treat premature ejaculation; flowers, filaments and stalk juice are astringent and heart tonic; roots are astringent and haemostatic, treating nausea, acne and eczema. The seeds are used for their antipsychotic, antihypertensive, tranquillising, tonic, aphrodisiac, nervine, antefebrile, antipyretic and cardiotonic activities, and are said to have an affinity for the spleen, kidneys and heart. They are usually taken in a decoction of 6-12g, but should not be used in the event of constipation, indigestion or abdominal bloating (Bremness 1994; Huang 1993; Nishibe et al. 1986; Reid 1995).

In s.e. Asia, the seeds are eaten raw, boiled or roasted, and the rhizome eaten as a vegetable or candied. In n. Australia, indigenous people eat the leaf stalks after stripping the tough outer layer, as well as eating seeds and rhizomes [see also **Nymphaea**] (Cribb & Cribb 1987).

Modern-day psychonauts have noted the seeds of N. nucifera to have +- narcotic properties (Ott 1993). The dried embryo seedlings, or 'plumules' ['lian xin' or 'lian zi xin' in Pinyin Chinese, 'nhuy sen khô' in Vietnamese] also have strong effects, and can be potentiated with small amounts of alcohol [eg. 1 fluid ounce of vodka]. Besides being taken orally, they have been smoked by the 'hot-knife' method [see *Methods of Ingestion*, **Cannabis**] for a "powerful narcotic effect", the smoke having a bitter, alkaloidal taste (theobromus pers. comm.).

The flowers of N. nucifera also have interesting psychtotropic properties, and some believe they may have been the 'lotus' eaten by the 'lotophagi' [as well as Odysseus and his men] in Homer's Odyssey [see also **Nymphaea**, **Ziziphus**; not to be confused with Lotus spp. – see *Endnotes*]. One psychonaut smoked a cigarette of the dried and crushed flowers, and described the effects as consisting primarily of pleasant euphoria, with clarity of thought, and strong apathy for the duration of the effects [up to 4 hours]. The effects had some similarity to those from smoked **Nymphaea** caerulea flowers, though less potent. Smoking another cigarette of the flowers shortly after the first had taken effect did not lead to a noticeable increase in the strength of the effects. Smoking the flowers in equal quantity with **Cannabis** led to profound euphoria and contentedness, with minor changes in visual perception, though the apathetic tendencies were more pronounced, and accompanied by feelings of inertia. This strong inertia was not noted by the same subject when smoking the lotus flowers alone, nor when smoking **Cannabis** mixed with **Nymphaea** caerulea flowers in the same manner. Smoking **Cannabis** near the end of a lotus flower experience enhanced the lingering effects of the lotus, but the inertia described previously did not eventuate; interestingly, the **Cannabis** smoked at this time did not seem to add its own signature to the subjective effects. The flowers may also be infused in wine [7g of flowers per bottle; see *Methods of Ingestion*] or soaked in cranberry juice extracts [1g of 5x extract per cup of juice] to be drunk, as with **Nymphaea** (Jones 2001, 2002).

N. lutea leaves and stems have yielded *nuciferine*, N-nornuciferine, armepavine and N-norarmepavine; petioles have yielded these alkaloids as well as N-methylasimilobine, anonaine and roemerine [see **Roemeria**] (Zelenski 1977).

N. nucifera seeds have yielded a variety of isoquinoline-type alkaloids – *nuciferine*, nornuciferine, pronuciferine, 0.01% armepavine, dl-armepavine oxalate, 0.02% neferine [antihypertensive], lotusine, liensinine [antihypertensive], 0.01% isoliensinine, roemerine, anonaine, demethylcoclaurine, 4'-methyl-N-methylcoclaurine, methylcorypalline and 5-MeO-6-OH-aporphine. Leaves have yielded *nuciferine*, nornuciferine, N-nornuciferine, pronuciferine, dehydronuciferine, anonaine, dehydroanonaine, 0.0015% asimilobine [*serotonin* receptor antagonist], N-methylasimilobine, 0.0022% liriniditie [*serotonin* receptor antagonist], liriodenine, roemerine, dehydroroemerine, armepavine, N-norarmepavine, N-methylcoclaurine, N-methylisococlaurine, 5-MeO-6-OH-aporphine and 0.1% nelumboside [quercetin-3-glucoglucuronide]. Roots contain raffinose and stachyose (Huang 1993; Kunitomo et al. 1973; Lassak & McCarthy 1990; Nishibe et al. 1986; Rastogi & Mehrotra ed. 1990-1993; Shoji et al. 1987). The genus also yields catechol tannins and flavonoids (Schultes & Raffauf 1990). A methanol rhizome extract was shown to have CNS-depressant or narcotic and muscle relaxant activity in mice (Mukherjee et al. 1996).

Nelumbo nucifera is a large aquatic herb with slender, elongate, branched, creeping stems sending out roots at the nodes; juice milky; rhizome horizontal. Leaves membranous, 30-60cm or more diam., orbicular, concave or cupped, erect, exactly peltate, entire, radiately nerved, glaucous, glabrous, much raised out of water; petioles very long, rough

with small distant prickles, otherwise smooth. Flowers solitary, 10-25cm diam., white or rosy; peduncles coming off from the stem nodes, sheathing at base; sepals small, 4-5, inserted on top of scape, caducous; petals many, 5-12.5cm long, elliptic, obtuse, finely veined, concave, at first erect, afterwards spreading, hypogynous, many-seriate, caducous; anthers with a clavate appendage; stamens numerous. Ovaries many, 1-celled, sunk in the flat top of an obconic fleshy torus; ovules 1-2, pendulous; torus 18mm high, spongy, the top flat, 2.5cm across, becoming enlarged in fruit to 5-10cm across; style very short, exserted; stigmas terminal, subdilated. Carpels ovoid, loose in the cavities of the torus, 12mm long when ripe, ovoid, glabrous; pericarp bony, smooth; seed filling the carpel, testa spongy, cotyledons thick and fleshy, enclosing the large folded plumule.

Throughout warmer parts of India; also distributed from Iran east to Australia (Kirtikar & Basu 1980).

NEOTATEA

(Bonnetiaceae/Theaceae)

Neotatea colombiana *Maguire, sp. nov.* – ma-nê-tê'-mee
Neotatea sp.

N. colombiana is used by Taiwano shamans of Amazonia, who dry and powder the flowers, and consume them for divination in unspecified ways [probably snuffed]. They also make use of an unidentified Neotatea sp. in diagnosis, snuffing the dried, pulverised flowers, which have a pleasant fragrance. This latter unidentified species is used by Kubeo shamans in some ritual practices, and is said to possess special powers. Their chemistry is unknown (Schultes & Raffauf 1990).

Neotatea colombiana is a small tree 2-7m tall; branches smooth, glabrous, whitish; terminal bark of branchlets red, dry, papery; wood brittle. Leaves glabrous, sessile, crowded, oblanceolate, usually 6-12 x 2.5-3.5cm, inaequilateral, apex rounded-obtuse, or slightly acute, somewhat subretuse, midrib prominent, lateral veins numerous, c.45° to midrib, parallel and ascending, 0.2-0.4mm apart. Flowers solitary; peduncle usually 18-22mm long, thick, glabrous, 2-3mm diam.; bracteoles soon falling, subtending; sepals 5, imbricate, elliptic-lanceolate, obtuse, 25-30mm long, externally c.20mm wide, internally c.15mm wide, glabrous; petals cordate-flabellate; stamens numerous, filaments free; anthers introrse, linear, basifixed. Ovary 3-locular, placentation subparietal-axillary; style terete, geniculate at base; stigmas 3. Fruit a conical capsule 22-25mm long, c.10mm wide, septicidal, endocarp a separate, solid cartilage; placentation subparietal-subaxillary; funicle descending; seeds numerous, reflexed, winged, 4-5mm long, c.1mm wide, covered with rough reddish hairs, lacking albumen; embryo erect, c.2.5mm long, cotyledons 2, c.1mm long, oblong-rotundate.

Colombia (Maguire et al. 1972).

NEPETA

(Labiatae/Lamiaceae)

Nepeta cataria *L.* **(N. bodinieri** *Vaniot***; Calamintha albiflora** *Vaniot***)** – catnip, catnep, catmint, nepeta, cat's wort, field balm
Nepeta cataria var. citriodora *Becker* **(N. citriodora** *Becker***)**
Nepeta elliptica *Royle ex Bentham*
Nepeta x faassenii *Bergmans* **(N. racemosa x nepetella** *L.***)** – Faassen's catmint
Nepeta grandiflora *Bieb.*
Nepeta hindostana *(Roth) Haines*
Nepeta leucophylla *Bentham*
Nepeta longibracteata *Benth.* **(Glechoma longibracteata** *(Benth.) Kuntze***)** – behungu
Nepeta nepetella *L.* **(N. lanceolata** *Lam.***)**
Nepeta racemosa *L.* **(N. mussinii** *Spreng.***)** – catmint
Nepeta sibthorpii *Bentham*
Nepeta spp.

'Catnip', N. cataria, is a common medicinal herb, with the notable ability to intoxicate cats and other felines merely by aroma, yet as the cats become more interested, they may also eat the herb. Apparently, the plant does not affect all cats of a given species, or felines under 3 months of age. Effects in cats usually last about 15 minutes; Nepeta spp. known to cause these effects so far are N. cataria, N. x faasenii, N. nepetella and N. sibthorpii (Tucker & Tucker 1988).

In ancient Rome, catnip was cultivated, and held in higher esteem than today; it was used as a food seasoning, medicine, and relaxing smoking herb (Bremness 1988). In other parts of Europe, catnip was brewed as tea, before 'real' tea [see **Camellia**] was imported from China (Bremness 1994).

The Cherokee of N. America use N. cataria [an introduced plant] as a stimulant, in the form of a leaf infusion (Hamel & Chiltoskey 1975). The Winnebago give a sweetened infusion of it to babies, to stop them crying and help them sleep. Root and leaf have been used to repel rats and flea beetles; leaves have also been used to flavour meat, or added to salads, and make a good poultice for bruises. An infusion promotes sweating, and is used to treat colds, flu, fever, headache and scalp irritation; it restores menstrual flow, relieves coughs, reduces flatulence and diarrhoea, and acts as a sedative antispasmodic. It has also been given as an enema to cleanse and heal the lower intestine. The leaves may also be chewed to treat toothache (Bremness 1994; Chiej 1984; Kindscher & Hurlburt 1998; Mabey et al. ed. 1990).

In Ladakh, India, N. longibracteata leaves are used "in worship", and leaves and young twigs of N. glutinosa are fed to goats to make them strong (Bhattacharyya 1991). N. elliptica and N. hindostana are ingredients of Ayurvedic preparations for treating epilepsy (Ott 1993).

Since at least the late 1960's, westerners have been occasionally known to experiment with smoking catnip [more rarely made into a tea], usually N. cataria, as a **Cannabis**-substitute. Often the leaves [sometimes flowers too] are smoked in a cigarette or water pipe, or an extract [sometimes available from pet stores] is sprayed on tobacco [see **Nicotiana**], which is then smoked. Effects are sometimes perceived as euphoric and mildly 'hallucinogenic' (Gottlieb 1992; Jackson & Reed 1969; Siegel 1976). These effects are often only experienced with good quality, relatively fresh samples, and the euphoria can be quite intense and pleasant; some people do not seem to perceive the effects. More often, particularly with material purchased from pet stores, catnip may be milder than the above, and produce only relaxation and mild feelings of well-being, or even no effects at all. Herbalists or health stores usually offer fresher, more potent catnip if sold in bulk or in clear packages. Avoid buying catnip [or any other herb, for that matter] which is packaged in a way that its quality can not be inspected. Better yet, grow your own! I have also tested N. x faassenii by smoking, and found it to be more potent than N. cataria. In both cases, flowers seem to be more potent than leaves (pers. exp.).

The psychoactive components of Nepeta spp. are primarily nepetalic acid, *nepetalactone*, and related lactones – these are generally concentrated in the trichomes (Hallahan et al. 1998; Harney et al. 1974, 1977; Tucker & Tucker 1988).

N. caesaria essential oil has yielded mostly 4aα,7α,7aα-*nepetalactone* [opioid-analgesic activity], as well as nepetalic acid, nepetonic acid, 1,5,9-epideoxyloganic acid, and 4 new dihydro-*nepetalactone* derivatives (Topçu et al. 2000).

N. cataria essential oil may contain 70-99.9% cis-trans-*nepetalactone* [*nepetalactone*] and 0.1-30% trans-cis-*nepetalactone* [iso-*nepetalactone*, epi-*nepetalactone*], as well as dihydro-*nepetalactone*, isodihydro-*nepetalactone*, neo-*nepetalactone*, 5,9-dehydro-*nepetalactone*, *eugenol* (Sakan et al. 1965; Tucker & Tucker 1988), thymol, geraniol, and carvacrol (Mabey et al. ed. 1990); nepetariaside has also been found (Murai et al. 1987).

N. cataria var. citriodora essential oil yielded 12.2% of a mixture of *nepetalactone*, iso-*nepetalactone* and dihydro-*nepetalactone* (Tucker & Tucker 1988).

N. grandiflora, collected in flower, yielded 0.18-0.31% essential oil from wild plants, consisting of 33.5% *nepetalactone*, 16.1% epi-*nepetalactone*, 13.5% pulegone, 6.3% terpineol, 3.8% *thujone*, 3.6% α-*pinene*, 0.8% β-*pinene*, 1.9% cineol, 0.9% menthone, 0.6% cymol, 0.4% citronellol, 0.4% *borneol*, and traces of isomethane; seed-grown plants in cultivation yielded 0.12-0.14% essential oil (Mishurova & Malinovskaya 1989).

N. hindostana essential oil has yielded 7.5% *nepetalactone*.

N. leucophylla essential oil has yielded 3% *nepetalactone*.

N. nepetella essential oil has yielded 76.5% *nepetalactone*, 0.6% iso-*nepetalactone*, 1.6% dihydro-*nepetalactone*, 0.4% neo-*nepetalactone* and traces of 5,9-dehydro-*nepetalactone* (Tucker & Tucker 1988).

N. racemosa essential oil may contain 16.7% *nepetalactone* and 70% cis-cis-*nepetalactone*, as well as iso-*nepetalactone* (Hallahan et al. 1998; Tucker & Tucker 1988).

Nepeta cataria is a strongly aromatic perennial herb; stems erect, much-branched, to 2m tall (usually less), finely pubescent. Leaves opposite, narrowly to broadly deltoid, 3-8cm long, coarsely crenate-dentate, truncate or subcordate at base, upper surface grey-green, lower surface paler and downy; petioles ½ as long as leaf blade. Flowers in whorled clusters from tips and leaf axils, 2-6cm long; calyx 5-toothed, 7mm long, lobes c.½ as long as tube; corolla tubular, 10-12mm long, with 2 lobes, upper bilobate, lower trilobate, dull white, lower lobe dotted with pink-purple. Gather late spring, when coming into flower.

Mountainous regions of Europe, in Britain by roadsides, hedgerows and streams; native to s.e. Europe and s.w. Asia, grows as a weed in North America (Chiej 1984; Gleason 1952). Easy to cultivate, but requires regular watering, and protection from excessive full sun. Care should be taken where it is grown, as the plant has great weedy potential due to vigorously spreading rhizomes (pers. obs.).

NEPHELIUM

(Sapindaceae)

Nephelium juglandifolium *Bl.* **(N. altissimum** *Teijs. et Binn.***)**
Nephelium topengii *(Merr.) Lo* **(Xerospermum topengii** *Merrill***)** – shan li chi, lung-li

N. topengii is thought to be referable to 'lung-li', mentioned in ancient Chinese herbal texts as having hallucinogenic properties. Its fruit, the flesh of which tastes like 'longan' [N. longana] fruits and has a sweet, hot nature, may only be eaten after steaming. If eaten raw, it is said to cause one to "go mad or see devils" (Li 1978). The pulp of N. litchi [Litchi chinensis; 'litchi' or 'lychee' tree] fruit is used in India to quench thirst in fever; it is said to be aphrodisiac (Nadkarni 1976). In China, N. litchi seeds are used to treat neuralgia; in TCM they are powdered and taken in a dose of 4-7g as an analgesic and astringent. N. longana arils are also used in TCM [dose – 10-15g] as a nutrient tonic to treat neuraesthenia and insomnia. The seeds of the Malaysian N. juglandifolium are known to be narcotic (Keys 1976; Perry & Metzger 1980).

Chemistry is obscure, though seeds of some species are known to contain saponins, tannins, sugars and vitamins (Keys 1976; Perry & Metzger 1980).

Nephelium topengii is a tree c.10m tall, subglabrous; branches terete, glabrous, branchlets puberulous. Leaves spirally arranged, 20-25cm long, 5-foliate; leaflets oblong-lanceolate, chartaceous, 10-15 x 3-4cm, acuminate, base acute, mostly unequal, upper side olive-green, glabrous, nitid, underside pallid, subglaucescent, lightly pubescent, hairs beneath appressed, nerves on both sides c.14, on underside conspicuous, reticulation on both sides distinct. Inflorescence paniculate, terminal and axillary, under fruit 10-12cm long, +- pubescent; flowers actinomorphic; calyx thick-fleshy, lobes 4-6, segments valvate, rounded or obtuse; petals 4-6 [or none], without appendages at base; stamens or staminodes 5-8, hairy. Disc usually glabrous; ovary densely pubescent, in female deeply 2-3-lobed, lobes 1-celled; cells 1-ovuled; style 2-3-branched. Fruit ellipsoid, 2-2.5cm long, rotundate, when dry dark chestnut brown, densely-tuberculate/knobbly, muricate, processes rigid, 2.5-3.5mm long, straight or slightly curved, obtuse or truncate, sulcate, 0.5-1mm across, base pyramid-shaped.

China, on forested slopes (Backer & Bakhuizen van den Brink 1965; Merrill 1923).

NICOTIANA

(Solanaceae)

NICOTIANA TABACUM

Nicotiana attenuata *Torrey* – mountain tobacco, dzil nat'oh
Nicotiana benthamiana *Domin.* **(N. suaveolens var. cordifolia** *Benth.***)** – anterlp, irranerratye, mara-kanyala, tjuntiwari, wanngati, multu, yarrampa, ingulba pudura
Nicotiana bigelovii *(Torrey) Watson*
Nicotiana cavicola *Burbidge* – talara, pinkaraangu
Nicotiana debneyi *Domin.* **(N. suaveolens var. debneyi** *Bail.***)**
Nicotiana excelsior *J. Black* **(N. suaveolens var. excelsior** *J. Black***; N. macrocalyx** *Domin.***)** – atnwengk, pitwerre, piturr, piturrba, warrngati, pulyantu, ukiri, wanngati, pulandu, inkulba, mingul, mingulba, carmen
Nicotiana glauca *Graham* – tree tobacco, me-he-kek, mingkulpa, mulapa
Nicotiana glutinosa *L.*
Nicotiana goodspeedii *H. Wheeler*
Nicotiana gossei *Domin* – rock pituri, ngkwerlp-rnpernp, rnpwernp, tjunpumpa, piturr, piturpa, jurnpurnpa, jurnpurrnpu, ingulba inbinba, ingulba, engulba, mingul, mingulba, ngulba
Nicotiana ingulba *J. Black* **(N. rosulata ssp. ingulba** *(J. Black) P. Horton***)** – sandhill pituri, ingulba ngunjiga, ngkwerlp-atherrk, arwernp, atnengkwe, pitwerre, manakarrata, tjurratja, anultja, talyunganu, tawal-tawalpa, yarunpa
Nicotiana macrophylla *Spreng.* **(N. latissima** *Mill.***)** – Maryland tobacco, broad-leaf tobacco
Nicotiana megalosiphon *Heurk et F. Muell.* **(N. suaveolens var. longiflora** *Benth.***)** – ingulba ndurilba
Nicotiana paniculata *L.* – tabaco cimarrón
Nicotiana quadrivalvis *Pursh* – four-valved tobacco
Nicotiana rustica *L.* – Turkish tobacco, English tobacco, East India tobacco, Indian tobacco, yellow-flowered tobacco, picietl, tabaco moro, oyengwe onwe ['real tobacco'], wipaka, makuchi, wiparu, wipanto
Nicotiana simulans *Burbidge* – tjanyungu, tjungarayi tjungarayi
Nicotiana suaveolens *Lehmann* **(N. exigua** *H. Wheeler***; N. undulata** *Vent.***)** – ingulbingulba, mingul-mingulba, ngulbingulba, pinna-pinna
Nicotiana sylvestris *Speg. et Comes*
Nicotiana tabacum *L.* – American tobacco, Virginia tobacco, tabaco blanco, bujjir bhang, tamaku, quauhyetl, wipaka, makuchi, tsaank, tsang, tsaan
Nicotiana trigonophylla *Dunal ex DC.* – desert tobacco, wild tobacco, coyote's tobacco, bawaráka, wipaka, ban vivga
Nicotiana velutina *Wheeler* – ingulba ndurilba
Nicotiana spp. – tobacco

Tobacco is one of the world's most widely used drugs, and has been used for centuries in many forms – chewing, drinking, snuffing and smoking are the usual approaches to its ingestion. It is considered the prime entheogen by many shamans of N. & S. America, which seems odd to those of us accustomed to weak commercial tobaccos. The types used shamanically are generally much richer in *nicotine* content, so much so that those not used to it can not take more than one inhalation of the acrid, pungent smoke. Since the Spanish conquest and discovery of tobacco use in the Caribbean, tobacco spread and was adopted by shamans and others almost worldwide, especially in s.e. Asia (Ott 1993; Pendell 1995; Rätsch 1992; Von Bibra 1855).

In some parts of Australia, however, the indigenous peoples already used native Nicotiana spp., and thus N. tabacum was only another addition from the 'white man'. The tribes of arid regions, where the tobacco grows [it was not cultivated, though it is in Torres Strait], chewed the dried, crushed leaves with alkaline ash [often from **Acacia** spp.], sometimes bound with animal hair and ochre, as a 'stimulant-narcotic'. Sometimes the flower buds and leaves were chewed fresh. It was often interchanged with 'pituri' [see **Duboisia**], considered by some to be more desirable. Species documented to have been used, in approximate descending order of potency and/or desirability, are N. gossei, N. excelsior, N. benthamiana, N. ingulba, N. cavicola, N. glauca, N. simulans, N. megalosiphon, and N. velutina – these last two species are considered too weak to be worth chewing. Although N. suaveolens is relatively common, it has remained virtually unutilised, apparently due to its low potency (Cribb & Cribb 1981; Johnston & Cleland 1933; Lassak & McCarthy 1990; Latz 1995; Low 1990; O'Connell et al. 1983; Peterson 1979; Thomson 1939).

Native peoples of the Everard Ranges [n. South Australia] and Blyth Ranges [w. South Australia, e. Western Australia] have been noted to use what was probably N. gossei. The leaves were prepared for use by "being almost dried over heated sand [taken from beneath a fire], kneaded into little balls between the teeth in order to give cohesion, then rolled into a mass about the size of the thumb, then dried again and reserved for future use." The prepared drug was used by placing it between the lower lip and the gums, for sucking; the wad was stored behind the ear when eating. In contrast, the Aranda and Luritja have been known to use the whole plant, including roots, which they sun-dry, grind, and mix with alkaline ashes (Johnston & Cleland 1933).

Smoking was believed to have been introduced as a method of consumption only after the arrival of Europeans, though in the Northern Territory, tobacco is often smoked in pipes, apparently a traditional use [probably originating from Papua New Guinea]. Such pipes vary considerably in their construction, some carved from the wood of various plants, others made from leg bones of birds, from marine mollusc shells or from crab pincers, amongst other ingenious innovations. Pipes may be passed ceremonially to establish solidarity or a communal bond; other ornate sacred pipes may only be smoked by fully-initiated members of

a clan (Thomson 1939). A Nicotiana sp. from Port Hedland [Western Australia], which was probably N. benthamiana, was noted to have been popular amongst local indigenous people for smoking. It "had the effect of making them at first excited, then stupidly heavy, and finally sent them off to sleep". It is worth noting that in many early literature reports, much reference has been made to N. suaveolens. However, previous to 1935, all native Nicotiana spp. in Queensland were known under this name. These include N. debneyi, N. gossei, N. megalosiphon and N. velutina (Johnston & Cleland 1933; Webb 1948). Early white explorers on one occasion reported sampling N. suaveolens when passing through flats near Mt. Flinders, in the Macquarie Ranges. A member of the expedition, Allan Cunningham, noted the dried lower leaves were "not a bad substitute for its congener, N. tabacum, although not so strong a narcotic" (Johnston & Cleland 1933).

The Bimin-Kuskusmin of Papua New Guinea use 'ritual' strains of N. tabacum in stages 4-9 of their initiation, occurring at dusk. The plants are surrounded with ritually sacrificed meat shortly before use. As well as being eaten, tobacco leaves are smoked with deep inhalations through pipes of bamboo [Bambusa sp.; stages 4-6] and pepper [**Piper** sp.; stages 7-9], wrapped in different leaves; other plants are also consumed [see also *Endnotes*] (Poole 1987). The use of N. tabacum as a magical plant is widespread in PNG (Glick 1967; Marshall 1987; Paijmans ed. 1976; Schmid 1991).

Although tobacco was only introduced to India in the 16th century [by the Portuguese], it has attracted reverence from some indigenous groups [though not from Hindus] who have elaborated numerous origin myths for the plant, some of which are described by Mehra (1979). It is often used in casual routine rituals, and as a recreational drug after a hard day's work. Amongst the Muria, asking for a 'puff of tobacco' after marriage is equivalent to asking for sexual intercourse. The Sema Nagas place a pipe and some tobacco in the graves of their deceased warriors, and the Bhil include tobacco in offerings to the dead during funeral rites (Mehra 1979). Chewing tobacco with betel nut [see **Areca**] is a common method of use in India. Tobacco is often smoked in India and Nepal in the form of 'bidi' cigarettes, for which numerous species may be used as wrappers [eg. see **Musa**, and Lyonia and Shorea in *Endnotes*], although bidis may also contain other herbs [eg. see **Datura**] (Müller-Ebeling et al. 2002; Nadkarni 1976).

Tobacco from introduced Nicotiana spp. is widely used recreationally in Africa, often snuffed or held between the lower lip and gums [called 'dipping' in parts of the US], though it is also smoked in pipes. The Xhosa and Mfengu are particularly known for their habitual 'dipping' (De Smet 1998; Watt & Breyer-Brandwijk 1962). Snuffs may take the form of dry powder [mixed with alkaline plant ashes], or a liquid [dried, powdered tobacco leaves mixed with ashes and water]. The liquid snuffs are measured by dose into the cup of the hand and more or less poured into the nostrils with the head tipped back. Special nose clips are often employed to hold the liquid inside the nasal cavities until the user has had enough (De Smet 1998). N. rustica is smoked and snuffed by the Southern Sotho, and it is decocted as an emetic by the Lissongo (Watt & Breyer-Brandwijk 1962). In eastern Africa, the Masai snuff tobacco as a mild euphoriant (Lehmann & Mihalyi 1982). N. glauca, which also grows in the area, has caused poisonings in ostriches, with symptoms including "staggering gait, spasmodic jerkings of the head, dullness and stupor", soon followed by death (Watt & Breyer-Brandwijk 1932). In some parts of Africa, 'juice' from tobacco pipes has been used as a homicidal poison (De Smet 1998).

North and Central American natives smoke tobacco in a ritual sense, and the Navajo, for example, have complex ritualised formats for the making of ritual pipes, which are used for shamanic purposes and at meetings [the 'peace pipe' – see also **Arctostaphylos** and other kinnikinnicks] (Winter 1998). To the Karuk of California, tobacco is a very important substance, and is generally smoked in pipes in the evenings. The cured stems constitute an inferior grade of tobacco, "used by hunters, priests of ceremony, and doctors as offerings to the Ikxarey, the 'old-time' people, who turned into animals, plants, rocks, mountains". Species used in N. America include N. attenuata, N. bigelovii, N. bigelovii var. exaltata, N. quadrivalvis, N. rustica and N. trigonophylla (Furst 1976; Harrington 1932; Winter 1998).

N. rustica was known as 'picietl' to the Aztecs, and the dried, powdered leaves are rubbed on the body for ritual purification, or chewed with lime; they also knew N. tabacum, as 'quauhyetl'. The flowers of the latter have been identified on the statue of the Aztec deity Xochipilli [see **Turbina**]. The Huichol smoke N. rustica as an entheogen, sometimes with **Tagetes** lucida; they also may drink it in the purification stages of the peyote quest [see **Lophophora**]. The Tarahumara smoke cigarettes of N. rustica during night ceremonies; more rarely, they smoke N. trigonophylla. To them, tobacco is more powerful than **Datura**, but is considered less important than peyote. Tobacco was very important to Mayan religion, and is still revered by surviving Mayan groups today (Bye 1979b; Emboden 1979a; Furst 1976; Robicsek 1978; Siegel et al. 1977; Wasson 1963, 1973).

In the Amazon, tobacco [usually N. rustica or N. tabacum] is often only smoked shamanically, in pipes or cigars, and is seen to protect from evil influences; for recreation, it is usually snuffed [with ash of **Theobroma** subincanum, and sometimes with **Capsicum** spp.], and sometimes boiled to a syrup ['ambil', 'ye-rras'] for application to the gums – this is sometimes taken with coca [see **Erythroxylum**]. Such syrups or thick decoctions are sometimes inhaled nasally [as is often done in the San Pedro ceremonies of the Andes – see **Trichocereus**]. The syrup may be prepared in a number of ways – one method is to steep the leaves in water for a long period, later mixing the strained liquid with 'yucca' starch [from Manihot utilissima] and 'sugii' [a Sorghum sp. – see *Endnotes*]. Another method resembles alchemical practices. Large, lower leaves are boiled slowly in a pot for several hours. Salts are prepared from leaves and petioles of a Chamaedorea sp. and young shoots of a Bactris sp. – these are burnt to ash, and water is passed through the ash. This water is evaporated to obtain the salts, which are added to the tobacco extract just before it becomes thick. The Chimila of Colombia chew dried tobacco leaves, which have been pulverised and mixed with a small amount of ash and honey, to form small cakes c.2cm long (Bennett 1992; Davis 1996; Emboden 1979a; Schultes & Raffauf 1990; Uscategui 1959). In Peru, shamans may use a variety of Nicotiana spp. N. rustica is used for curing, and N. tabacum for liquid snuff ['shingada'] made by soaking the leaves in cane alcohol. N. glauca is used for its CNS-stimulant and 'hallucinogenic' properties, and N. paniculata is also known to be a potent species (De Feo 2003).

Shamans of the Guianas have been known to smoke tobacco in large hand-rolled cigars, as well as eating, drinking and snuffing it during initiations. Shaur boys drink the juice from steeped tobacco leaves at the age of 6, to help them find their soul or 'arutam'. Girls also drink it in ceremonies to communicate with spirits governing crop cultivation. Tobacco is often used in the Americas throughout ceremonies centred on the use of another visionary substance [eg. ayahuasca (with which it is commonly brewed, also – see **Banisteriopsis**), **Virola**, **Lophophora**], sometimes in very large amounts which would be toxic to outsiders. Shamans of the Orinoco have been known to smoke 5-6 1m-long cigars in one session – such long cigars often need to be supported by a forked prop! Tobacco shamans are skilled in accurately measuring out dosage, and they need to be, because tobacco is highly toxic and can kill. Shamans and initiates addict themselves to tobacco over long periods [even the gods are said to be addicted to it], until they can master the dose needed to elicit an entheogenic state – this dose is near the lethal dose, and it causes novices to be 'driven out of their minds', go blind, and collapse into a death-like sleep. Initially there is nausea, vomiting, abdominal pain, sweating, salivation, trembling, rapid and irregular heartbeat, high blood pressure, dizziness, confusion, and heavy, laboured breathing, followed by tremors and convulsions, lowered blood pressure, and collapse. If the dose was correct, the participant returns to consciousness after a few hours, once the *nicotine* alkaloids have been metabolised; if not, death due to respiratory paralysis may occur. The whole experience is intended to be a journey towards the realms of dying, where shamanic work is completed, before returning to the world miraculously (Bennett 1992; Davis 1996; Emboden 1979a; Furst 1976; Pendell 1995; Rätsch 1992; Rivier & Lindgren 1972; Robicsek 1978; Schultes 1972; Turner & Szczawinski 1991; Uscategui 1959).

Many shamans in the Amazon eat little 'real' food, consuming tobacco in a variety of ways instead, as it is considered a food that is nourishing to shamans. Tobacco is known to inhibit hunger pangs for up to several hours per administration, as well as raise blood sugar levels and cause *epinephrine*-release [hence the anorexic effects]. Tobacco-shamans ['tabaqueros'] also have 'guttural and dark-timbred singing voices', reputedly an aid to spirit-communication, which is developed and fed with continual tobacco smoking [a 'shamanic voice-box']. Their eyes are also said to be 'special', caused by the pupil-constriction of tobacco-smoking, as well as the optical disorder 'tobacco amblyopia' [dim-vision and colour-blindness, or yellow-tinted vision – also including symptoms such as fatigue, depression, anxiety, insomnia, suppressed appetite for food and sex, constipation and pallid skin], which allows him to see better at night than at daytime, thus becoming a true 'creature of the night' like the jaguar, an animal of great shamanic power. The tobacco also causes decreased skin temperature [due to peripheral vasoconstriction] and analgesia [due to central cholinergic blockade], allowing him to display tolerance to fire and pain. Tobacco smoke is often utilised in healing sessions by blowing it over the patient, or spitting tobacco-juice at afflicted body parts. The former is known to usually calm the patient, and lower their temperature [leading to greater comfort], aiding natural healing processes (Furst 1976; Pendell 1995; Wilbert 1991).

An unusual and dangerous initiation rite has been described by Bear (1997) and Bear & Vasquez (2000). About 200g tobacco is decocted in water and strained; this decoction is placed in a small hollow, carved into a remocaspi tree [see **Aspidosperma** and **Pithecellobium**]. The hole is plugged up with mud, and splinters from the tree, and left for 8 days. After this time, the preparation has fermented, and is inundated with mould-fungi [see **Aspergillus**, **Geotrichum**, **Hypomyces**, **Penicillium**, and **Rhizopus**], which are stirred into the drink before it is consumed. A semi-comatose state soon prevails, during which the initiate experienc-

es visions; this state lasts for 3 days, if the initiate does not die. It is said that if one survives this process, they will be a powerful healer (Bear 1997; Bear & Vasquez 2000).

Tobacco, when smoked in small amounts, is a short-term CNS-excitant and tranquilliser, which can improve cognitive functioning in regular smokers. In higher amounts, or with very potent tobaccos, the effects are more extreme and may range from a brief 'rush' followed by increased heart-rate and core-body temperature, perspiration, nausea and dizziness, lasting only a few minutes, to unconsciousness due to fainting (pers. obs.). Overdose causes symptoms described in the text above. The health risks of smoking tobacco are well known and need not be further discussed here. I will note, however, that *nicotine* is reportedly more addictive than heroin (Byrne 1988)!

In Australia, illicit cheap tobacco known as 'chop-chop' is widely sold under the counter, and many users believe it to be 'organic' and therefore healthier and free of additives. Not only is the supposed organic origin of this tobacco highly suspect, much of it has been reported to be cut with straw, and dampened with water and chlorine bleach, leading to greater deterioration of health in smokers of such products (Robotham 2002). Legal tobacco isn't much better, carrying high levels of pesticide residues as well as numerous unspecified additives used to improve the smoking characteristics of the finished product [although in some countries tobacco companies are required to inform government agencies of additives used in the industry, it is practically unheard of for the actual additives and quantities used to be identified for any particular brand, and although lists of hundreds of additives can be found, any given brand may only use a relatively small number of these]. Contrary to popular opinion, pipe and rolling tobaccos may contain far more additives than the tobacco in pre-rolled cigarettes [10.7-33.4% as opposed to 0.2-0.4%, respectively, in one limited analysis] (Chapman 2003) Most tobacco companies also add ammonia and ammonia-forming compounds to tobacco to increase the *nicotine* impact, as this converts the nicotine from its salt to its free-base form, which is much more volatile [analogous to free-base or 'crack' *cocaine*] (Pankow et al. 1997). Also, as a piece of trivia, studies on the width of tobacco fibers have shown that increased width raises the levels of *nicotine*, tar, and dry condensate in smoke, whilst their accumulation in the cigarette butt decreased. A threshold of 0.8mm width was found, above which little further change was noted (Georgiev 1973).

Smoking tobacco causes [in regular smokers] inhibition of MAO-A [c.28%] and MAO-B [c.40%] in the brain, measured 2.7 hours after smoking. Also, in isolated rat brain, similar inhibition of MAO-A & -B inhibition was shown by cyano-derivatives of 1,2,3,4-tetrahydroisoquinoline [THIQ], which are formed by reaction of brain THIQ with cyanide-compounds found in tobacco smoke (Fowler et al. 1996; Khalil et al. 2000; Mendez-Alvarez et al. 1997). Smoking tobacco increases levels of *harman* and *norharman* from 40-100 times the concentration found in fresh leaves, which is expressed in the smoke [0.00036-0.00058% *harman*, 0.00126-0.00141% *norharman*; one study found 207-2780ng β-carbolines per cigarette] (Herraiz 2004; Poindexter & Carpenter 1962), elevating plasma *norharman*-levels within 5-10 mins, and declining after 1hr (Breyer-Pfaff et al. 1996). Tobacco smoke also contains *harmine* and *harmaline* (Shulgin & Shulgin 1997), which may contribute to reported MAO-A inhibition. As well as *harman* and *norharman* [and many other compounds, largely resulting from chemical additives to commercial tobaccos], *anabasine*, N-methylanabasine, nicotinamide, β-nicotyrine, myosmine, 2,6-dimethylquinoline, pyridine, 2,2'-bipyridyl, hydrocyanic acid [HCN], ammonia, hydrogen sulphide, carbon monoxide and carbon dioxide have been found in cigarette-smoke condensate (Brown & Ahmad 1972; Watt & Breyer-Brandwijk 1962).

Nicotine is found in all parts of the plant, in *nicotine*-dominant species; leaves become more potent towards the apex, and at ripeness; stems contain less than 1/3 the amount of *nicotine* found in leaves; flowers less than 1/3 of that in stems; roots may yield more than twice as much as flowers. *Nicotine* is present in the fresh plant partly as a mixture of the glucosides tabacilin and tabacin [0.4-0.5%]. Tabacilin yields *nicotine* and glucose on hydrolysis; tabacin, when heated to around 110°C, breaks down into tabacol [a powerful convulsant poison], tabacinic acid and a sugar – tabacol yields *nicotine* on protracted heating with potassium hydroxide (Watt & Breyer-Brandwijk 1962).

N. attenuata leaves yielded 2.2269% alkaloids [98.4% *nicotine*, 0.8% each of *nornicotine* and anatabine and traces of *anabasine*]; roots yielded 0.2484% alkaloids [89.8% *nicotine*, 5.2% *nornicotine*, 5% anatabine, traces of *anabasine*].

N. benthamiana leaf has yielded 0.002-0.31% *nornicotine*, 0.29-0.48% *nicotine*, 0.0058% *anabasine* and 0.009% anatabine; roots yielded 0.26% *nicotine*, 0.005% *nornicotine*, 0.1% *anabasine* and 0.015% anatabine (Latz 1995; Saitoh et al. 1985; Webb 1948).

N. bigelovii leaves yielded 0.78% alkaloids [96.8% *nicotine*, 2.3% *nornicotine*, 0.9% anatabine, traces of *anabasine*]; roots yielded 0.22% alkaloids [91.7% *nicotine*, 4.9% *nornicotine*, 3.4% anatabine, traces of *anabasine*] (Saitoh et al. 1985).

N. cavicola leaf yielded 0.0285% alkaloids [76.9% *nornicotine*, 16.8% *nicotine*, 6.3% *anabasine*, traces of anatabine]; roots yielded 0.3798% alkaloids [58% *nicotine*, 25.4% *anabasine*, 9.1% *nornicotine*, 7.5% anatabine].

N. debneyi from e. Australia has yielded 0.113-0.4% *anabasine*, 0.076% *nicotine*, 0.0388% *nornicotine* and 0.0174% anatabine from the leaves; roots yielded 0.105% *nicotine*, 0.16% *anabasine*, 0.004% *nornicotine* and 0.0325% anatabine (Everist 1974; Saitoh et al. 1985; Webb 1948).

N. excelsior leaf has yielded 1.89% alkaloids [95.9% *nicotine*, 1.1% *nornicotine*, 0.9% *anabasine*, 2.1% anatabine]; roots yielded 0.477% alkaloids [66.5% *nicotine*, 1.4% *nornicotine*, 20% *anabasine*, 12.1% anatabine] (Saitoh et al. 1985; Shaw et al. comp. 1959).

N. glauca showed a rise in alkaloids, nitrogen, proteins and citric acid after clipping the tops. Leaf has yielded 0.3-1.3% *anabasine*, 0.11-0.9% *nicotine*, 0.013% *nornicotine*, 0.008% anatabine, 2% rutin, citric acid, oxalic acid, malic acid and succinic acid; roots yielded 0.629-1% *anabasine*, 0.186% *nicotine* [3.6% in fresh root], 0.147% *nornicotine* and 0.054% anatabine (Khmura 1938; Kovalenko 1934; Saitoh et al. 1985; Schermerhorn et al. ed. 1957-1974; Smith 1935; Watt & Breyer-Brandwijk 1962; Webb 1948). The coumarins *scopoletin* and aesculetin are found in the aerial parts [up to 0.00092% w/w] (Kala 1958).

N. glutinosa leaf has yielded 0.9309% alkaloids [90.7% *nornicotine*, 6% *nicotine*, 3% anatabine, 0.3% *anabasine*]; roots yielded 1.467% alkaloids [83% *nicotine*, 10.8% anatabine, 3.2% *nornicotine*, 3% *anabasine*] (Kovalenko 1934; Saitoh et al. 1985).

N. goodspeedii, which is widespread in parts of southern Australia (Haegi et al. 1982), has yielded 0.008% *nicotine* (Shaw et al. comp. 1959).

N. gossei leaf has yielded 0.96-1.2% *nicotine*, with traces of *nornicotine*, *anabasine* and anatabine; roots yielded 0.53% *nicotine*, 0.129% *anabasine*, 0.054% anatabine and 0.0065% *nornicotine* (Latz 1995; Peterson 1979; Saitoh et al. 1985). Earlier the plant was stated to contain "solely *nicotine*", in a yield of 1.1% (Webb 1948).

N. ingulba leaf has yielded 0.0669% alkaloids [44.8% *nornicotine*, 42.2% *anabasine*, 7.5% *nicotine*, 5.5% anatabine]; roots yielded 0.48% alkaloids [46.3% *nicotine*, 42.3% *anabasine*, 4.5% *nornicotine*, 6.9% anatabine].

N. megalosiphon from n.e. and c. Australia has yielded 0.013-0.22% *nornicotine*, 0.0126% *anabasine*, 0.0059% *nicotine* and traces of anatabine in the leaf; roots yielded 0.28% *nicotine*, 0.243% *anabasine*, 0.01% *nornicotine* and 0.022% anatabine (Saitoh et al. 1985; Webb 1948).

N. paniculata leaves yielded 0.71% *nicotine*, 0.13% *nornicotine*, 0.002% *anabasine* and 0.008% anatabine; roots yielded 0.42% *nicotine*, 0.4% *nornicotine*, 0.013% *anabasine* and 0.026% anatabine (Saitoh et al. 1985).

N. rustica leaf has yielded [0.18-]4.5-8.6% *nicotine*, 0.0069-0.48% *nornicotine*, 0.0085% *anabasine*, 0.012% anatabine, 0.66-0.89% rutin, 3.6-11.8% citric acid, *choline* and sucrose; root has yielded 0.688% *nicotine*, 0.014% *nornicotine*, 0.0557% *anabasine* and 0.085% anatabine (Steiner 1932; Watt & Breyer-Brandwijk 1962). The coumarins *scopoletin* and aesculetin are found in the aerial parts, though only *scopoletin* is found in the root [up to 0.001% w/w] (Kala 1958).

N. simulans leaf has yielded 0.0258% alkaloids [67% *nornicotine*, 19% *anabasine*, 14% *nicotine*, traces of anatabine]; roots yielded 0.66% alkaloids [45.1% *nicotine*, 44.3% *anabasine*, 6.4% *nornicotine*, 4.2% anatabine].

N. suaveolens leaf has yielded 0.4954% alkaloids [85% *nicotine*, 13.6% *nornicotine*, 0.9% *anabasine*, 0.5% anatabine]; roots yielded 0.6658% alkaloids [51.7% *nicotine*, 29% *anabasine*, 9.9% *nornicotine*, 9.4% anatabine] (Saitoh et al. 1985; Shaw et al. comp. 1959).

N. sylvestris leaf has yielded 2.96% alkaloids [80% *nicotine*, 19.1% *nornicotine*, 0.7% anatabine, 0.2% *anabasine*]; roots yielded 0.7864% alkaloids [89.9% *nicotine*, 6.3% *nornicotine*, 2.8% anatabine, 1% *anabasine*] (Kovalenko 1934; Saitoh et al. 1985); flowers also yielded rutin and kaempferol-3-rhamnoglucoside (Schermerhorn et al. ed. 1957-1974). *Scopoletin* was found in the leaf [0.0002% w/w] and root [0.0048% w/w] of a young plant (Kala 1958).

N. tabacum may yield c.0.05-2% *nicotine*, sometimes up to 6% or more; as well as 0.05-0.36% *nornicotine*, *anabasine*, N-methylanabasine, piperidine, pyrrolidine, N-methylpyrroline, 3-acetylpyridine, nicotinamide, nicotinic acid, nicotianine, orynicotine, nicoticine, nicotimine, nicotyrine, nicotoine, nicotelline, anatabine, N-methylanatabine, trimethylamine, myosine, *harman* [0.000002-0.00033%], *norharman* [0.000018-0.00123%], *tryptophan* [0.007-0.45% free, 0.3-0.9% protein-bound], *tryptamine* [0.000035% w/w], indoleacetic acid, 0.21% rutin, *chlorogenic acid*, caffeic acid, citric acid, succinic acid, fumaric acid, oxalic acid, malic acid, iso-hexoic acid, phthalic acid, caprylic acid, isoquercetin, isovaleric acid, *eugenol*, *pinene*, butyl alcohol ester, furfural, *glutamic acid*, *GABA*, *aspartic acid*, *glutamine*, asparagine, *scopoletin*, aesculetin, heptacosane, hentriacontane, scafatin, calcium chloride, fructose, pectin, tannin and mucilage (Kala 1958; Poindexter & Carpenter 1962; Schermerhorn et al. ed. 1957-1974; Schneider et al. 1972; Shaw et al. comp. 1959; Watt & Breyer-Brandwijk 1962). *Nicotine* content of the flower [of N. tabacum] in one test was as follows – flower axis 0.0254%, calyx 0.1435%, petal 0.0086%, ovary base 0.0156%, ovary 0.008%, stamen 0.0014% and stigma/style 0.0014%. Capsules of N. tabacum also yielded small amounts of *nicotine*; the calyx of immature capsules yielded 0.6% *nicotine*, as well as 0.0024%

nornicotine and 0.0015% *anabasine*, whilst the mature capsule calyx yielded only 0.26% *nicotine*. Seeds also contain traces of *nicotine*, possibly due to contamination from plant material (Saitoh et al. 1985).

N. trigonophylla leaf yielded 0.11% alkaloids [94.9% *nornicotine*, 3.3% anatabine, 1.8% *nicotine*, traces of *anabasine*]; roots yielded 1.4458% alkaloids [55.8% *nicotine*, 38.2% *nornicotine*, 5.6% anatabine, 0.4% *anabasine*] (Saitoh et al. 1985).

N. velutina from central Australia yielded 0.5276% alkaloids from the leaf [88.4% *nornicotine*, 8.1% *anabasine*, 2.8% *nicotine*, 0.7% anatabine]; roots yielded 2.4817% alkaloids [52.9% *nicotine*, 32.3% *anabasine*, 13.4% *nornicotine*, 1.4% anatabine] (Saitoh et al. 1985; Webb 1948). In one test, only 0.0012% *nicotine* was found, from unspecified parts (Shaw et al. comp. 1959).

Other high-alkaloid species include N. benavidesii [1.46% in root], N. cordifolia [1.34% in root], N. exigua [1.2% in root], N. fragrans [1.49% in leaf; 1.33% in root], N. maritima [1.4% in root], N. nesophila [1.06% in leaf; 1.4% in root], N. nudicaulis [1.1% in root], N. raimondii [1.58% in root], N. spegazzinii [1.2% in root] and N. stocktonii [1.1% in leaf; 1.2% in root] (Saitoh et al. 1985).

Nicotiana tabacum is an erect, glandular-pubescent annual (or short-lived perennial) herb. Leaves alternate, sessile (the lower clasping the stem, semi-amplexicaul and decurrent), large (to 30cm long or more), oblong-lanceolate to ovate, apex acuminate, base cuneate, softly hairy and sticky, tender. Flowers solitary or several in axils and in terminal panicle- or raceme-like inflorescences; flowers bisexual, actinomorphic; calyx tubular to narrowly campanulate, connate margins often thin and translucent, calyx-teeth lanceolate, acute; corolla tubular or salver-shaped, rosy pink or reddish, limb 5-lobed, lobes usually folded in bud; stamens 5, only 4 or so reaching throat of corolla-tube; anthers bilocular, dorsifixed, not cohering, dehiscing longitudinally. Ovary bilocular; stigma capitate. Fruit a smooth-walled capsule c.1.5cm long, surrounded by persistent calyx, dehiscing from apex by 4 valves; seeds many, dark-brown, reniform to C-shaped, often angled, finely honeycombed or wrinkled on surface (Chopra et al. 1965; Haegi et al. 1982; pers. obs.).

Native to Central & South America [may be a cultivated hybrid of species originating in eastern valleys of the Bolivian Andes] (Furst 1976); widely cultivated.

Growing medium affects the taste of the resultant tobacco when smoked. The Greeks use sheep or goat dung to manure the soil, and the tobacco is very pungent [some add 'repulsive' to that description]; when they use cow dung, however, the flavour is milder and more pleasant. These tobaccos [fertilised with dung] are considered more suitable for snuffing, and smoking tobacco is often best fertilised with vegetable matter-derived compost. Plants fertilised with pig dung are said to produce tobacco that smells of 'anise' [see **Pimpinella**] (Von Bibra 1855).

Seeds are sown in early spring, once frosts have passed; seedlings planted out in late spring; harvested late summer. Lateral shoots are usually removed as they appear. Requires a well-drained, fertile nitrogen-rich soil, with regular deep watering and full sun; grows easily (French 1964; pers. obs.). This plant is nutrient-hungry, and will rapidly strip soil of its fertility. Global tobacco cultivation is having a detrimental effect on the land, and it is recommended that personal tobacco crops, if grown, be minimal in size, and regularly refurbished with organic compost. The seeds can also easily spread when capsules ripen, and the surrounding area should be monitored for escaped seedlings (pers. obs.).

When reaching maturity, the top of the plant is cut off to create more abundant leaf growth, and side-shoots are removed. Mature leaves are either harvested individually, or the whole plant may be cut at the base. The material is allowed to wilt and turn yellow, before being hung and dried [not too dry – this is a matter of expertise] for 8-10 weeks in a dark, well-ventilated room. For even colouring, leaves must be harvested at the same state of maturity. Midribs of leaves are resistant to drying, and need to be monitored for rot. The leaves are then assembled into parcels and stacked for careful fermentation [which develops the characteristic tobacco smell, taste and colour], with turning to avoid rotting. They are later spread and cooled, and sometimes a second fermentation is performed. The leaves may later be 'sauced', or soaked in a concentrated syrup of molasses and other plant extracts [to add extra aroma, taste, body, and sometimes subjective potency], before being dried, shredded and slightly moistened, or even left whole and twisted into sticks. Commercial tobaccos are often a blend of different tobaccos, with a unique individual method of curing and sauce recipe [including synthetic chemicals as well as plant extracts and other natural products]. It should be noted that the curing process causes considerable loss [15-25%] of *nicotine* (French 1964; Garner 1951; Lehane 1977; Von Bibra 1855). Proper curing of tobacco can be difficult when working with very small quantities.

Or, you can just dry the leaves and smoke them, with less loss of *nicotine*. This is much simpler, though it doesn't smoke the same as fully cured tobacco, burning quicker and having less taste and harshness (pers. obs.). Also, the powdered tobacco snuffs used in Amazonia are generally made with green, uncured tobacco.

NYMPHAEA and NUPHAR

(Nymphaeaceae)

Nymphaea alba *L.* **(N. candida** *C. Presl.***; N. minoriflora** *(Simonk.) Wissjul.***; Castalia alba** *(L.) W. Wood.***; C. speciosa** *Salisb.***)** – white water lily, shining water lily, flower of chastity

Nymphaea ampla *(Salisb.) DC.* **(Castalia ampla** *Salisb.***)** – white water lily, precious water lily, quetzalxochiatl

Nymphaea caerulea *Savigny* **(N. caerulea** *Andrews***; N. calliantha** *Conard.***; N. capensis** *Thunb.***; N. discolor** *Lehm.***; N. maculata** *Schum. et Thonn.***; N. mildbraedii** *Gilg.***; N. nelsonii** *Burtt-Davy***; N. nouchali** *Burm. f.* **var. caerulea** *(Sav.) Verdc.***; N. poecila** *Lehm.***; N. spectabilis** *Gilg.***; N. stellata** *Willd.***; N. vernayi** *Bremek. et Oberm.***)** – blue water lily, Cape blue water lily, Egyptian lotus, sacred lily of the Nile, nénuphar bleu de ciel, djaberi djongel

Nymphaea lotus *L.* **(N. liberiensis** *A. Chev.***)** – Egyptian lotus, white lotus, white water lily

Nymphaea lutea *L.* **(Nuphar lutea** *(L.) Sm.***; Nu. luteum** *(L.) Sm.***)** – yellow pondlily, brandybottle, great root, 'seat of the bullfrog'

Nymphaea pubescens *Willd.* **(N. lotus var. pubescens** *(Willd.) Hook. f. et Thomson***; N. nouchali** *Burm. f.***)** – night lotus

Nymphaea pumila *(Timm.) Hoffm.* **(N. lutea var. minima** *Willd.***; N. lutea var. pumila** *Timm.***; Nuphar lutea ssp. pumila** *(Timm.) E.O. Beal***; Nu. lutea var. pumila** *Timm.***; Nu. minima** *(Willd.) Sm.***; Nu. pailum** *Sm.***; Nu. pumila** *(Timm.) DC.***; Nu. subpumila** *Miki***; Nu. tenella** *Rchb.***)** – dwarf dock

Nuphar japonica *DC.* – Japanese yellow water lily

Nuphar variegata *Durand* **(N. variegatum** *Engl.***; N. lutea ssp. variegata** *(Durand) E.O Beal***; Nymphozanthus variegatus** *(Durand) Fernald***)** – North American yellow water lily

Nymphaea spp. and Nuphar spp. – water lilies

The Greeks claimed that N. alba grew from a nymph who died of jealousy, and they dedicated water lilies to the nymphs – later leading to the generic designation Nymphaea (Rätsch 1992; Viljoen & Notten 2002). The Greeks added N. alba to their wine [see *Methods of Ingestion*] for its tranquillising and parasympathetic activity. In Mediaeval times, monks and nuns would consume the plant as an anaphrodisiac to help them remain chaste. The roasted seeds have also been used as a coffee substitute [see **Coffea**]. The flower used to be plucked at night with blocked ears to protect against bewitchment by water spirits; once obtained, it was worn as a love amulet (Chiej 1984; Rätsch 1992). In Sierra Leone, the rhizome is used as an anticonvulsant (Lebbie & Guries 1995). In early experiments on eels, mice and dogs, the rhizome produced a spasmolytic activity, followed by narcosis (Emboden 1979b). In one human psychonaut, a tincture of the fresh flowers acted as a pleasant narcotic sedative (theobromus pers. comm.). It has been found to have similar psychotropic properties to N. caerulea [see below], though less potent (Jones 2002).

N. ampla is depicted in many Mayan murals and carvings, often in association with toad motifs [see **Bufo**] in a context suggestive of ritual use. It is also associated with themes of death, entailing visits to the underworld and subsequent rebirth (De Rios 1974, 1990; Emboden 1979a, 1979b). Westerners have been observed in highland Chiapas, Mexico, harvesting N. ampla bulbs and stems for use as a psychotrope. The plant is also used as a cardiac sedative in Afghanistan (Diaz 1979; Ott 1993). The flowers of N. ampla and N. caerulea have been noted as being 'narcotic'. Species found in the Antilles [identity not reported] have been used for their flowers as an effective opium substitute [see **Papaver**] (Emboden 1979b).

N. caerulea was a symbol of death and rebirth to the ancient Egyptians, and was held sacred to Osiris, who was said to have been reincarnated as a blue water lily after his murder by Seth. A text called "Transformation into the Water Lily" [or alternately lotus – see **Nelumbo**] from the Egyptian Book of the Dead makes reference to a blue water lily associated with Ra and Hathor, and the pure light of the sun. The incantation discusses the desire of Ani to "transform himself into the sacred blue water lily so that his body might have new birth and ascend daily into heaven." N. caerulea is widely depicted in ancient Egyptian art and relics, usually with ritual significance. It is often depicted with **Mandragora**, **Papaver** and toads [see **Bufo**], and was sometimes worn as an amulet. The flowers were also found with the mummified remains of Ramses II, and some other mummies. The flowers are thought to have been used as a ritual entheogen by ancient Egyptian priests (Emboden 1979a, 1979b; Faulkner 1972; Rätsch 1992). Recently N. caerulea has been identified as the 'Tree of Life' depicted in many myths and art-works of the ancient Middle East (McDonald 2002), and it has been proposed as the identifty of 'soma' [see **Amanita**] (McDonald 2004). In Guinea, a decoction of the flowers is taken for its narcotic effects and in Tanganyika, a root decoction is taken with **Ipomoea** aquatica leaf sap to treat 'mental derangement' (Burkill 1985-1997). In Zimbabwe, N. caerulea is taken orally to 'arouse spirits' (De Smet 1998). A root and stem infusion is emollient and diuretic, and the seed may be used to treat diabetes (Watt & Breyer-Brandwijk 1962).

A decoction or wine-infusion of 3-10 unopened N. caerulea flower

buds has narcotic, anaphrodisiac, mildly euphoric and antitussive effects; with wine infusions, some have described the effects as empathogenic. Adding too much flower material to wine results in a mucilaginous and foul-tasting beverage, although the effects may be stronger (pers. comms.). One source recommends using 7g of flowers per bottle of wine. They have also been soaked in cranberry juice [1g flowers per cup of juice] and the juice drunk, which in one bioassay was more 'incapacitating' than a similar wine extract. A smokeable extract of the flowers is similarly active, and has cumulative effects if taken over an extended period. Cumulative effects presumably develop with oral administration, also. The flowers themselves may also be smoked. One person described cumulative entheogenic effects from smoking flowers of a pink variety of N. caerulea [as N. nouchali], followed a day later by smoked N. alba flowers [see above]; this occurred after over a year of previous sporadic experimentation with different water lilies. The experience "lasted for four days and I found myself at times coexisting in two complete and separate worlds simultaneously", and by the third day included "extreme physical joy and mental and spiritual amazement". He noted that introspection and lack of social distractions may enhance the perceived effects. These preparations seem more effective when combined with alcohol. It seems that all of these observations may be applied to other Nymphaea spp., according to the current record of experimentation (friendly pers. comm.; Jones 2002).

N. lotus was held in high esteem by the Egyptians [similarly to N. caerulea – see above], and the flowers were given to honoured guests. The Greeks, after arriving in Egypt and observing this custom, applied the name 'lotos' ['precious'] to this plant. The 'lotophagi' or 'lotus eaters' referred to in Homer's Odyssey are thought to have been eating fruits of **Ziziphus** rather than a **Nymphaea** or **Nelumbo** (Burkill 1985-1997). Others doubt this, believing the effects of members of these latter genera adequately fit the description of the effects given by Homer (Jones 2001).

Gambian women sometimes chew N. lotus roots as a kola nut substitute [see **Cola**]. In Tanganyika, the root is decocted for its tranquillising properties, to treat 'mental derangement'. The roots are decocted in Nigeria as a respiratory stimulant, sedative for coughs, and fever remedy. The tea may also relieve insomnia. The leaf sap, or a decoction of the leaves, has been used as a sedative to treat hysteria and 'mad' people. The roots, leaves, and flowers have narcotic sedative effects, though the flower receptacle, seeds and cooked root are used as food (Burkill 1985-1997). The seed is regarded as a tonic food (Watt & Breyer-Brandwijk 1962). The flowers have similar effects to those of N. caerulea, though generally less potent (Jones 2002).

The Iroquois drink a root decoction of N. variegata to divine the cause of harmful magic. They also use the plant as a charm against witchcraft and demons, in varying ways, though for these purposes it is usually not ingested. A Nymphaea sp. known as 'Irupé' is respected by the Guarani, who say that its scent can enchant a person. They named this plant after a woman who drowned herself when learning of her husband's death, later transforming into a water lily (Rätsch 1992). In the Philippines, juice of N. pubescens is rubbed on the forehead and temples as a soporific; it has astringent and mild narcotic properties (Perry & Metzger 1980).

Aboriginal peoples of n. Australia use the processed rhizomes, seeds, flowers and stems of Nymphaea spp. as food, and drink the flower nectar [too much of which causes headache]. The flowering stems may be eaten raw, often after the outer skin is peeled away. Tubers are eaten after boiling or roasting on hot coals; 2-3 of them may cure diarrhoea. The seeds are ground to make flour for damper, which is cooked between the leaves. To indigenous people of Arnhem Land, Northern Territory, the water lily is the morning star, and its stalk is its path across the sky. The spirits of the dead follow this star after death to be led to their resting place (Isaacs 1987; Low 1991a; Smith et al. 1993).

These plants contain aporphine, sesquiterpene, and indolizine-type alkaloids which presumably synergise to produce the desired effects (pers. obs.). In some animal experiments, overdose of Nymphaea alkaloids [which may act in part as respiratory excitants] has caused death due to 'lung poisoning' (Burkill 1985-1997).

Nymphaea alba root bulb has yielded nympheine and nupharine [spasmolytic hypotensive]; root and seed also yielded tannonymphaein, nymphaetannic acid, citric acid, oxalic acid, malic acid, fat and resin. Flowers also contain the cardioactive glycoside nymphalin (Bulajewski & Modrakowski 1937; Bures & Hoffmann 1934; Chiej 1984; Schermerhorn et al. ed. 1957-1974). An extract causes excitation in animals, but larger doses lead to respiratory paralysis (Rätsch 1992).

N. ampla flowers have yielded aporphine, nupharine and nupharidine (Emboden 1979a; Rätsch 1992).

N. caerulea was claimed to have yielded nupharine, nupharidine and *nuciferine* (Emboden 1979a), though I could find no primary reference for this. Flowers have yielded delphinidin-anthocyanin derivatives, and 7 flavonoids which are rhamnoside derivatives of myricetin, quercetin and kaempferol (Fossen et al. 1999), which has MAOI effects (Sloley et al. 2000).

N. lotus has been shown to contain nupharine, nupharidine, nympheine and nelombine (Burkill 1985-1997).

N. lutea rhizomes have yielded nupharine, α-nupharidine [deoxynupharidine; tonic, hypertensive], β-nupharidine and nupharolutine [an isomer of nupharidine and castoramine]. Seed also contains nupharine; flower contains nymphalin and carotenoids. The plant has also yielded nuphacristine, and a great number of nupharidine-derivatives. A plant extract has anaphrodisiac effects (Achmatowicz & Mollowna 1940; Bulajewski & Modrakowski 1937; Cybulski & Wróbel 1989; Harborne & Baxter ed. 1993; Rätsch 1992; Schermerhorn et al. ed. 1957-1974; Wróbel et al. 1972). In one human psychonaut, a tincture of the fresh flowers had pleasant narcotic sedative effects (theobromus pers. comm.).

N. pumila rhizomes yielded 0.5% alkaloids, including (+)-nupharidine, (+)-7-epi-nupharidine, (-)-deoxynupharidine, (-)-7-epi-deoxynupharidine and traces of (+)-nupharopumiline [0.15% of total alkaloids], a new alkaloid (Peura & Lounasmaa 1977).

Nuphar japonica rhizomes have yielded anhydronupharamine (Forrest & Ray 1971); seco-dihydrocastoramine has also been found in the plant (Cybulski & Wróbel 1989).

N. variegata rhizomes have yielded 2.2% crude bases, containing the piperidine alkaloids nuphenine, 3-epinuphamine and 3-epinupharamine (Forrest & Ray 1971).

Nymphaea caerulea is a stout or weak aquatic herb with floating leaves; rhizome tuberous, thick, ovoid, 25-75mm long, 20-65mm thick, brownish. Leaves 8-30cm long, 6-28(-40)cm diam., oval, suborbicular or elliptic, coriaceous, base narrowly peltate, lobes obtuse or acute, divergent, nearly closed or overlapping, cleft nearly to centre where petiole is attached, margin entire or slightly undulate towards base, involute, incised-cordate, upper surface green, smooth, shiny, undersurface green, often speckled with crimson spots, particularly where bordering the margin, nervation raised or flat, primary lateral nerves 5-8(-10) on each side of midrib, 4-5 pairs of secondary nerves; petiole 30-50cm long or more, depending on water depth. Flowers sky-blue or pink to white, 6-20cm diam., broad, solitary, conical in bud; sepals 4, thick, not very different to petals, normally 4.3-8 x 1.1-2.5cm, lanceolate, or oblong-ovate to oblong-lanceolate, green externally, white to blue internally, sometimes marked with dark purple or reddish lines or dots, sometimes with reddish purple margins; petals 12-24, as long as sepals, lanceolate, oblong-lanceolate, obtuse or acute, some outer ones occasionally sepaloid, light blue above, whitening below (sometimes with colour variants of white, mauve or pink); stamens (30-)50-75(-100 or more?), bright golden yellow, externals broad, centrals short and narrow; anthers long-acuminate, in 2 parallel rows, terminating in connective, bluish, central stamens with broader anthers. Ovary almost hemispherical, of 14-21(-24) carpels; style short. Fruit depressed-globose, up to 4-6cm broad, 25-35mm high, truncated above; seeds numerous, very small, ellipsoid, ornate, with 17 longitudinal lines of very short hairs. Fl. spring to late summer. Dormant in winter.

In water; Egypt, widespread in tropical Africa and Transvaal (Berhaut 1979; Exell et al. ed. 1960-1993; Viljoen & Notten 2002).

This species should not be confused with N. caerulea *G. et Perr.*, which is also known as N. micrantha (Berhaut 1979).

It is worth noting that there is not universal agreement on the synonymy of Nymphaea lutea with Nuphar lutea, and Nymphaea pumila with Nuphar pumila (theobromus pers. comm.). Due also to variation in flower colour and growth forms, the taxonomy of water lilies is in a state of ever-changing confusion (Viljoen & Notten 2002).

Water lilies can be cultivated from division of the rhizomes in early spring, using pieces with budding leaf growth. Either plant in the bottom of a pond in a 15cm-deep mix of sand and compost, or grow in a pot sitting in the pond; top off with sand and pebbles. They require at least 30cm water depth, and full sun; they do not like quickly moving water or wind, and should not be planted near fountains. N. caerulea tolerates temperatures as low as -1(to -4)°C. Plants with developed leaves should be planted at a depth appropriate to petiole length, and later adapted to greater depths. Soil should be regularly enriched with organic fertiliser or compost, in non-natural settings; in natural stands, this is not needed due to natural accumulation of humus at the pond floor.

Seed may be difficult to collect before they disperse into the water, after the sudden bursting of the seed pods; a muslin bag may be tied over the ripening pods to ensure seed collection. Cultivate from seed spring to summer, in finely sieved loam soil low or deficient in organic matter; sow thinly, cover with a thin layer of soil, and submerge in water up to 2.5cm deep, in a sunny spot. Seeds should germinate within 3-4 weeks; prick out and repot in deeper water after the first several floating leaves appear (Viljoen & Notten 2002).

OCHROSIA

(Apocynaceae)

Ochrosia moorei *(F. Muell.) F. Muell. ex Benth.* **(Bleekeria moorei** *(F. Muell.) Koidz.***; Lactaria moorei** *F. Muell.***)**

Ochrosia nakaiana *Koidz* – yorodo

Ochrosia poweri *F.M. Bailey* **(O. newelliana** *F.M. Bailey***; Neisosperma poweri** *(F.M. Bailey) Fosberg et Sachet***)** – milkbush, red boat tree

The above plants yield an interesting array of indole alkaloids, though I am not aware of any ethnobotanical uses. In n.e. Australia, bark of O. elliptica ['Ochrosia plum'] has been used to treat malaria (Lassak & McCarthy 1990). O. borbonica is used medicinally in Reunion and Vietnam – its bark ['quinquina du paya'] treats fevers, and the leaves are used as a general tonic. In Java, a root decoction of O. oppositifolia treats stomach pain and seafood poisoning (Usher 1974).

O. elliptica bark and fruit from Cardwell, Queensland [Australia], harvested in August, tested strongly positive for alkaloids (Webb 1949).

O. moorei trunk bark has yielded 0.93% alkaloids, consisting of ellipticine, tetrahydroalstonine, reserpinine, reserpiline [elliptamine], rauvoxine, ochropposine, ochropposinine, ochrolifuanine and many other alkaloids; the plant has also yielded dihydrocorynantheol, 10,11-dimethoxy-*ajmalicine* and many other alkaloids from unspecified parts (Ahond et al. 1981; Buckingham et al. ed. 1994; CSIRO 1990).

O. nakaiana bark has yielded 0.38% alkaloids, consisting of *harman*, *vobasine*, reserpiline, *akuammidine*, venoterpine, serpentine chloride, and 10-MeO-corynantheol β-N-metho salt (Sakai et al. 1974); leaves have yielded 0.047% bornesitol (Nishibe et al. 1971a).

O. poweri bark has yielded isoreserpiline, ochropine and ochropamine; leaf has yielded *reserpine*, reserpiline, isoreserpiline, powerine, poweridine and poweramine (CSIRO 1990). Leaf, stem and bark from Queensland have all tested strongly-positive for alkaloids (Webb 1949).

Many of these alkaloids possess hypotensive and tranquillising properties, and some possess antitumour activity (CSIRO 1990). See also **Alstonia**, **Rauwolfia**, **Tabernaemontana** and **Vinca**.

Ochrosia poweri is a glabrous shrub or tree to 9m tall, with milky latex; terminal buds enclosed in a firm yellow gum. Leaves opposite or in whorls of 3, oblanceolate to obovate or elliptic, 6-14 x 2-5cm, apex mucronate or short-acuminate, gradually tapered to base, upper surface dark green and glossy, lower surface paler green; venation more prominent on upper surface, secondary veins 12-18 pairs, intramarginal vein present; petiole 2-10mm long. Flowers white, scented, in cymes, glands absent; corolla with a narrow, cylindrical tube c.7mm long, lobes c.5mm long, overlapping to the left in bud; stamens enclosed in tube, free from style head. Carpels free except for style; ovules few. Fruit a pair of bright red [in northern Australia; fruits on plants in n. NSW and s.e. Qld are bright yellow-orange] glossy drupes, sometimes only 1 developing, ellipsoid to ovoid, 2.5-4(-6 or more)cm x 12-16mm, apex pointed, endocarp thick, hard, nearly smooth; seed 1, flattened. Fl. autumn.

Subtropical rainforest, rare; north-central NSW, Queensland [Australia] (Harden ed. 1990-1993; comments in square parentheses are from observations of living plants communicated by Torsten 2001).

OCIMUM

(Labiatae/Lamiaceae)

Ocimum basilicum *L.* – basil, sweet basil, garden basil, tulsi, hsun ts'ao, lo le, babul, ajagandhika, albacar

Ocimum gratissimum *L.* **(O. frutescens** *L.***; O. guineense** *Schumach. et Thonn.***; O. viride** *Willd.***; Melissa cretica** *Lour.***; M. maxima** *Ard.***; Mentha perilloides** *Lam.***; Perilla avium** *Dunn***; P. frutescens** *(L.) Br.* **var. frutescens; P. ocymoides** *L.***; P. urticaefolia** *Salisb.***; Salvia infuscata** *Epling***)** – shrubby basil, vantulasi, ramtulasi

Ocimum micranthum *Willd.* **(O. campechianum** *Mill.***)** – pichanga, abaca, albahaca, iroro, fweroro

Ocimum sanctum *L.* – tulasi, sacred basil, sacred balm

Ocimum spp. are best known for O. basilicum, the common basil popularly used as a cooking herb, of which there are many varieties available commercially. O. basilicum and O. sanctum are native to India, and are esteemed there as sacred plants associated with Vishnu. Basil is said to have grown from one of Krishna's lovers. The Brahmans offer O. sanctum to Shiva and Vishnu, and Nepalese Vishnuites consider it to be an incarnation of Lakshmi, the Hindu goddess of love and luck. It is often planted around temples for its power to repel evil spirits and to heal, as well as being used magically to affect love and empathy. Wearing beaded segments of O. sanctum trunk around the neck apparently "induces religious tendency and longevity". It is so revered, that in some parts of India the plant is used in court to swear oaths on! Furthermore, basil [O. basilicum] was said to be found growing around Christ's tomb after the resurrection, and some Greek Orthodox churches use it to prepare their holy water [the name 'basil' comes from the Greek word for King]. Also in India, the seeds of O. basilicum are used as an aphrodisiac, in doses of 2-5.5g, and roots of O. sanctum are consumed as a nerve tonic. Many other Indian Ocimum spp., including O. gratissimum, are considered stimulants (Bremness 1988; Cunningham 1994; Kirtikar & Basu 1980; Nadkarni 1976; Rätsch 1992).

In Indo-China, the seeds of O. basilicum are taken as a sedative and antipyretic tea. Seeds of O. sanctum are used in similar ways in the Malay Peninsula, and in Indonesia, O. sanctum leaves are used in baths as a sedative, nervine and antipyretic (Perry & Metzger 1980). Indigenous people in Queensland, Australia, have been reported to drink an infusion of O. sanctum leaves as a tonic, for fevers and sickness (Webb 1948). In New Britain, Papua New Guinea, O. basilicum is used in rain magic (Paijmans ed. 1976). In Monterrey, Mexico, O. basilicum leaf and stem are infused as a sedative, calmative, stomachic and headache treatment (Nicholson & Arzeni 1993).

O. micranthum is used in Mexico as an analgesic and pediatric treatment. In Guatemala, it is decocted as an analgesic and anthelmintic, and in the s.w. Amazon Basin, it is used by the Sharanahua and Culina as an ayahuasca additive [see **Banisteriopsis**] (McKenna et al. 1995; Ott 1993; Pinkley 1969; Schultes 1972). In Peru, it is prepared with **Dictyoloma** peruvianum and given to decrease sexual desire in women. It is also used to make rattles ['schacapas'] which are shaken in the dark during ayahuasca ceremonies to heal, and to stimulate visions (Luna & Amaringo 1991).

O. basilicum is slightly stupefying, antibacterial, anthelmintic, stomachic, carminative, galactagogic and mosquito repellant. In India it is considered rejuvenating, antipyretic, diaphoretic, expectorant and blood-purifying; it is also sometimes used as a tonic and aphrodisiac, and stimulates the adrenal cortex (Bremness 1994; Chiej 1984; Kirtikar & Basu 1980; Polunin & Robbins 1992; Rätsch 1992). O. sanctum has shown analgesic, anti-inflammatory, antipyretic, antioxidant (Godhwani et al. 1987; Kelm et al. 2000), and anti-carcinogenic activity in animals (Aruna & Sivaramakrishnan 1992). An ethanol extract of the leaves was psychoactive in mice, and appeared to affect *dopamine* receptors (Sakina et al. 1990).

O. basilicum may yield c.0.25% essential oil from leaves, and c.1.5% from flowering tops, consisting of 23-86% *estragole*, 0.74-5.9% *eugenol*, *anethole*, *methyleugenol*, *safrole*, 0.37-1.43% *camphor*, and small amounts of *pinene*, camphene, myrcene, limonene, ocimene, linalool, terpineol, citronellol, geraniol, methyl cinnamate, p-MeO-cinnamaldehyde, p-MeO-benzaldehyde, bornyl acetate, thymol, dipentene, cymene, cineol, *borneol*, fenchol and sambulene; plant also contains vitamins A & C. The oil of the whole plant is predominantly *estragole*, and the oil from the flower spikes is predominantly linalool (Battaglia 1995; Bruneton 1995; Chiej 1984; Pogany et al. 1970; Polunin & Robbins 1992; Rastogi & Mehrotra ed. 1990-1993; Schermerhorn et al. ed. 1957-1974). Today, the chemistry of O. basilicum has become more complicated due to the development of a great variety of cultivars bearing different essential oil profiles.

O. gratissimum exists in methylcinnamate- and *eugenol*-dominant chemotypes; essential oil has also yielded *estragole*, carvacrol and thymol, though strains bearing *eugenol* do not seem to contain carvacrol or thymol, and vice versa (Bos et al. 1983; Fun & Svendsen 1991; Nadkarni 1976).

O. sanctum essential oil has yielded 71% *eugenol*, *eugenol* methyl ether, *estragole*, cineole, linalool, caryophyllene, carvacrol and methyl homoanisic acid (Perry & Metzger 1980; Webb 1948); aerial parts have also yielded cirsilineol, cirsimaritin, isothymonin, isothymusin, *apigenin*, luteolin, vicenin-2, vitexin, orientin, aesculin, aesculetin [see **Aesculus**], rosmarinic acid, *chlorogenic acid* and caffeic acid (Kelm et al. 2000; Skaltsa et al. 1999). Herbage harvested in April from Rockhampton [Queensland, Australia] tested positive for alkaloids (Webb 1949).

Ocimum basilicum is a strongly-scented erect branching herb, 60-90cm tall, glabrous or +- hispidly pubescent; stems and branches green or sometimes purplish. Leaves 2.5-5cm or more long, ovate, acute, entire or +- toothed, base cuneate, entire, petiole 1.3-2.5cm long. Flowers small, in 6-10-flowered whorls in dense racemes, the terminal raceme usually much longer than the lateral ones; pedicels with recurved tips; bracts small, caducous, stalked, shorter than calyx, ovate, acute; calyx 5mm, enlarged in fruit, very shortly pedicelled, ovoid or campanulate, 2-lipped, upper lip broad, flat, decurrent, erect in fruit, lower lip usually with 4 mucronate teeth, the 2 middle the largest; corolla 2-lipped, 8-13mm long, white, pink or purplish, glabrous or variously pubescent, tube short, not annulate within, upper lip subequally 4-fid, lower lip hardly longer than upper, declinate, entire, flat or nearly so; stamens 4, slightly exserted, upper filaments toothed at base; anther cells confluent. Ovary 4-partite; disc entire or 3-4-lobed; style lobes subulate or flattened. Nutlets 4, c.2mm long, ellipsoid, black and pitted.

Indigenous on lower hills of the Punjab; cultivated in India, Ceylon, Burma, and throughout much of the world (Kirtikar & Basu 1980).

Greenhouse-grown O. basilicum benefits from UV-B light supplementation [UV-B is virtually absent in greenhouse light], which increases phenylpropenoid levels [especially of *eugenol*] in the leaf, as well as levels of the terpenoids; in younger plants, only the phenylpropenes were increased (Johnson et al. 1999).

OLMEDIOPEREBEA

(Moraceae)

Olmedioperebea sclerophylla *Ducke* **(Maquira sclerophylla** *(Ducke) Berg***; Perebea xinguana** *Standl.***)** – rape dos Indios, Indian snuff

The bark, and sometimes fruits of this gigantic tree were once used in central Brazil by indigenous people of the Pariana area, to manufacture a snuff that presumably had psychoactive properties. Little else is known of it, but for a modern test, where a bark extract injected [i.p.] in rats produced "*amphetamine*-like" CNS-stimulation, followed by "motor incoordination, decreased exploratory activity, ataxia and muscle relaxation"; effects lasted c.30 minutes. No oral activity was observed (De Carvalho & Lapa 1990; Schultes 1967b).

O. sclerophylla bark contains cardenolides, steroids, phenols and terpenes, but no alkaloids were found (De Carvalho & Lapa 1990).

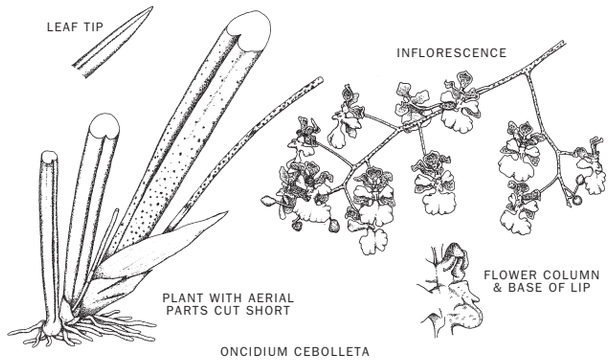
The related Maquira calophylla has caustic latex, and its bark contains furocoumarins (Schultes & Raffauf 1990).

Olmedioperebea sclerophylla is a tall tree 25-35m, monoecious or dioecious, lacticiferous, shedding leaves at end of rainy season; stems puberulent. Leaves coriaceous or chartaceous, elliptic-lanceolate, apex acuminate, base obtuse, 13-38 x 5-16cm, glabrescent above, scabridulous beneath, margin revolute, veins prominent, in 13-20 pairs; petioles 8-25mm long; stipules caducous. Staminate inflorescences up to 4 together, discoidal to subglobose, 3-12mm diam.; involucre with ovate, acute bract in 3-5 series; peduncles 1.5cm long, pilose; flowers free or basally connate; perianth c.2mm long, 4-lobed; stamens 3-6; anthers extrorse. Pistillate inflorescences solitary or with 1-2 staminate inflorescences, subsessile or pedunculate; peduncle 6-8mm long; involucre with reniform to ovate, acute or obtuse bracts in 3 series; flowers single and free or 2-4 basally connate; perianth 4-lobed; ovary inferior; stigmas 2, short, thick. Fruiting perianth usually globose, c.20mm high, 30-35mm long, puberulous.

In forests above flood level; lower Amazon of Brazil, north to Surinam (Off. Graphicas 1922; Schultes & Hofmann 1980).

ONCIDIUM

(Orchidaceae)



Oncidium cebolleta *(Jacq.) Sw.* **(O. brachyphyllum** *Lindl.***; O. cepula** *Hoffmanns.***; O. glaziovii** *Cogn.***; O. humboldtii** *Schltr.***; O. juncifolium** *(L.) Lindl.***; O. longifolium** *Lindl.***; O. sprucei** *Lindl.***; O. wittii** *Oppenheim***; Cohniella cebolleta** *(Jacq.) Christenson***; Cymbidium juncifolium** *(L.) Willd.***; Trichocentrum cebolleta** *(Jacq.) Chase et Williams***)** – cebolleta

This epiphytic orchid is considered to be a companion to [or substitute for] 'peyote' by the Tarahumara of n. Mexico, when **Lophophora williamsii** is not available. It is prepared by crushing the whole, fresh leaf in water, and this infusion is consumed. It may also be used as an external application to treat contusions and bone fractures; in this case, it is crushed with salt before application (Bye 1979b; Stermitz et al. 1983). It is not known whether the plant also has psychotropic effects as has been presumed, or if it simply serves as a medicinal substitute for peyote (pers. obs.). It has been claimed in recent horticultural literature that the seed pods "have potent psychotropic powers" (Banks & Perkins 2005), though the origin and accuracy of this information is unclear. The Huastec Maya of Mexico use O. carthagenense to treat headaches, and the Kofan of Colombia and Ecuador use O. pusillum as a topical antiseptic for cuts (Ott 1993; Schultes & Raffauf 1990).

O. cebolleta has yielded 0.006% 2,7-dihydroxy-3,4,6-trimethoxyphenanthrene, 0.0035% 2,7-dihydroxy-3,4,6-trimethoxy-9,10-dihydrophenanthrene, 0.014% 2,3-dihydroxy-4,7,8-trimethoxyphenanthrene, 0.0088% 2,7-dihydroxy-4,8-dimethoxyphenanthrene, 2,7-dihydroxy-3,4-dimethoxyphenanthrene (Stermitz et al. 1983), 1,5-dimethoxy-2,7-phenanthrenediol and nudol (Buckingham et al. ed. 1994). Some phenanthrenes produce sedation in rats, induce compulsive gnawing in mice, and pecking and emesis in pigeons (Castedo & Tojo 1990).

In an alkaloid screening, O. ansiferum, O. asparagoides, O. cheirophorum, O. globuliferum and O. warscewiczii were found to contain alkaloids; none were detected in O. cababrae, O. heteranthum, O. panduriforme, O. powellii, O. pulchellum or O. varicosum (Lüning 1967).

Oncidium cebolleta is a rhizomatous epiphyte, with pseudobulbs 1.5-2cm, conical to almost spherical, each with 1 leaf; sheaths enveloping pseudobulbs all leaf-bearing. Leaves terete, fleshy, 7-40cm, slightly grooved, erect, often tinged or spotted with purple, folded when young. Flowers numerous in a panicle to 1.2m, stalk spotted with purple; sepals 6-10mm, obovate, greenish-yellow with red-brown spots, not fleshy, usually spreading and clawed, lateral sepals free or variably united at base; petals similar to sepals, margins wavy, lip 3-lobed, with lateral lobes rather large, oblong or obovate, central lobe larger than sepals, shortly clawed, kidney-shaped, deeply notched at apex, yellow, callus consisting of a sharp projecting ridge surrounded by tubercles; column with a fleshy plate below the stigma, but without a foot, and with distinct oblong, sometimes 2-lobed, auricles on either side; rostellum short or beaked; pollinia 2, ovoid to spherical, stipe linear, longer than pollinia, viscidium small, making acute angle with stipe. Fl. spring.

Tropical America, from Mexico and West Indies to n. Argentina (Cullen ed. 1992; Dunsterville & Garay 1979). Slow growing; can be propagated by division, mounted on cork blocks or something similar. Enjoys lots of light, but not necessarily much full sun; prefers winter min. 16°C. Water regularly (Banks & Perkins 2005).

OPLOPANAX

(Araliaceae)

Oplopanax horridus *(J.E. Smith) Miq.* **(Echinopanax horridum** *(Sm.) Decne. et Planch.***; Fatsia horrida** *(Sm.) Benth. et Hook. f.***; Panax horridum** *Sm.***)** – devil's club, Alaskan ginseng

Oplopanax japonicum *(Nakai) Nakai* - haribuki, jigoku bara

The juice from the roots or bark of this plant was once used as the sole intoxicant of Tlingit shamans, who consumed it to receive dream visions and "magical powers of great strength". It was also said to increase the ability of the shaman to hypnotise and control others. To the Tlingit, it is said to be the "most important medicinal and magical plant of all", and they also use it as an emetic, purgative and poultice. The Eyak have also used the plant 'ceremonially', and elsewhere in Alaska it has been applied externally as a "prophylactic against witchcraft". The inner bark and root have been used to treat skin infections, burns, rheumatism, diabetes, tuberculosis, colds, sore throats, headaches, constipation and lung haemorrhages (Kobaisy et al. 1997; Lipp 1995; Smith 1983). One psychonaut who investigated the psychoactive effects of the plant reported that it gave him "a noticeable sedative buzz" (Hoodoo pers. comm. 2001). Young shoots and peeled roots are apparently eaten as a survival food in the Pacific Northwest. In rural Japan, leaves and stems of O. japonicum are boiled to make a mildly stimulant tea, which also treats colds (Brussell 2004).

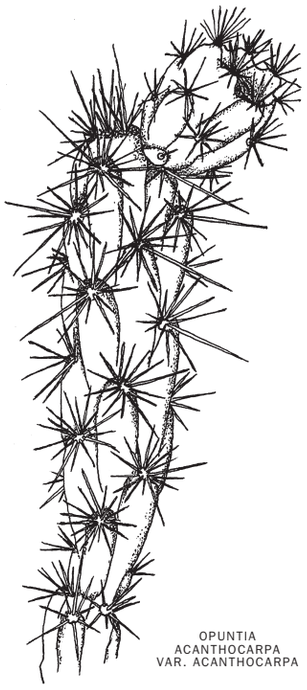
O. horridus inner stem bark has yielded 1.3% falcarindiol, 1.12% oplopandiol, 0.65% oplopandiol acetate, 1.6% 9,17-octadecadiene-12,14-diyne-1,11,16-triol,1-acetate and falcarinol (Kobaisy et al. 1997); root bark has yielded the sesquiterpenes trans-nerolidol [major component; nerolidol is sedative and spasmolytic in mice], α-cubebene, oplopanone [antipyretic, antitussive] and spathulenol, as well as stearic acid, stigmasterol [antirheumatic], β-sitosterol [anticholesteremic], lignan 1,3-benzodioxole, and 5,5'-tetrahydro-1H,3H-furo[3,4-c]furan-1,4-diyl)bis [original reference made it unclear whether these last two compounds were actually meant to go together as the name of a single compound; an opening bracket was also not included in the name]. Extracts of the inner bark may have antipyretic, antitussive, antibacterial and hypoglycaemic activity; extracts from unspecified parts showed antifungal and antimicrobial activity (Bloxton et al. 2002); the root extract also shows hypoglycaemic activity. Severe hypoglycaemia can lead to convulsions and a state of unconsciousness "in which meaningful dreams may be experienced", though it is uncertain as to whether this is the pharmacological cause of the intoxication (Lipp 1995; Smith 1983).

Oplopanax horridus is a spiny shrub 1-3m tall, densely spiny on stem, petioles and leaf veins. Leaves long-petioled, nearly rotund in general outline, 5-7-lobed, up to 35cm long and wide, cordate at base, lobes acuminate or cuspidate, serrate. Inflorescence numerous crowded, head-like umbels in ample terminal racemes; calyx small, its limb truncate to denticulate; petals 5, valvate or scarcely imbricate, usually distinct, deciduous at maturity; stamens 5, inserted on disc within calyx; anthers short, longitudinally dehiscent. Ovary inferior, 2-celled, with 1 anatropous pendulous ovule in each cell; styles 2, separate to the base. Fruit a berry or leathery drupe. Fl. Jun.

In wet woods and ravines, forming almost impenetrable thickets; Isle Royal, Michigan, Alaska to Montana and Oregon (Gleason 1952; Smith 1983).

OPUNTIA

(Cactaceae)


OPUNTIA
ACANTHOCARPA
VAR. ACANTHOCARPA

Opuntia acanthocarpa *Engelmann et Bigelow* **(O. thornberi** *Thornber et Bonker***; Cylindropuntia acanthocarpa** *(Engel. et Big.) F. Knuth***)** – buckthorn cholla, major cholla

Opuntia basilaris *Engel. et Big.* **(O. basilaria** *Engel. et Big.* [incorrect spelling]**; O. intricata** *Griffiths***; O. whitneyana** *Baxter***)** – beavertail cactus, wo-gay-be, nah-vombi, devil's rope

Opuntia brasiliensis *(Willdenow) Haworth* **(O. argentina** *Grisebach***; O. bahiensis** *Britton et Rose***; O. neoargentina** *(Backeberg) Rowley***; O. schulzii** *Castellanos et Lelong***; Brasiliopuntia bahiensis** *(Br. et R.) Berger***; B. brasiliensis** *(Willd.) Berg.***; B. neoargentina** *Backeb.***; B. schulzii** *(Castell. et Lel.) Backeb.***; B. subacarpa** *Rizzini et Mattos***)** – Brazilian cactus, cha'i [?], tchai [?]

Opuntia echinocarpa *Engel. et Big.* **(O. deserta** *Griff.***; Cylindropuntia echinocarpa** *(Engel. et Big.) F. Knuth***)** – silver cholla, golden cholla

Opuntia ficus-indica *(L.) Miller* **(O. cordobensis** *Spegazzini***; O. ficus-barbarica** *Berger***; O. tuna-blanca** *Speg.***; O. vulgaris** *Mill.***; Platyopuntia cordobensis** *(Speg.) Ritter***)** – Indian fig, Barbary fig, common prickly pear, mission cactus, chumbera, penca, barshoom, raquette, tunas

Opuntia imbricata *(Haworth) DC.* **(O. decipiens** *DC.***; O. magna** *Griff.***; O. spinotecta** *Griff.***; O. vexans** *Griff.***; Cylindropuntia imbricata** *(Haw.) F. Knuth***)** – cane cholla, tree cholla, coyonostli

Opuntia leptocaulis *DC.* **(O. ramulifera** *Salm-Dyck***; Cylindropuntia brittonii** *(J.G. Ortega) Backeb.***; C. leptocaulis** *(DC.) F. Knuth***)** – Christmas cholla, desert Christmas cactus, jumping cactus, coyote cactus, pencil cholla, turkey pear, tasajillo

Opuntia spinosior *(Engel.) Toumey ex Bailey* **(O. whipplei var. spinosior** *Engelm.***; Cylindropuntia spinosior** *(Engelm.) F. Knuth***;** sometimes traded commercially as **O. arborescens var. spinosior)** – cane cholla

A vessel retrieved from an archaeological site in northern Peru [c.500AD] depicts male and female jaguars [a well-known shamanic animal in Central and South America] with dilated pupils, in association with what appears to be enema paraphernalia adorned with Opuntia sp. pads (Trout & Friends 1999); the implications are interesting to say the least!

The Sharanahua of the Peruvian Amazon cultivate an unidentified Opuntia sp., called 'cha'i' or 'tchai' [see also **Lygodium**], which they obtained from the nearby Amahuaca. It has been added to ayahuasca [see **Banisteriopsis**]; the resultant combination was reported to be "very strong and is never used medicinally" (Rivier & Lindgren 1972; Schultes 1972). Sometimes it was consumed before drinking ayahuasca, in order to "increase the hallucinations" (Harner in Stuart 2002b). It is rarely used today with ayahuasca, as it was considered to be "too intense", but the raw juice of the cactus is still used alone, purportedly as an entheogen, by some amongst the Amahuaca and Shipibo. Although it has not yet been properly identified, it is similar in appearance to O. brasiliensis (Stuart 2002a, 2002b; Trout & Friends 1999), and is reported to bloom in the wild between mid-May and mid-July with blue and white flowers. Three varieties of tchai are recognised – large, medium, and small – although it is still not known whether these represent different species. The large variety is considered the most potent medicinally; one Shipibo man claimed that it "was only used by brujos for sorcery, although with special precautions it might also be used by a curandero for healing". The smaller varieties are considered either less useful medicinally, or useless; others regard all Opuntia spp. with pads as having similar medicinal properties [eg. externally for wounds, internally for rheumatism, stomach ache, diarrhoea, body aches] (Stuart 2002a).

A closer investigation of the presumed psychoactivity of this plant resulted in R. Stuart keeping a diet prescribed by a Shipibo shaman and consuming tchai prepared by the shaman over four nights, in an attempt to meet the 'mother spirit' of the plant. The initial dose was 2 branch pads, going up by 2 pads each night to culminate in a final dose of 8 pads. Each dose was prepared by mashing the pads to a pulp with a smooth stone, mixing the pulp with water and a "large pinch of tobacco" [see **Nicotiana**], blowing tobacco smoke and singing over the brew, and drinking it cold. Although some doses resulted in vomiting or strange bodily sensations, perhaps attributable to the tobacco present, no definite psychoactivity was perceived. A later bioassay, which involved consuming the green pulp of 18 pads [c.77g] with ¾ tsp **Peganum** harmala seeds after having fasted for 24hrs, also resulted in no psychoactivity (Stuart 2002a, 2002b).

The fruits of O. leptocaulis are "known among the Spanish-Americans as tasajulla and garrambulo", and are added to 'tulbai', a chicha-like corn-based beverage [see *Methods of Ingestion*]. The berries are said to be narcotic on their own, with a single fruit claimed to "make one 'drunk and dizzy'", though cactophiles who have eaten the fruits based on this report did not experience any psychoactive effects (Smith 2000). It has been suggested that an alcohol tincture might be more effective (theobromus pers. comm.).

The Zuni of N. America grind O. imbricata under their armpits during warrior initiation (Benson 1982). The Hopi drink a decoction of O. whipplei roots with globe mallow to treat diarrhoea. The Navajo, and some Californian tribes, apply the peeled stems of Opuntia spp. to skin disorders (Winter 1998). A number of Opuntia spp. have been applied to treat cancerous tumours in the Americas, including O. ficus-indica, O. moniliformis and O. pseudo-tuna (Hartwell 1968). In Spain, O. ficus-indica stem ['palas'] is heated and applied externally for pain and respiratory problems; the flower is infused to treat diarrhoea (Martinez-Lirola et al. 1996). In S. Africa, this species is used as a host to rear the 'cochineal beetle' [Dactylopius coccus]; this is also a practice in Peru and the Canary Islands (Brutsch & Zimmermann 1993). Several tribes in the Golden Triangle of n. Thailand cultivate O. dillenii in their villages to ward off evil spirits (Anderson 1993).

From Australia, there has been an unsubstantiated report of indigenous people near Tennant Creek [NSW] consuming flesh or juice of an Opuntia sp. in large quantity to reach a state of stuporous intoxication for several hours, sometimes with 'violent' side effects. Those intoxicated were also observed to be easily startled and suffer apparent fear of the dark. More precise details are lacking (Torsten pers. comm.).

Many Opuntia spp. have been shown to contain varying quantities of *mescaline*. Although most quantified so far have been minor, the verified shamanic use of an unidentified Opuntia sp. [see above] would suggest that some species and strains might prove to be potent.

O. acanthocarpa contained c.0.01% *mescaline*, 0.1% *DMPEA* and <0.01% 3,5-dimethoxy-4-OH-*phenethylamine*.

O. basilaris contained c.0.01% *mescaline* and <0.01% 3,5-dimethoxy-4-OH-*phenethylamine* (Ma et al. 1986).

O. cylindrica [Austrocylindropuntia cylindrica] has yielded no alkaloids yet (Agurell 1969a); another study claimed to have found 0.9% *mescaline* (Turner & Heyman 1960), though the specimen tested was actually **Trichocereus** pachanoi, which strangely was once confused with O. cylindrica (Agurell 1969a), a very different plant!

O. echinocarpa contained c.0.01% *mescaline*, 0.01% *DMPEA* and 0.01% 3,5-dimethoxy-4-OH-*phenethylamine* (Ma et al. 1986).

O. ficus-indica has yielded *mescaline*, *tyramine*, N-methyl-*tyramine* (El-Moghazy et al. 1982) and *phenethylamine* (Lundstrom 1989), as well as mucilage containing glucose, galactose, arabinose, rhamnose, xylose, glucuronic acid and galacturonic acid; flower petals yielded the flavonoids kaempferol, luteolin, penduletin, quercetin, quercitrin and rutin; fruit yielded 0.09% ascorbic acid [vitamin C], as well as other acids (El-Moghazy et al. 1982), including piscidic acid, and indicaxanthin. Stem and fruit of O. ficus-indica var. saboten were found to inhibit MAO, more potently on MAO-B; 1-monomethyl citrate, 1,3-dimethyl citrate, trimethyl citrate and 1-methyl maleate were isolated and shown to share this activity (Han et al. 2001).

O. imbricata has yielded *mescaline*, *tyramine*, 3-MeO-*tyramine*, *DMPEA*, and an unidentified alkaloid (Meyer et al. 1980).

O. polyacantha was shown to yield 0.007% opuntiol [2-OH-methyl-4-MeO-α-pyrone] when under investigation for alkaloids; however, no alkaloids were actually reported (Telang 1973).

O. spinosior has yielded 0.00004% *mescaline*, 0.0018% *tyramine*,

0.0011% 3-MeO-*tyramine*, and traces of *DMPEA* (Kruger et al. 1977; Pardanani et al. 1978).

In a screening of Argentinian Opuntia spp., all samples tested contained alkaloids (Falco & Hilbug 1949). The genus has also been shown to contain betacyanins, betaxanthins, flavonoids [including quercetin 3-methyl ether] and their aglycones, oleanane triterpenoids; and less interesting phenethylamines are found in some other species (Trout ed. 1999).

Opuntia acanthocarpa forms an arborescent shrub 1-3(-4)m tall; trunk short, to 10-15cm diam. Larger terminal branches 12-50 x 2-3(-4)cm; tubercles conspicuous, sharply raised and laterally compressed, (12-)20-25(-50)mm long, +-4.5mm wide and high; leaves slender, tapering, roughly as thick as wide, +-12mm long, +-1.5mm diam.; areoles circular, 5-6mm diam., 2-4cm apart; spines tan to reddish-tan, to straw-coloured or whitish, turning brown, later black, 6-25 per areole, spreading, straight, longer ones 1.2-2.5(-4)cm long, 0.8-1.2mm thick at base, subulate, narrowly linear in cross-section; spines with conspicuous sheaths, straw-coloured, rarely silvery, persisting for c.1 year; glochids minute. Flowers 4-5.5cm diam., 4-6cm long; sepaloids greenish-yellow to greenish-red, broadly spatulate, to 20mm long, to 20mm wide in upper parts, rounded; petaloids of variable colour (usually red, purplish or yellow), narrowly obovate, 25-40mm long, up to 15mm wide, rounded, mucronulate, with a few shallow sinuses; filaments 9-12mm long; anthers to 3mm long; style 15-20 x 2-3mm; stigmas 5, broad, 3-4.5mm long; ovary spiny in anthesis. Fruit deciduous in late summer or autumn, turning tan or brown and dry, tuberculate, with numerous spreading spines except at base, obovoid-turbinate, 2.5-4 x 1.5-2cm, with deep, cup-like umbilicus; seeds pale tan or whitish, flattened, irregularly angular, 5-8 x 3-5 x 2-3mm.

The varieties of this species can be divided as follows:-

O. acanthocarpa var. acanthocarpa – 1.2-1.8m tall; few joints, forming acute angles, joints 20-50cm long, +-3cm diam.; tubercles 30-38mm long, broad; 15-20 spines per areole, +-2.5cm long; in gravelly or sandy soils at desert edge, also in woodland and brush; Mojave desert, Utah, Arizona, +-1200m.

O. acanthocarpa var. coloradensis – 1.2-1.8(-4)m tall; joints as above, but 15-30 x 2-2.5cm; tubercles 20-23mm long, narrow; 10-12 spines per areole, 2.5-4cm long; sandy or gravelly soils; Mojave desert, Sonoran desert, California, Colorado, Utah, Arizona, 600-1300m.

O. acanthocarpa var. ganderi – 0.9-1.2m tall; joints as for var. acanthocarpa, but 3-4cm diam.; tubercles 12-16mm long, narrow; spines dense, obscuring stem, 15-25 per areole, 1.2-3cm long; in sand and gravel on flats and hillsides, Colorado desert, and edge of California chaparral, 300-900m.

O. acanthocarpa var. major – sprawling, diffuse, 0.9-1.5m tall; joints numerous, with many obtuse angles, 12-25 x 2-2.5cm; tubercles 20-25mm long, narrow; 10-15 spines per areole, +-2.5cm long; sandy soils, mainly in Arizona desert, Arizona, California, Sonora [Mexico], 300-900m.

O. acanthocarpa var. thornberi – diffuse, 0.9-1.5m tall; joints forming acute and obtuse angles, 25-50 x +-2cm; tubercles 30-50mm long, narrow; spines sparse, not obscuring stem, 6-11 per areole, 1.2-2.5cm long; sometimes no or few spines on fruit; rocky or gravelly soils, on hillsides and ridges, upper edges of Arizona and Mojave deserts (Benson 1982).

Opuntia spp. forming flat pad-like branches are referred to colloquially as 'prickly pears'; those forming +- cylindrical branches are known as 'chollas'.

OSTEOPHLOEUM

(Myristicaceae)

Osteophloeum platyspermum *(Spruce ex DC.) Warburg* **(O. platyphyllum** *Holmstedt et al. nomen nudum***; O. sulcatum** *Little***; Myristica platysperma** *Spruce ex DC.***; Palala platysperma** *(Spruce ex DC.) Kuntze***)** – cumala blanca, cumala, machin cara yura ['capuchin monkey bark tree'], ilauta caspi, huapa, anya huapa, huachig caspi, tungebanpe, ta-le-mee-na, archireeupa, lacre de mata, uccuuburana, uccuuba branca

The Quicha of Amazonian Ecuador once used the sap of this tree as an orally-administered hallucinogen to communicate with the spirit world. Mature trees, yielding large quantities of sap, were scored across the bark of the trunk, and the red sap collected in a leaf-vessel. This was cooked, sometimes with pieces of bark as well, and drunk when cooled. It was sometimes mixed with a **Brugmansia** sp. known as 'guandu', and 'tsicta' [**Tabernaemontana** sananho], and was said to be fatal in excessive quantities. The Quicha also would put a few drops of the sap into the noses of their dogs to improve their senses (Bennet & Alarcon 1994).

The Maku drink the sap to cure coughs and colds. The Kuripako burn the leaves in their homes to cleanse the dwelling after a serious illness. The Makuna and the Ingano use the inner bark as a poultice for wounds, and Colombian Amazonians use the sap to aid in wound healing (Schultes 1978; Schultes & Raffauf 1990). Labourers in the Reserva Ducke, near Manaus, inhale the smoke from the burning leaves to relieve asthma (Fo et al. 1984). It should be noted that the vernacular names 'cumala' and 'cumala blanca' are also applied to some **Iryanthera** spp. (Schultes & Holmstedt 1971), **Theobroma** spp. and **Virola** spp.

While one sample yielded 0.62% alkaloids from the dry bark, consisting of *DMT*, *5-methoxy-DMT* and *bufotenine*, others contained no tryptamines at all. Leaves have yielded abrine methyl-ester [N-methyl-*tryptophan* methyl ester] (Holmstedt et al. 1980; McKenna et al. 1984b), δ-cadinene, (-)-kaur-16-en-19-oic acid, eperu-7,3-dien-15-ol-18-al, eperu-13-en-8β,15-diol and eperu-8(20),13-dien-3α,15-diol. Branches and leaves together have yielded (-)-kaur-16-en-19-oic acid, stearic acid, sitosterol, stigmasterol, (+-)-maackiain and (+-)-3-demethylhomopterocarpin. Fruits have yielded eperu-8(20),13-dien-3α,15-diol, sitosterol, glyceryl laurodimyristate, glyceryl 1,3-lauromyristate and neolignans [guaiacin, otobaphenol, hydroxyotobain, hydroxyoxyotobain and dihydroguaiaretic acid] (Fo et al. 1984). Pharmacology of this plant is poorly known.

Osteophloeum platyspermum is a dioecious tree to 40m; branches and branchlets terete, minutely and densely puberulent with sessile, stellate, 4-6-branched hairs, later glabrous. Leaves alternate, simple, entire, (8-)10-15(-20)cm long, 3.7-5(-6.5)cm wide, oblong-obovate, coriaceous, velvety and translucent (not hyaline) when young, later glabrous, often shiny above, minutely punctate and often ceriferous beneath, often slightly emarginate, margins narrowly revolute, apex rotundate or rounded, base acute-cuneate or gradually attenuate, pinnately nerved, lateral nerves (6-)7-9(-12) on both sides, semi-spreading, tertiary nerves scarcely distinct; petiole (1.5-)1.9-2.5(-3)cm long. Inflorescences 1-3 in leaf axils or on defoliate branchlets, subumbellate, simple or with 1-4 short, lateral branches; male inflorescence densely pubescent externally, 1-6cm long; peduncle 2.5-3.8cm long, paired, axillary and above axils; pedicels bracteolate at apex, (in male) branched at apex, bearing 5-6 flowers, to 5mm long; bracts small; bracteoles tiny, semiorbicular, later short-rotundate, sessile, surrounding base of flower, c.2mm wide, 1mm long; flowers solitary or in irregular fascicles of 2-8, apetalous; perianth c.4mm long, ovoid-obtuse, carnose, glabrous inside, 3-lobed nearly to base, lobes valvate; androecium 2.5-3mm long, filaments connate into a carnose column 1mm long or less; stamens (2-)3-10; anthers (6-7?)12(-14), linear, crowded, fused at apex, 2-celled, dehiscing longitudinally. Ovary superior, sessile, conic, densely and minutely lepidote-tomentellous, 1-celled; ovule 1, +-basal; stigma sessile, oblique. Fruiting inflorescences glabrous throughout when mature; fruits few, fleshy, depressed-globose, transversely ellipsoid, 15-25mm long, 20-25mm broad, conspicuously bicarinate, valved, furrowed, pericarp 0.5-1.5mm thick, woody, covered by an aril, aril obscurely laciniate; pedicel twice as long as fruit; seed c.½ as long as broad, uniform in colour.

Peru [Loreto, mouth of Rio Santiago; Iquitos; Amazon river], Amazonian Colombia, n. Amazonian Brazil [Panure, Rio Uaupes, Rio Negro] (De Candolle 1856; Smith 1938).

OXYTROPIS

(Leguminosae/Fabaceae)

Oxytropis lambertii *Pursh* – crazyweed, loco, locoweed, Lambert's locoweed, purple locoweed, stemless locoweed

Oxytropis puberula *Boriss.* **(O. glabra var. roschanica** *B. Fedtsch.***)** – rakhdzham

Oxytropis sericea *Nutt. ex Torr. et. Gray* **(O. albiflora** *(A. Nelson) A. Nelson***; O. condensata** *(A. Nelson) A. Nelson***; O. pinetorum** *(A. Heller) K. Schum.***; O. saximontana** *(A. Nelson) A. Nelson***; O. vegana** *(Cockerell) Wooton et Standl.***)** – locoweed, white locoweed, white point locoweed, silky crazyweed, silvery oxytrope

Oxytropis spp. ['milkvetches'] are widespread herbs often used as fodder plants for stock animals. However, some species are known to be toxic, causing intoxications in animals (Allen & Allen 1981; Culvenor 1970; Keeler 1975; Komarov et al. ed. 1986). O. lambertii and O. sericea are known as 'locoweeds' in North America [see also Astragalus in *Endnotes*], causing sometimes fatal intoxication in horses and other stock animals. However, some feeding tests on animals using O. lambertii and some Astragalus spp. did not reveal any adverse effects (Anon. 1888b; Kingsbury 1964; Molyneux & James 1982; Pammel 1911). Prairie 'Indians' from South Dakota may have ingested some locoweeds to induce visions (Rätsch 1992).

O. glabra has yielded the alkaloids anagyrine, sparteine [see **Cytisus**, **Laburnum**, **Lupinus**], thermopsine and adenine, as well as terpenoid saponins and flavonoids (International... 1994).

O. montana and O. uralensis contain canavanine [see **Canavalia**] (Bell et al. 1978).

O. pseudoglandulosa contains alkaloids in the whole plant – N-benzoyl-2-OH-*phenethylamine*, 2-benzoyloxy-*phenethylamine* and (E)-N-2-phenylethylcinnamide; as well as the flavonoids chrysin [see **Passiflora**] and isoliquiritigenin [MAOIs (Hatano et al. 1991; Sloley et al. 2000)], and the waxy hydrocarbon-derivatives hentriacontane, heptacosane, non-

acosane, pentacosane and tricosane (International… 1994).

O. puberula aerial parts have yielded *harmine*, (-)-N-nicotinoyl-2-OH-*phenethylamine* and β-sitosterol glucopyranoside (Akhmedzhanova et al. 1995); the plant has been noted to be toxic to animals (Komarov et al. ed. 1986).

O. sericea has yielded the toxic alkaloids swainsonine and swainsonine N-oxide [see **Swainsonia**] (Molyneux & James 1982).

Oxytropis puberula is a perennial herb; stems few, 4-70cm long, nearly erect, branching in upper part, +- puberulent. Leaves 7-10cm long, pinnate; leaflets 5-7-paired, oblong-oval or oval-lanceolate, 10-20(-40)mm long x 2-5(-10)mm wide, covered on both sides with fine appressed hairs, sparser above; stipules ovate, 7-12mm long, not adnate to petioles, connate at base, spreading-hairy. Inflorescences oblong racemes, 5-10cm long; pea-flowers subsessile, peduncles as long as leaves or longer; bracts narrowly linear, c.2mm long, acute, long-hairy; pedicels very short; calyx campanulate, c.3mm long, densely short-puberulent, teeth lanceolate, ½ as long as tube; corolla violet, standard 6-8mm long, limb orbicular and slightly emarginate at apex, wings shorter than standard, keel slightly shorter than wings, beak c.1mm long. Fruit oblong-oval or oblong pods, (7-)8-15mm long, 4-6mm wide, compactly membranous, inflated, dehiscing at ventral suture, beak and stipes c.1mm long, pendulous with short black and white spreading hairs. Fl. Jul.-Aug.

In valleys, pastures, on riverbanks, near lakes, roadsides; endemic in central Asia (Komarov et al. ed. 1986).

PACHYCEREUS

(Cactaceae)

Pachycereus pecten-aboriginum *(Eng.) Britton et Rose* **(Cereus pecten-aboriginum** *Engelmann***)** – cardón, cardón hecho, hecho, cawé, chawé, wichowaka, bitaya mawali, pitahayo, organo

Pachycereus pringlei *(S. Watson) Br. et R.* **(Cereus pringlei** *S. Watson***)** – cardón, cardón pelón, sahueso, senita, xáasx, elephant cactus, Mexican giant cactus

The Tarahumara of Mexico prepared a ceremonial beverage called 'cawé' or 'chawé', from P. pecten-aboriginum. The brew is said to produce 'dizziness and visions'. The young branches are crushed in a hollow rock, and the juice added to water [roughly 1:3]. The resulting preparation is consumed under ritual circumstances. Sometimes the sap is added to corn beverages [eg. 'chicha' – see *Methods of Ingestion*]; sometimes it is cooked and fermented by itself, in which form it is said to act as a strong purgative. The seeds are also known to be ground into a flour for food, and its spiny fruit is used as a hairbrush. The cactus has also been used medicinally, to treat cancer [success rate not reported!], gastric ulcers (Bruhn 1973; Bruhn & Lindgren 1976; Bye 1979b; Hartwell 1968; Usher 1974) and "general aches and pains" (Salmón 1995).

Flesh from the related P. pringlei has been claimed to have 'inebriating' properties (Smith 2000). Amongst a group of people who all consumed similar doses of material from the same sample, some experienced psychedelic inebriations, whilst others experienced only strong nausea and vomiting (Shulgin pers. comm. 2002). Stems of P. pringlei have also been given as a decoction [orally or rectally] to treat cancer of the uterus, in Mexico (Hartwell 1968). The Seri of Sonora use a heated, de-spined slice of the stem wrapped in cloth, to apply to aches and rheumatic pains (Felger & Moser 1974).

The fermented beverage prepared from P. pecten-aboriginum might be aided by the presence of a Drosophila-yeast relationship, as seen with **Carnegiea**. P. pecten-aboriginum is known to be host for the fruit fly Drosophila nigrospiracula, as well as what was thought to be D. spencceri (Kirscher & Heed 1970). Pichia heedii, the yeast also associated with **Carnegiea**, is known to be associated with some 'pachycereoid' cacti (Holzschu & Phaff 1982).

P. pecten-aboriginum has yielded 0.01-0.05% alkaloids [w/w], of which up to 10% was isohomovanillylamine [3-OH-4-MeO-*phenethylamine*], as well as homovanillylamine [3-MeO-*tyramine*; 3-MeO-4-OH-*phenethylamine*], *DMPEA*, and the tetrahydroisoquinolines arizonine [8-OH-7-MeO-1-methyl-THIQ], carnegine [6,7-dimethoxy-1,2-dimethyl-THIQ; pectenine; see **Carnegiea**], salsolidine [main alkaloid; N-norcarnegine; 6,7-dimethoxy-1-methyl-THIQ][produced tremors in mice; MAOI], salsoline [6-OH-7-MeO-1-methyl-THIQ; MAOI], isosalsoline [MAOI; salsoline and isosalsoline caused tremors, convulsions and decreased motor activity in mice] and heliamine [6,7-dimethoxy-THIQ]; quinic acid was also found (Agurell et al. 1971; Bembenek et al. 1990; Bruhn & Lindgren 1976; Lundstrom 1989; Shulgin & Shulgin 1997; Strömbom & Bruhn 1978; Unger et al. 1980).

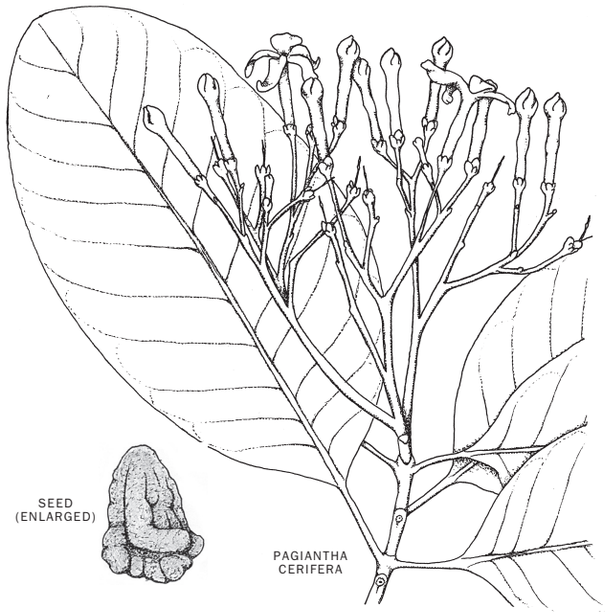
P. pringlei has yielded 0.05% tehuanine [2-methyl-5,6,7-trimethoxy-THIQ], 0.014% tehuanine N-oxide, 0.017% heliamine, lemaireocereine [7,8-dimethoxy-THIQ], weberine [5,6,7,8-tetramethoxy-THIQ; weak MAOI] (Bembenek et al. 1990; Mata & McLaughlin 1980; Pummangura et al. 1982b), weberidine [7-MeO-THIQ], N-methylheliamine (Unger et al. 1980), carnegine and *DMPEA* [tentative] (Trout ed. 1999, citing unpublished work by Crockett & Shulgin).

Pachycereus pecten-aboriginum is a very large tree-like cactus 5-10m tall, with a trunk 1-2m x 30cm, crowned with many erect branches; 10-11 ribs; areoles 1cm diam. or less, extending downwards in narrow grooves, in the flowering ones forming brownish cushions connecting with the areoles below, densely tomentose, greyish except in flowering ones, which are brownish or reddish; spines 8-12, 1-3 central, all short, usually 1(-3)cm long or less, greyish with black tips. Flowers diurnal, 5-7.5cm long; outer perianth segments short, spatulate, purple, succulent; inner ones white, fleshy; tube covered with small scales bearing felt and bristles in their axils; stamens included, very numerous, inserted along throat. Ovary covered with dense soft hairs with only a few or no bristles; style included, with 10 linear stigma-lobes. Fruit 6-7.5cm diam., dry, covered with yellow wool and long yellow bristles; seeds large, black.

Mexico [Chihuahua, Sonora, Colima], lower California (Britton & Rose 1963).

PAGIANTHA

(Apocynaceae)



Pagiantha cerifera *(Panch. et Sébert) Markgraf* **(Tabernaemontana cerifera** *Panch. et Séb.***; Ochrosia novo-caledonica** *Däniker***)**

This small New Caledonian tree is used in indigenous medicine as a charm and violent purgative (Bouiteau 1981).

P. cerifera leaves have yielded *voacangine*, *voacangine* hydroxyindolenine and *ibogaine* (Harmouche et al. 1976). A later study observed 2 different ecotypes of this species, which differed in their chemistry, though were not significantly different botanically. However, it should also be noted that some of the samples were over 20 years old when analysed. The form growing as a small tree, in schistic rock, was harvested in October, 1967 [leaves and fruits] and September, 1983 [trunk bark] from Rivière Tendé; the form growing as a shrubby bush, in peridotitic rock, was harvested in September, 1978 from La Coulée [leaves] and September, 1983 from Rivière Bleue [trunk bark and fruits]. The former type yielded 0.27% alkaloids from leaves [40% *voacangine*, 20% *ibogaine*, 5% *voacangine* hydroxyindolenine], 0.95% from trunk bark [32% *voacamine*, 30% *vobasine*, 6% descarbomethoxy-*voacamine*, 5% methuenine, 0.02% pagisulfine], and 0.6% from fruit [45% *coronaridine*, 29% oxo-3-*coronaridine*, 6% *coronaridine* hydroxyindolenine]. The latter type yielded 0.43% alkaloids from leaves [40% *vobasine*, 8% *ibogaine*, 7% voaphylline, 5% perivine, 3% vallesamine, 3% stemmadenine], 0.6% from trunk bark [18% *vobasine*, 18% methuenine, 10% tabernamine, 7% perivine, 4% olivacine, 2% dihydroellipticine, 0.5% ceridimine, 0.4% pagisulfine, 0.25% ervitsine, 0.25% pericyclivine, 0.1% pagicerine], and 0.25% from fruits [40% *vobasine*, 30% *ibogaine*] (Bert et al. 1989).

Pagiantha cerifera is a small tree or shrubby bush, 4-10m tall, often composed of several stems, slightly ramified, green-yellowish towards summit; bark in 2 distinct parts, external layer suberose, whitish, rugose, internal layer thin and brown. Leaves ovate-lanceolate to elliptic, 11-17 x 5-8cm, rounded or very obtuse towards apex, base cuneiform, coriaceous, margin often briefly reduplicate, central nerve strongly raised beneath, canaliculate above; lateral nerves 8-11 on each side, 10-15mm distant, no tertiary reticulation visible; petiole robust, 8-15mm long; anisophylly discreet. Inflorescences in terminal cymes, with more than 2 later-

al branches; peduncles 4-5cm long, robust; bracts small and caducous; pedicels 10-15mm long, often bearing a bracteole towards the middle; calyx with sepals free almost to the base, broadly oval, apex rounded, ciliate, nerves apparent, often unequal, the largest to 4.5 x 3.3mm, bearing a row of 5-7 glandular appendices at the base of the internal face; corolla white, tube 20-22mm long, very weakly reinflated towards the middle; stamens inserted in inferior part of this bulge, just to the lower-half of the tube, 3mm high, very shortly mucronate to apex, on edge slightly and irregularly lobed, lobes 12-14mm long, ribboned, contorted, overlapping. Ovary and carpels fused; style composed of 2 fused stylodes but remaining distinct; clavoncule cylindrical, weakly dilated and papillose to the base, then attenuated in columns thinner than the style, bearing stigmas at apex. Fruit +- apocarpous at length, syncarpous to the base, rarely hemisyncarpous, with very persistent calyx; mericarps equal, or sometimes very unequal due to one of them aborting, ovoid, shortly apiculate to apex, 4-5cm long, 2.5cm wide, 2cm thick; seeds with deep ventral furrows, on the back adorned with broken lines of nipples, but without furrows; albumen ruminated; embryo straight, cotyledons elliptic, rounded to the base.

New Caledonia (Boiteau 1981).

PANAEOLUS [including COPELANDIA and PANAEOLINA]

(Agaricaceae/Coprinaceae)

Panaeolus africanus *Ola'h*

Panaeolus antillarum *(Fr.) Dennis* **(P. ovatus** *(Cke. et Mass.) Sacc.***; P. phalaeranum** *(Fr.) Quélet***; P. sepulcralis** *Berk.***)** – jingasatakemodoki

Panaeolus ater *(Lange) Kühner et Romagnesi* **(P. fimicola** *Fr.***)**

Panaeolus castaneifolia *(Murrill) Gerhardt* **(P. castaneifolia** *(Murr.) Bon.***; P. castaneifolius** *(Murr.) A.H. Sm.***)**

Panaeolus goosensiae *Beeli*

Panaeolus microsporus *Ola'h et Cailleux*

Panaeolus olivaceus *Möller*

Panaeolus rubricaulis *Petch* **(P. campanuloides** *Guzmán et K. Yokoy.***)**

Panaeolus semiovatus *(With. ex Fr.) Lundell et Nannf.* **(P. semiovatus** *(Sow. ex Fr.) Lund. et Nannf.***; P. separatus** *(L. ex Fr.) Gill.***; P. separatus** *(L. ex Duby) Wünsche***)** – jingasatake, phak timu

Panaeolus sphinctrinus *(Fr.) Quélet* **(P. campanulatus** *(Fr.) Quél.***; P. campanulatus var. sphinctrinus** *(Fr.) Bres.***; P. papilionaceus** *(Bull. ex Fr.) Quél.***; P. retirugis** *(Fr.) Quél.***; Agaricus callosus** *Fr.***)** – waraitake ['laughing mushroom']?, maitake ['dancing mushroom']?, odoritake ['jumping mushroom']?, hikagetake

Panaeolus subbalteatus *(Berk. et Broome) Sacc.* **(P. venenosus** *Murrill***)** – belted-cap Panaeolus, weed Panaeolus, poisonous Panaeolus, senbonsaigyogasa, gold tops, gold caps

Panaeolus venezolanus *Guzmán* **(P. annulatus** *Natarajan et Raman***)**

Copelandia affinis *Horak* **(P. affinis** *(Horak) Gerhardt***)**

Copelandia anomala *Murrill* **(P. anomalus** *(Murr.) Sacc. et Trotter***)** – gold tops, gold caps

Copelandia bispora *(Malencon et Bertault) Sing. et Weeks* **(C. papilionacea var. bispora** *Malen. et Bert.***; P. bisporus** *(Malen. et Bert.) Gerhardt***; P. cyanescens var. bisporus** *(Malen. et Bert.) Moreno et Esteve-Raven.***)** – gold tops, gold caps

Copelandia cambodginiensis *(Ola'h et Heim) Sing. et Weeks* **(P. cambodginiensis** *Ola'h et Heim***)** – gold tops, gold caps

Copelandia chlorocystis *Sing. et Weeks* **(P. chlorocystis** *(Sing. et Weeks) Gerhardt***)**

Copelandia cyanescens *(Berk. et Br.) Sing.* **(C. papilionacea** *(Bull. ex Fr.) Bres.***; P. cyanescens** *(Berk. et Br.) Sacc.***; P. papilionaceus** *sensu Bres.***)** – blue meanies, hed keequai ['mushroom which appears after water buffalo defecates'], cone-heads, gold tops, pan cyan

Copelandia lentisporus *(Gerhardt) Guzmán* **(P. lentisporus** *Gerhardt***)**

Copelandia mexicana *Guzmán*

Copelandia tirunelveliensis *Natarajan et Raman* **(P. tirunelveliensis** *(Natarajan et Raman) Gerhardt***)**

Copelandia tropicalis *(Ola'h) Sing. et Weeks* **(P. tropicalis** *Ola'h***)** – gold tops, gold caps

Copelandia westii *(Murr.) Sing.*

Panaeolina foenisecii *(Fr.) Maire* **(Panaeolus foenisecii** *(Fr.) Kühner***; Psathyrella foenisecii** *(Fr.) Smith***; Psilocybe foenisecii** *(Pers. ex Fr.) Quél.***; Agaricus foenisecii** *Pers. ex Fr.***)** – haymaker's toadstool, haymaker's mushroom

Panaeolina indica *Sathe et J.T. Daniel* **(P. microsperma** *Natarajan et Raman***)**

Panaeolina rhombisperma *Hongo*

Panaeolina sagarae *Hongo*

The 'laughing mushroom' or 'waraitake' [as well as the 'maitake' and 'odoritake'], which has caused historic joyous inebriations in Japan, is thought to have been Panaeolus sphinctrinus [as P. papilionaceus], though this identification may be in error [see also **Gymnopilus**]. It would seem more likely that Copelandia cyanescens or a similar species were involved; C. cyanescens had previously been known as P. papilionaceus under a different author. Of the waraitake, it is said "people who eat of this mushroom get drunk. They may become extremely excited and dance and sing or see various hallucinations" (Sanford 1972). Portuguese witches were reported to have used P. papilionaceus for magical enchantments (Graves 1970). It has been proposed that the mushroom thought to have been used at the Lesser Mysteries of Eleusis [see **Claviceps**] may have been a Panaeolus sp. [see also **Amanita**]. In some areas of modern Greece, locals know of unidentified 'hallucinogenic' mushrooms which they refer to as 'crazy mushrooms'. They are not regarded as poisonous, but they are known to be "inebriating like wine, though in an entirely different way" (Samorini 2001; Wasson et al. 1978).

P. sphinctrinus [as P. campanulatus var. sphinctrinus] was collected as an example of 'teonanácatl' [see **Psilocybe**] in Mexico (Schultes 1939; Wasson 1963), but the authenticity of the claimed use of this mushroom in Oaxaca is under question, as is its psychoactivity. The Mexican shamanic use of P. ater has also been reported (Wasson 1961). Recently, it was discovered in Nepal that some Kirati shamans eat [or inhale as an ingredient of a compound snuff] a Panaeolus sp. known as 'gobar chyau' for shamanic travel, or as one shaman related, "We take this mushroom only when it is very important to fight against demons. We roast it and take it with salt in order to neutralise its poison. We take it for medicine and knowledge". P. semiovatus may also be so used (Müller-Ebeling et al. 2002).

C. cyanescens is consumed and sold to tourists and restaurants on the islands of Koh Samui and Koh Pha-Ngan, Thailand; this is also known to occur in other areas of Thailand, Indonesia [Java, Sumatra], Samoa, Bali and the Philippines to some extent. They are cultivated on dung in rice paddies, but also occur spontaneously in dung of the cattle Bos guarus, B. indicus, B. sundaicus and the domestic water-buffalo Bubalus bubalis, as well as the horse [Equus caballus]. Other species used in these areas include P. ater [Indonesia], C. cambodginiensis [Kampuchea] and C. tropicalis [Philippines, Kampuchea] [see also **Psilocybe**] (Allen & Gartz 1997; Allen & Merlin 1992). Children in Koh Samui have warned researchers that P. antillarum was 'antaray' [dangerous] (Gartz et al. 1994). Similar practices of sale of C. cyanescens to tourists have been observed in Jamaica (Allen & Gartz 1997), and this species has also become popular in Peru (Allen 1998).

In Hawaii, many species have been used 'recreationally' in non-native practices since the late 1960's/early 1970's – including C. anomala, C. bispora, C. cambodginiensis, C. cyanescens, P. subbalteatus and C. tropicalis. This use is thought to have been introduced by Australian surfers, and has even been noted amongst military personnel on the islands. No traditional use of these fungi has been uncovered, though one elderly native man from Maui admitted to consuming psychedelic mushrooms in the 1940's to exorcise evil spirits; he knew of no-one else who did this (Allen 1998; Merlin & Allen 1993).

P. subbalteatus is well-known as a weed of commercial mushroom [Agaricus bisporus] crops (Singer & Smith 1958), and is used as a psychedelic in parts of e. & s. USA, as well as in other countries in which it grows. One early recorded experiment of consumption of 1.5g [in the name of science] resulted in "a strong favourable and euphoriant effect", deemed to be more desirable than the effects of **Psilocybe** caerulescens, probably due to the great differences in potency. Consumption of 0.5-1g oven-dried specimens elicited a mild and pleasant inebriation, accompanied by some dizziness, sweating, and slight mydriasis. In another early experiment, twice this amount of P. subbalteatus was required by the subject to perceive effects, consisting of a 'tranquil inebriation' (Stein 1959, 1960; Stein et al. 1959). C. cyanescens and P. subbalteatus are also cultivated in the US and other countries by underground mycologists (Stamets & Chilton 1983).

P. sphinctrinus has also sometimes been consumed, with 40-250 specimens being ingested to produce the hoped-for effects. According to literature reports, P. sphinctrinus consumption has led to a wide history of documented human intoxications in Europe and America, though species identification was most likely in error. Such early reports are notorious for the hasty identifications of mushroom species alleged to have caused inebriations; the identifications have usually been based on presumption rather than microscopic analysis. Most authorities do not consider this species to be psychoactive. It has been claimed that individual sensitivity varies, and moderate quantities produce no effect. Even "thrifty farmers taking advantage of a chance to get drunk for nothing" have taken it in New England. One report of ingestion of 2g parboiled specimens resulted in "noticeable intoxication, but no hallucinosis" (Allen 1997a; Beug & Bigwood 1982; Guzmán et al. 1976; Pollock 1976; Sanford 1972; Weil 1977b). One researcher ate 6 dry specimens [0.8g], as P. campanulatus, and experienced no effects of any kind (Tyler & Malone 1960). Another man, from New Jersey, conducted an experiment with P. papilionaceus as food [probably actually another, *psilocybin*-containing species], not realising what he and his wife were in for. In his own words – "Last Sunday morning I had great difficulty in finding any mushrooms whatever, so I

was happy when I finally came across a few specimens of Coprinus [see *Endnotes*] mixed in with a few of Panaeolus papilionaceus. I have never tried this last mushroom, but, as Mr. McIlvaine says that in small quantities they are harmless and contain a very mild intoxicant only, I did not hesitate to let them join the Coprini in the pot. The results, however, were very startling." The man ate "five times as much" as his wife, who ate approx. 3 caps [it was not stated what portion of the caps were from the purported P. papilionaceus]. Curiously, whilst the lady felt effects within 5-6 min., the man did not note any effects until 1-2 hrs later. The experience was compared to "violent opium poisoning" [see **Papaver**], which the couple believed they knew about from reading the visionary experiences described in De Quincy's "Confessions of an English Opium-Eater". All effects subsided within 4-5 hrs (Fries 1916).

There has been a report of accidental mushroom-intoxication in France, believed to have involved C. cyanescens or a similar species which had become naturalised. This species normally occurs in tropical areas. Specimens of the Copelandia sp. were shown to contain 0.15-0.2% *psilocybin*, and similar quantities of *tryptophan*; these were also present in the mycelium (Heim et al. 1966).

C. cyanescens is also used and highly-prized by some in n.e. Australia and South Australia, where specimens are known as 'blue meanies', referring to the strong bluing reaction of this species [and to the characters of the same name in 'Yellow Submarine']; its potency rivals many of the commonly used **Psilocybe** mushrooms. Some people do not like elements of the effects, however, and prefer **Psilocybe**. P. antillarum may also have been used in Australia for its psychotropic properties, and there are reports from earlier last century of intoxications produced by P. ovatus [a synonym of P. antillarum] in NSW, Australia, though identification may have been in error (pers. obs.; Aberdeen & Jones 1958; Low 1985; Southcott 1974; Trotter 1944).

A psychedelic intoxication from P. foenisecii was reported from Adelaide [S. Australia], in a 2-year-old girl who had eaten the fungi from her parent's lawn (Southcott 1974). This species has been implicated in several other incidents where children have become intoxicated. Intentional intoxications have also been reported from the UK; in one case, 3 young men each ate 20-30 fresh specimens and experienced psychedelic effects (Cooles 1980). It has been suspected by some that the identity of the mushrooms was in error (Allen & Merlin 1993), possibly involving **Psilocybe** semilanceata. A friend has also consumed P. foenisecii on numerous occasions [from 3 widely separate regions of the US, and 3 widely separate regions of Australia], with mild psychotropic effects experienced. He reported that large amounts must be consumed for any effects, and that the substrate in which the fungi are growing may affect the chemical composition. Based on these experiments, he believes that "apparent *psilocybin* concentration is directly proportional to the concentration and freshness of cow/horse manure in the substrate, and that it is most often found apparently in symbiosis with domestic fescue-type thinblade lawns" [see **Festuca**] (Turney pers. comm.). Most ingestions of this species - even in very large amounts - result in diarrhoea but no noteworthy CNS effects (pers. comms.).

As some researchers now insist that P. foenisecii is 'inactive' and does not ever contain *psilocybin* or *psilocin* (Allen & Merlin 1993), there is still some confusion about this species. Although the content of *psilocybin* and/or *psilocin* is in doubt, and is usually not found, it is certain that this species is occasionally capable of exerting mild psychoactive effects, with particular batches consumed in large enough quantities [over 50g fresh]. The assumption that *tryptophan* and *5-hydroxytryptophan* might be responsible for this is confused by the low yields of these compounds from P. foenisecii [see below], but as hardly anyone has actually quantified these chemicals in this species we know hardly anything about the true range of concentrations found naturally. Further research is needed to clarify this contentious issue.

Panaeolus spp. generally are high in urea content, most so when sporulating; the urea is mostly concentrated in the caps (Stijve 1992).

Panaeolus acuminatus [P. rickenii] has yielded only 0.016% *serotonin* [*5-HT*], 0.066% *5-hydroxytryptophan* [*5-HTP*] and 0.029% *tryptophan*, as well as 5-OH-indoleacetic acid (Stamets 1996; Tyler & Smith 1964); HPLC showed a compound with retention time similar to that of *psilocybin*, but with different response ratios (Christiansen & Rasmussen 1983). Czech specimens were found to contain no detectable *psilocybin* or *psilocin* (Stríbrný et al. 2003).

P. africanus contains *psilocybin* and *psilocin* in variable amounts; it grows on elephant and hippo dung (Stamets 1996). It has been considered to be '*psilocybin*-latent' (Ola'h 1968).

P. antillarum is generally considered to be inactive, containing no *psilocin* or *psilocybin* [though Brazilian specimens yielded 0.035% *5-HT*] (Beug & Bigwood 1982; Stijve & de Meijer 1993), but a collection from Koh Samui, Thailand, yielded less than 0.01% each of *psilocin*, *psilocybin* and *baeocystin*, 0.035% *tryptophan*, 0.015% *5-HT*, less than 0.002% *tryptamine*, and 2.8% urea (Allen & Merlin 1992); Japanese specimens yielded 0.045-0.083% *psilocybin* (Kusano et al. 1986). It is also found in Australia in dung [SA, NSW, Qld] (Young 1989).

P. ater contained small amounts of *psilocybin* and/or *psilocin*, in some samples (Ola'h 1968; Stamets 1996); Sardinian specimens were found to contain 0.14% *psilocybin* and 0.03% *psilocin* (Ballero & Contu 1998); others have found none, only small amounts of *5-HT*, urea (Gurevich 1993) and *tryptamine* (Wurst et al. 1992). Widespread in Africa, Europe and the Americas (Stamets 1996). It has been recorded in dung from Melbourne and Port Phillip [Vic., Australia], but has not been collected again there formally since the 19th century (Young 1989).

P. castaneifolia has been considered to be '*psilocybin*-latent' (Ola'h 1968); some specimens have been shown to contain *psilocybin* and/or *psilocin* in small amounts (Stamets 1996).

P. fontinalis has yielded *tryptamine*, *tryptophan*, *5-HT* and *5-HTP* (Tyler & Smith 1964).

P. goosensiae from Hawaii yielded less than 0.01% *psilocin/psilocybin*, less than 0.005% *5-HTP*, 0.01% *5-HT* and 0.6% urea (Merlin & Allen 1993), though a later work states that this species is not psychoactive (Allen 1998). No explanation is offered for the discrepancy; perhaps the species used in the previously mentioned analysis had been incorrectly identified, or perhaps it is in reference to the low potency.

P. guttulatus has been found to contain *tryptamine* and *5-HT* (Wurst et al. 2002).

P. microsporus cultured specimens have yielded *psilocybin* (Allen et al. 1992); this species has been considered to be '*psilocybin*-latent' (Ola'h 1968).

P. nirimbii has been found to contain *5-HT* (Wurst et al. 2002).

P. olivaceus yielded 0.005% *psilocybin* from 1 out of 3 fresh Finnish samples (Ohenoja et al. 1987).

P. rubricaulis has been reported to contain *psilocybin* (Guzmán et al. 2000).

P. semiovatus is generally considered to contain no *psilocin* or *psilocybin* (Beug & Bigwood 1982; Ola'h 1968), but Japanese specimens yielded 0.0007-0.001% *psilocybin* (Kusano et al. 1986); *5-HT*, *tryptophan* and *5-HTP* have also been found (Tyler & Smith 1964).

P. sphinctrinus has been considered to be '*psilocybin*-latent', or, as P. campanulatus and P. retirugis, 'non-psilocybian' (Ola'h 1968). Many specimens have been shown to contain *tryptophan*, *5-HT*, *5-HTP*, 5-OH-indoleacetic acid and urea, but only some strains ['RP1', some strains from Quebec, and some Italian & Japanese specimens] have been shown to contain *psilocin* and sometimes *psilocybin* as well. One Italian collection reportedly yielded 0.08% *psilocybin* (Gurevich 1993; Ott & Guzmán 1976; Pollock 1976; Tyler & Groger 1964b; Tyler & Smith 1964); specimens from Sardinia [Italy] yielded 0.11% *psilocybin* and 0.008% *psilocin*; specimens identified as P. retirugis [generally considered a synonym] yielded 0.12% *psilocybin* and 0.05% *psilocin*; specimens identified as P. papilionaceus [synonymy less certain – see above] yielded 0.07% *psilocybin* and 0.04% *psilocin* (Ballero & Contu 1998). Japanese specimens have yielded 0.014-0.017% *psilocybin*, and as P. campanulatus, 0.04-0.05% *psilocybin* (Kusano et al. 1986). As P. campanulatus, both cultivated and wild specimens were shown to contain citrulline, as well as *tryptophan*, *5-HT*, *5-HTP*, urea, what was possibly *choline*, and 4 unidentified compounds. These researchers believed muscarine to be present in small amounts (Tyler & Malone 1960), though the evidence offered to support this assumption was grossly insufficient. Mycelial culture did not yield any detectable levels of indoles (Neal et al. 1968). In Australia, it has been found [usually on horse dung] in WA, SA, Vic., NSW and Qld (Young 1989).

P. subbalteatus from Europe yielded 0.01-0.7% *psilocybin*, 0.004% *psilocin* [in one sample only] and 0.008-0.46% *baeocystin*, as well as 0.08-0.3% *5-HT*, small amounts of *5-HTP*, *tryptamine* and *tryptophan*, and urea. Some samples contained more *psilocybin* in caps than in stems, though others were +- equipotent in this regard. Highest *psilocybin* and *baeocystin* content was in smaller specimens. Russian samples yielded [from the caps] 0.05-0.36% *psilocybin*, up to 0.11% *baeocystin*, *5-HT*, and large amounts of urea; stems yielded 0.05-0.17% *psilocybin*, traces of *baeocystin*, and small amounts of *5-HT*, *5-HTP* and urea (Gartz 1989b; Gurevich 1993, 1995; Ohenoja et al. 1987; Stijve & Kuyper 1985; Tyler & Smith 1964). Sardinian specimens yielded 0.31% *psilocybin* and 0.11% *psilocin* (Ballero & Contu 1998). Brazilian specimens yielded 0.033-0.08% *psilocybin*, no *psilocin*, 0.058-0.097% *5-HT* and 0.1-0.21% *5-HTP* (Stijve & de Meijer 1993). Japanese specimens yielded 0.061-1.46% *psilocybin* (Kusano et al. 1986). Samples from Pacific n.w. US yielded 0.16-0.65% *psilocybin*, and no *psilocin* (Beug & Bigwood 1982). In US samples of sometimes considerable age, only 0-0.005% *baeocystin* was detected (Repke et al. 1977). Preliminary tests showed *psilocybin* and/or *psilocin* to also be present in the sclerotia (Singer & Smith 1958). One early preliminary analysis could not detect any *psilocybin*; 4 unidentified compounds were detected, including one which appeared to be a 4-OH-indole compound, but was not identical to *psilocybin* (Stein et al. 1959). Later, cultivated mycelium was shown to contain 0.07% *psilocybin*, 0.1% *5-HT*, 0.2% *tryptophan* and traces of *tryptamine* (Gartz 1989b). About 30g fresh, or 7-20 specimens, may constitute a dose (Allen 1998). Though this species has been claimed to definitely occur in Australia (Allen pers. comm.), its presence is presently considered highly suspect and was not able to be verified (Young 1989).

P. texensis has yielded *5-HT* and *5-HTP* (Tyler & Smith 1964).

P. venezolanus has been reported to contain *psilocybin* (Guzmán et al. 2000).

C. affinis has been reported to contain *psilocybin* (Guzmán et al. 2000).

C. bispora from Switzerland has yielded 0.41% *psilocin* and traces of *psilocybin* from dried specimens (Senn-Irlet et al. 1999); this species loses c.50% of its potency when dried. From 7-10 fresh specimens may constitute a dose. It is often found growing with C. cyanescens in Hawaii (Allen 1998).

C. cambodginiensis from Hawaii yielded 0.3-0.6% *psilocin*, 0.13-0.55% *psilocybin*, less than 0.005-0.02% *baeocystin*, less than 0.005-0.008% *tryptophan*, 0.005% *tryptamine* and 0.1-0.56% urea (Merlin & Allen 1993). From 7-10 fresh specimens may constitute a dose (Allen 1998).

C. chlorocystis yielded 0.46% *psilocybin* and 0.29% *psilocin*, as well as a compound which is probably *baeocystin*. It grows in the Okeechobee region of Florida on rich sod in grass (Weeks et al. 1979).

C. cyanescens from Koh Samui, Thailand yielded 0.4-1.05% *psilocin*, less than 0.025% each of *psilocybin* and *baeocystin*, less than 0.02% *tryptophan*, 0.026-0.033% *5-HT*, 0.002-0.008% *tryptamine* and 2-3.3% urea (Allen & Merlin 1992). Australian samples [from Qld] yielded 0.025-0.71% *psilocin*, <0.012-0.04% *psilocybin*, <0.01% *baeocystin*, <0.01-0.03% *tryptophan*, <0.004-0.02% *tryptamine*, 0.023-0.45% *5-HT* and 0.2-4.5% urea; Hawaiian samples yielded 0.04-1.3% *psilocin*, 0.01-0.73% *psilocybin*, <0.005-0.035% *baeocystin*, 0.006-0.02% *tryptophan*, <0.005% *tryptamine*, 0.005-0.24% *5-HT* and 0.07-3% urea. Caps and stems contained +- even proportions of *psilocin*, but stems contained 3x more *psilocybin*; *5-HT* is concentrated in the caps (Stijve 1992; Stijve & de Meijer 1993). From 7-10 fresh specimens may constitute a dose (Allen 1998). Using Hawaiian samples of C. cyanescens [containing 0.6% *psilocin*, 0.2% *psilocybin*], 1g of dried, powdered mushroom has been sufficient to cause strong psychedelic effects (Stijve 1992).

C. lentisporus has been reported to contain *psilocybin* (Guzmán et al. 2000).

C. tirunelveliensis has been reported to contain *psilocybin* (Guzmán et al. 2000).

C. tropicalis contains moderate to high levels of *psilocybin* and/or *psilocin* (Ola'h 1968; Stamets 1996). 7-10 fresh specimens may constitute a dose (Allen 1998).

C. mexicana and C. westii are presumed to be active due to their bluing reaction when bruised (Ott 1993). Some consider C. westii a synonym of C. cyanescens (Guzmán et al. 2000).

Panaeolina foenisecii from Indiana yielded 0.17% *psilocybin* (Robbers et al. 1969), though many samples from other locations contained no *psilocybin* or *psilocin* (Beug & Bigwood 1982; Mantle & Waight 1969; Ott & Guzmán 1976; Stamets 1996; Stijve & de Meijer 1993). Robbers et al. (1969) only noted the absence of *psilocybin* from collections more than 6 years old. In one test, only 2 out of 19 dry Finnish samples yielded 0.03% *psilocybin* each (Ohenoja et al. 1987). Sardinian specimens yielded 0.06% *psilocybin* and 0.04% *psilocin* (Ballero & Contu 1998). Australian specimens yielded *psilocybin* but no *psilocin* (Anastos et al. 2006). The species has also yielded *tryptamine*, *tryptophan*, *5-HT*, *5-HTP* and 5-OH-indoleacetic acid (Robbers et al. 1969; Tyler & Smith 1964). Swiss specimens yielded 0.22-0.5% *5-HT* and 0.33-0.45% *5-HTP*, but no *psilocybin*, *psilocin* or *baeocystin*, similarly to Brazilian specimens which yielded only 0.25% *5-HT* and 0.58% *5-HTP* (Stijve & de Meijer 1993). It is also found in grass in southern Australia; some Australian samples have not tested positive for the presence of *psilocybin* (Young 1989), although one sample did, yielding 0.068-0.073% *psilocybin* and no *psilocin* (Anastos et al. 2006). It is now commonly considered to be inactive (Allen & Merlin 1993; Allen et al. 1992), after long being considered '*psilocybin*-latent' – that is, *psilocybin* is sometimes found, sometimes not (Ola'h 1968), possibly dependent on substrate. It is likely in some cases that positive laboratory assays have relied on inadequate identification of the compounds present, but it is questionable to assume that this applies to all positive results.

Panaeolina indica, P. rhombisperma, and P. sagarae have been reported to be psychoactive (Guzmán et al. 2000).

Copelandia cyanescens has a cap 1-3.5(-4)cm across, hemispheric to campanulate to convex at maturity; margin initially translucent-striate when wet, incurved only in young fruiting bodies, soon opaque and decurved, expanding in age, becoming flattened and often split and irregular at maturity; light brown at first, becoming pallid grey or nearly white, with centre remaining tawny brown, soon fading; cap cracking horizontally in age with irregular fractures; flesh readily bruising bluish. Stem (65-)85-115mm x 1.5-3(-4)mm, equal to bulbous at base, tubular; often greyish towards apex, pale yellowish overall, flesh coloured to light brown towards base; surface covered with fine fibrillose flecks, which soon disappear; partial veil absent; flesh readily bruising bluish. Gills adnexed-adnate, close, thin, with 2-3 tiers of intermittent gills; mottled greyish-black at maturity. Spores black, 12-14(-16) x 7.5-11(-12)µ, opaque, without granulations, lens-shaped to slightly hexagonal; basidia (2-)4-spored; pleurocystidia fusoid-ventricose, narrowing to acute apex, 30-60(-80) x 12-17(-25)µ; cheilocystidia 11-15 x 3-5(-6)µ, +- cylindrical, hyaline and thin-walled.

Scattered to gregarious in dung in pastures and fields; US [Hawaii, Louisiana, Florida], Mexico, Brazil, Bolivia, Philippines, Thailand, Australia [NT, Qld, NSW (east coast, north of Sydney)], and occasionally near Menton, France; also in many other semitropical zones (Stamets 1996; Young 1989; Young, T. 1994). Also recently confirmed growing in dung in cow pastures near Lorne, Victoria [Australia] (Bluemeanie pers. comm. 2002).

Most Panaeolus spp. and Copelandia spp. appear in spring or rainy seasons; most are coprophilic [dung-loving] and grow directly on dung [usually of cattle or horses]; some spp. grow in soil or in grassy areas [such as P. ater, P. castaneifolia and P. foenisecii]. Check your local mushroom guide for details, as some of these mushrooms are quite widespread.

Some authors and mycologists maintain Panaeolus campanulatus, P. papilionaceus and P. retirugis as separate species to P. sphinctrinus. The choice to treat them here as equivalent, as did Stamets (1996), is based on convenience rather than agreement with any particular taxonomic argument. Regardless, these species are very similar and variable in appearance.

PANAX

(Araliaceae)

Panax bipinnatifidum *Seem.* **(P. japonica var. bipinnatifidus** *(Seem.) Wu et Feng***; P. pseudoginseng ssp. himalaicas var. bipinnatifidus** *(Seem.) Li***)** – yü-yeh chu-chieh sêng ['feather-leaf bamboo ginseng'], double cut-leaved ginseng

Panax ginseng *C.A. Meyer* – jên-sêng, ren-shen, nin-sin, ginseng, chosen ninjin, korai ninjin, otane ninjin

Panax japonicum *C.A. Meyer* **(P. pseudoginseng ssp. japonicus** *Hara***)** – chu-chieh sêng ['bamboo ginseng'], Japanese ginseng, chikusetsu ginseng, chikusetsu ninjin, tochiba ninjin

Panax major *(Burkill) Ting* – ta-yeh san ch'i

Panax notoginseng *(Burkill) F.H. Chen* – san-ch'i ginseng

Panax pseudoginseng *Wall.* **(Aralia quinquefolia var. pseudoginseng** *(Wall.) Burkill***)** – san-ch'i, jên-sêng san ch'i, chin-pu-huan, han-san-ch'i, Himalayan ginseng

Panax quinquefolia *L.* **(P. quinquefolium** *L.***)** – American ginseng, hsi-yang-sêng, hua-ch'i-sêng, garent-oguen, a tali kuli

Panax stipuleanatus *H.T. Tsai et K.M. Feng* – pin-bin-san-chek, ye san qi, tu san qi, bai san qi, zhu jie qi

Panax trifolius *C.A. Meyer* – chikusetsu-ninjin, satsuma-ninjin, dwarf ginseng, groundnut

Panax zingiberensis *C.Y. Wu et K.M. Feng* – san-qi, jiang zhuang san qi, ginger ginseng

'Ginseng' [usually referring to P. ginseng], the revered root of the Orient, is believed to be the crystallised "essence of heaven and earth in the form of a man". The anthropomorphic form sometimes taken by older ginseng roots helped give rise to the view that they had potent medicinal properties, a view borne out in experience and modern pharmacological testing. The root has been reputed to "support the five visceral organs, calm the nerves, tranquillise the mind, stop convulsions, expunge evil spirits, clear the eyes, and improve the memory", as well as increasing longevity with daily use. Since ancient times in China, even a single wild ginseng root ['yeh-shan-sêng'] has fetched a very high price – the older and more anthropomorphic the root, the higher the fee. It is possible to obtain roots from plants hundreds of years old. Severe danger lay in store for the ginseng-collectors [known in China as 'va-pang-suis'], as the plant grew deep in forests in virtually inaccessible terrain, and the collectors also had to contend with bandits and wild animals. Today, the wild plant is virtually extinct, but is widely cultivated ['yuan-sêng'] in China, Japan, Korea and Russia. Although considered 'king of herbs' in TCM, the properties of ginseng were long doubted in the west, until recent scientific verification. Work in the west was slow as researchers were looking for alkaloids and other chemicals with specific, individual medicinal activities; it is now known that the compounds present in ginseng work synergistically, and present their pharmacological effects in a manner different to traditional western medicines; that is, the herb works as an adaptogen (Brekhman & Dardymov 1969b; Fulder 1993; Gillis 1997; Hu 1976; Huang 1993; Kimmens ed. 1975). In rural Japan, P. japonicum is used similarly to P. ginseng as a medicinal tonic for a wide array of ills, although contraindicated for pregnant women (Brussell 2004).

P. quinquefolia has been used by native North Americans to "strengthen mental processes", and to treat coughs, fever and headache. In the early 1700's, Europeans discovered the species growing in Canada, in similar habitat to P. ginseng in Asia. Shortly after, the trade in American ginseng exploded, as settlers wild-harvested the plant [which they called 'sang'] for export. Many of these people did not even use the herb themselves, or have any belief in its virtues, yet they knew that Chinese people would pay good money for it. As the boom in ginseng trade grew to epic proportions, plants were often harvested regardless of season or age, and in great quantity, wherever they could be found by those seeking a quick profit.

By the early 1900's, wild P. quinquefolia was virtually non-existent. Due to the poor harvesting practices and often inappropriate preparation used [eg. hasty drying], much of the later product was rejected anyway, by the Chinese customers. This is a prime historic example of the destructive abuse of a plant. Early attempts at establishing a domestic cultivation industry quickly failed due to a combination of pests and diseases, and the delicate growing requirements of the plants. Today, with greater experience, the species is again more widely cultivated, both in N. America and China, where its use has been adopted in TCM (Fulder 1993; Huang 1993; Kimmens ed. 1975).

Apparently ginseng has been used in folk medicine, alone or with other herbs, to treat opium addiction [see **Papaver**]. The effectiveness of this has been recently reflected in the laboratory; the ginsenosides of ginseng have been shown to have weak analgesic effects, and to prevent *morphine* tolerance in rats (Choi et al. 2000).

Ginseng on the marketplace comes in many varieties. The most desirable is usually considered to be red ginseng or Korean red ginseng ['kaoli-sêng' or 'hung-sêng'], which is the root of P. ginseng prepared by steaming the cleaned root for 3 hours prior to drying it in the sun or over a low fire. The more commonly available white ginseng is also from P. ginseng, but is of a pale yellowish-white colour, and is prepared by bleaching the cleaned roots with sulphur gas before sun-drying. Sometimes this process is taken further to produce sugared ginseng ['t'ang-sêng'], in which case the roots are next soaked in boiling water for 3-7 mins, before being pricked with needles in vertical and horizontal rows, soaked in a strong sugar-syrup for 10-12 hrs, and sun-dried. The last three points are repeated another 3 times before t'ang-sêng is considered ready. Chinese herbalists usually sell ginseng in thin slices – as the dried root is very hard, it must have its 'head' removed and be steamed to soften it for slicing. White ginseng may simply be wrapped in a moist towel for softening. Samples with a broad cross-section and a yellowish-brown colour are of higher quality than small, pale samples. Small, lateral rootlets are usually used separately to the main root, and are known as 'whiskers' ['hsü'], with various prefixes noting their grade and the manner in which they were prepared. These parts are less potent compared to the main root, and are usually used to constitute less-expensive ginseng products. The root hairs do sometimes contain higher levels of active compounds than the main root [see below], but the makeup is less diverse and thus they show a narrower profile of therapeutic activity. Other parts of the plant can also be used, and share some of the properties of the root.

The next most-used species are P. pseudoginseng and P. quinquefolia, which have similar but less-varied medicinal properties, and are cheaper – the latter, however, has shown greater potency in modulating neuronal activity than the Chinese species. Other species listed above are used locally as tonics, though not as effective overall as P. ginseng. Ginseng may be taken regularly without side-effects in the majority of people, though breaks of 1-2 months are recommended after 1 month of continuous [ie. twice daily] use. It may be used regularly without breaks by the elderly or the chronically ill. More should be taken during the winter, though it should not be taken if suffering from a cold, flu or lung infection. Some of ginseng's actions are enhanced by combining it with vitamin C [ascorbic acid]. It is considered incompatible with some metal utensils, as well as opiates, dairy products, tea [see **Camellia**] and coffee [see **Coffea**]. Ginseng may be decocted [traditionally in a silver vessel], though it is more convenient to simply chew and suck on several slices of the root. Effects are fairly rapid via this route, and are thus suitable for when one may need a cognitive and energy boost for a demanding task. In pharmacies and health shops, ginseng is usually available in the form of tablets, capsules or alcoholic extracts. The strongest preparations are often in the form of thick molasses-like extracts (Chuang et al. 1995; Fulder 1993; Hu 1976; Huang 1993; pers. obs.). Ginseng has been used as a tea by **Cannabis**-smokers to soothe the throat and 'clear the head' (Gottlieb 1993). Ginseng leaf tea is available in some Chinese supermarkets in England, claimed on the packet label to 'raise the spirits' (theobromus pers. comm.).

P. ginseng is anxiolytic; stimulates the immune system; regulates the CNS; relieves fatigue; enhances memory, learning, alertness and other cognitive functions; increases cerebral circulation; prevents or compensates for damage to the nervous and endocrine systems caused by stress; inhibits uptake of *dopamine*, *GABA*, *glutamate*, *norepinephrine* and *serotonin* in rat brain; increases rate of alcohol metabolism; acts as an aphrodisiac; stimulates liver function, including synthesis of RNA, DNA and vital proteins; strengthens the heart; helps prevent and heal stomach ulcers; balances hormone activity, protects and stimulates adrenal function; counteracts intoxication, and helps relieve hangover; is an antioxidant and free-radical scavenger; helps heal deformities of the cornea, especially clouding; regulates blood-sugar, blood pressure, and red and white blood-cell count according to the body's need; and shows some antitumour and anticancer activity in humans. It should not be combined with the pharmaceutical drug phenelzine, as headaches and tremor may result. P. notoginseng root has been used as a haemostatic, analgesic, antiinflammatory and tonic. P. zingiberensis root has been used as an analgesic and haemostatic; it has been shown to increase coronary blood flow, reduce blood pressure, and reduce the oxygen consumption of heart tissue. Occasional side-effects such as dry mouth, nausea, vomiting, nervousness, insomnia, and high skin temperature have been observed from ginseng use or abuse (Attele et al. 1999; Bhattacharya et al. 1991b; Brekhman & Dardymov 1969b; Fugh-Berman 2000; Fulder 1993; Gillis 1997; Hsu et al. 1986; Huang 1993).

Ginseng is completely safe in practical amounts. It has been estimated that a human lethal dose may be 2kg of root consumed at one sitting – this is 1,000-5,000 times the effective dose (Fulder 1993). A human fatality has been reported following consumption of 500ml of a 3% ginseng tincture, though the alcohol content of that dose would have been high (Bensky & Gamble 1993). Excessive use can cause adverse symptoms, however, such as excessive stimulation, insomnia, hypertension, headache, dizziness and itching (Gillis 1997; Huang 1993; Siegel 1979). Do not take continuously for more than 6 weeks at a time. Should not be taken with *caffeine*, or by pregnant women (Chevallier 1996). Some women may experience heavy and painful periods with regular ginseng consumption (theobromus pers. comm.).

P. ginseng root contains c.1-4.4% glycosidal triterpene steroid saponins called ginsenosides [concentrated in the outer layer of root (8% in one analysis), and especially in the 'tail' of the root], many based on 20-S-protopanaxadiol and 20-S-protopanaxatriol. Ginsenosides Rb1 and Rg1 play a large part in eliciting the CNS effects of ginseng, and they also prevent *hyoscine*-induced memory deficits by increasing cholinergic activity. In mice, ginsenoside Rb1 was found to "exert an anticonvulsive effect on *strychnine* poisoning" and "antagonise the shock syndrome produced by *cocaine* intoxication". Ginsenosides also compete with *GABA* receptor ligands as agonists. Four year-old plants were analysed as separate plant parts, for the presence of ginsenosides – leaves [1.078% Rg1, 1.52% Re, 1.11% Rd, 0.74% Rc, 0.55% Rb2, 0.18% Rb1; 5.19% total], leaf stalks [0.33% Rg1, 0.19% Rc, 0.14% Re, 0.11% Rd; 0.76% total], stems [0.4% Rb2, 0.3% Rg1, 0.07% Re; 0.76% total], main root [0.38% Rg1, 0.34% Rb1, 0.19% Rc, 0.15% Re, 0.13% Rb2, 0.09% Rf, 0.04% Rd, 0.02% Rg2; 1.35% total], lateral roots [0.85% Rb1, 0.74% Rc, 0.67% Re, 0.43% Rb2, 0.41% Rg1, 0.2% Rf, 0.14% Rd, 0.09% Rg2; 3.53% total], and root hairs [1.51% Re, 1.35% Rb1, 1.35% Rc, 0.78% Rb2, 0.38% Rd, 0.38% Rg1, 0.25% Rg2, 0.15% Rf; 6.15% total]. In general, root-branches and rhizomes contain saponin levels several times higher than the main root [8.28% and 6.23%, respectively, in one analysis]. The root has also yielded 0.05-0.5% essential oil, peptides, maltol [sedative – see **Passiflora**], small amounts of B-vitamins, folic acid, salicylic acid, vanillic acid, sugars, amino acids and minerals [including zinc, iron, manganese, copper, cobalt and vanadium]. Red ginseng contains mostly ginsenosides Rb1, Rb2, and Rc; this differs from white ginseng [which contains mostly Rb1 and Rg1, as well as lower total saponin levels], in that it contains virtually no malonylginsenosides, as the malonylginsenosides mRb1, mRb2 and mRc convert to Rb1, Rb2 and Rc, respectively, on heating. Maltol is believed to be formed in steamed [red] ginseng through transformation of maltose and an amino acid. The leaf and stem contain similar saponins to those in the root, the leaf in higher yield [up to c.12.2%]; flowers and buds have yielded 15% saponins; seed has yielded 0.7% saponins (Attele et al. 1999; Bruneton 1995; Chuang et al. 1995; Fulder 1993; Hsu et al. 1986; Huang 1993: Kubo et al. 1980).

P. japonicum root has yielded 13.6-20.6% saponins, including ginsenoside Ro, chikusetsa saponin II and chikusetsa saponin IV; P. japonicum var. major root has yielded 9.34% saponins (Huang 1993).

P. notoginseng root has yielded 5.3% ginsenoside Rb1, 3.9% ginsenoside Rg1, and ginsenoside Rd as the major constituents [up to 86% of total saponins]; 13.6-20.6% total saponins have been found. It comes in black or white varieties; the large, black roots are said to be the best quality (Chuang et al. 1995; Huang 1993).

P. quinquefolia root has yielded mostly ginsenosides Re [1.04%], Rb1 [0.26%] and mRb, as well as Rg1 [0.24%], Rd [0.095%] and Rc [0.063%]; total saponin content may range from 1.7-4.9%. Saponin levels are 1.5-5 times higher in wild varieties than in cultivated varieties (Chuang et al. 1995; Huang 1993; Soldati & Sticher 1980). Roots have also yielded 0.069% panaxytriol, 0.019% panaxynol, 0.018% panaxydol and 0.0093% falcarindiol, polyacetylenes which inhibit the production of nitrites by inducible nitric oxide synthase [see also **Siler**] (Wang et al. 2000).

P. zingiberensis root has yielded 12% saponins, mostly arasaponins A, B, C, D, E and R, which produce panaxadiol and panaxatriol on hydrolysis. Root extract shows more potent antiirradiation effects than other Panax spp. A standard dose of this herb is 1-1.5g, 3 times a day (Huang 1993).

Panax ginseng is a perennial plant to 60cm tall with a fleshy, persistent root; stems erect, terete, glabrous, smooth, slender, in cultivation 1 joint added annually; primary root attached immediately below short rhizome, thick, light yellow, with a rounded head, cylindrical or fusiform, often oblique, branched at lower end, 1-2.5(-5)cm diam. Leaves palmately compound, numbers affected by plant age (usually 1 for a 1-yr old, 3-6 for mature plants); leaflets (3-)5, upper 3 larger, almost similar in size and shape, oblong-elliptic or obovate, 4.5-15 x 3-5.5cm, lower 2 smaller, elliptic or ovate, 2-4cm long, apex acuminate, base cuneate, margin

serrate, sparsely ciliate, glabrous; petioles long. Peduncles scapose, terminal, 7-20cm long; inflorescence umbelliform, simple, containing 4-40 flowers; flowers small, 2-3mm diam.; sepals 5, green; petals 5, cream-yellow, ovate, apex obtuse; stamens 5, filaments short; anthers oblong-orbicular. Ovary inferior, 2-locular; styles 2, united at base; pistil 1; disc cup-shaped. Fruit a berry-like drupe, compressed-spherical, 5-9mm diam., many crowded forming heads, bright red at maturity; seeds 2, hemispherical, cream-white, 5-6 x 4-5mm. Fl. Jun.-Jul. (after 3rd or 4th year), fr. Jul.-Sep. (Hu 1976).

In mixed forest in humus-rich soil with broad-leaved and coniferous trees, in high mountains of n.e. China, Manchuria [Kirin Mts.] and Korea.

Wild ginseng is best gathered from Aug.-Sep., when fruits are red or leaves are yellowing; very old plants are more valued. The root is very carefully dug out, with soil being scraped aside with a bone-needle. Optimum climate for Kirin ginseng has temp. ranging from -10 to 10°C, annual rainfall 50-100cm. Cultivated ginseng is often grown in fields under shading frames, providing c.80% shade. This artificial shading is often accompanied by an increased need for the use of pesticides and fungicides, but usually gives a viable harvest from 3-4 years, with higher yields. Growing in forest conditions simulating the natural habitat, incorporating natural shading, gives a slower-growing crop taking 5-12 years to reach a harvestable state, but the herb is of higher quality. Also requires wind protection. Soil should be well-drained, of a light-medium texture; regular weeding is appreciated. Prefers 20-30mm water per week; soil should be kept damp, but not soaked; water in the evening. The roots will rot if the soil is too wet. Propagation from seed is in autumn, planting 30-60cm apart, up to 15cm deep; seed may lie dormant for at least 18 months after planting, and should be fairly freshly gathered. Germination is aided by keeping seed in moist sand at 8°C for 3 weeks prior to planting in the ground. Plants die back every autumn, returning in spring. The cultivated root is harvested in the same time period as wild roots, from [4-]6-7[-16] year-old plants, after dismantling the shading frame. Roots are generally cleaned of dirt, washed, and the finer rootlets removed, before they are processed; rootlets may be processed separately (Hu 1976; Huang 1993; Kimmens 1975; Whitten 1999).

PANCRATIUM

(Amaryllidaceae)

Pancratium maritimum *L.* – sea daffodil
Pancratium trianthum *Herb.* – kwashi, spider lily
Pancratium spp.

The genus name Pancratium translates roughly as 'all-powerful'. It has been suggested that Pancratium spp. [as 'chreston'] were used in the mystery rites of the early Christians. P. maritimum is believed to be the identity of the 'narkissos' flowers often featured in ancient Minoan art in sacred and sometimes seemingly shamanic contexts. By extension, it might also represent the narkissos picked by Persephone at the time of her abduction by Hades [see also **Narcissus**] (Webster et al. 2001). P. trianthum is used by Bushmen of Dobe, Botswana as a ritual entheogen. Often planted around shrines and other areas of sacred importance, the cut bulb of the plant is rubbed on an incision made on the forehead. The effects are felt more or less immediately, and are said to consist of vivid, colourful visions (De Smet 1996; Emboden 1979a; Schultes & Hofmann 1980).

P. arabicum has yielded lycorine, lycorenine, homolycorine, tazettine, haemanthidine [pancratine], *galanthamine* and sickenbergine (Ahmed et al. 1964).

P. biflorum has yielded lycorine, pseudolycorine, tazettine, pretazettine, *phenethylamine*, *tyramine* and *hordenine* (Lundstrom 1989; Martin 1987).

P. maritimum has yielded lycorine, lycorenine, homolycorine, demethylhomolycorine, haemanthidine, tazettine, *galanthamine*, sickenbergine, vittatine, *hordenine*, *tyramine*, N-methyltyramine, *phenethylamine* and 44 other alkaloids [0.2-0.42% alkaloids in bulb, 0.22-0.4% in rhizome, 0.12-0.3% in stem, 0.28-0.37% in seed, 1.1% in seed capsule] (Ahmed et al. 1964; Lundstrom 1989; Sandberg & Michel 1963).

P. sickenbergeri has yielded lycorine, homolycorine, tazettine, haemanthidine, sickenbergine and *galanthamine*.

P. tortuosum has yielded lycorine, tazettine, haemanthidine, *galanthamine*, vittatine and sickenbergine (Ahmed et al. 1964).

P. trianthum aerial parts yielded 0.39-0.42% alkaloids, and underground parts yielded 0.49-0.52% alkaloids, consisting of *galanthamine*, hippeastrine, tazettine, haemanthidine, lycorine, trispheridine, trianthine and *hordenine* (Dabire & Muravjova 1983; Martin 1987).

Pancratium spp. are known to be very toxic, and caution is advised. See also **Narcissus**.

Pancratium trianthum is a small, bulbous scapose herb with a basal rosette of strap-shaped leaves, linear, mostly appearing with the flowers. Flowers solitary, sometimes several together in scapes, bisexual, regular, white or greenish-white, in an umbel at the apex of an erect, solid leafless stem, subtended by 2 or more membranaceous bracts; perianth funnel-shaped, with a long tube and 6 narrow, spreading segments; stamens 6, united with a conspicuous coronal cup above their insertion at mouth of tube, filaments webbed with a corona. Ovary inferior or superior of 3 carpels with axile placentation; ovules many in each cell. Fruit a capsule; seeds few to numerous, black, often angular or winged.

In dry bushland; tropical w. Africa (Agnew 1974; Schultes & Hofmann 1980).

PANDANUS

(Pandanaceae)

Pandanus anataresensis *St. John* – kiinduur, agen, deair, kiiyen
Pandanus brosimos *Merr. et Perry* – bokuur, kuuriya, kosuuk
Pandanus julianettii *Martelli* – minaar, bidiip, daakhru, guubon, kaawaon, muaar, fuurok, arok
Pandanus odoratissima *L.* **(P. fascicularis** *Lam.***; P. tectorius** *Soland.***)** – jambuka, shivadvishta, indukalika, viphala, kazi, ketuki, keura, fara
Pandanus papuanus *Solms*
Pandanus utilis *Bory* **(P. candelabrum** *Hook.***; P. distichus** *Hort.***; P. elegantissimus** *Hort.***; P. flabelliformis** *E. Carr.***; P. maritimus** *Hort.***; P. mauritianus** *Hort.***; P. odoratissimus** *Jacq., non L.***; P. sativus** *Thou.***; P. spiralis** *Oudem., non R. Br.***; P. spurius** *Miq.***)** – vacoa
Pandanus spp. – screw pines

In Papua New Guinea, the Nangamp of the Wahgi region, and natives of the neighbouring Chimbu region, eat the nuts from some Pandanus spp. to induce a psychotropic state known as 'karuke madness'. In these cases, P. papuanus is believed to possibly be one of the species used. The Wopkaimin near the Ok Tedi region are also known to partake, with whole villages periodically going into 'hysterical excitement'. The condition, sometimes also called 'kapipi', occurs during the Pandanus fruiting season [Sep.-Jan., though P. anataresensis fruits all year]. About 1 hour after eating large quantities of the nuts, some small percentage of the people become restless, excited, and sometimes dangerous to themselves or others. Some people under the influence have been reported as falling from rope bridges and drowning, due to the degree of the intoxication. The eyes are said to become glazed and the user experiences ecstatic visions. As the drug wears off, the user falls into a dazed state, with froth at the mouth and disturbed equilibrium, and a good-humoured mood with 'unwarranted' laughing leads them into a deep sleep. The whole experience is said to last up to 12hrs. The tree responsible is said to probably be a mountain species of Pandanus, all of which grow near Ok Tedi. It may be that more than one species is used. The Wopkaimin have a highly elaborate classification system for their many Pandanus spp. Their men plant and maintain their own specimens of P. julianettii and other species, even marking their trees to keep others away. Pandanus spp. have many other uses – the nuts are usually eaten raw or roasted as food, or pressed for their edible oil. Some are used for their wood in building huts, and torches are sometimes made from the prop-roots. P. anataresensis is used in magic medicine bundles to combat fever, headache, diarrhoea and laboured breathing. As a symbol of semen, its leaf fibres [along with those of P. adino-

botrys, symbolising male blood] are woven with clay into the hair of initiates to make a ceremonial head-dress for male initiation (Bock unpubl.; Hyndman 1984; Reay 1960; Stopp 1964).

The Bimin-Kuskusmin of West Sepik, PNG, use P. anataresensis, P. brosimos and P. julianettii nuts in the 12 stages of their initiation rites, each with a different name for each stage. The nuts are consumed along with other psychoactive plants [and others of unknown pharmacology], in conjunction with a major plant [see *Endnotes*, **Nicotiana**, **Boletus**, **Kaempferia** and **Psilocybe** for more discussion]. Pandanus nuts are associated with female bird-spirit messengers. Nuts of P. anataresensis and P. julianettii are sometimes eaten in ritual circumstances by women, mixed with **Ipomoea** batatas ['sweet potato'] flowers and **Boletus** mushrooms. These nuts are also sacramentally placed under ritual types of cultivated tobacco [see **Nicotiana**], in order to attract nurturing spirits to the latter plant (Poole 1987). Some tribes in PNG will plant a Pandanus tree to magically strengthen a sick person in their village (Paijmans ed. 1976).

Pandanus spp. are important to many aboriginal groups in northern Australia. The leaves are much used as fibre material for making baskets and many other items. The nuts [after dropping to the ground], the fleshy bases of ripe fruit, and soft inner new leaves are eaten as food. The seeds inside the fruits may be eaten raw or roasted. The base of the leaf of P. spiralis is chewed and swallowed to treat sore throat or mouth pain; it has antiseptic, counter-irritant and anodyne activity. The Ngarinyman recognise two varieties of P. spiralis – one which grows along creek lines, and one which grows on sandy flats. The prop-roots of the former variety are decocted and used to treat scabies. A strained decoction of the leaf bases of the latter variety is used as eye-drops, to relieve sore or tired eyes. At Roper River, the nuts are crushed and left in water to ferment, producing a presumably intoxicating alcoholic drink. The Lardil, of Mornington Island in the Gulf of Carpenteria, have a strict ownership of individual Pandanus trees, which they mark with knotted leaves – ignoring this sign may result in retaliation by sorcery (Aboriginal Communities 1988; Isaacs 1987; Smith et al. 1993).

In Tanganyika and Zanzibar, Africa, the aromatic inflorescence of a Pandanus sp. is used to drive out evil spirits from the insane (Watt & Breyer-Brandwijk 1962). In India, Pandanus spp., especially P. odoratissima, are revered for the sensual scent of their flowers. Buddhist cave paintings of Pandanus spp. [probably representing P. odoratissima] in India date back to 5AD (Payak 1998). P. odoratissima is used in Ayurvedic medicine – the leaves are considered aphrodisiac and tonic, treating brain and heart disorders, leucoderma, fever, pain, small pox, scabies, syphilis and leprosy. The oil of the plant is stimulant, antispasmodic and diaphoretic, and is said to "cool and strengthen the brain". The anthers and bract-tips may also be snuffed to treat epilepsy (Kirtikar & Basu 1980; Nadkarni 1976). In Seychelles, aerial roots of P. utilis are decocted to prepare an aphrodisiac beverage (Rätsch 1990).

One researcher bioassayed a sample of roasted Pandanus sp. nuts said to lead to 'karuke madness', eating up to ½ a pound [roughly 230g], which he stated to be more than 10 times the suggested dose. He experienced no effects other than nausea and gastric disturbance, which led him to conclude that the 'karuke madness' was psychosomatic and consisted of some kind of socially-conditioned hysteria (Stopp 1964). This should be considered a premature assumption, though not one to be ruled out entirely. It seems more likely to me that a) the nuts may be quite variable in chemical content, and b) any intoxication might require an even larger amount of said nuts than Stopp had eaten. If Stopp [and my translation of his article] was accurate in reporting the suggested dose, this would mean a mere 23g or so of roasted nuts – which seems to be far from the 'large quantities' usually reported to be eaten for psychotropic effects. It may be [as has been proposed with **Boletus** and the accompanying 'mushroom madness'] that other plants are consumed with the nuts to result in the desired effects, through some chemical interaction similar to that seen with ayahuasca [see **Banisteriopsis**, *Methods of Ingestion*].

Unidentified Pandanus sp. nuts from Minj, New Guinea, were shown to contain small amounts of *DMT*, as well as other unidentified alkaloids (Hyndman 1984).

P. amaryllifolius leaves yielded traces of pyrrolidine lactone alkaloids – pandamarilactonines A & B, and norpandamarilactonines A & B (Takayama et al. 2001).

P. odoratissima nut cores tested tentatively positive for the presence of *DMT*, *harmine* and another β-carboline; these compounds were not detected in the fibrous outer layer of the nut (Heffter 1996; Trout ed. 1997d). Ripe fruit also contains an essential oil [0.02% w/w] consisting mainly of geranyl acetate [27.5%], 3-methyl-3-buten-1-yl-cinnamate [17.1%] and 3-methyl-3-buten-1-yl-acetate [10.1%], with traces of *eugenol* [0.1%] and α-humulene [0.1%]; as well as sterols, fatty acids and amino acids (Vahirua-Lechat et al. 1996).

P. utilis [from Madagascar] nuts have been shown to contain *DMT* as the major component, as well as other indole compounds that were tentatively identified as *N-methyltryptamine* and *harmine*; in another assay, only *harmine* was tentatively observed (Heffter 1996; Trout ed. 1997d).

Nuts of edible Pandanus spp. can be quite nutritious, being high in protein, carbohydrates, fibre and fats (Hyndman 1984).

Pandanus odoratissima is a dioecious shrubby tree to 6m tall, rarely erect; stems much branched, stems and branches winged with distinct leaf scars; aerial roots present, usually in the form of prop roots, supporting the stems. Leaves glaucous-green, 0.9-1.5m long, in 4 rows, spiralled, crowded towards apices of stems or branches, simple, linear, ensiform, caudate-acuminate, coriaceous, bases sheathing, margins recurved, margins and midrib prickly, marginal spines pointing forward or backward. Inflorescences dense, pedunculate spikes with large spathe-like bracts; flowers very reduced, unisexual; perianth usually absent. Male spadix with numerous subsessile cylindric spikes 5-10 x 2.5-3.8cm, formed by stamen filaments fused into a column, enclosed in long white fragrant caudate-acuminate spathes; staminal column 6-13mm long; anthers longer than slender filaments, cuspidate, inserted along whole length of upper portion. Female spadix solitary, 5cm diam., spikes pedunculate; with 1-locular, superior ovary sometimes confluent with adjacent ovaries to form a cylindroid mass of obpyramidal groups of 6-10 or fewer; stigmas separate or united, short, reniform, yellow; ovules solitary to many, basal or parietal; carpels united into hard, smooth phalanges, aggregated on a thick rachis forming a syncarp when mature. Fruit an oblong or globose syncarpium 15-25cm long and wide, yellow or red; individual fruit a drupe, numerous (50-60), usually woody, bright red, orange or yellow when ripe, often 2- or 3-toned, each consisting of 5-12 carpels; carpels 5-7.5cm long, turbinate, angular, the crown smooth, convex, +- depressed round the reniform stigmas; seed solitary.

Sea coast of the Indian Peninsula on both sides, Andamans (Harden ed. 1990-1993 [for some genus detail]; Kirtikar & Basu 1980).

Pandanus utilis is a tree to 20m tall, branched. Leaves 50-75cm x c.8cm, firm, erect, glaucous, with red spines. Male inflorescence simply branched, spathe broad, shortly subtended, spike 10-20cm long; stamens in long, slender umbellate columns; anthers linear, filaments of equal length. Stigmas sessile, reniform, flat, 2-2.5mm wide. Fruit a solitary syncarp, 15cm diam., trigonous-globulose, pendulous, long-pedunculate; drupes c.100 in syncarp, 3-8-locular, 3-3.5cm long, 2-3cm wide, free from middle, upper part convex, pyramid-shaped, lower part mostly prismatic, scarcely narrowed, base truncate, apex not areolate but truncate and +- sulcate; endocarp arranged below middle of drupe, mesocarp fibrose-medullary.

Madagascar, cultivated in Mauritius, Bourbon, West Indies and C. America, as well as a household ornamental plant for indoors and greenhouses (Engler 1900).

P. utilis should be grown in a sunny position; prefers 18-29°C temp., 25% or more relative humidity. Propagate from seed or offsets. Let surface of soil dry out between waterings. Bring inside for winter months, in non-tropical areas. Commonly suffers from mealybug infestations of leaf nodes and axils (pers. comms.).

PAPAVER

(Papaveraceae)

Papaver albiflorum *(Bess.) Paczoski*
Papaver armeniacum *(L.) DC.* **(P. roopianum** *(Bordz.) Sosn.***; Argemone armeniaca** *L.***)**
Papaver bracteatum *Lindl.* **(P. orientale var. bracteatum** *Ledeb.***)** – oriental poppy, great scarlet poppy
Papaver cylindricum *Cullen*
Papaver decaisnei *Hochst. et Steud.*
Papaver fugax *Poir.* **(P. caucasicum** *M. Bieb.***)**
Papaver oreophilum *Rupr.*
Papaver orientale *L.* **(P. intermedium** *DC.***)** – oriental poppy
Papaver pavoninum *Schrenk*
Papaver rhoeas *L.* **(P. orientale var. intermedium** *(DC.) Grossh.***; P. strigosum** *(Boenn.) Schur***)** – field poppy, common poppy, red poppy, lal-poshta, rakta-posta, hexe, amapola, amapola de China
Papaver setigerum *DC.* **(P. somniferum ssp. setigerum** *(DC.) Corbiere***)** – wild opium poppy, wild setaceous poppy, small-flowered opium poppy
Papaver somniferum *L.* – opium poppy, white poppy, carnation poppy, amapola, amapola de opio, sclafmohn, khas khas, abiphena ['serpent's foam'], aphim, ophim, ying-su-qiao [seed pods in TCM]
Papaver tauricola *Boiss.*
Papaver triniaefolium *Boiss.*
Papaver spp. – poppies

Poppies are well known to all as popular ornamentals, but the best known is P. somniferum, source of medicinal and narcotic alkaloids [concentrated in 'opium', the dried and sometimes processed latex from the seed pods], as well as the commercial poppy seeds used in cooking. This species, now considered a cultigen, was originally derived from P. setigerum, probably in the n. and w. Mediterranean region. It has a long and rich history of use for purposes of analgesia and intoxication, properties which have been known for millennia. The medicinal use of poppy capsules was mentioned in the Egyptian Ebers Papyrus [c.1550BC].

The Egyptians regarded it as a sacred plant for priests, warriors and magicians. The Assyrians, Greeks, Romans, and later the Arabs and Indians, all grew and used the herb, and depicted it in their artwork and artefacts of religious significance. Extracts of the mature plant were often mixed with wine and other herbs for consumption [see *Methods of Ingestion*; note that combining opiate alkaloids with alcohol can be a risky and potentially deadly affair]. Persian coffee-houses [see **Coffea**] once sold a poppy decoction called 'kokemaar', which was drunk as hot as possible and produced a 'violent' intoxication. The Greeks usually chopped the poppy heads and infused them in water or wine, the mixture being called 'mekoneios' ['flavoured with opium']; opium itself was called 'mekoneion'. Many cultures across Eurasia held it sacred, and respected its powerful pharmacological actions. This certainly aided in the rapid spread of its cultivation. One of its current strongholds is the Golden Triangle region of s.e. Asia, which supplies much of the world with opium for the production of heroin [diacetyl-*morphine*, a semi-synthetic drug]. The indigenous peoples who are induced to grow it for sale cannot rightly be blamed, though, due to their forceful exploitation. Many of them smoke opium traditionally, and many are chronic users [or addicts]. Shamans of the Miao in the Triangle smoke it before and during their trance rituals. In India, P. somniferum enjoys the usual array of medicinal and narcotic uses, but the seeds, mixed 2:1 with wild lettuce seeds [see **Lactuca**], are mixed with water, and the extracted mucilage mixed with sugar and taken for insomnia. Hakims used it as an aphrodisiac "believed to lengthen the time of seminal discharge during coitus, but the drug after a temporary stimulation diminishes sexual desire and causes impotence" (Anderson 1993; Emboden 1979a; Kapoor 1995; Nadkarni 1976; Pendell 1995; Rätsch 1992; Von Bibra 1855). In Nepal, Kirati shamans sometimes use opium for shamanic travel, and believe it to be "directly connected to the Seti Naga, one of the eight sacred snakes of the underworld" [see **Naja and Ophiophagus**]. It is also used medicinally to treat all kinds of poisoning, and is an offering to Shiva (Müller-Ebeling et al. 2002).

In Germany, P. rhoeas has been known as 'hexe', denoting an association with witches (De Vries 1991). In 1735, an Irish herbalist [k'Eogh] recorded that P. rhoeas is "cooling and refreshing...By drinking a decoction of five or six heads in wine, pain is alleviated and sleep is induced... the bruised leaves of the green heads can be applied to boils, hot ulcers, and burning fevers" (Chevallier 1996). P. rhoeas has been used medicinally as a sedative, soporific, antitussive and emollient (Chiej 1984), and in India the capsule latex is considered to be a narcotic and mild sedative (Nadkarni 1976).

Although the Chinese have been cultivating P. somniferum since at least 1057AD, it was generally for ornamental and food purposes [ie. seeds]. They imported opium from India since at least the 13th century for medicinal use. By the 19th century, opium smoking had been introduced to China, who tried to outlaw its importation by the British, leading to the Opium Wars [which still occur today, with some different players...] (Emboden 1979a; Kapoor 1995). The politics of poppy cultivation, opiates and the heroin trade [and heroin use] are very complex for the naïve, and are beyond the scope and intentions of this book. It should be said that the detailed discussion of opium and its use here should not in any way be taken to be an endorsement of heroin.

Morphine content of P. somniferum latex does not reach its peak until 15-21 days after the petals have fallen from the seed-pods [capsules], and does not fall significantly after that, even in dried pods. At this point the rays on top of the pod will probably be beginning to curve upwards, and the colour of the pod starts to become whitish and glaucous. This is the best time to 'lance' the pods for opium collection. Lancing should be done with a fine, sharp blade, preferably taped or guarded so that only about a 1mm edge emerges. If the walls of the pod are pierced completely, the latex bleeds inside the pod and is essentially lost for this purpose. The blade should pierce the outer skin, though, which allows the latex to bleed externally. Cutting methods tested to be most efficient for yield were either a single vertical incision, or the 'Turkish spiral cut', beginning at the top and spiralling around the pod to the bottom in one long incision. With the vertical methods, subsequent lancing can be made a few days later – however, longer cuts initially reduce the *morphine* content of the subsequent lancings. The first lancing is apparently the only one to contain *papaverine*, and is preferred. Lancing is preferably done in the evening, and the latex is scraped from the pods when it has congealed and turned a dark brown colour, preferably before 8am the next morning. However, in India, lancing is done after midday, so that the hot sun quickly dries a skin on the latex and it is less likely to be lost [alkaloids are also highest between midday and 4pm], although low in *morphine* content at this time – see below. This congealed latex is opium. Opium may be smoked or decocted as is, or it may be prepared for smoking in a form known as 'chandu' (Kapoor 1995; Pendell 1995; pers. obs.).

One way to make chandu is to dissolve the raw opium in boiling water, which is then filtered and concentrated. The concentrate is gently roasted until it becomes brittle – it is then extracted first with cold water, then again with warm water. The extracts are combined and concentrated until reaching c.25% moisture content, and then packed into sealed earthenware jars to age before being ready for smoking. During this stage, it may be attacked by **Aspergillus** fungi which could potentially add to the strength and toxicity of the chandu (Bock & Voogelbreinder in press; Pendell 1995).

A crude opium extract can be prepared simply by boiling finely chopped mature poppy heads in water, then filtering and concentrating the extract. However, it has a greater content of moisture and plant 'gunk' [chlorophyll, sugars etc.] that render it less efficient for smoking purposes. Opium is often simply mixed with **Nicotiana** or **Cannabis** and smoked in a pipe [usually a water pipe], but it is most efficiently utilised with vapourisation, usually requiring a specialised glass pipe or similar improvised device [see *Methods of Ingestion*]. The charred black residue left in the pipe after a smoking session is called 'dross', and is sometimes scraped out and re-smoked – it contains less *morphine*, but more of the secondary alkaloids that are more stupefying in effect. The leaves and dried pods can also be smoked, for a milder effect. Opium and poppy parts can be decocted in water and drunk, though care must be taken with dosage. With good opium, for oral consumption, a lump around the size of a small pea should suffice, but practice may be needed to find an optimum dose. Opium can also simply be swallowed. Tender leaves and petals are tasty and fairly harmless eaten in salads (Pendell 1995; pers. obs.).

'Laudanum' ['tinctura thebaica'] is a tincture of opium, though the term originally referred to a solid extract. The first fluid preparations of laudanum used canary wine as the solvent, and in addition to opium, contained saffron [see **Crocus**] and other herbs (Kapoor 1995). The laudanum known in modern medicine is made using opium dissolved in 70% alcohol, adjusted to contain c.1% [w/v] anhydrous *morphine*; it is used in doses of 0.3-2ml (Martindale 1952).

Opium and the opium poppy [P. somniferum] are narcotic, sedative, hypnotic, analgesic, euphoriant, sudorific, antispasmodic, antitussive and cause constipation [thus relieving diarrhoea]. Higher doses cause nausea, vomiting, weak and rapid pulse, constricted pupils, thirst, cold skin and eventual sleep or coma – death may occur through respiratory and circulatory depression. A lethal dose may be as low as 300mg of opium in some individuals, although tolerances differ between people, and addicts can tolerate higher doses. Continual use usually causes both physical and psychological addiction (Chevallier 1996; Chiej 1984; Morton 1977; pers. obs.). Seeds of P. somniferum have shown some anticancer properties (Aruna & Sivaramakrishnan 1992).

P. albiflorum has yielded *thebaine*, *protopine*, allocryptopine, berberine [AChEI], corytuberine and other alkaloids (Onda & Takahashi 1988; Preininger 1986; Ulrichová et al. 1983).

P. armeniacum has yielded *thebaine*, *protopine*, armepavine, coptisine [AChEI], cryptopine, palmatine, sanguinarine [AChEI] and other alkaloids (Preininger 1986; Ulrichová et al. 1983).

P. bracteatum contains [w/w] up to 2.73-4.57% *thebaine* in its capsules; content increases with plant age [highest (1.7% dry) c.8wks after beginning flowering, 6wks after petals drop]. Roots [collected early in flowering period] have also yielded 0.7-1.3% *thebaine*. Iranian strains [where the plant is native] yield only 2 alkaloids, mostly *thebaine*, as well as alpinigenine; Turkish pods yielded 0.3% *thebaine* and 0.225% salutaridine. Other alkaloids found include isothebaine, *codeine*, orientalidine, oripavine, neopine, *nuciferine*, *protopine*, coptisine, oxysanguinarine and alpinine. This ornamental is a prohibited plant (Aynehchi & Jaffarian 1973; Corrigan & Martyn 1981; Nyman & Bruhn 1979).

P. cylindricum has yielded *narcotine*, *thebaine*, armepavine, *papaverine* and other alkaloids (Preininger 1986).

P. decaisnei is the only poppy other than P. setigerum and P. somniferum shown to yield *morphine*, and it also contains *codeine*, *narcotine*, *papaverine*, *protopine* and *thebaine* (Preininger 1986).

P. fugax has yielded *narcotine*, *nuciferine*, *protopine*, *thebaine*, armepavine, aporheine, chelerythrine [AChEI], coptisine, palmatine, sanguinarine and others (Preininger 1986; Ulrichová et al. 1983).

P. orientale may contain [w/w] 0.001-3.08% *thebaine* in its capsules, and 0.01-0.95% in stems, with lesser amounts in the leaves. 'Goliath' cultivars are generally more potent (Aynehchi & Jaffarian 1973; Corrigan & Martyn 1981). Different chemotypes have been found – of 5 types from Iran analysed, A yielded [from dry seedless capsules] 1-1.25% oripavine; B yielded 0.8-0.88% oripavine and 0.1-0.4% *thebaine*; C yielded 0.5% oripavine and 0.3% isothebaine; D yielded 0.5% oripavine and 0.3% alpinigenine; and E yielded 0.8-1.2% oripavine, 0.3-0.35% *thebaine* and 0.05% alpinigenine (Shafiee et al. 1977). The plant inhibits human plasma AChE (Orgell 1963b). This ornamental is a prohibited plant in some places. A nursery in Victoria [Australia] was recently raided by police for possessing the plant for sale – they had been unaware of its illegality, being a popular cottage ornamental (Arnold 1996).

P. oreophilum has yielded *nuciferine*, *protopine*, *thebaine*, sanguinarine, allocryptopine, berberine, magnoflorine [see **Magnolia**] and other alkaloids (Preininger 1986).

P. pavoninum has yielded 2-methyl-1,2,3,4-tetrahydro-β-carboline, from the whole plant (Shulgin & Shulgin 1997), as well as allocryptopine, coptisine, papaverrubines D & E, *protopine*, rhoeadine and sanguinarine (Preininger 1986).

P. rhoeas has yielded *protopine*, *thebaine*, allocryptopine, berberine,

coptisine, sanguinarine and other alkaloids (Onda & Takahashi 1988; Preininger 1986); root has yielded 6-MeO-2-methyl-1,2,3,4-tetrahydro-β-carboline [2-methyl-*pinoline*]. P. rhoeas var. chelidonioides has yielded 2-methyl-1,2,3,4-tetrahydro-β-carboline (Shulgin & Shulgin 1997). Flower petals from P. rhoeas contained anthocyanins, but no alkaloids; a 10% ethanol extract [given i.p.] showed sedative effects in mice (Soulimani et al. 2001). In tissue culture, callus tissue from the plant was shown to contain *morphine*, *thebaine* and *narcotine* (Khanna & Sharma 1978).

P. setigerum contains a similar group of alkaloids to P. somniferum, including *morphine*, but yields lower quantities of a less-potent sap (Preininger 1986). Capsules have yielded 0.11% *morphine*; 0.045% in leaf; 0.05% in stem; and 0.03% in root (Kleinschmidt 1958). A prohibited plant, sometimes growing as an escaped weed.

P. somniferum, like other poppies, contains a wide array of alkaloids, mostly of the isoquinoline class. The chief component in mature plants, concentrated in the latex, is *morphine*, followed by *codeine* and *papaverine*, and also containing *thebaine*, allocryptopine [anaesthetic], berberine [respiratory stimulant, sedative, hypotensive, AChEI], coptisine [antimicrobial, AChEI], corytuberine [respiratory stimulant, retards pulse, increases reflex excitability in frogs], cryptopine [skeletal relaxant, respiratory stimulant, hypotensive – similar to *papaverine* and berberine], gnoscopine, isoboldine, isocorypalmine, laudanidine, laudanine [similar activity to *strychnine*], laudanosine [causes agitation, incoordination, convulsions], magnoflorine, narceine [stimulates respiration, antitussive, hypotensive], *narcotine*, *protopine*, reticuline, sanguinarine [adrenolytic, local anaesthetic, AChEI], somniferine and other alkaloids, as well as nor-, pseudo-, oxy- and other derivatives of some of the above. It also contains meconic acid, glucose and fructose (Brochmann-Hanssen & Nielsen 1966; Kapoor 1995; Preininger 1975; Preininger 1986; Rastogi & Mehrotra ed. 1990-1993; Ulrichová et al. 1983). The 'Norman' strain developed by Australian scientists, as well as other recently developed strains, contain predominantly *thebaine* and oripavine, which are extracted and used as precursors for medicinal opioid drugs (Fist et al. 2000). The 'Norman' strain now comprises a large portion of Tasmanian poppy crops. This is presumably partly due to the frequent 'poaching' of poppy heads from the peripheries of plantations, by locals and visitors to this island state (pers. comms.). Oripavine and *thebaine* are much more toxic and less psychoactive than *morphine* or *codeine*, though as far as I am aware, there have not yet been any reports of accidental toxicity from human ingestion of crude extracts from such strains.

In P. somniferum, terminal capsules contain the most *morphine*; *morphine* content rises rapidly at first, then levels off as the capsule approaches maturity [about 40 days after flowering], yielding up to 7.5% *morphine*, up to 1.5% *codeine*, up to 2.4% *papaverine*, up to 0.95% *thebaine* and up to 2.7% *narcotine* – though the values are usually much lower (Bernáth et al. 1988; Tookey et al. 1976). Alkaloid levels also may fluctuate widely over the period of 1 day. In general, *morphine* levels are highest at early morning [pre-sunrise], late morning, and evening, being lowest at midday and afternoon, as well as night. *Thebaine* levels tended to increase towards midday, as did *codeine* levels, but patterns of variation were wide (Fairbairn & Wassel 1964). It is usually stated that the seeds do not contain opium alkaloids, but many strains have been shown to contain traces of *morphine*, *codeine* and other alkaloids. Indian P. somniferum seeds [off-white in colour] yielded 0.0175% *morphine*, 0.0043% *codeine*, 0.0041% *thebaine*, 0.0067% *papaverine* and 0.023% *narcotine*; slate-blue seeds from the Netherlands yielded only 0.004% *morphine*, 0.00019% *codeine*, 0.0001% *thebaine*, 0.000017% *papaverine* and 0.000084% *narcotine*. I know many people who have successfully decocted a 'poppy wash' from the seeds and consumed it, although dosage is harder to predict, and unpleasant side-effects are often more predominant (Paul et al. 1996; Pendell 1995; pers. obs.). There is a strong possibility that the alkaloid content measured in seeds derives from traces of opium clinging to the seed-surface. P. somniferum is a prohibited plant in most countries, though its cultivation is rarely interfered with except if plants show signs of lancing for latex.

Opium from P. somniferum may contain 3-38.4% *morphine*, 0-8.8% *papaverine*, 0.2-8% *codeine*, 0.75-11.9% *narcotine* and 0-3.2% *thebaine* (Anderson 1993; Bernáth et al. 1988; James 1950; Von Bibra 1855).

P. tauricola has yielded *narcotine*, *nuciferine*, *protopine*, *thebaine*, armepavine, cryptopine, palmatine and other alkaloids.

P. triniaefolium has yielded *nuciferine*, *papaverine*, *protopine*, *thebaine*, armepavine, coptisine, palmatine, sanguinarine and other alkaloids (Preininger 1986).

Papaver somniferum is a bluish-green erect annual herb to 1m or more high, with milky sap or latex in all parts; root a shallow branching taproot, with many branching laterals; stems robust, smooth, hollow, with scattered stiff hairs. Leaves alternate, obovate-lanceolate, 5-18cm long, margins sharply but unevenly toothed and wavy, with bristle-pointed lobes; tapers to a stalk-like base; forms a dense rosette when young; stem leaves sessile, ovate, 3-10cm long, shallowly lobed, base heart-shaped, clasping the stem. Inflorescence often much branched, with long erect stiffly bristled stalks; flowers solitary, 4-5cm diameter; sepals 2(-3), cupped, shed as the flower opens; petals 4, rounded, overlapping, delicate, coloured either white, or pale lilac to pink with a darker spot at the base; stamens many. Fruit a globose capsule, glabrous to glaucous, dull or bluish-green, straw-coloured when dry, 2-5cm diameter, with 7-10 or more persistent ray-like ridges at apex; ripe fruit opens by pores beneath the ridges. Seeds usually dark brown to black, numerous, minute, covered with a fine network of veins, kidney-shaped on close inspection.

Almost worldwide in warm temperate zones, cultivated or as an escaped weed. P. setigerum also occurs as a weed, and is distinguished by its smaller stature, and smaller, much more slender capsules.

Seeds germinate in late autumn or early winter; stems appear in early spring; flowers late spring to summer, continuing until plants die in autumn [if moisture is still applied] (Chiej 1984; Parsons & Cuthbertson 1992; pers. obs.). Sow seeds where they are to grow, and keep soil moist. Seedlings emerge in around 10 days and are delicate, and the opium poppy does not transplant well. They enjoy moderate to full sun, and a well-drained manured or composted soil. Preferred soil pH is 7. Phosphorous is important in early growth, and nitrogen later, improving the quality and yield of latex. Boron is also necessary, and sodium in small concentrations may increase *morphine* levels. Plants should be thinned out, selecting the most vigorous to remain, when still small. Poppies are cold-resistant, but sensitive to frosts, and do not tolerate heavy rain and strong, drying winds (Kapoor 1995; Morton 1977; Pendell 1995). Tropical conditions with high light levels and heat have been shown to increase alkaloid production in P. somniferum (Bernáth et al. 1998).

PARMELIA

(Parmeliaceae)

Parmelia conspersa *(Ehrh.) Ach.* **(P. subconspersa** *Nyl.***; Lichen conspersus** *Ehrh.***; Xanthoparmelia conspersa** *(Ehrh. ex Ach.) Hale***)** – jevud hiosig, earth flower, peppered rock shield

Parmelia karatschadalis – silavalka, charela, phathar-ke-phul, davala, hinna-i-korisha, stone flower, rockmoss, yellow lichen [all names for this and the three species directly below]

Parmelia paraguariensis *Lynge* – duftfletche ['fragrant lichen']

Parmelia parietina *L.* – common wall lichen

Parmelia perforata *(Jacq.) Ach.* **(Parmotrema perforatum** *(Jacq.) A. Massal.***; Parmotrema reticulatum** *(Taylor) M. Choisy***)** – perforated ruffle lichen

Parmelia perlata *(Huds.) Ach.* **(P. trichotera** *Hue***; Lichen chinensis** *Hale et Ahti***; Parmotrema chinense** *(Osbeck) Hale et Ahti***; Parmotrema perlatum** *(Huds.) Choisy***)** – powdered ruffle lichen, shaileyam, shilapushpa, ushna

Parmelia sulcata *Taylor* – waxpaper lichen, net-marked Parmelia, powdered shield lichen, hammered shield lichen

Parmelia spp. – lichens

P. conspersa [and possibly other unidentified lichens] is considered potently magical and sacred by the Pima and Papago of s. Arizona and n.w. Mexico. It is believed to confer luck in matters ranging from hunting to love. In one of their legends, a cannibal monster is overpowered by cigarettes made from this lichen. Mixed with tobacco [see **Nicotiana**] and smoked in cigarettes, it reputedly "makes young men crazy" and dizzy. Its 'narcotic' effect has been described as similar to that of **Cannabis** (Lipp 1995; Sharnoff undated, citing Curtin 1984). The lichen may also be used to make a yellow dye (Smith 1921). Other unidentified lichens used by the Mojave and Kiowa are reported to have similar properties (Kumar & Upreti 2001). In the New Mexico region, an unidentified grey lichen is boiled "and given to one who talks and laughs to himself", or for headaches (Sharnoff undated, citing Curtin 1974). In Mauritania, P. paraguariensis is imported from the north and smoked by men, crushed with tobacco [1 part lichen to 10 parts tobacco]. It is also burned as an insect repellent. Although normally odourless, it is soaked in fragrant substances including rose oil, and used by women as a powdered perfume (Lange 1957).

P. molliuscula sometimes causes poisoning in sheep and cattle who eat it when other food sources are scarce, resulting in paralysis, and sometimes death (Turner & Szczawinski 1991). In the Canadian Rocky Mountains, bighorns have been observed feeding habitually on a yellowish-green rock-dwelling lichen, the identity of which was not divulged. It was also said that "local Indians...found the lichen to be a narcotic." Of the sheep, it was also said "small ewes have been observed repeatedly leaving the group to scrape this lichen off the rocks with their teeth. The habit becomes so tenacious that the animals wear down their teeth to the level of the gums" (Siegel 1989).

Parmelia spp., such as P. cirrhata, are eaten as a vegetable in times of famine in Sikkim, India. Three species of Parmelia are used to prepare a crude drug known as 'chharila' in India. This is used in Ayurvedic and Unani medicine as an aphrodisiac, analgesic and carminative, which may also be used to treat sore throat, dyspepsia, diseases of blood and heart, stomach disorders, bronchitis, scabies, leprosy, excessive salivation, and other disorders. Powdered, it is applied to wounds or snuffed as a cephalic; its smoke relieves headaches (Saklani & Upreti 1992). The Indian P.

karatschadalis, P. parietina, P. perforata and P. perlata are also considered soporific and sedative, and may be used as incense to relieve headache (Nadkarni 1976). P. sulcata has reportedly been used in Indian folk medicine to treat "cerebral maladies" (Kumar & Upreti 2001). During the Middle Ages in Spain, P. sulcata was used to treat disorders of the brain. According to the Doctrine of Signatures, it would be effective due to its wrinkled brain-like appearance (Gonzalez-Tajero et al. 1995).

Many Parmelia spp. and other lichens are toxic to humans when eaten raw, due to their indigestibility and chemical content. Symptoms from eating small amounts may simply consist of stomach cramps and discomfort. Some lichens can cause contact dermatitis, known as 'woodcutter's eczema' (Turner & Szczawinski 1991). See also Usnea spp. in *Endnotes*.

P. cirrhata has yielded salazinic acid, protolichesterinic acid and atranorin (Saklani & Upreti 1992).

P. comtseliadalis and P. linctina contain brominated fatty acids (Rezanka & Dembitsky 1999).

P. conspersa has yielded salazinic acid (Smith 1921), usnic acid, stictic acid and norstictic acid (Brodo et al. 2001).

P. furfuracea yielded 0.63% methyl-β-orcinolcarboxylate, 0.87% atranorin and 1.13% 5-chloroatranorin (Caccamese et al. 1985).

Parmelia conspersa is a lichen – lichens are a dual symbiotic organism consisting of one or more fungi and one or more algae species. Lichens are usually identified primarily by the fungal half of the relationship. In this case, the host alga is a Protococcus sp. Thallus closely adnate, middle-sized or larger, straw-coloured, covered +- thickly with minute black dots, varying in overall colour towards greenish or yellowish, smooth or somewhat wrinkled, often sorediate or bearing coralloid branchlets toward the centre, the lobes long and rather narrow, crowded and often imbricate, sometimes much-branched, margins wavy to crenate, imbricated central lobes often forming a continuous crust; black below with brown margins, dark rhizoids usually present; apothecia subsessile, small to middle-sized, 3-12mm across, the disc concave, chestnut-brown, exciple subentire to crenulate; hypothecium hyaline to brownish; hymenium hyaline or brownish above; paraphyses rarely branched; asci clavate to broadly clavate; spores (2-)8(-many), hyaline, ellipsoid, 8-12 x 4.5-7µ, non-septate.

On sunny side of rocks and rarely on wood, sometimes on tiles; throughout northern US, southward in the mountains (Fink 1935). The psychoactive Pima 'earth flower' was reported as being ash-grey in colour, though other medicinal Pima earth flowers have been reported with different colours (Sharnoff undated, citing Curtin 1984), suggesting that this name is not exclusive to only one kind of lichen.

PASSIFLORA

(Passifloraceae)

Passiflora actinea *Hook.* **(P. paulensis** *Killip***)**

Passiflora alata *Dryand.* **(P. brasiliana** *Desf.***; P. maliformis** *Vell***; P. mauritiana** *Du Pet.***; P. oviformis** *Roem.***; P. sarcosepala** *Barb.***)** – winged stem passionflower, maracuja de refresco, granadilla

Passiflora alba *Link et Otto* **(P. adenophylla** *Mast.***; P. atomaria** *Planch. ex Mast.***; P. stipulata** *Aubl.***; P. subpeltata** *Ortega***)** – wild passionfruit, white passionfruit, white passion vine, granadilla, granada de zorra

Passiflora biflora *Lam.* **(P. brighamii** *S. Watson***; P. lunata var. costata** *Mast.***; P. transversa** *Mast.***; Decaloba biflora** *(Lam.) M. Roem.***)** – two-flowered passionflower, ala de murcielago, camacarlata, guateguate, parche

Passiflora bryonioides *Kunth* **(P. bryonifolia** *Kunth ex Spreng.***; P. inamoena** *A. Gray***)** – cocapitos, granadina, pasionaria del monte

Passiflora caerulea *L.* **(P. hartwiesiana** *Hort. ex Mast.***; P. mayana** *Veitch ex Voigt.***)** – blue passionflower, blue passionfruit, hardy passionflower, burucuya, murucuja, viricuja

Passiflora capsularis *L.* **(P. hassleriana** *Chod.***; P. paraguayensis** *Chod.***; P. piligera** *Gardner***; P. pubescens** *Kunth***)** – capsule-fruited passionflower, calzoncillo, maracuja branco miudo

Passiflora coccinea *Aubl.* **(P. fulgens** *Wallis ex E. Morr.***; P. toxicaria** *Barb. Rodr.***; P. velutina** *DC.***)** – red granadilla, granadilla agria, granadilla venenosa, costada sacha, snekie marcoesa, thome assu, marudioura, monkey guzzle

Passiflora costaricensis *Killip*

Passiflora x decaisneana *M.J.E. Planch.* **(P. alata x quadrangularis;** often misidentified as **P. quadrangularis)**

Passiflora edulis *Sims* **(P. middletoniana** *Paxt.***; P. pallidiflora** *Bertol.***; P. pomifera** *M. Roem.***; P. rigidula** *Jacq.***; P. rubricaulis** *Jacq.***; P. vernicosa** *Barb. Rodr.***; P. verrucifera** *Lindl.***)** – passionfruit, edible passionflower, purple grenadilla, purple-shelled passionfruit, granadilla, rosa del passione, maracuyá, maracuja, maracuja de doce, maracuja peroba, parcha amarilla, parche, couzou, lilikoi, linmangkon

Passiflora eichleriana *Mast.*

Passiflora foetida *L.* **(P. balansae** *Chodat***; P. hastata** *Bertol.***; P. hibiscifolia** *Lam.***; P. hispida** *DC.***)** – stinking passionflower, running pop, popping jay, wild watermelon, love in the mist, fit weed, granadilla, flor de granadita, bedoca, bombillo, bejuco canastilla, amapola, maracuja de cobra, maracuja de lagartinho, parchita de culebra, puropuro, ñorbo cimmarón, kin-val, kpà-zu, kpà-toto, ogwu agwo

Passiflora incarnata *L.* **(P. edulis var. kerii** *Mast.***; P. kerii** *Spreng.***)** – wild passionflower, old field apricot, apricot vine, serpent's tongue, pop apple, may pop, may apple, maricock, maracock, mahcawq, fiore della passione, ground ivy, holy trinity flower

Passiflora involucrata *(Masters) A. Gentry* **(P. quadriglandulosa var. involucrata** *(Masters) Killip***; P. vitifolia var. involucrata** *Masters***)** – chontay huasca

Passiflora jorullensis *HBK* **(P. medusaea** *Lem.***; P. trisetosa** *DC.***; Cieca trisetosa** *(DC.) Roem.***)** – coanenepilli

Passiflora ligularis *Jussieu* **(P. serratistipulata** *DC.***)** – granadilla, granadilla de China, pomme d'or

Passiflora mollissima *(HBK) Bailey* **(P. tomentosa** *Triana et Planchon***; Tacsomia mollissima** *Kunth.***)** – banana passionfruit, banana poka, granadilla cimarrona, curuba, tumbo, tintin, trompos

Passiflora murucuja *L.* **(Murucuja ocellata** *Pers.***; M. orbiculata** *Pers.***)** – Dutchman's laudanum, bullhoof

Passiflora oerstedii *Mast.* **(P. dispar** *Killip***; P. populifolia** *Triana et Planch.***; P. praeacuta** *Mast.***; P. purpusii** *Killip***; P. rojasii** *Hassl. ex Harms***)** – granadilla

Passiflora quadrangularis *L.* **(P. macrocarpa** *Masters***; P. tetragona** *M. Roem.***)** – giant grenadilla, granadilla, granadilla real, maracuja mamao, sandia de la passion, barbadine, badea, grote markoesa, mereekoeja fireberoe, quijon, tumbo

Passiflora quitensis *(Benth.) Killip*

Passiflora rubra *L.* **(P. bilobata** *Vell. non Juss.***; P. cisnana** *Harms***; P. obscura** *Lindl.***)** – Dutchman's laudanum, bullhoof, bat wing, liane couleuvre, pomme de liana zombi, pasionaria de cerca

Passiflora suberosa *L.* **(P. angustifolia** *Swartz***; P. puberula** *Hook. fil.***)** – cork-barked passionflower, pap bush, noxbe cimarron, huero de gallo, pintero

Passiflora warmingii *Mast.*

Passiflora spp. have fruits with a juicy, edible pulp, and are widely cultivated. P. incarnata and its close relatives, including P. edulis [common edible passionfruit], have long been used as sedatives and antidepressants. P. incarnata received its common name 'passionflower' because to the Christian mind, the flower is evocative of the holy trinity, Christ's crown of thorns etc., and was used by Jesuit teachers to represent the passion of Christ. Today, P. incarnata sees widespread use in over-the-counter herbal preparations, for insomnia and anxiety. In Europe, a tincture of the herb is used as an antispasmodic for patients with Parkinson's Disease. The Cherokee use a tea of P. incarnata root as a 'social drink', and to wean babies; they also use it as a liver tonic, and external wash for wounds and earaches. Other Native American groups use the herb to treat swellings and sore eyes, and also use the root as a tonic (Bremness 1994; Hamel & Chiltoskey 1975; Vanderplank 1996). In the tropical Americas, a 'mildly inebriating wine' is made from the fruits (Festi & Samorini 1999a). In Pernambuco, Brazil, huge quantities of P. incarnata fruit juice or the leaf are taken mixed with 'jurema' [see **Mimosa**] (Da Mota 1997; Ott pers. comm.). In common with P. edulis, P. incarnata has fruit with delicious

edible pulp and juice, though the yield of juice per fruit is lower in P. incarnata. Archaeological finds suggest that Native Americans in the region of the south-eastern US have used P. incarnata fruit as food for thousands of years. This species is now sometimes used in breeding with P. edulis and others [which are from subtropical and tropical zones, as opposed to the temperate native climate of P. incarnata] to give greater cold-hardiness to cultivated passionfruit vines (McGuire 1999).

The roots of the rare P. involucrata are used as a psychotrope and ayahuasca additive [see **Banisteriopsis**] by the Yahua of Peru (Montgomery pers. comm.). In Colombia, the Kubeo give the fruit juice to children for sore throats, and a leaf decoction for insomnia (Schultes & Raffauf 1990). In the West Indies, P. murucuja or a similar species known as 'Dutchman's laudanum' is considered an "excellent substitute for opium" [see **Papaver**]. The concentrated sap is often the part used; otherwise, the flowers are made into a water infusion, or powdered and added to wine or other alcoholic spirits, in which form they are "regarded as a safe and effective narcotic" (Cooke 1860). P. rubra is also known as 'Dutchman's laudanum' in the West Indies, and is similarly used as a narcotic. In Ecuador, the fruits are known to be narcotic, and they are added to chicha [see *Methods of Ingestion*]. Also in Ecuador, leaves of P. ligularis and P. mollissima are used as a narcotic, sedative, antispasmodic, anthelmintic and diaphoretic. In Peru, the liquefied fruit of P. quadrangularis is taken as a sedative, and in Brazil, the fruit rind is used for the same purpose. The roots, leaves and flowers have abortifacient properties, and the stems are considered toxic. In Indo-China, the fresh root is known to be a strong narcotic and poison. In Brazil, P. alata is used to treat anxiety and insomnia. It has edible fruit. Similarly, P. caerulea is used as a sedative and antispasmodic in Italy, and as a sedative, anthelmintic, emmenagogue and diuretic in Argentina (Duke & Vasquez 1994; Festi & Samorini 1999a; Pammel 1911; Perry & Metzger 1980; Vanderplank 1996). In Brazil, P. caerulea is used as an emetic (Pammel 1911). P. coccinea is used in the Amazon in decoction, taken 3 times a day, to treat fever. Its fruit and flowers are edible (Duke & Vasquez 1994), and the herbage is psychoactive [see below].

The Aztecs used P. jorullensis as an analgesic, diuretic, diaphoretic, and treatment for poisoning or snakebite (Emboden 1979a). In Mexico, the petals of P. foetida [known as 'amapola' – Spanish for 'poppy'] are consumed in tea as an opium substitute [see **Papaver**] (Rätsch 1998), and P. edulis twigs are infused as a sedative (Nicholson & Arzeni 1993). P. edulis is reportedly used as a psychotrope by indigenous Paraguayans, possibly with **Pereskiopsis** scandens (Stuart 2002b). In Malawi, the leaves of P. edulis are used to treat insomnia, epilepsy and migraine (Festi & Samorini 1999a). In Brazil, P. edulis leaf is used as a sedative tea, and the fruit juice is drunk as a cardiac tonic (Duke & Vasquez 1994); P. foetida is also used there as an antispasmodic (Pammel 1911). In Nigeria, an infusion of P. foetida fruit and leaves [2-3 tablespoons] is taken for its sedative and hypnotic effects to treat hysteria (Nwosu 1999). In India, leaves of P. foetida are applied to the head to treat dizziness and headache (Nadkarni 1976). As P. hispida, this species has also been reported in use as a 'narcotic' in Jamaica (Pammel 1911).

P. incarnata, when smoked, produces a very mild '**Cannabis**-like' high (pers. obs.; Siegel 1976). The herb may be concentrated to provide a crude extract of alkaloids and flavonoids for use in ayahuasca brews. A dose of 300g dry herb, decocted, has proven sufficient to inhibit MAO for ayahuasca-analogues, in some human bioassays. In another interesting experiment, an extraction was performed on a 1 litre commercial extract of P. incarnata, yielding only c.30mg of crystalline material, as freebase. When vapourised and inhaled, this material sent the subject into a "yellow and purple dot matrix" for several minutes. The nature of the effects was described as very pleasant and 'friendly', but still comparable to *DMT* in power (E pers. comm.). It would be very interesting to learn what compound/s were responsible for this experience. Also, a dry concentrated extract has been successfully smoked previous to vapourising *DMT*, in order to potentiate the latter [though inefficient due to low alkaloid yield] (Gracie & Zarkov 1985). A tincture of fresh P. rubra flowers acted as a pleasant-tasting potent sedative, reminiscent of limeflowers in effect [see **Tilia**] (theobromus pers. comm.).

These herbs generally may treat insomnia, anxiety, hypertension, nervous spasms, and irritable bowel syndrome. They appear to work by a synergy of the total constituents. Passiflora spp. are well-known for their content of alkaloids [β-carbolines, as well as the sedative alkaloid maracugine from some of the older literature, which was most likely a crude mix of β-carbolines], flavonoids and glycosides [some of which are cyanogenic] (Bremness 1994; Bruneton 1995; Festi & Samorini 1999a; Ulubenen et al. 1981). Interestingly, despite sharing similar chemistry, a methanol extract of P. edulis was inactive as an anxiolytic when compared with P. incarnata (Dhawan et al. 2001a).

Although the dried herbage of species used in herbal medicine is generally regarded as being non-toxic in therapeutic doses, there is one unusual report of an individual who experienced marked toxicity presumably related to consumption of a commercially-available P. incarnata extract. This extract, in tablet form, was standardised to contain 500mg active constituents per tablet. The batch of tablets taken by the patient was examined by chromatography and shown to have a similar profile to other batches of the product, as well as P. incarnata herb. The patient experienced nausea after taking 3 tablets [the recommended therapeutic dose]; the next day she took 4 tablets, and "began vomiting profusely". By the third day, she was still suffering these symptoms, as well as tachycardia, fatigue and drowsiness. One week later, she had fully recovered (Fisher et al. 2000). Based on this report, it should be advised that caution be taken with Passiflora spp. [and any substance!], as some people have unusual sensitivity, or allergy, to certain compounds. The starting dose in any experimentation should always be small to begin with, for this reason.

Extended feeding on Passiflora spp. [such as P. alba, P. aurantia, P. herbertiana, P. suberosa] has been implicated in stock poisonings, producing a CNS syndrome involving excitation, convulsions, staggering, incoordination, sometimes drowsiness, ataxia, diarrhoea or constipation, and occasionally death. Although these plants are known to be cyanogenic, other principles are also believed to be involved in the toxic syndrome (Everist 1974; Hungerford 1990; Hurst 1942; McBarron 1983). Also, P. adenopoda has caused fatality, and is cyanogenic, containing linamarin and lotaustralin; the pericarp of the unripe fruit has caused poisoning in humans, and produces HCN, though completely ripe fruit did not produce any HCN. In cyanogenic species, cyanogens are usually most concentrated in the leaves, stems, and arils of immature seeds. Unripe fruits are often considered toxic. It is worth bearing in mind that in a survey of over 570 Passiflora spp., 2/3 were found to be cyanogenic. Others not listed elsewhere here include P. amabilis, P. antioquiensis, P. apetala, P. aurantia var. pubescens, P. biflora, P. brachystephana, P. cinnabarina, P. conzattiana, P. coriacea, P. cuprea, P. filamentosa, P. laurifolia, P. lindeniana, P. lobbii, P. lutea, P. manicata, P. nitida, P. pendens, P. perfoliata, P. pittieri, P. platyloba, P. racemosa, P. sanguinolenta, P. sclerophylla, P. talamancensis, P. trifasciata, P. vespertilio and P. vitifolia (Saenz & Nassar 1973; Seigler et al. 1982; Shaw et al. comp. 1959; Spencer 1988). See *Chemistry of Psychoactive Compounds* for a discussion on the properties of cyanogenic glycosides and glucosides.

P. actinea leaves yielded 0.005% *harman* and 0.119% maracugine (Neu 1954b).

P. alata leaf has yielded 0.0217% β-carbolines [as *harman*], and 4.48% flavonoids [vitexin, isovitexin, isoorientin, 2"-xylosylvitexin] (Oga et al. 1984); earlier examinations found [in leaves] 0.082% *harman*, 0.49% maracugine, and 0.32% passiflortannoid, and [in roots] 0.128% *harman* and 0.152% maracugine (Neu 1954b). The cyanogenic glucosides tetraphyllin B-4-sulphate and epitetraphyllin B-4-sulphate have also been found (Spencer 1988).

P. alato-caerulea, a hybrid between P. alata and P. caerulea, contained the same cyanogens as P. caerulea (Seigler et al. 1982). The highest levels of HCN were produced in the root, with lesser [but still significant] amounts in all other parts of the flowering and fruiting plant [with unripe fruit]; lowest amounts were produced in the ripe pericarp and ripe aril, and none was found in the ripe seed (Spencer 1988).

P. alba has yielded 0.0075% alkaloids including *harman* [0.000039%] (Löhdefink & Kating 1974; Neu 1956), as well as cyanogenic glycosides (Fischer et al. 1982; Hurst 1942). The fresh plant [100g] has been successfully used in an ayahuasca analogue to inhibit MAO; however, strong side-effects continued for 3 days. Symptoms included headaches and general uneasiness; any attempt to place sugar or meat in the mouth [even in tiny amounts] caused immediate throat constriction and pain (E pers. comm.).

P. aurantia has been shown to produce hydrocyanic acid in the fruits and stems, but not in leaves (Hurst 1942).

P. biflora has not been analysed for alkaloid content; however, in feeding tests with butterflies and their larvae [see **Heliconius**], *harman*, *norharman* and *harmine* were detected in the insects (Cavin & Bradley 1988), so it would seem likely that these alkaloids are also found in the plant.

P. bryonioides was shown to contain *harman* – 0.00017-0.00027% in leaves and stems, and 0.000017-0.000027% in roots. In chromatography of the extract of stems and leaves, many other bands were visualised but not identified (Neu 1956; Poethke et al. 1970). The cyanogenic glycoside passibryonoidin has also been found in the herb (Spencer 1988).

P. caerulea has yielded 0.0082-0.0378% alkaloids including *harmine*, *harman* [0.000056%] and *harmol*; the flavonoids chrysin [5,7-dihydroxyflavone; MAOI, BZ-agonist, anxiolytic, anticonvulsant], kaempferol [MAOI, potential neuroprotectant] and quercetin; as well as licopine, and 0.006% HCN [in fresh plant] (Festi & Samorini 1999a; Löhdefink & Kating 1974; Medina et al. 1990; Poethke et al. 1970; Sloley et al. 2000; Wolfman et al. 1994). Root, leaf, flower and seed all contained HCN (Watt & Breyer-Brandwijk 1962); in leaf the major cyanogenic glucosides are tetraphyllin B-4-sulphate and epitetraphyllin B-4-sulphate (Seigler et al. 1982).

P. capsularis has yielded *harman* (Neu 1956), and the cyanogenic glycoside passicapsin (Spencer 1988).

P. coccinea leaf [from Adelaide Bot. Gard., Australia] yielded 0.1% passicoccin, a cyanogenic glycoside (Spencer & Seigler 1985); epipassicoccin has also been found (Spencer 1988). It has not been analysed for

alkaloids; however, it is known to be psychoactive. The fresh, leafy stem [c.1.5m length] has been used successfully as an MAOI in ayahuasca analogues [see *Methods of Ingestion*], with pleasant effects of its own, and no reported side-effects. The leaf is also pleasantly psychoactive when smoked (E pers. comm.).

P. costaricensis has not been analysed for alkaloid content, but based on feeding tests probably contains *harman*, *norharman* and *harmine* [see P. biflora above] (Cavin & Bradley 1988).

P. cyanea leaves yielded 0.017% 2"-xylosylvitexin, a c-glycosylflavonoid, as well as 0.005% aesculetin, a coumarin [see **Aesculus**] (Ulubelen et al. 1981).

P. x decaisneana has yielded 0.0022% alkaloids including *harman* [0.000085%] (Löhdefink & Kating 1974).

P. edulis whole plant has yielded c.0.022% alkaloids including *harman* [0.0004% *harman* in fresh leaf and stem]. Leaf has yielded 0.00012% total alkaloids [calculated as *harman*] (Lutomski & Malek 1975b), though in one early examination [cited in Neu 1954b] it is unclear whether no *harman* was found, or its concentration not quantified. Also, 0.000002% alkaloids were found in root, 0.000002% in seed, and 0.000027% in fruit peel. *Harmine* was also found in the fruit peel, seed and root, and *harmaline* in the fruit (Löhdefink & Kating 1974; Lutomski & Malek 1975b; Neu 1954b, 1956; Slaytor & McFarlane 1968). Leaf also has yielded 0.004% [w/w] *tryptamine* and acetyl-*tryptamine* [the latter experimentally verified as being present as an intermediate in biosynthesis of *harman*, although it could not be detected in the plant] (Schneider et al. 1972; Slaytor & McFarlane 1968; Smith 1977b), as well as 0.196% maracugine and 0.42% passiflortannoid (Neu 1954b). Leaves and stems [Japanese greenhouse plants, harv. Mar.] have also yielded cycloartane triterpenes [cyclopassifloic acids A-D, 0.003% combined] and their related saponins [cyclopassiflosides I-VI, 0.12% combined], as well as the cycloartane saponin passiflorin [0.25%; not the same as *harman*] and its aglycon, passifloric acid [0.001%] (Yoshikawa, K. et al. 2000). P. edulis forma flavicarpa ['yellow passionfruit'] also yielded 0.0007% *harman* from leaves, 0.00017% from stems, and none from roots (Lutomski & Malek 1975a), though Festi & Samorini (1999a) gave these figures as 0.7% and 0.17%; this was a simple confusion relating to the annoying tendency of Lutomski & Malek to give their yields as mg%. The tranquillising fruit juice of P. edulis has yielded 0.000012-0.0007% alkaloids [*harman*, *harmine*, *harmol*, *harmaline* and an unidentified alkaloid], which were present in greater levels in P. edulis f. flavicarpa, as well as 0.001-0.00106% flavonoids [vitexin, rutin, quercetin, saponarin, saponaretin, homoorientin], 0.000058-0.00016% carotenoids, vitamin C (Lutomski et al. 1975), and traces of passicol, a polyacetylene compound with antibacterial and antifungal properties (Birner & Nicholls 1973). The leaves have been shown to contain the cyanogenic glycoside prunasin. The fruit juice and peel also contain cyanogenic glycosides, with profiles differing between samples of P. edulis and P. edulis f. flavicarpa. Reports of mandelonitrile rutinoside isomers given here are tentative identifications. P. edulis [as juice/peel] was shown to contain 0.0043%/0.023% prunasin, 0.004%/0.00177% mandelonitrile rutinoside 1, 0.001%/0.0011% mandelonitrile rutinoside 2, 0.0031%/0.00196% amygdalin, and 0.00004%/0.00056% sambunigrin. P. edulis f. flavicarpa was shown to contain 0.0056%/0.0287% prunasin, 0.01%/0.0062% mandelonitrile rutinoside 1, 0.0014%/0.00014% amygdalin, and 0.00032%/0.00157% sambunigrin (Chassagne et al. 1996). The seeds produce HCN (Watt & Breyer-Brandwijk 1962). Fruits contain greatest levels of cyanogens when still unripe (McGuire 1999).

P. eichleriana leaves yielded 0.05% *harman* and 0.5% maracugine (Neu 1954b).

P. foetida has yielded 0.0051% alkaloids including *harman* [0.00007%] (Löhdefink & Kating 1974) and *serotonin* (Festi & Samorini 1999a), as well as cyanogenic glycosides – specimens from Galapagos Is. yielded tetraphyllins A and B, deidaclin and volkenin; specimens from Reunion Is. yielded tetraphyllin B, volkenin and linamarin (Andersen et al. 1998); passifoetidin was found in material of unreported origin (Spencer 1988). The leaf resin from P. foetida var. hispida has yielded traces of 3 polyketides, passifloricins A-C (Echeverri et al. 2001). The unripe fruits contain cyanogenic glycosides, but the ripe fruits have been eaten safely by children (Hurst 1942). The flowers contain a flavonoid pigment, anthocyanin malvidin-3-monoside, and bracts contain anthocyanin delphinidin-3-pentoseglycoside (Shaw et al. comp. 1959).

P. herbertiana stems yielded 0.038% hydrocyanic acid when fresh, 0.015% when dry. Leaves did not contain any, whilst the fruit pulp appeared to be rich in hydrocyanic acid (Hurst 1942). Flowers contain a flavonoid pigment, anthocyanin peonidin-3-pentoseglycoside (Shaw et al. comp. 1959). Leaf and stem from Queensland, Australia [harv. Nov.] tested tentatively positive for alkaloids (Webb 1949).

P. incarnata leaves and stems have yielded 0.00012-0.1% alkaloids, or up to 0.2% crude alkaloids [0.000055-0.011% *harman*, 0.002-0.015% *harmine*, *harmaline*, 0.002-0.021% *harmol*, *harmalol*], c.1.5% flavonoids [including *apigenin*, kaempferol, orientin, isoorientin, saponarin, saponaretin, vitexin, isovitexin], 0.05% maltol [CNS-depressant, sedative, anticonvulsant, likely BZ-agonist] and ethylmaltol, the hydrocarbon derivative nonacosane, a miscellaneous 8-pyrone derivative, phenolic acids, coumarins, phytosterols [such as sitosterol and stigmasterol], 0.1% essential oil, and cyanogenic glycosides (Bruneton 1995; Hultin 1965; Löhdefink & Kating 1974; Lutomski 1960a, 1960b; Lutomski et al. 1968a; Neu 1954a, 1954b, 1956; Oga et al. 1984; Poethke et al. 1970; Schilcher 1969; Soulimani et al. 1997; Wren et al. 1988) such as gynocardin [0.01% w/w] (Festi & Samorini 1999a). In one test, leaves and stems were analysed separately; leaves contained 0.00002% alkaloids, and stems contained 0.000012% alkaloids [both calculated as *harman*] (Lutomski & Malek 1975b). Fruits have yielded *serotonin* and vitamin C; roots have yielded *scopoletin* and umbelliferone (Festi & Samorini 1999a). In a Polish study, alkaloid content was lower in field-grown plants [0.005% *harman* and no detectable *harmine*] than in greenhouse-grown plants [0.012-0.019% *harman* and 0.007% *harmine*; 0.025-0.032% total alkaloids, also including *harmol*, *harmalol* and unidentified alkaloids] (Lutomski & Nowicka 1969; Lutomski et al. 1969). The Polish climate would be unlikely to mimic the native conditions of this species, so it is likely that these differences would not apply in warmer regions. Extracts of the herb, as the alkaloid fraction [shown to contain *harman*, *harmine*, *harmol* and 0.07% of 2 unidentified bases (probably *harmaline* and *harmalol*)] and flavonoid fraction [containing 4 flavonoids, as well as *harmol*], were tested separately on mice. Both exhibited sedative activity (Lutomski & Wrocinski 1961), though the presence of *harmol* in the flavonoid fraction makes it unclear what conclusions may be drawn from this. The fluid extract of the herb as used medicinally [45-52% alcohol] has also been shown to contain *harman*, *harmine* and *harmaline*; *harman* and *harmine* were detected at levels of 10-20mg/100ml (Bennati 1968, 1969, 1972; Bennati & Fedeli 1969). When extracts of separate plant parts were tested for anxiolytic activity in mice, the roots and flowers were found to be practically inactive. The main activity was found in methanol extracts of foliage (Dhawan et al. 2001b).

P. jorullensis is said to have yielded *harmol*, *harmalol*, *harman*, *harmine*, *harmaline* and passicol (Emboden 1979a), but I have found no supporting data in the literature.

P. ligularis leaf has yielded 0.0041% β-carboline alkaloids (Martinod et al. 1981). The fruit juice did not contain any detectable cyanogens, but the peel was shown to contain 0.00012% prunasin and traces of mandelonitrile rutinoside 1 [the identification of this latter cyanogen was tentative] (Chassagne et al. 1996).

P. menispermifolia leaves have yielded aesculetin [see **Aesculus**], as well as 0.006-0.016% each of the c-glycosylflavonoids orientin, vitexin, cirsiliol [6-OH-luteolin 6,7-dimethyl ether] and luteolin 7-β-D-glucoside (Ulubelen et al. 1981).

P. mollissima leaf has yielded 0.00213-0.00264% β-carboline alkaloids (Martinod et al. 1981); the cyanogenic glycosides tetraphyllin B-4-sulphate and epitetraphyllin B-4-sulphate have also been found in the herbage (Spencer 1988). The whole fruit was shown to contain 0.00007% prunasin (Chassagne et al. 1996), and the rind contains passicol (Birner & Nicholls 1973).

P. oerstedii has not been analysed for alkaloid content, but based on butterfly feeding tests, probably contains *harman*, *norharman* and *harmine* [see P. biflora above] (Cavin & Bradley 1988). Leaves yielded β-sitosterol, 3-β-D-glucoside, sugars, the flavonoid 2"-xylosylvitexin [0.023%] (Ulubelen et al. 1981), and the cyanogen gynocardin (Spencer 1988).

P. quadrangularis root has yielded unquantified levels of *harman* (Neu 1954b, 1956), and leaf yielded 0.0001% *serotonin*, 0.00003% *norepinephrine* (Applewhite 1973) and *tryptamine* (Smith 1977b); based on butterfly feeding tests, the leaves probably also contain *harman*, *norharman* and *harmine* [see P. biflora above] (Cavin & Bradley 1988). Leaves have also yielded the cycloartane triterpene glycoside quadranguloside (Orsini et al. 1986); the herbage and seed contain cyanogenic glycosides (Fischer et al. 1982; Watt & Breyer-Brandwijk 1962), including tetraphyllin B-4-sulphate, epitetraphyllin B-4-sulphate and passiquadrangularin (Spencer 1988).

P. quitensis has yielded 0.00252% β-carboline alkaloids (Martinod et al. 1981).

P. suberosa has yielded *harman* (Neu 1956 – mis-spelt as P. ruberosa); cyanogenic glycosides including gynocardin (Seigler et al. 1982), volkenin, epivolkenin, passisuberosin and epipassisuberosin have been found (Spencer 1988), as well as their expected by-product, HCN (Shaw et al. comp. 1959). Leaf of July-harvested material growing in Brisbane [Australia] was weakly alkaloid-positive (Webb 1949).

P. warmingii has yielded 0.0022% alkaloids including *harman* [0.000065%] (Löhdefink & Kating 1974), as well as the cyanogenic glycosides linamarin and linustatin (Spencer 1988).

Passiflora incarnata is a herbaceous or woody vine, climbing by tendrils or trailing, up to 8(-10)m long, glabrous or finely pilose. Leaves alternate, suborbicular in general outline, truncate or rounded to a small cuneate base, deeply 3-lobed, 60-150mm long, mid-nerve puberulent beneath, lobes ovate-lanceolate, constricted at base, acuminate, margins finely serrulate; stipules setaceous, deciduous, 2-3mm long; petioles c.80mm long, pubescent, biglandular at or near summit. Peduncle stout, 10cm long, bearing biglandular-serrulate bracts (4-8 x 2.5-4mm) near summit; flowers solitary from axils, 5-merous, perfect, 4-6(-9)cm wide, perigynous with well developed saucer-shaped to tubular hypanthium; se-

pals 3-5, white, mauve, or lavender inside, green outside with keel and awn 3mm long, lanceolate-oblong, 30mm long, alternating with 3-5 petals (also white or pale lavender; shorter than sepals) and attached with them to the margin of the hypanthium, which also bears a corona (a double or triple fringe); outer corona 1.5-2cm long, purple or pink, inner corona 2-4mm long; stamens 5, monadelphous around gynophore, 1-celled, with 3-5 parietal placentae and numerous ovules; styles 3, elongate, with capitate or clavate stigmas. Fruit an edible yellow (lime green when unripe) berry, 5-6cm long. Fl. Jun.-Aug.

Moist or dry soil in fields, roadsides and thickets, also open woods; Virginia to s. Ohio, s. Illinois and Oklahoma, south to Florida and Texas (Gleason 1952; Vanderplank 1996); introduced in Australasia, Hawaii, S. America, Bermuda, and Europe. Due to its extensive root development [shoots may develop up to 6m away from the parent rootstock], this species has potential for becoming an invasive weed under the right conditions, and should be cultivated with care, if at all (McGuire 1999).

Propagate in early spring. Seeds, particularly older ones, may need a 24-hr soak in warm water prior to planting. Sow seed on surface of light soil or peat moss with bottom heat. The best chances for germination are found by using seed from fresh fruit. With some pulp still attached, they should be soaked in a warm place in the juice of the fresh fruit, before sowing with the whole mixture. Apparently the acidity helps initiate germination. Artificial acid applications, or scarification, reduce viability. Best temp. for germination is a constant 19-24°C. When seeds have germinated, plant 2-6cm deep in sand or loam, and let the seedlings develop. Plant out after 6 months.

Or – propagate from 15cm cuttings of half-ripened growth, rooting in sand. Best chances are with end-shoot cuttings, cut closely below the node of the 2nd mature leaf, from the tip; remove bottom leaves, tendrils and flower stalks. A humidity tent is needed in the first 1-2 weeks. Can also be propagated from rooted basal offshoots, or from 4-8cm long root or rhizome fragments. These fragments must be kept moist until planted, to preserve viability.

Prefers light, rich, well-drained soil, not too rich in nitrogen. Mulching around the base of the plant is advantageous, especially in winter to protect from frosts. Prefers warm climates and full sun, though will still grow well in shade. Hardy, dies back in winter, though may not recover from heavy ground-frosts. There is a better chance of surviving frosts if planted on a southern exposure. Needs provisions for climbing, as the vine does not support itself. Much water may be required to establish the plant, though when mature they should not be over watered. Harvest herbage at end of growing season, when fruit have formed (Festi & Samorini 1999a; McGuire 1999; Vanderplank 1996; Whitten 1999). Whitten claimed the alkaloids are at their highest concentration at this point, though I have not been able to find any documentation to support this. However, this does not mean that he was wrong!

PAULLINIA

(Sapindaceae)

Paullinia cupana *Humb., Bonp. et Kunth* **var. sorbilis** *Ducke* **(P. sorbilis** *Mart.***)** – guarana, Brazilian cocoa, uabano, uaranzeiro
Paullinia yoco *Schultes et Killip* – yoco

Guarana, the ground seed of P. cupana var. sorbilis, has been traditionally used as a stimulant by people of the lower and middle Tapajos in the Amazon. The seeds are collected each October, and are then processed for storage. This involves grinding them and mixing with 'cassava' flour [from Manihot esculenta] and water, forming a brown paste. This paste is shaped into sausages, which are baked slowly over a wood fire until very hard. When required for use, a little is grated off [c.½ tsp.] into a cup of hot or cold water, which may be sweetened (Emboden 1979a; Schultes 1942; Schultes & Raffauf 1990). Guarana is said to have originated through the misfortune of a Maue boy, who spread happiness and goodwill everywhere – a jealous evil spirit transformed into a snake and killed the boy when he ventured out alone one day to gather fruit. He was found lying facing the sky with eyes wide open. A bolt of lightning hit the earth, and the boy's mother announced she had received divine instructions to bury his eyes. The first guarana vine grew from these eyes (Erickson et al. 1984).

Guarana soda has been made industrially in Brazil since 1907, and became the 'national drink' in the 1940's (Lleras 1994). Today, guarana is consumed in huge quantity across the world, available as powdered seed, pills or pharmaceutical preparations, an ingredient of numerous 'smart drinks' and 'energy drinks', or in a variety of foodstuffs as a 'healthy' alternative to pure *caffeine*. Guarana is being pushed to partying youth as a drug by pharmaceutical health supplement companies, with often tactless marketing ploys, encouraging its use for a 'high'. Western demand for the herb has caused native peoples to be encouraged to clear large tracts of virgin rainforest for its cultivation. Thus, people purchasing it should be aware of the environmental implications of its use (pers. obs.).

The bark of P. yoco is used as a stimulant tonic in the western Amazon of Colombia, Ecuador and Peru. Natives of the area recognise many different varieties of 'yoco', which are said to be indistinguishable botanically. Starting from the roots, the liana is cut down in 30-90cm lengths. The sections are stored by the villagers for up to a month, the bark only being rasped when it is required for use. At such times, it is freshly rasped and kneaded in water – this is strained and again kneaded and strained. Roughly 90-100g of bark is used for each serve, drunk from a gourd; 1-2 gourdfuls may be drunk early each morning, which staves off hunger and gives endurance until noon, when the first meal is eaten. In higher doses, yoco is used to treat malaria, and as a vermifuge and purgative (Schultes 1942, 1986, 1987b; Schultes & Raffauf 1990; Uscategui 1959).

The sap and seeds of the Central American P. pinnata [Serjania curassavica] are used to stupefy fish, poison arrows, and as a criminal poison (De Smet 1998; Usher 1974). In Africa, the leaf juice is used as a remedy for mental disease; the root and seeds are the most toxic parts (Watt 1967).

P. cupana var. sorbilis seeds may contain c.2.7-6% *caffeine* [seed coats containing the most], as well as 0.02-0.06% *theobromine*, 0-0.25% *theophylline* (Erickson et al. 1984; Gilbert 1986; Maravalhas 1966; Meuerer-Grimes et al. 1998; Power & Chesnut 1919a; Schultes 1942; Suzuki et al. 1992), saponins and 2-3% tannins [with antioxidant activity]. Small doses of guarana exhibit adaptogenic and performance-enhancing effects in animals, while larger doses do not (Espinola et al. 1997; Schultes 1942; Schultes & Raffauf 1990).

P. pinnata has yielded timboin, which is a nerve-poison, causing first convulsions, then paralysis (Watt 1967); leaves and twigs contain saponins and tannins (De Smet 1998).

P. yoco bark has yielded 2.73% *caffeine*, which is also found in the inflorescence (Schultes 1942).

Despite much effort on behalf of the health-food industry to divert attention from this fact, yes, 'guaranine' is identical to *caffeine*. The reason guarana is not as 'jittery' as a cup of coffee in effect, is because of the important complementary tonic role of the other constituents.

Paullinia cupana var. sorbilis is a climbing or suberect shrubby or bushy plant; branches deeply 4-5-grooved, apex dark brown-pilose, soon glabrate, in the main woody and unbranched. Leaves 5-foliolate-pinnate, 20-40cm long; leaflets 10-20 x 4.5-9cm, upper leaves oblong, lower ovate, apex shortly acuminate, acumen +- obtuse, base terminally acutely subcuneate, sides rotundate, shortly to moderately petiolulate, upper partly scattered subrepand-dentate, teeth subobsolete, coarse, mostly obtuse, coriaceous, obscurely latticed-venose, glabrate below, covered with microscopic glands, subscabrous to touch, scarcely punctate pellucid, with lactiferous utricule, sparsely ramificate below, fibres of sclerenchyma close to upper surface, epidermis not mucus-bearing; petioles 7-15cm long, rachis naked, glabrous; stipule small, ovate-subulate from base. Inflorescence a +- ovoid or ellipsoid panicle with cymose branches, solitary, loosely subvillose-pilose, pistillate flowers in inflorescence c.1/6 of total; cincinni sessile, contracted; bracts and bracteoles small, subulate; flowers unisexual, large, odorous; sepals 4, externally setulose-pilose, interior 3mm long, submembranaceous; petals 4, oblong, c.5mm long, margin villose, upper crest shortly appendiculate, shortly deflexed, with short tuft of hairs; receptacle glandulate, shortly ovate, base pilose; stamens 8, filaments complanate, subulate, clothed with long hairs; anther glabrous, introrse, affixed dorsally above base, emarginate. Ovary trilocular, ellipsoid, stipitate, base and apex angustate, in style long-angustate, glabrous; style subulate or filiform, apex with 3 exserted, excurrent stigmas. Fruit a 3-locular capsule 2-3cm long, stipe 6-8mm long, reddish-orange above, deep yellow below, dark or blackish when dry, ellipsoid, apiculate, externally glabrous, internally subfuscous-tomentose; seeds 1-3, c.12mm long, ovoid, glabrous, testa deep reddish-brown or black, aril red, each weighing 1g or less when dry.

Brazilian and Venezuelan Amazon (Erickson et al. 1984; Fridericus & De Martius 1965-1975). Despite reports stating otherwise, P. cupana is still known to occur in the wild state. On the other hand, P. yoco is only known from the wild, growing in a small area along the Putumayo, in the region joining Colombia and Peru (Lleras 1994).

All open flowers on a given flowering branch will be of the same sex on any given day. Male flowers open early morning, and have shed most of their pollen by midday; female flowers are only receptive for 1 day. Fruits ripen within c.75 days.

Seeds germinated in moist sawdust, appearing in 1-3 months. Seedlings are transplanted into 1-litre plastic containers filled with soil, and kept heavily shaded; a year later, in Jan. or Feb. [height of the rainy season], they are planted out where they are to grow. Soil should be deep, well-drained, rich in organic matter, and of a medium to heavy texture. Annual mean temp. in native range is 28-29°C, though it is often cultivated within an annual mean of 20-22°C; tolerates a minimum of 12°C. Annual precipitation must be greater than1400mm, with rain well distributed throughout the year; annual precipitation in native range is 2200-2500mm (Erickson et al. 1984; Lleras 1994).

PEDICULARIS

(Scrophulariaceae)

Pedicularis attollens *Gray* **(Elephantella attollens** *Heller***)** – little elephant's head
Pedicularis bracteosa *Benth.* – cobra head, fern leaf, bracted lousewort
Pedicularis canadensis *L.* – common lousewort, wood betony
Pedicularis groenlandica *Retz.* **(P. surrecta** *Benth.***)** – elephant's head, pink elephants
Pedicularis racemosa *Dougl. ex Hook.*
Pedicularis spp. – betony, wood betony, lousewort, pseudo-ginseng

Special thanks must first be made to Ghostpipe for aiding in the compilation of this entry; it would probably not have existed without him! Pedicularis is a genus of partially-parasitic herbs, requiring the roots of a host plant to survive. Apparently, they are not host-specific. It has recently come to wider knowledge that the flower buds of many Pedicularis spp., when smoked or eaten, can produce **Cannabis**-like psychotropic effects [when dried, they can even look suspiciously like **Cannabis** buds!]. Some describe the herbs as acting as tranquillisers and muscle-relaxants. Potency and quality of subjective effects may vary widely between individual plants and different species. P. bracteosa is said to be psychoactive, and a strain of P. canadensis sampled by numerous independent researchers, including myself, was found to be very similar to moderately-potent **Cannabis** in effect and duration [when smoked]. P. attollens has been found to be similarly active, but less potent. P. groenlandica is also said to be one of the 'milder' species. Pedicularis spp. have also been used in smoking mixtures, both commercial and home-made. One of those that has been commercially available in such mixtures is P. racemosa. It has been claimed that some native N. Americans may smoke Pedicularis spp. in smoking mixtures. Pedicularis spp. have been used in brewing non-traditional beers [see *Methods of Ingestion*]. The European Stachys officinalis [which has similar properties and is also known as 'betony' or 'wood betony'; see *Endnotes*] has, however, been used traditionally to brew beer. P. canadensis has been used most commonly as a medicine by native N. American tribespeople, as an aphrodisiac, analgesic, cathartic, emetic, cardiotonic, antitussive, abortifacient, antitumour and blood-cleansing herb, amongst other applications (Brounstein 1995; Buhner 1998; Ghostpipe pers. comms.; Hamel & Chiltoskey 1975).

In n.w. China, Pedicularis spp. such as P. artselaeri are known as 'pseudo-ginseng' [see **Panax**]. They are used in folk medicine as a cardiotonic, and to treat collapse, exhaustion, general debility, sweating, spontaneous ejaculation and senility, as well as to "invigorate the circulation of blood and mind" (Gao et al. 1997; Su et al. 1998; Zimin & Zhongjian 1991). In some parts of northern Asia, P. lanata is used as a tea substitute [see **Camellia**] (Von Bibra 1855). In India, P. pectinata is used as an astringent and haemostatic (Nadkarni 1976).

P. canadensis, P. lanceolata, P. palustris, P. sylvatica and P. sudetica are recorded as having been toxic to stock animals (Pammel 1911), though the genus is regarded as particularly safe in humans.

Pedicularis spp. have been theorised to absorb phytochemicals from the host plant (Ghostpipe pers. comm.); however, they are usually found to possess iridoid glucosides, neolignan glycosides and/or phenylpropanoid glycosides as the major constituents, as well as alkaloids (Abdusamatov & Yunusov 1970; Zhongjian et al. 1992).

P. artselaeri [flowering whole plant] has yielded 6 phenylpropanoid glycosides [0.0019% artselaeroside B, 0.023% others], a phenylethanoid glycoside [0.0016% artselaeroside A], 3 iridoids [artselaenins A-C, c.0.0017% combined], and 10 iridoid glycosides [0.0006% 6-O-methylaucubin, 0.015% others] (Su et al. 1998).

P. bracteosa leaves yielded the iridoid glycosides aucubin and mussaenoside; stems, flowers and seed pods together only contained aucubin.

P. crenulata aerial parts yielded the iridoid glycosides euphroside [major component], aucubin and plantarenaloside (Schneider et al. 1996).

P. dolichorrhiza has yielded the alkaloids (R)-boschniakinic acid [(R)-plantagonine] and indicamine (Buckingham et al. ed. 1994).

P. groenlandica stems, flowers and seed pods together yielded the iridoid glycosides aucubin and euphroside (Schneider et al. 1996).

P. lasiophrys has yielded 0.0014% cistanoside D, 0.0017% pedicularioside F, 0.00428% verbascoside, 0.00057% cistanoside C, 0.00057% pedicularioside E and 0.00028% 8-epiloganin (Zhongjian et al. 1992).

P. longiflora has yielded 0.0017% verbascoside, 0.00035% longifloroside, 0.00035% cistanoside D, 0.00023% cistanoside C, 0.00023% loganic acid, 0.00017% mussaenoside, 0.00011% pedicularioside I and 0.00011% geniposidic acid (Jia & Liu 1992); another study found four different longiflorosides – A [0.0006%], B [0.001%], C [0.0004%] and D [in a mixture with dehydrodiconiferyl alcohol-4-O-β-D-glucopyranoside] (Wang & Jia 1997).

P. ludwigi has yielded (R)-boschniakine [(R)-indicaine] and (R)-boschniakinic acid (Buckingham et al. ed. 1994).

P. olgae has yielded N-methyl-*cytisine*, (R)-boschniakine, 0.11% (R)-boschniakinic acid, indicainine, pedicularine, pedicularidine, pediculidine, pediculine and pediculinine. The flowering plant, collected in July in Russia, yielded 0.54-0.65% alkaloids (Abdusamatov & Yunusov 1970, 1971; Abdusamatov et al. 1968, 1970, 1971; Buckingham et al. ed. 1994; Khakimdzhanov et al. 1971; Ubaev et al. 1963).

P. palustris tested positive for the presence of c.0.01-0.03% alkaloids (Hultin & Torssell 1965).

P. procera leaves yielded the iridoid glycosides mussaenoside, 6-deoxycatalpol, shanzhiside methyl ester, 8-epiloganic acid [all major components], aucubin and gardoside; stems, flowers and seed pods together yielded only aucubin and 6-deoxycatalpol.

P. racemosa stems, flowers and seed pods together yielded mostly aucubin, and lesser amounts of euphroside (Schneider et al. 1996).

P. rhinanthoides flowering aerial parts [harv. Jul., Russia] yielded 0.38% alkaloids, of which (R)-boschniakinic acid and d-tecostidine were identified (Abdusamatov & Yunusov 1970).

P. silvatica tested positive for the presence of c.0.01-0.03% alkaloids (Hultin & Torssell 1965).

P. striata yielded the phenylpropanoid glycoside pedicularioside A [0.0017%] and the iridoid glycosides acteoside [0.0022%], isoacteoside [0.0022%], decaffeoylacteoside [0.00022%], echinacoside [0.0026%] and 8-acetylharpagide [0.00152%] (Zimin & Zhongjian 1991); P. striata ssp. arachnoides root yielded 0.004% aucubin, 0.0016% 8-O-acetylharpagide, 0.001% dihydrocatalpolgenin and 0.002% of the sesquiterpenoid eremophila-10,11-diene-7α,13-diol (Gao et al. 1997).

Pedicularis canadensis is a hairy, perennial herb; stems simple, closely clustered, to c.40cm high. Leaves scattered, alternate, the lowest pinnately parted, the others partly pinnatifid, all or nearly all petioled, blade to c.15cm long, 5cm wide. Inflorescence a large-bracted raceme, dense and 3-5cm long in flower, elongated to 20cm in fruit; calyx 7-9mm long, split in front, otherwise almost entire, oblique; corolla yellow or yellowish, to 23mm long, strongly bilabiate, upper lip incurved and hooded, 2-toothed under apex, lower corolla lip usually shorter, erect at base, 2-crested above, 3-lobed, lobes commonly spreading, the lateral ones rounded and larger; stamens 4, didynamous; anthers transverse, enclosed by upper calyx lip, cells pointless; stigma capitate. Capsule lance-oblong, flattened, asymmetrical, twice as long as calyx, glabrous, loculicidal, mostly arcuate and opening mostly on upper side; seeds several, slightly winged. Fl. Mar.-May.

In open forest or edge of forest, on open seepage slopes, prairies, clearings; from Quebec to Manitoba, south to Florida, Mississippi, Louisiana, e. Texas and n. Mexico (Correll & Johnston 1970; Hitchcock et al. 1959). Difficult to establish in cultivation. Sow seed where they are to grow. Prefers moist, well drained, peaty soil, and a host grass, in a part-shaded to sunny position (pers. comms.).

PEGANUM

(Zygophyllaceae)

Peganum harmala *L.* – Syrian rue, African rue, wild rue, harmel, harmal, hurmal, isband, esfand, techepak, peganon, churma, besasa, uzerlik, gamarza, gandhya
Peganum nigellastrum *Bunge* – luo-tuo-hao

The seeds of the weedy shrub P. harmala are best known nowadays for two reasons – they are [or were] the source of the red dye 'Turkish red' used in Turkish and Iranian carpets [and for Turkish fezes (Ott 1993)]; and they are now popular as a component of modern ayahuasca-analogues, due to their exceptionally high content of β-carboline alkaloids. The seeds and the whole plant are more or less narcotic in their own right, and are used medicinally throughout their natural range. To the ancient Egyptians, the plant ['besasa'] was associated with the god Bes, and was thought to protect against evil. It may also have been burnt as an incense offering to Bes, who was the guardian deity of women in labour. Modern Egyptians use the seed oil ['zit-el-harmel'] as an aphrodisiac and protective. During the Iranian spring festival of Nuruz, the seeds are burnt – inhaling the smoke of the burning or smouldering seeds is known to be an effective means of obtaining the inebriating effects of this plant. Shamans of the Hunza burn them to enter trance and communicate with otherworldly beings. The Douvans of Bokhara also burn them and become 'exuberant'. Moroccans inhale the fumes to clear the mind and enter a clairvoyant state, as well as to treat headache and to purify themselves to protect against evil (Emboden 1979a; Jordan 1992; Rätsch 1992). Some modern Iranians living in Australia also use it in the same way, to ward off evil spirits (pers. comm.), and it is burned as an incense against the evil eye in parts of Central Anatolia, Turkey (Ertug 2000). In Israel, traditional healers have used the seeds in steam-baths to treat "nervousness, weariness and exhaustion" (Palevitch et al. 1986). In Egypt, the seeds are taken with the pollen grains of dates [Phoenix dactylifera] to "restore sexual potency" (Islam et al. 1991). Bedouins use the plant as an emmenagogue and abortifacient (Mahmoudian et al. 2002).

In parts of India and Pakistan, the seeds are placed on burning charcoal as a fumigant to magically protect new born infants from poor health, as well as during marriage ceremonies. The smoke of the plant is also known to be disinfectant and to repel mosquitos. Also in India, the seeds, taken orally, are said to increase sexual desire and menstrual flow, as well as acting as a galactagogue. In large doses, the seeds have been prescribed to treat asthma, and to procure abortion. As 'techepak', the seeds are consumed in Ladakh, India. They are roasted, pulverised, and sifted [the resulting preparation being known as 'techepakchiatzen'], before being either eaten, or smoked with tobacco [see **Nicotiana**]. Indian Muslims also use the leaves as an incense, called 'dhup'. Elephants have been observed to become furiously intoxicated after eating P. harmala seeds; elephants in this state of rage are referred to as being 'mast' or 'masth'. The plant and its seeds have even been proposed to represent both the Hindu 'soma', and the Iranian 'haoma' [see also **Amanita**]. Amongst the many other uses of the plant in medicine, P. harmala acts as a narcotic, aphrodisiac, antispasmodic, emetic, emmenagogue, galactagogue, alterative, antiperiodic, anthelmintic, antirheumatic, antidiarrhoeal, abortifacient, antimicrobial, diuretic and antiasthmatic (Chopra et al. 1965; Flattery & Schwartz 1989; Hassan 1967; Nadkarni 1976; Navchoo & Buth 1990; Ott 1993, 1998b; Parsons & Cuthbertson 1992).

In n.w. China, P. nigellastrum has been used to treat inflammation, rheumatism and abscesses. The basic extract of the plant has also shown antitumour activity (Ma et al. 2000).

In recent years, P. harmala seeds have become very popular as a potent MAOI for use in ayahuasca analogues [see *Methods of Ingestion*], where **Banisteriopsis** is not available for this purpose. Roughly 3-4g, or 1 heaped tsp. of ground P. harmala seeds is enough to inhibit MAO sufficiently to activate an oral dose of *DMT* in most people. The seeds are often prepared in a lemon juice/water extraction [3:7] which is consumed either shortly before, or with, the *DMT* preparation. Sometimes the ground seed or a dried extract of the seeds is simply encapsulated and swallowed. In larger amounts, up to 15g or more, the psychoactive effects of the seeds by themselves are more noticeable, usually consisting of a heavy hypnotic feeling, sometimes with closed-eye imagery. People seem to react to these harmala alkaloids rather differently at psychoactive levels, according to various studies mostly using pure *harmine* or *harmaline* – some reporting stimulation, or even mild psychedelic effects. P. harmala seeds also may cause more unpleasant side-effects, such as strong nausea and vomiting, especially in psychoactive doses (Ott 1994; Shulgin & Shulgin 1997; pers. comms.; pers. obs.).

The ground seeds may also be smoked, though they do not burn easily. Fortunately, the major alkaloids are very easy to extract in a relatively pure form [see *Producing Plant Drugs*], allowing more accurate dose measurement, and ease of vapourisation. P. harmala seeds [or extract] can be used [orally or smoked] to potentiate or synergise with the effects of some other substances [eg. **Psilocybe** mushrooms, **Cannabis**, **Trichocereus**] when taken during the early part of the experience, or during the peak (Kent 1995; pers. comms.; pers. obs.). The extract may be smoked previous to smoking *DMT*, in order to extend the available time period for inhaling the *DMT* vapours, and to lengthen the experience (Gracie & Zarkov 1985; pers. comms.). The harmala alkaloids when smoked in this way are active in very small amounts, and impart their own character to the experience they are being applied with, 'smoothing the edges' and giving a greater ability to focus shamanic attention (Trout ed. 1998; pers. obs.). Some people enjoy drinking a decoction of the seeds in doses of 5g and above for the mild 'entheogenic' state they may produce, although most people find them unpleasant at psychoactive doses (Most 1985; pers. comms.). Doses of up to 150g of seeds have been survived by humans, although negative effects at such doses are profound. It is worth noting that animals who eat the plant [which they will usually avoid if there is a choice of other foraging herbs] sometimes suffer abortion and death (Mahmoudian et al. 2002).

The dyes produced from P. harmala seeds take two forms – a yellow dye prepared from simple water infusion, and a red dye obtained after chemical treatment. Although the red pigment is thought to derive primarily from oxidised β-carboline alkaloids (Ott 1993), it seems likely that the anthraquinones found in the seeds could contribute to pigmentation (pers. obs.), as quinones are well known plant pigments (Harborne & Baxter ed. 1993).

P. harmala contains predominantly β-carboline alkaloids [such as *harmaline*] and quinazoline alkaloids [such as vasicine (peganine)], with relative proportions differing across different plant-parts at different times of year [see below]. The quinazolines are thought to act as abortifacients through uterine-stimulant activity (Mahmoudian et al. 2002).

Alkaloids are concentrated in the seed coat of the seeds of P. harmala (Gröger 1959). Ripe whole seeds may yield 2-7% alkaloids [much lower yields were said to be obtained from green fruits – see below for some conflicting data]; roots 1.4-3.2% [3% *harmine* was found in roots in one test; as well as *harmaline*, vasicinone and deoxyvasicinone]; stem and fruits 0.8% [in summer stems contained mostly deoxyvasicinone, as well as 0.06% *harmine* and 0.03% *harmaline*]. Harmala-alkaloid content is highest in winter; the seeds contain more *harmaline* than *harmine* in winter, and this pattern reverses in summer; the roots contain more *harmine* than *harmaline* in winter, and this also reverses in summer. The flowering aerial parts have yielded vasicine [respiratory stimulant, bronchodilator, antihypertensive, uterine stimulant, abortifacient], deoxyvasicine [reputed to show cholinergic activity], vasicinone, deoxyvasicinone and *harmine*. In the vegetative material and fruits [not including seeds], vasicine is usually the major alkaloid. In the seeds, *harmaline* is often the dominant alkaloid [2.01-2.09%; or 1/2-2/3 of total], as well as *harmine* [0.3-1.6%], with trace alkaloids including *harmalol*, *tetrahydroharmol*, *harmol*, *tetrahydroharman*, *harmalan*, isoharmine, *leptaflorine* [tetrahydroharmine], 0.0001% harmidine [may be identical to *harmaline*], harmalicine, 8-glucosidyl-*harmine*, 8-glucosidyl-*leptaflorine*, 8-glucosidyl-*harmaline*, 6-OH-*tryptamine* [only in strains from Dijon], vasicine, vasicinone, 0.0008% deoxyvasicinone and oxopeganine [uterotonic, AChEI's]; flavonoids including quercetin, kaempferol [MAOI (Sloley et al. 2000)] and peganetin; and anthraquinones. Other researchers found the unripe seeds [summer harvest] to yield 4.3% *harmine*, 0.28% *harmaline*, 0.28% vasicine and 0.28% deoxyvasicinone; as opposed to the ripe seeds yielding 0.9% *harmine*, 0.6% *harmaline*, 2.5% vasicine and 0.9% deoxyvasicinone. Seed has also yielded 14.23-15.86% of an oil. Also found in the plant are *harman* [in root], harmalanine, harmalicinine, harmalidine, ketotetrahydronor-*harmine*, pegamine, peganidine, isopeganidine, deoxypeganidine, peganol, dipegine, alkaloid YC2 and 9,14-dihydroxyoctodecanoic acid. Seedlings have yielded, as well as *harmaline*, *harmine* and *harmalol*, the alkaloids *harmol*, ruine [8-OH-glucosylharmine], dihydroruine [8-OH-glucosylharmaline] and 6-OH-*tryptamine*, as well as gentisate 2,5-β-diglucoside (Buckingham et al. ed. 1994; Chatterjee & Ganguly 1968; Fischer 1901; Fischer & Täuber 1885; Gill & Raszeja 1971; Gröger 1959; Henry 1939; Khashimov et al. 1970; Kurachko et al. 1970; Marion 1952a; McKenzie et al. 1975; Nettleship & Slaytor 1971; Ovejero 1948; Rastogi & Mehrotra ed. 1990-1993; Reinhard et al. 1968; Rozenfeld 1931; Shulgin & Shulgin 1997; Trout ed. 1998).

P. nigellastrum aerial parts [harv. Aug.] yielded 0.007% *harmine*, 0.0001% 3-phenylquinoline, 0.00006% 3-(4-hydroxylphenyl)quinoline, 0.00006% 3-(1H-indol-3-yl)quinoline, 0.00006% luotonin C, 0.00002% luotonin D, and the flavonoids dihydrosinapylferulate [0.00008%] and dihydroconiferylferulate [0.0001%] (Ma et al. 2000); *harmaline* was found in the roots (Shulgin & Shulgin 1997).

Peganum harmala is a much branched, glabrous, spreading perennial herb 30-80cm tall, with a woody rootstock; stems glabrous, slender, cylindrical below, angled above, rather stiff, branching frequently. Leaves alternate, multifid, divided several times into narrow +- linear acute segments 2-5cm long, bright green, succulent; bristle-like stipules occur at base of each leaf stalk. Flowers solitary on pedicels to 2cm long, leaf-opposed, 1.27-1.9cm across, white; sepals 4-5, often toothed or divided, 8-20mm long, linear, exceeding the petals; petals elliptic-oblong, obtuse, 12-17mm long, creamy-white; stamens mostly 15, inserted at the base of disc, some antherless; filaments dilated below. Ovary deeply 2-3-lobed; styles basal, twisted, 2-3-keeled above middle, the keels stigmatose. Fruit a globose capsule, deeply lobed, 7-10mm long, 8-12mm diam., dehiscing with 3 valves or indehiscent. Seeds dark brown, angled. Fl. summer-autumn.

In arid regions; native to n. Africa, Mediterranean region, east to Tibet and Russia north of the Caspian Sea; introduced in parts of Australia [Vic (only recorded as a pasture-weed in Katamatite, Mooroopna West and Nathalia areas), SA, NSW] and the US [Texas, New Mexico, Arizona,

Nevada] (Chopra et al. 1965; Harden ed. 1990-1993; Jeans 1999; Parsons & Cuthbertson 1992).

Although P. harmala sometimes thrives as a weed, it can be quite difficult to cultivate successfully. Plant viable seed in spring. Approaches to this that have been reported as successful in producing germination include planting in commercial seed-raising mix; planting in a peat moss/sand mix; and folding in a wet paper towel, sealed inside a zip-lock bag and placed under light [reported to produce germination in 4-7 days]. In the case of the zip-lock bag method, sprouts should be carefully removed and potted quickly after germination. Raise seedlings in filtered sunlight and moderate moisture, letting the surface dry between waterings. Later transfer carefully into pots [regular potting soil is reported to be o.k.; a sandy but fertile soil mixture is said to be best] and introduce them gradually into the sun, watering lightly. Well-drained soil is essential as the roots may rot easily if too moist, particularly when plants are still young. Maintain a partial filter from hot midday sun. A heating pad set at 30°C, placed under pots, is reportedly beneficial to aerial and root growth [in areas cold enough for it to be necessary], as is bottom-watering. Bring indoors in winter in colder areas – they often die back at this time and may be stored in a cool, dark, dry place until spring (DeKorne 1994; Grubber 1973; pers. comms.).

PELECYPHORA

(Cactaceae)

Pelecyphora aselliformis *Ehrenberg* – peyote, peote, peyotillo, peotillo, peyote meco ['shaking' or 'rocking' peyote], hatchet cactus

This cactus is a representative of the group of 'false peyotes' found in Mexico [see **Lophophora**], as evidenced by its common names. Reputed in Mexico to have medicinal properties, P. aselliformis is sold in San Luis Potosi markets to treat fever and rheumatic pain (Bravo 1937; Britton & Rose 1963; Schultes 1937a, 1937b).

P. aselliformis has yielded <0.00002-0.003% [d/w] *mescaline*, traces of N-methylmescaline, 0.0002% [w/w] *DMPEA*, traces of N-methyl-*DMPEA*, 0.000018% [d/w] N,N-dimethyl-3-OH-4,5-dimethoxy-*phenethylamine*, 0.00063[d/w]-0.0007[w/w]% *hordenine*, <0.0001% [w/w] *tyramine*, 0.0002% [w/w] N-methyltyramine, 0.000067% [d/w] anhalidine [6,7-dimethoxy-8-OH-2-methyl-THIQ] and 0.0000094% [d/w] *pellotine* (Agurell et al. 1971; Neal et al. 1972; Siniscalco 1983; Štarha 1994).

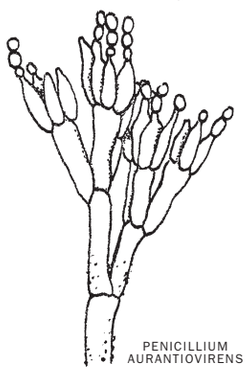
Pelecyphora aselliformis is a tufted, slenderly globose-cylindric, later club-shaped cactus, blue-green to grey-green, 5-10cm high, 2.5-5.5cm diam., covered with tubercles arranged in spirals, solitary or forming clusters; tubercles hatchet-shaped, strongly flattened laterally, somewhat stalked at base, up to 5mm high, axils wooly; areoles at top of tubercles very long and narrow, crowned with an elongated, scale-like grey spine up to 4mm long, with numerous lateral ridges, usually free at apex, giving peculiar pectinate appearance, connivent at base. Flowers central, solitary or several together near apex, funnel-shaped to campanulate-rotate, 2cm long, 3cm wide or more, carmine-violet; perianth segments in 4 rows, the outer sometimes white, oblong, acute; stamens borne at top of tube, much shorter than perianth segments; stigma lobes 4, erect. Fruit a spindly berry deliquescent when ripe; seeds kidney-shaped, brown or blackish, almost smooth.

San Luis Potosi, c. Mexico (Britton & Rose 1963; Haustein 1991).

Slow-growing; requires protection from excessive moisture, and frosts (Trout & Friends 1999).

PENICILLIUM

(Hyphomycetaceae/Trichocomaceae)



PENICILLIUM AURANTIOVIRENS

Penicillium aurantiovirens *Biourge* **(P. verrucosum var. cyclopium** *(Westling) Sams., Stol. et Hadl.***)**
Penicillium chermesinum *Biourge*
Penicillium concavo-rugulosum *Abe*
Penicillium roquefortii *Thom.* – noble mildew, blue cheese mould, king of molds
Penicillium rugulosum *Thom.*

Some Penicillium moulds are best known as being sources of the antibiotic penicillin. However, P. camembertii is used to make 'Camembert' [for the whitish crust], and P. roquefortii to make blue-vein 'Stilton' and 'Roquefort' cheeses [for the blue-veins] (Bock & Voogelbreinder undated; Hobbs 1995). Amongst dream-inducing cheeses [see *Influencing Endogenous Chemistry*], Stilton is one type known to be most effective and to produce the most bizarre dream content (British Cheese Board 2005). Some species and strains of Penicillium can produce ergot-type alkaloids [see **Claviceps**], amongst other diverse compounds.

P. aurantiovirens strain VKM F-229 in culture has yielded *agroclavine*, *elymoclavine*, *penniclavine*, isopenniclavine, *chanoclavine* and aurantioclavine (Solov'eva et al. 1996); a wide array of other metabolites have been found in the species, including penicillic acid, cyclopiazonic acid [both antibiotic, but toxic to mammal liver and kidney], 2,3-dihydroxy-4-phenylquinoline, ergosterol, tremortins A and B [tremorgenic], puberulic acid, poly-(L)-malic acid [proteinase inhibitor] and terrestric acid [a 4-OH-γ-lactone] (Domsch & Gams 1993).

P. chermesinum strain PC 106-I in culture has yielded the little-studied ergot alkaloid costaclavine [see **Claviceps**] (Agurell 1964).

P. concavo-rugulosum in culture has yielded *chanoclavine*, as well as related alkaloids rugulovasine A & B; these latter alkaloids are hypotensive in animals (Abe et al. 1969).

P. roquefortii strain PRL 1463 in culture was found to produce what appeared to be *agroclavine*, *elymoclavine* and *penniclavine* (Taber & Vining 1958); strain IBPM-F-141 and other strains in culture yielded *festuclavine*, isofumigaclavines A and B, and new indoles, roquefortines A [0.00002-0.00036% of commercial Roquefort cheese; antidepressant, local anaesthetic and muscle relaxant in animals; LD50 340mg/kg i.p. in mice], B and C, and 3,12-dihydroroquefortine (Hong & Robbers 1985; Kozlovskii et al. 1979; Ohmomo et al. 1975). Several strains were shown to produce large amounts of (+)-aristolochene in culture, with smaller amounts of valencene. P. roquefortii may also produce PR-toxin (Demyttenaere et al. 2002).

P. rugulosum has yielded *chanoclavine*, rugulovasines A & B, and other indole compounds (Abe et al. 1969).

P. sizovae in culture has yielded *agroclavine*-1 dimer and a mixed dimer of *agroclavine*-1 and epoxyagroclavine-1 (Kozlovskii et al. 1995).

P. dipodomyis and P. nalgiovense have yielded penicillin and dipodazine, a diketopiperazine alkaloid (Sørensen et al. 1999).

Solid fermentation culture of Penicillium sp. WC75209 yielded a new ergoline alkaloid, 1-MeO-*agroclavine*; it inhibits the enzyme LCK tyrosine kinase, which may be beneficial in controlling cancer proliferation, as well as other diseases (Padmanabha et al. 1998).

Some Penicillium spp. also produce benzodiazepines [see *diazepam*] (Rahbaek et al. 1999), such as P. aurantiogriseum [which produces the benzodiazepine auranthine], P. clavigerum, P. commune, P. melanoconidium, P. sclerotigenum and P. verrucosum [which produce sclerotigenin (auranthine B)] (Larsen et al. 2000). P. avellaneum, P. brefeldianum, P. lilacinum and P. thomii have tested positive for alkaloids (Abe et al. 1969).

Penicillium aurantiovirens grows in colonies reaching 4.5-5cm diam. or less in 14 days at 24°C; blue-green, often becoming yellow- or light grey-green with age, in fresh isolates often fading to light ochraceous in centre; reverse uncoloured, yellow, orange or brown. Conidiophores usually finely roughened, in some isolates smooth-walled. Conidia globose to subglobose, 3.5-4µm diam. Odour usually strong, earthy and pungent.

Widely distributed – it has been found in Australia, New Zealand, Europe, e. Siberia, the White Sea, Syria, Egypt, Libya, Kuwait, Pakistan, Somalia, South Africa, Ivory Coast, India, China, Japan and Peru. Usually occurs in forest soils, peat bogs, heathland, grassland, desert soils, sand dunes, caves and on stalactites; it has also been found in water, and growing on many plants, grains, stored fruits, hay, compost, sewerage, fermented food, frozen fruit cake, refrigerated dough products, birds, rabbits and gerbil nests, amongst other things (Domsch & Gams 1993).

PERESKIA

(Cactaceae)

Pereskia corrugata *Cutak* **(Rhodocactus corrugatus** *(Cutak) Backeb.***)**
Pereskia grandiflora *Hort. ex Pfeiffer* – rose cactus, blade apple
Pereskia tampicana *Weber* **(Rhodocactus tampicanus** *(Weber) Backeb.***)**

These plants are interesting leafy cacti, which to the untrained eye do not look like cacti at all! P. aculeata, 'Barbados gooseberry', was suspected of having killed two calves and a horse in Murwillumbah, NSW [Australia]. It was not noted whether this was due to mechanical injury from the spines, or due to chemical poisoning. A human was also reported to have gotten blood poisoning from one of the thorns of this plant (Hurst 1942). In Brazil, crushed stems of a Pereskia sp. ['rose madeira'] are sometimes applied as a poultice to treat cancer (Hartwell 1968).

P. corrugata was shown to contain 0.0005% *mescaline*, *tyramine*, homovanillylamine [3-MeO-*tyramine*] and *DMPEA*.

P. grandiflora was shown to contain β-OH-*mescaline*, 4-MeO-β-OH-*phenethylamine* and *tyramine*.

P. grandifolia was shown to contain *tyramine*, 3-MeO-*tyramine* and 4-MeO-β-OH-*phenethylamine*.

P. tampicana has yielded 0.0013% *mescaline*, *phenethylamine*, *tyramine*, 4-MeO-β-OH-*phenethylamine* and 0.0025% *DMPEA* (Doetsch et al. 1980).

Pereskia tampicana is a leafy shrub; branches often without spines, or spines several, needle-like, black, 2-3cm long, in pairs or in clusters in leaf axils, neither sheathed nor barbed; areoles globular, appearing as knobs along the stem; branches and leaves not easily detached. Leaves alternate, broad, flat, deciduous or somewhat fleshy, c.5cm long, petioled. Flowers solitary, corymbose or paniculate, terminal or axillary, wheel-shaped, 2.5cm long, petioled; axils of sepals without long hair or bristles; petals entire, at least not fimbriate, rose coloured; stamens numerous; style single; stigma-lobes linear. Seeds black, glossy, with a brittle shell, the embryo strongly curved; seedlings without spines.

E. Mexico, known only from the type locality [near Tampico] (Britton & Rose 1963).

It should be noted that there is some confusion regarding P. grandiflora and P. grandifolia [for which reason I have included the illustration of the latter]. P. grandifolia *Haworth* is considered by some to be equivalent to P. grandiflora *Hort. ex Pfeiffer*, though others who have cultivated both species have noted minor differences. It would seem that although they are very similar, more evidence is needed to clarify their classification. P. grandifolia may also sometimes be encountered in the horticultural trade as P. bleo.

Cultivate Pereskia spp. in loose, rich soil, in partial sun. Easily cultivated from cuttings taken in summer; do not let cuttings callus over, but plant immediately. Water moderately, and mist occasionally. Requires heavier feeding than most cacti (Trout & Friends 1999).

PERESKIOPSIS

(Cactaceae)

Pereskiopsis scandens *Britton et Rose*

There does not appear to be any noteworthy useage of this leafy cactus. However, a confusingly-worded passage seems to suggest that "Peireskia sandents (ysypóvori)" is used by indigenous inhabitants of Paraguay, either alone or with **Passiflora** edulis, as a psychotrope. Presumably this should read **Pereskia** scandens (Stuart 2002b, citing E.S. Costantini), but as far as I am aware this name does not exist, so I further presume it refers to the closely related Pereskiopsis scandens.

P. chapistle has been shown to contain *tyramine*, 3-MeO-*tyramine*, *phenethylamine*, and 4-MeO-β-OH-*phenethylamine*.

P. scandens has been shown to contain 0.0022% *mescaline*, as well as *tyramine* and 0.0029% *DMPEA* (Doetsch et al. 1980).

Pereskiopsis scandens is a slender, irregularly branching cactus, climbing or clambering over walls, up to 10m long, with +- rod-shaped shoots; branches terete, greyish, smooth; areoles circular, white-wooly when young, grey in age, with a short spine 5mm long and a bunch of brown glochids in upper edge. Leaves ovate, 1.5-2cm long, flat, glabrous, acute, fleshy. Flowers yellow, from the areoles on old branches, rather large, rotate; pericarpel mostly with leaves or scales. Fruit club-shaped, fleshy, red, maturing slowly (perhaps over 2-3 years), very narrow, 5-7cm long, somewhat tubercled, with a deep umbilicus; seeds few, almost round with narrow collar, white, felted-hairy. Fl. Jun.

S. Mexico (Britton & Rose 1963; Haustein 1991).

Cultivated as for **Pereskia**, but may require more sun (Trout & Friends 1999).

PERIPENTADENIA

(Elaeocarpaceae/Euphorbiaceae)

Peripentadenia mearsii *C.T. White* **(Actephila mearsii** *C.T. White***)** – grey quandong, buff quandong

This Australian tree, recorded earlier last century from numerous locations in Queensland, is now possibly extinct [or at least very rare] due to logging of its natural habitat (Bock pers. comm.). It was found on at least one occasion to yield interesting tropane alkaloids, including *tropacocaine*. Later studies failed to replicate this, but it is known that this species is highly variable in alkaloid content.

Leaves of P. mearsii [from Boonjie, Qld] have yielded 0.25% alkaloids, of which 21% was *tropacocaine*, 11% (+)-3-α-acetoxy-6-β-OH-tropane and 28.4% (+)-2-α-benzoyloxy-3-β-OH-nortropane (Johns et al. 1971). A later study found leafy stems to yield 0.33% alkaloids, consisting of peripentadenine, di-nor-N-peripentadenine, peripentamine and anhydro-peripentamine (CSIRO 1990); the alkaloid mearsine has also been isolated (Buckingham et al. 1994).

Peripentadenia mearsii is a glabrous tree to 19m, bole to 51cm

diam.; outer bark dark brownish, marked by longitudinal lines of lenticels; inner bark pale brown, reddish on outer surface; branchlets drying reddish-brown or olivaceous, slightly angular, older ones greyish, terete, finely rugulose; internodes 1-3(-5)mm diam., 1-9(-30)mm long or much longer at base of some lateral branchlets; stipules deltoid or suborbicular, very caducous. Leaves spiral, rarely subopposite, chartaceous, elliptic- or oblong-lanceolate, (3.5-)5-15(-24) x (1.3-)2-5(-7)cm, apex acuminate, base narrowed and often +- biglandular, margin remotely crenate or crenate-dentate, upper surface shining, lower opaque and paler, midrib slightly elevated above, prominently so below, 5-10(-12) slightly elevated lateral nerves; petiole +- pulvinate at both ends, 0.6-2.5(-4.5)cm long, channelled above, rounded below, +- narrowly winged on margins. Flowers solitary, axillary, subtending leaves often reduced and soon falling, in bud 5-ribbed from outcurved margins of sepals, at anthesis pendulous, back from ends of branches, c.1.7-2cm long; pedicel 2-3.5(-5)cm long, thickened gradually upwards; sepals 5, thickly coriaceous, oblong-lanceolate, 10-12 x 4-5mm, pointed, tip inflexed, margins at first held together by matted hairs, outer surface glabrous, inner densely and shortly pubescent, with elevated midrib; petals 5, whitish, glabrous, obovate to oblong-obovate, c.1.6-1.9cm x 8-9mm, 3-lobed, each lobe cut into smaller lobes, each petal +- holding a group of c.10 stamens by its incurved lower margins; stamens c.55, septulose-hispid, c.10 encircling each appendage of the torus and 1 opposite each sepal; filaments expanded and compressed towards base, incurved towards apex, 6-8mm long, obliquely attached to base of anther; anthers linear, 3.4-3.6 x 0.5-0.6mm, opening by terminal cleft; appendages 5, opposite petals, compressed-ovoid, c.1.5-2mm long, obtuse, obliquely ascending. Ovary densely covered with short, appressed hairs, broadly ovoid, c.3mm long, 3-ribbed by the decurrent style-bases, 3-celled, each cell with 2 pairs of ovules pendulous from near apex; styles 3, laterally compressed, narrowed upwards to punctiform stigma. Capsule almost woody when dry, subglobose, 3-ribbed, 2-3.5cm diam., 3-celled with 2 of them abortive, and 1 with a single seed, +- loculicidally dehiscent, with persistent, curved central axis; seed ovoid, c.2.5 x 1.5cm, except for hilum which is completely covered by reddish arillus, hilum just below apex, circular, 3-5mm diam.

Rainforest; Queensland, Australia [Cook District, Gadgarra (State Forest Reserve 310 – Windin & Swipers Logging Areas), Boonjie, Topaz, Millaa Millaa] (Smith 1956).

PERNETTYA

(Ericaceae)

Pernettya furens *(Hook. ex DC.) Klotzsch* **(P. furiens** *(Hook. et Arn.) Klotzsch***; P. insana** *(Molina) Gunckel***; Gaultheria furiens** *(Hook.) Hook. et Arn.***; G. insana** *(Molina) Middleton***)** – hierba loca, hued-hued, hysh-hued

Pernettya parvifolia *Benth.* – hierba loca, taglli

Pernettya prostrata *(Cav.) Sleumer* – macha-macha

P. furens of Chile and P. parvifolia of Ecuador are known to produce a drastic intoxication following ingestion of the berries. The effects are said to resemble those of **Datura**, affecting motor coordination and causing confusion, delirium, hallucinations and 'madness'. Though their toxicity is well known locally, these plants seem to have no other uses (Ott 1993; Schultes & Hofmann 1980, 1992). In Bolivia and Colombia, P. prostrata is also known to cause dizziness and intoxication if the fruits are eaten; children have died from this (Altschul 1967). In areas where San Pedro is consumed [see **Trichocereus**], a Pernettya sp. known as 'toro-maique' is sometimes consumed with it. Also, in Chile, Pernettya spp. including P. mucronata and P. myrtilloides have been used in the making of chicha [see *Methods of Ingestion*] (Rätsch 1998).

Overdose of toxic Pernettya spp. from eating the sweet, insipid berries induces salivation, vomiting, colic pains, depressed respiration, debility, collapse and even death (Luteyn ed. 1995).

P. furens aerial parts have yielded sesquiterpenes – pernetic acids A [0.0092%], B [0.00025%], C [0.00022%], D [0.00085%] and E [0.0008%], pernetic acid A methyl ether [0.0004%], pernetol [0.00003%] and pernetal [0.00006%] (Hosozawa et al. 1985), as well as the flavonoid quercetin (Buckingham et al. ed. 1994).

P. parvifolia has yielded toxic glucosides, andromedotoxins [grayanotoxins; see Rhododendron in *Endnotes*] (Lewis & Elvin-Lewis 1977).

Pernettya furens is a bushy herb 60-120cm tall, wider than tall. Leaves alternate, persistent, ovate to narrowly so or elliptic, 2.5-5cm long, leathery, finely toothed and lightly bristly-hairy; stipules none. Flowers 6-9mm long, 1 or more in nodding inconspicuous terminal racemes or panicles 3-4cm long; calyx persistent, lobes 5, broad, often ciliolate; corolla urceolate, white, lobes 5, very short, recurved; stamens 10, included, filaments dilated below; anthers 2-celled, mostly oblong or oval, appendaged at apex, dehiscing apically. Ovary superior, sessile, 5-celled, usually spheroidal; ovules numerous, anatropous; style columnar; stigma minute. Fruits nodding, smooth, globose or subglobose, brownish-red, c.5mm long. Fl. late spring-early summer.

Central Chile, coastal zone.

Pernettya spp. are cultivated in Europe in rock gardens. Propagate by seed, suckers or layering in spring, or from cuttings in late summer. Grow in a neutral to acid soil, with moderate light, keeping moist (Beckett ed. 1994; Small 1914).

PETALOSTYLIS

(Leguminosae/Caesalpiniaceae)

PETALOSTYLIS CASSIOIDES

Petalostylis cassioides *(F. Muell.) Symon* **(P. labicheoides var. cassioides** *(F. Muell.) Benth.***; P. labicheoides var. microphylla** *Ewart et Morrison***; P. millefolium** *E. Pritz.***; P. spinescens** *E. Pritz.***; Petalogyne cassioides** *F. Muell.***)** – butterfly bush

Petalostylis labicheoides *R. Br.* **(Petalogyne labicheoides** *(R. Br.) F. Muell.***)** – butterfly bush

These Australian shrubs are not recorded as having any ethnobotanical uses; however, they do yield some interesting alkaloids.

P. cassioides stem and leaf has yielded 0.44-0.47% *tryptamine*, 0.052-0.078% of a mixture of *DMT* and *tetrahydroharman* (Johns et al. 1966a), and *melatonin* (Shulgin & Shulgin 1997). Test material in regards to *tryptamine*, *DMT* and *tetrahydroharman* levels quoted, was collected in Oct. 1965. Although the levels of the last two alkaloids were low, it is possible that harvest at different times of year may yield higher concentrations or different alkaloidal proportions.

P. labicheoides has yielded *tetrahydroharman* (Badger & Beecham 1951). Leaf, harvested in June [from Miles, Qld], gave strong positive reactions for alkaloids; bark gave weaker reactions (Webb 1949).

Petalostylis labicheoides is an erect bushy shrub, nearly glabrous, somewhat glaucous, 1-3m tall; stems often pruinose, semi-deciduous; young shoots minutely silky. Leaves alternate, imparipinnate, sparsely to densely pubescent; rachis 1.5-6cm long; pinnae 5-21(-30 or more), mostly alternate, appearing opposite at distance, with an odd terminal one, lanceolate to elliptic or oblong-oblanceolate, 15-30mm x 4-8mm, apex acuminate to mucronate, narrowed at base, sparsely hairy, thick, somewhat concave, midrib only conspicuous beneath; stipules narrow and deciduous. Inflorescence a short, axillary raceme, bracteate, 1-5-flowered; sepals 5, 8-10mm long, unequal, scarcely united at base, lanceolate, imbricate, acute, green, glabrous; petals deep yellow, 5, 1 with reddish markings, nearly unequal, ovate to obovate, 15-20mm long, shortly clawed, spreading; fertile stamens 3, 5-7mm long, dehiscing by longitudinal slits; staminodes 2, small. Ovary +- sessile, appressed-pubescent; ovules 4-6; style deep yellow, oblique, petaloid, 8-10mm x 3-5mm, saccate immediately above ovary, with 3 erect lobes, 2 short ones in front, the 3rd much longer, concave, the midrib prominent inside and terminating at apex in a small stigma. Pod 2-3cm long, erect, flat, +- oblong, +- leathery, oblique, elastically dehiscent; stipe 10-20mm long; seeds few, ovate-oblong, compressed, oblique, shiny, arillate, separated by pithy partitions. Fl. spring.

On sand plains, dune fields, rocky ridges; Northern Territory [Dampier's Archipelago & Nichol Bay], Queensland [rare], New South Wales [n.w. & c.w. slopes, n.w. & s.w. plains], South Australia [Akava River, Mt Serle & towards Spencer's Gulf], n.w. Western Australia.

P. cassioides is essentially very similar to the above, but with 11-80 leaflets, obovate or oblong, obcordate or suborbicular, apex rounded or obtuse, emarginate, retuse or shortly mucronate, 0.2-1.8cm long; leaf rachis 1.5-14cm long.

On sand plains, stony plains, sandstone and rocky outcrops, scree slopes, gravel and along creek beds; WA, n.w. SA, n.w. Qld [Sturt's Creek & Gulf of Carpenteria], NT [near Alice Springs] (Bentham 1864; Harden ed. 1990-1993; Johns et al. 1966; Ross 1998).

PETROSELINUM

(Umbelliferae/Apiaceae)

Petroselinum crispum *(Miller) Nyman ex A.W. Hill* **(P. sativum** *Hoffm.***)** – parsley, persil

Petroselinum crispum ssp. tuberosum *Bernh. ex Rchb.* – Hamburg parsley

Folklore regarding parsley in England is mostly of rumours related to women, the devil, and bad luck. It was said that the seed must visit with Satan numerous times before it sprouts, so that he may have his share. This belief probably derives from the long and sporadic germination of parsley seed. It was also said that a girl who sowed parsley seeds, or picked parsley leaves, would become pregnant as a result. Girls were reputed to be born under parsley plants, which in Sussex, were said to have been given to women by faeries. The herb is said to be best cultivated by a woman, or by members of a household of which a woman is head. It was believed to be bad luck to be given parsley. If a parsley plant was transplanted, it was claimed that the death of the entire household of the person responsible would follow (Le Strange 1977; Opie & Tatem 1989).

Parsley [presumably the seed] was reputedly used in witches flying ointments [see *Methods of Ingestion*] (Rätsch 1992). In ancient Greece, tombs were bedecked with parsley, the 'herb of death', which was associated with Archemorus and Persephone. They also used the herb medicinally, crowned victorious athletes with it, and fed it to their war-horses. The Romans were the first to use it as food – they consumed the foliage regularly in large amounts, and made garlands of it for banquet guests to counter strong odours and allay intoxication. Some have said that eating the seeds "helpeth men that have weyke braynes to beare drinks better". The seeds were also eaten by both men and women to increase fertility (Bremness 1988; Chevallier 1996; Cunningham 1994; Le Strange 1977). This is interesting, as the leaves are reputed traditionally [in England] to be abortifacient when eaten, or when the leaf juice is applied to the mouth of the womb (Opie & Tatem 1989).

The Lahu of n. Thailand eat P. crispum seeds to 'help the spirits make the medicine work' in cases of intestinal pain, where a mixture of Carica papaya, Cucurbita spp. [see *Endnotes*] and Sanseviera trifasciata is administered; alternately, seeds of **Lactuca** may be chewed for the same purpose (Anderson 1993).

The leaves, root and seeds are used to treat urinary infections, stones and gout, and as an antirheumatic, galactagogue, emmenagogue, uterotonic, digestive and diuretic. They also have antioxidant and antihistamine properties. The leaves may be used to freshen the breath, as a poultice for sprains and cuts, and as a hair, skin and eye tonic. The seeds should not be consumed by pregnant women, or those with kidney problems (Bremness 1994; Chevallier 1996; Mabey et al. ed. 1992; Polunin & Robbins 1992). It has been suggested that the essential oil of the seed may be ingested as a stimulant-psychedelic, with likely undesirable side-effects (Gottlieb 1992), as parsley seed oil is highly toxic. The oil [at least some batches] does have strong 'hallucinogenic' activity comparable to that of nutmeg [see **Myristica**], though subjectively it feels much harsher and more toxic (Torsten pers. comm.). Apparently, the root of P. crispum ssp. tuberosum and the leaves of P. crispum ssp. crispum have been smoked for their effects. The essential oils have been used in the synthesis of psychotropic *phenethylamines* (Rätsch 1998).

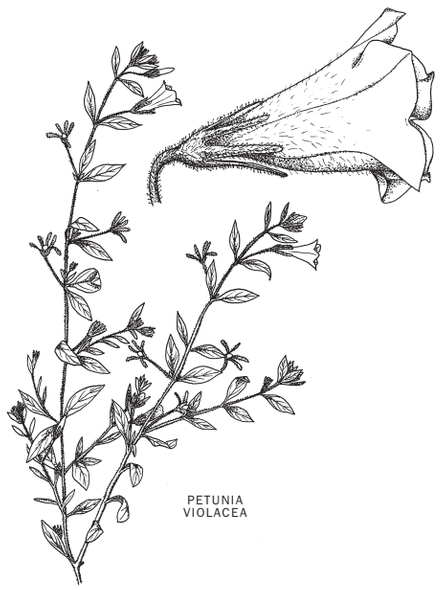
P. crispum leaf contains vitamins A & C, iron, manganese, calcium, phosphorous, flavonoids and a glycoside, as well as small quantities [c.0.7% w/w] of a pale yellow or greenish essential oil. The essential oil comes in three chemotypes – one is dominant in *myristicin* [20-85%], with 0-18% *apiole*, 1-23% *1-allyl-2,3,4,5-tetramethoxybenzene* and 0.3% *elemicin*; one is dominant in *apiole* [58-80%], with 9-30% *myristicin* and traces-6% *1-allyl-2,3,4,5-tetramethoxybenzene*; and one is dominant in *1-allyl-2,3,4,5-tetramethoxybenzene* [52-57%], with 26-37% *myristicin* and no *apiole*, or traces of it; p-methyl-*acetophenone*, 4-isopropenyl-1-methylbenzene, phellandrene, *pinene*, myrcene, terpenolene, menthatriene, carotel and many other compounds are also found in the leaf oils. A yellow, amber or brownish essential oil is concentrated in the seeds [2.4-3.2%], and consists mainly of *apiole* [18%] and *1-allyl-2,3,4,5-tetramethoxybenzene* [38%], as well as 1% *myristicin*, 20% α-*pinene*, 16% β-*pinene* and volatile fatty acids (Battaglia 1995; Harborne et al. 1969; Kasting et al. 1972; Lawless 1995; MacLeod et al. 1985; Rajkowski 1964; Shulgin 1967). The plant also contains furocoumarins which can cause photosensitisation (Culvenor 1970).

Petroselinum crispum is an erect annual or biennial glabrous herb; stem terete, solid, at anthesis up to 1m tall, much-branched, branches ascending. Leaves deltoid or triangular in general outline, 3-pinnate; the numerous leaflets 10-20mm, linear to cuneate-obovate, variously toothed or lobed, often crispate in cultivars. Umbels 5-8cm wide, long-peduncled, terminal and lateral, flat-topped; rays 8-20, about equal; umbellets many-flowered; involucel of 4-6 lanceolate bracts shorter than the pedicels; bracts 1-3, entire or 3-fid; bracteoles 5-8, linear-oblong to ovate-cuspidate; sepals none or minute; petals 5, usually +- 3-lobed, yellow or greenish-yellow, emarginate; stamens 5. Carpels (1-)2; styles (1-)2, often with thickened base; ovule pendent, 1 in each loculus. Fruit broadly ovate, 2-3mm long, flattened laterally, constricted at the commissure, ribs 5, narrow, prominent, filiform; oil-tubes solitary in the intervals, 2 on the commissure; carpophore cleft to the base.

Origin uncertain, probably s.e. Europe and w. Asia; cultivated as a culinary herb, also naturalised in some parts of Europe (Gleason 1952; Tutin et al. ed. 1964-1980).

PETUNIA

(Solanaceae)



Petunia violacea *Lindley* **(P. dichotoma** *Sendt.***; P. integrifolia** *(Hook.) Schinz et Thell.***; P. phoenicia** *D. Don, ex Loudon***)** – shanin, petunia

This herb is said to have been used as a 'hallucinogen' in highland Ecuador. Its consumption is said to cause a sensation of flying, a phenomenon sometimes attributed to the hallucinogenic tropane alkaloids [such as *hyoscine*]. Substantiating evidence has so far proven elusive (Butler et al. 1981; Schultes & Hofmann 1980).

P. violacea leaves were found to contain no volatile alkaloids, in an early screening alongside some **Nicotiana** spp. (Kovalenko 1934); a later alkaloid screening also found no alkaloids in stem or leaf of Uruguayan plants [harv. Dec.] (Fong et al. 1972), and neither did a later analysis of cultivated material of horticultural origin [seeds, roots, stems and flowers from plants at different stages of development] (Butler et al. 1981). As P. integrifolia, it has yielded the ergostane-type steroid petuniasterone N [c.0.15%] from the leaves (Elliger et al. 1989). P. violacea has been shown to strongly inhibit human plasma AChE (Orgell 1963b).

P. x hybrida flowers have yielded cyanidin, delphinidin, malvidin, petunidin, paeonidin, cinnamic acid and flavones (Hess 1964; Steiner 1970); leaves accumulate flavonol glycosides and anthocyanins, via activity of the enzyme flavanone-7-O-glucosyltransferase (Durren & McIntosh 1999). Leaves and stems have yielded ergostane-type steroids, including petuniasterone A, petuniasterone N [c.0.02%] and petuniasterone B 22-O-((methylthio)-carbonyl)acetate (Elliger et al. 1988, 1989).

Petunia violacea is a perennial herb (annual in cultivation), branching from the base, ascending or semierect, glandular-pubescent, to 60cm tall. Leaves alternate (or opposite apically), entire, ovate to ovate-lanceolate, apex acute, base attenuate, glabrous or slightly pilose, to 15-50 x 5-20mm; pseudopetiole winged. Flowers solitary in axils of terminal leaves, forming racemose-like clusters; pedicels pubescent, 1-4cm long; calyx campanulate, hirsute-glandular, deeply pentasect, with tube 2-3mm long, segments linear, somewhat widened towards apex, obtuse or semiacute, 5-17mm long x 1-1.5mm wide; corolla violet, pubescent, infundibuliform, with tube wide and limb open 25-40mm long x 25-30mm wide; stamens unequal. Capsules globose-ovoid, 6-7mm long; seeds subglobose, fine-

ly reticulate.

Brazil, from Paraná through Rio Grande to Sul, Paraguay, Uruguay and n.e. Argentina; frequent in Entre Rios (Burkart 1979).

Petunias are commonly cultivated the world over, and most cultivated varieties [P. x hybrida] have been believed to be hybrids between the S. American natives P. axillaris [white flowers] and P. violacea [purple flowers] (Haegi et al. 1982). However, others believe that P. axillaris and P. violacea may be synonymous, with P. violacea representing a variant. Not only that, but many plants circulated in horticulture as 'P. violacea' may in fact be incorrectly named hybrids based on P. axillaris and other species (Sink 1984).

PEUCEDANUM

(Umbelliferae/Apiaceae)

Peucedanum decursivum *(Miq.) Maxim.* **(P. melanotilingia** *(Boissieu) Boissieu***; P. porphyroscias** *(Miq.) Makino***; Angelica decursiva** *(Miq.) Franch. et Sav.***; Pimpinella decursiva** *(Miq.) Wolff.***; Porphyroscias decursiva** *Miq.***; Selinum melanotilingia** *Boiss.***)** – zi-hua qian-hu, nodake, shikazenko

Peucedanum dhana *Wall.*

Peucedanum japonicum *Thunb.* **(P. litorale** *Vorosch. et Gorovoj***)** – fang-k'uei, fang kui

Peucedanum ostruthium *(L.) W. Koch* **(P. imperatoria** *Endich.***; Imperatoria ostruthium** *L.***; I. trilobata** *Gilib.***; Selinum imperatoria** *Crantz***; S. ostruthium** *Wallr.***)** – masterwort, hog fennel

Peucedanum verticillare *(L.) Koch. ex DC.* **(P. altissimum** *(Miller) Thell., non Desf.***; Tommasinia altissima** *(Miller) Thell.***)** – hog fennel

The root of 'fang-k'uei', P. japonicum, is used in TCM as a sedative, eliminative and diuretic, which acts as a tonic with extended use. It is also used to treat epilepsy, hernia, and other disorders. However, its use is not recommended in excess, or by feverish people, as it reputedly then "causes one to be delirious and see spirits" and "act somewhat like mad" (Li 1978). P. ledebourielloides and P. wawrii roots may have been used as 'fang-feng' in the past [see **Siler**] (Wang & Lou 1989). Root of P. decursivum is also used by the Chinese as a nervine, aphrodisiac, ch'i tonic (Rätsch 1992), analgesic, expectorant, antitussive and antipyretic, in doses of 5-10g (Keys 1976). A fermented root extract of P. ostruthium is said to be euphoric and analgesic, and treats toothache, bronchial catarrh and stomach upsets. Its leaves are used to flavour some cheeses (Chiej 1984). In the Himalayas, roots of P. dhana are taken as a tonic (Usher 1974).

P. decursivum root has yielded coumarins – decursidin, bergapten, nodakenetin, nodakenin, 3'(S)-senecioyloxy-4'(R)-OH-3',4'-dihydroxanthyletin, 3'(S)-OH-4'(R)-senecioyloxy-3',4'-dihydroxanthyletin and 3'(S)-angeloyloxy-4'(R)-acetoxy-3',4'-dihydroxanthyletin (Sakakibara et al. 1982).

P. japonicum root has yielded coumarins, including peucedanol, hamaudol, (+)-samidin, khellactone-derivatives, bergapten (Hata et al. 1968; Shigematsu et al. 1982), coumarin [sedative hypnotic in large doses – see **Justicia**] and furocoumarin; and 3-methyl-2-butenoic acid has also been found in the plant (Buckingham et al. ed. 1994; Schultes & Hofmann 1980). cis-Diisovalerylkhellactone and disenecioylkhellactone from this plant showed anorexic activity (Hsu 1987).

P. ostruthium has yielded aviprin, ostruthin, ostruthol, oxypeucedanin, pabulenol, pabulenone, peucenin, imperatorine, ostruthine, ostrol, Z-ligustilide, senkyunolide, emetine, tannin and starch (Buckingham et al. ed. 1994; Chiej 1984; Gijbels et al. 1984).

P. verticillare aerial parts [harv. late Jun., central Italy] yielded 0.05ml essential oil per 100g [w/w], consisting mostly of sabinene [39.6%] and (E)-*anethole* [29.5%], as well as epi-*camphor* [7.8%], α-*pinene* [6.3%], α-phellandrene [5.6%], β-myrcene [4.7%] and traces of other compounds; fresh fruits [harv. mid Jul., same location] yielded 0.125ml/100g [w/w], consisting mostly of sabinene [63%], as well as α-phellandrene [9.3%], β-myrcene [8.1%], nerol [3.5%], (E)-*anethole* [1.8%], β-*pinene* [1.6%] and traces of other compounds; dry fruits [dried on plant; harv. Aug. & Sep., same location] yielded 0.21ml/100g, consisting mostly of β-caryophyllene [24.2%] and α-phellandrene [20.8%], as well as (Z)-β-farnesene [12.8%], β-bisabolene [9%], β-cubebene [7.5%], caryophyllene oxide [6.7%], trans-α-bergamotene [5.3%], geranyl acetate [5%], γ-terpinene [3.8%], (Z)-β-ocimene [2.7%] and cis-caryophyllene [2%] (Fraternale et al. 2000).

Some members of the genus Peucedanum contain *scopoletin* (Buckingham et al. 1994).

Peucedanum japonicum is a rather stout, glabrous, perennial herb 60-100cm tall. Leaves long-petiolate, 1-2-ternate, 10-35cm long incl. petiole, the leaflets obovate-cuneate, 3-6cm long, 2-4cm across, petiolate or sessile, often slightly 3-lobed at apex; pinnules dentate or slightly lobed; cauline leaves reduced upwards; petioles 10-20cm long, sheathing at base. Umbels compound; peduncles 3-10cm long; involucres deciduous, linear-lanceolate, 5-8mm long, pubescent; rays 15-30, 1-5cm long, spreading-ascending, subequal; involucels several, linear-lanceolate, 5mm long, pubescent; umbellules 1cm long; flowers polygamous, white; calyx teeth prominent to obsolete, hirsutulous, 1cm long; petals ovate, with narrower inflexed apices dorsally, glabrous to pubescent; stylopodium conical. Fruit oblong-ovate, dorsally-compressed, 4-6 x 2-4mm, pubescent, dorsal ribs filiform, not winged, lateral ribs winged, shorter than body; vittae 3-5 in the intervals, 8-10 on the commissure; seed face slightly concave.

Maritime areas, along seashores; Japan, the Ryukyus, China, Philippines, Taiwan, Lanyu Island (Flora of Taiwan Editorial Committee ed. 1977).

PHALARIS

(Gramineae/Poaceae)

Phalaris angusta *Nees ex Trin.* **(P. intermedia** *Bosc. ex Poir.* **var. angusta** *Chapm.***)**

Phalaris aquatica *L.* **(P. tuberosa** *L.***)** – Toowoombah canary grass, large canary grass

Phalaris aquatica *L.* **x arundinacea** *L.* – ronpha grass

Phalaris arundinacea *L.* – reed canary grass

Phalaris brachystachys *Link.*

Phalaris canariensis *L.* – canary grass

Phalaris caroliniana *Walt.* **(P. intermedia** *Bosc. ex Poir.***)**

Phalaris coerulescens *Desf.* – blue canary grass

Phalaris minor *Retz.* – canary grass

Phalaris paradoxa *L.* – paradoxa grass

Phalaris stenoptera *Hack.* **(P. aquatica var. stenoptera** *(Hack.) Burkart***; P. tuberosa var. stenoptera** *(Hack.) Hitchc.***)** – Harding grass

Phalaris truncata *Guss. ex Bertol.*

Phalaris spp. – phalaris grass

Phalaris grasses [usually P. aquatica or P. arundinacea] have long been popular grown as stock fodder for grazing animals. Some species, such as P. minor and P. canariensis, are grown for bird seed [hence, 'canary grass']. However, Phalaris spp. [particularly P. aquatica and P. arundinacea] are known to cause a neurological intoxication of variable duration known as 'Phalaris staggers', under some conditions, in sheep and cattle. Also known is a cardiac disorder often called 'sudden death syndrome', though death does not always result. These poisonings were thought to have been caused by the psychoactive *tryptamine* alkaloids present in these grasses [due almost entirely to questionable research conclusions by C.H. Gallagher – see Festi & Samorini 1994b and Trout ed. 1998]. Occasionally death occurs, in animals that have eaten a particularly large patch, or have been grazing it over a long period. These deaths are now known not to be directly related to the *tryptamine*-content of these grasses. The presence of 3-methylindole and N-methyl-*tyramine* has also been suspected as a causative agent. It is also known that potentially lethal levels [for grazing animals] of nitrate [c.0.29%] and HCN [0.02-0.036%] may be accumulated in some stages of growth [eg. HCN may be produced primarily in first cuttings of young growth]. The tryptamines do, however, appear to be responsible for the neurological symptoms of the intoxication, as well as causing diarrhoea; these symptoms are observed when indole alkaloid content exceeds 0.2% d/w. *Hordenine* is responsible for the unpalatability of some strains. P. aquatica x arundinacea, P. angusta, P. brachystachys, P. caroliniana and P. minor also produce intoxications in livestock (Bourke et al. 1988, 1992b; Cheeke 1995; Festi & Samorini 1994a, 1994b; Hungerford 1990; Oram 1970; Parmar & Brink 1976; Rendig et al. 1976; Ruelke 1961). P. coerulescens and P. paradoxa are suspected of having caused the death of horses in Australia, although they appear not to be toxic to ruminants (Anderton et al. 1998; Bourke et al. 2003). Several 'quick tests' for alkaloid concentration in Phalaris spp. have been devised (Frelich & Marten 1973), but to the non-chemist, it would seem simpler to extract a sample of grass to a freebase alkaloid mix, and evaluate alkaloid quantity from the end yield.

The *tryptamine*-alkaloid content, however, is the reason these grasses deserve extra attention, as several species have yielded useful quantities of the tryptamines *DMT* and *5-methoxy-DMT* [*5-MeO-DMT*]. Experiments with smoking dried young plants of P. aquatica 'AQ-1' [see below] cut from the second re-growth resulted in barely perceptible effects. However, psychedelic effects could be obtained by inhaling vapour emitted from heated fresh plant cuttings [these were, of course, not heated to the point of combustion] (Festi & Samorini 1994a). Some of the more potent strains of P. aquatica and P. arundinacea, rich in *5-MeO-DMT*, have only required a simple 1-shot extraction [solvent extraction, or juicing the shoots, the extract then being dried] to yield a visionary smoking material (DeKorne 1994). However, apart from Jim DeKorne who first reported this, I have not heard of anyone meeting with any success via this route. It seems best to go to a bit of extra effort and extract the alkaloids to a pure or near-pure state [see *Producing Plant Drugs*]. P. aquatica and P. arundinacea have also been used as constituents of ayahuasca analogues [see *Methods of Ingestion*], combined with **Peganum** harmala seeds, to

produce a powerful experience. It seems that *5-MeO-DMT*, when present in higher amounts, can make for a physically unpleasant and extremely intense experience via this route (DeKorne 1994, ed. 1996; pers. comms.).

The first reported use of Phalaris spp. in an ayahuasca analogue was an experiment conducted by two Italian researchers, using an extract of 4.5g **Peganum** harmala seeds [consumed first] with an extract of c.400g fresh P. aquatica 'AQ-1' [consumed 20mins later], for each dose. 'AQ-1' is a wild Italian strain named by Giorgio Samorini, who found it growing near Bologna. This has proven to be a potent strain [see below], which was not known at the time of the first bioassay. Effects were noted 30mins after consumption, and seemed to then diminish, followed by a strong return of effects an hour later. Some 40mins after this point one of the researchers became unconscious for an extended period [not returning to normal for some 13hrs after ingestion]. His symptoms, observed by his friend and co-bioassayist, included "symptoms of adrenergic activation with strong mydriasis, muscular hypertonicity [particularly in the nape and the back], muscular clonus, tremors, exaggerated reflexes." Needless to say this was a most distressing experience for both involved. A second bioassay using an extract of c.2.5g P. harmala seeds and an extract of c.60g fresh 'AQ-1' was much more manageable, and without adverse reactions. It has been thought that any *5-MeO-DMT* present in the 'AQ-1' might have produced the adverse reaction of the first bioassay (Festi & Samorini 1994a; Samorini pers. comm.), though it is unusual that only one of the researchers experienced these effects. The symptoms seem to suggest 'serotonin syndrome' [see *Influencing Endogenous Chemistry*], which might perhaps be induced by an overdose of *5-MeO-DMT* with MAOI (pers. obs.).

P. brachystachys and P. stenoptera have also been used successfully in ayahuasca analogues (Green 1999a, 2000). It is not recommended to use the fresh juice of Phalaris spp., as many bioassays have indicated increased toxicity ["many more side-effects and toxic 'hangover' after-effects"] (Trout ed. 1998). One person did not note side-effects, but did experience a "very powerful, very short, psychedelic journey" after ingesting 1tsp fresh P. aquatica juice with 3g **Peganum** harmala seeds. This psychonaut noted that the experience was very different from that of *DMT* or *5-MeO-DMT*, an assertion backed up by friends who later tried the same preparation. These effects were not noted in summer harvests, or if the juice extract was dried; they were noted to be present when the night greenhouse temperature fell below 60ºF. Freezing the extract immediately after juicing preserved this unique activity. It was proposed that the subjective effects were due to an unknown *tryptamine* (Green 2000), though one is forced to wonder whether *bufotenine* may be responsible.

I have experienced 'threshold' effects from ingesting a water/lemon juice [7:3] extract of 3g ground **Peganum** harmala seed, with a similar extract of P. aquatica [10g dry young shoots]. An enhancement of sound-perception and awareness of the space around me was noticed after 20-30mins. The effects progressed little further, though another 30mins later when I was lying down with eyes closed, I experienced several delightfully-pleasant 'rushes' of mild psychedelic energy tingle up my spine and burst in my head. The effects receded almost imperceptibly over the next hour or two, and no after-effects were noted. The preparation did not cause nausea and felt 'friendly' to my body and mind. The grass had been cultivated from rhizome-cuttings [taken from escaped P. aquatica growing near Dandenong Creek, Victoria, Australia] in a 30cm diam. pot with fertile, moderately well-drained soil; it was grown largely in semi-shade, fertilised every month or so with dilute urine, and generally ignored except for weeding. After several initial clippings, I allowed the plant to mature and flower (it very much resembled P. minor, and I developed a suspicion that P. minor might be a younger growth-form of P. aquatica, as the parent of these rhizomes was definitely P. aquatica; I also wondered if it was possible that the continuous clipping of the plant had simply stunted the stature of its flowers when eventually allowed to mature). After cutting the mature growth, I again began collecting the young regrowth in the mornings, and saving the dried foliage in a zip-lock bag until I had enough to experiment with. This took many months, as the size of the plant was restricted to the one pot.

P. angusta contained an unidentified *tryptamine* that was not *5-MeO-DMT*, but gave a similar colour reaction (Festi & Samorini 1994a).

P. aquatica has yielded 0.03-0.178% alkaloids, containing *DMT*, *5-MeO-DMT* and *bufotenine*; the amount of *bufotenine* is minor, and the other two compete for status as the major alkaloid. The highest yields in these tests were from the 'S184' strain from Crete, which yielded mostly *5-MeO-DMT*, and only 5% of the alkaloids was *DMT* (Culvenor et al. 1964; Oram & Williams 1967). 'Australian commercial' P. aquatica has yielded 0.1% *DMT* and 0.05% *5-MeO-DMT*, with traces of *tryptophan*, *tryptamine*, *serotonin*, *5-MeO-tryptamine* and *bufotenine*; seedlings only contained *DMT* and *5-MeO-DMT* (Baxter & Slaytor 1972a, 1972b). However, in a more detailed assay, 7 day-old seedlings of this cultivar were shown to contain 23 different bases, of which 15 were identified. *DMT* was identified as the major alkaloid [300nmol/100 seedlings], with other compounds identified as *5-MeO-DMT*, 5-MeO-*NMT*, *5-MeO-tryptamine*, *bufotenine*, 5-OH-*NMT*, *NMT*, *serotonin*, *tryptamine*, *tryptophan*, 5-MeO-*tryptophan*, *gramine*, 3-aminomethylindole, 3-methylaminomethylindole, and indole-3-aldehyde (Mulvena & Slaytor 1982). Yields of up to 0.3% *DMT* have been reported in Australia (Hungerford 1990); though the wild Italian 'AQ-1' strain has yielded c.1% alkaloids [mostly *DMT*] (Festi & Samorini 1994a, 1994b). Strain 'Sirolan' yielded only 0.0004-0.0005% alkaloids [w/w]; strain 'Sirosa' yielded 0.0029% alkaloids [w/w]; and slow-growing winter strains yielded 0.0092% alkaloids [w/w] (Skerritt et al. 2000). The 'Sirocco' strain, growing in southern Australia, yielded *5-MeO-DMT* as the major alkaloid. Several South Australian strains – 'GB81', 'Seedmaster', 'Sirocco', 'High alkaloid' and 'Low alkaloid' – yielded 0.001-0.06% alkaloids, highest with active growth after rain in autumn and early winter. All contained at least c.5% each [of total alkaloids] 2-methyl-THβC and 2-methyl-*pinoline*, though 'Seedmaster' contained higher levels of these compounds (Frahn & O'Keefe 1971). The species has also yielded N-methyl-THβC, *tetrahydroharman*, N-methyl-*tyramine* (Anderton et al. 1999; CSIRO 1990; Shulgin & Shulgin 1997; Vijayanagar et al. 1975), coerulescine and phalarine [see below] in smaller amounts (Bourke et al. 2003). Fresh samples contain higher proportions of *bufotenine* than dried samples (Culvenor et al. 1964). Grass may consist of c.80% water by weight (Trout ed. 1998).

P. aquatica has been observed infected with the ergot **Claviceps** phalaridis, of unknown chemistry and toxicology. As well as residing inconspicuously within the ovary of the flower, where it is not easily seen, autumn growth of the infected grass is also seen to bear intercellular hyphae of the endophyte in the vegetative growth (Walker 1970).

P. arundinacea has yielded [0-]0.004-1.19% alkaloids [clone '108-3' yielded the higher value; clone '255-10' gave 0.91%], though this has been said to range up to 2.75%; the major base in 'palatable' [to stock animals] strains is *gramine* [up to 0.3%], up to 0.07% *5-MeO-DMT* and no *DMT*; whereas 'unpalatable' strains contained up to 0.02% *DMT*, <0.01-1% or more *5-MeO-DMT* and no *gramine*; some strains yield only *DMT* (Barker & Hovin 1974; Barnes et al. 1971; Culvenor et al. 1964; Marten et al. 1973; Parmar & Brink 1976; Williams et al. 1971). It has also yielded *hordenine*, 5-MeO-*NMT* (Ghosal 1972; Wilkinson 1958), and c.0.0002% each of 2-methyl-*pinoline* and 6-MeO-2,9-dimethyl-THβC (Vijayanagar et al. 1975) – 2-methyl-*pinoline* sometimes may occur in higher concentrations [clones 'R37' and 'R52'], with little or no *5-MeO-DMT* and some *hordenine*. Plants producing *DMT* may also yield 2-methyl-THβC in varying ratios (Gander et al. 1976). In N. American plants, those with low *DMT*-content had high β-carboline levels, and vice versa (Bourke et al. 1988). In general, *DMT* and *5-MeO-DMT* were not found in plants of the same strain; in this case, *5-MeO-DMT* producers usually yielded 2-methyl-*pinoline* and *hordenine*, whilst *DMT* producers did not (Gander et al. 1976). Strain 'Ottawa Synthetic C' yielded 0.009% *hordenine* and lesser amounts of *gramine*, 6-MeO-2,9-dimethyl-THβC and n-octacosanol (Audette et al. 1970). Strain 'NRG 741' from Canada, collected after seeding, yielded 0.067-0.115% *5-MeO-tryptamine* and 0.059-0.063% *gramine*, whilst strain 'NRG 721' yielded 0.027-0.074% *gramine* and no *5-MeO-tryptamine* (Majak et al. 1978). The 'PI 172443' strain from Turkey ['Turkish Red'] showed an increase in *DMT* content on drying, which was stable over time; yet the 'PI 253317' strain from Yugoslavia ['Yugoslavian Fresh Cut'] showed highest *DMT* levels when fresh – on drying, total alkaloid levels decreased, as did the relative concentration of *DMT* (Appleseed 1993). Grass may consist of c.65-81% water by weight (Trout ed. 1998).

Traces of 5-methyl-*tryptamine*, 7-MeO-*gramine* and 5,7-dimethoxy-*gramine* have also been found in these two Phalaris spp. during some stages of growth (Festi & Samorini 1994a, 1994b).

P. brachystachys has been found to contain *DMT* in high concentration, as the sole alkaloid (Festi & Samorini 1994a). Greek plants have been found to give good yields of *DMT* (Green 1999a).

P. canariensis has been found to contain *DMT* as the major alkaloid, as well as *5-MeO-DMT* and traces of *bufotenine* (Festi & Samorini 1994a, 1994b); this species was consistently observed to have low alkaloid concentration in one study (Oram 1970).

P. coerulescens was found to contain *DMT* as the major alkaloid, with traces of *bufotenine* (Festi & Samorini 1994a, 1994b), though later work has given a different picture. This species recently yielded 2-methyl-THβC, possibly 2-methyl-*pinoline*, traces of *DMT* [in some samples], 0.001% coerulescine [a new oxindole], horsfiline [an oxindole – see **Horsfieldia**], and 0.003% of a new furanobisindole, phalarine. It was observed that a standard sample of *bufotenine* in aqueous methanol degraded rapidly at room temperature, suggesting that any *bufotenine* present in the plant extract may be hard to detect in some circumstances (Anderton et al. 1998, 1999a, 1999b; Bourke et al. 2003). Perhaps the differences in relative levels of *DMT* and the other alkaloids are related to the stage of growth of the plant material analysed (pers. obs.).

P. minor has been found to contain traces of *DMT* as the only alkaloid (Festi & Samorini 1994a).

P. paradoxa has been found to contain *DMT* as the major alkaloid, as well as *NMT* and traces of *bufotenine* (Festi & Samorini 1994a, 1994b). As with the closely-related P. coerulescens, recent analysis has shown other alkaloids to be more predominant – 2-methyl-THβC, phalarine and coerulescine, and methoxylated derivatives of all three (Bourke et al. 2003).

P. stenoptera has yielded 0-0.28% alkaloids, consisting of *5-MeO-*

DMT [major alkaloid], *DMT* and traces of *bufotenine*. Alkaloid peaks were often observed in September when grown in California (Festi & Samorini 1994b; Rendig et al. 1976; Trout ed. 1998). This species has been bioassayed in ayahuasca analogues, and observed to be c.1/3 as potent as Greek P. brachystachys (Green 1999a, 2000).

P. truncata has been found to contain *DMT* as the major alkaloid, as well as *5-MeO-DMT*, *NMT* and traces of *bufotenine* (Festi & Samorini 1994a, 1994b).

Oram assayed 33 strains of 14 Phalaris spp., finding all to contain tryptamines, though the identities of the species were not given (Oram 1970).

Cyanogenic compounds are usually present in Phalaris spp., but in levels too low to be of concern for human consumption, and they detoxify rapidly to trans-aconitic acid (Anderton et al. 1998, 1999; Festi & Samorini 1994a, 1994b). Apparently, the genes controlling *gramine* synthesis in Phalaris spp. are recessive to those controlling synthesis of other indoles (Trout ed. 1998); hence, breeding could perhaps adapt non-desirable *gramine*-dominant strains to desirable *tryptamine*-producers.

Recently, concerns have been raised by Dr. A.T. Shulgin and others regarding some of the β-carbolines present in Phalaris spp., which have close structural similarity to β-carbolines of demonstrated toxicity. In animal studies, 2-methyl-, 2,9-dimethyl- and 2-methyl-3,4-dihydro- β-carbolines have been shown to inhibit mitochondrial respiration (Albores et al. 1990; Matsubara et al. 1998). Also, (-)-(1S, 3S)-1-methyl-THβC-3-carboxylic acid has been shown to be neurotoxic to mature neurons, though promoting the survival of immature neurons (Brenneman et al. 1993). Although toxicity of the 1,2,3,4-tetrahydro-β-carbolines in Phalaris has not been demonstrated, there remains a possibility that they may be metabolised intraneurally to form neurotoxins (Shulgin pers. comm.; Trout pers. comm.).

Nitrogen [only in full light; best soil absorption from ammonium nitrogen], increased temperature, periods of water deprivation [growth after the drought is up to 3x more potent, though also contains greater levels of N-methyl-*tyramine*], and shading all increase alkaloid concentration in young growth. There are also large variations in alkaloid concentration over different times of day – *DMT* content [in shaded plants] is highest in early morning, whereas *5-MeO-DMT* is highest in late morning. In P. arundinacea, water stress and continuous harvests promote an increase in *gramine* levels, in *gramine*-producing strains. Also, clippings from the first regrowth after cutting-back have yielded higher alkaloid levels than the initial cutting [which may yield small levels of cyanogenic compounds, and is often deficient in *tryptamine* alkaloids]. Alkaloid levels decrease as the plant gets older. Young, chlorophyllous growth [upper 1/3 of leaf blades before solid stems have formed] is most potent; 7-day old plants have been most potent in regards to first harvest. Roots, stems, sheaths, lower portions of leaf blades, and older leaves yield negligible levels of alkaloids. Late summer to autumn is generally the best harvesting time. *Hordenine* is mainly present in leaf sheath and other parts, in later stages of growth. Drying reduces the alkaloid levels by up to 50%, with some exceptions [eg. 'Yugoslavian Fresh Cut' – see above] (Cheeke 1995; Culvenor et al. 1964; Festi & Samorini 1994a, 1994b; Hungerford 1990; Marten et al. 1973; Moore et al. 1967; Parmar & Brink 1976; Skerritt et al. 2000; Trout ed. 1998). Some research suggests that 'common' and older plantings of these grasses are more often found to be rich in alkaloids (Appleseed 1993).

Experiments with P. aquatica 'Australian commercial' suggest that the production of *5-MeO-DMT* and perhaps *DMT* might be self-limiting, as the latter alkaloid inhibits a *tryptophan* decarboxylase enzyme found in seedlings [as do *tryptamine*, *5-hydroxytryptophan*, indoleacetic acid and indole acetaldehyde] (Baxter & Slaytor 1972a). However, numerous potential metabolic pathways exist for the biosynthesis of alkaloids [such as *5-MeO-DMT*] in this species, and it is unclear what conclusions can be drawn from this (Baxter & Slaytor 1972b).

Phalaris aquatica is a tussock-forming perennial grass, spreading slowly by short rhizomes; to 2m tall. Tillers swollen at base; leaf blades 15-40cm x 4-15mm, flat, glabrous, greyish-green in older growth, young leaves rolled in bud, green; auricles absent, a pale greenish 'collar' at blade base; ligule white, translucent, 3-5mm long, longer than wide, rounded at apex; leaf sheath greyish-green, glabrous, round in cross-section – when cut through at base, exudes a pink sap (I have only noticed this in young plants, and present as more of a red stain). Inflorescence a dense, cylindrical, spike-like panicle 5-15cm x 10-15mm; spikelets of 3 florets, the fertile floret +- oval and laterally flattened, 5-7mm long, 2 outer glumes enclose floret, 2 minute sterile lemmas attached at base of fertile floret represent the 2 infertile florets; glumes laterally flattened, strongly keeled, winged on distal half, striped green and pale green or whitish, boat-shaped and equal in length, awnless; lemma covered with fine, loosely appressed hairs when young, at maturity shiny and smooth, cream to pale brown, awnless; anthers 3, yellow.

Native to Mediterranean region; introduced as a forage crop in US, Australia, S. Africa, Argentina and Uruguay, as well as other countries, now a widespread weed of roadsides, wetlands and waste ground.

Sow seed in a weed-free bed where they are to grow, in autumn or spring; grows in a wide range of soils, prefers sandy soil with clay subsoil [within 30cm of surface]; drought-tolerant; +- dormant in summer. Plants may take several years to become fully established (Lamp et al. 1990; pers. obs.).

Field identification in Australia might be hampered, in some instances, by the existence of a fertile hybrid between P. aquatica and P. minor, which originated in Queensland and has been proposed as a new species, P. daviesii (Blake 1956).

PHRAGMITES

(Gramineae/Poaceae)

Phragmites australis *(Cav.) Trin. ex Steud.* **(P. communis** *Trin.***; P. dioica** *Hack. ex Conert***; P. dioica** *Hack. ex Hicken***; P. maximus** *(Forssk.) Chiov.***; P. phragmites** *(L.) H. Karst.***; P. vulgaris** *(Lam.) Bonnet***; Arundo australis** *Cav.***; A. maxima** *Forssk.***; A. occidentalis** *Sieber et Schult.***; A. phragmites** *L.***; Zizania effusa** *Munro***)** – common reed, reed grass, ditch reed, carrizo, lu-ken, lu-jen, bous, ghab, qoboi, qasba

Common over much of the world, P. australis is used to make thatching, mats, and brooms. The herb is sometimes now planted to treat sewage organically by absorbing impurities from water-sources. Various native American groups have cooked the seeds into a gruel, boiled the young shoots as a vegetable, ground the rhizomes into flour, and eaten the sap. In Japan, young shoots are cooked and eaten as a vegetable, and the manna-like gum that exudes from the stem is also eaten. The rhizome in TCM is considered sweet and cold in energetics, with affinities for the lungs and stomach. It is used to treat nausea, urinary problems, arthritis and thirst from fever; it may also treat coughs, excess phlegm, hiccoughs, lung pain and fish-poisoning [medicinal dose – 15-60g] (Bremness 1994; Duke 1983; Hsu et al. 1986; Kokwaro 1995; Tierra 1988). In parts of Arabia, the rhizome is used in folk medicine as an antiemetic, antipyretic, diaphoretic, diuretic and stomachic (Wassel et al. 1985). In southern Africa, the rhizome ['qoboi'] has been reported as an ingredient of a compound drug ['sehoere' – see *Methods of Ingestion*] consumed in intoxicating ritual feasts by the Basuto (Laydevant 1932). Seri shamans of Sonora prepare tubes of P. australis stem, filled with a special powder prepared with the aid of 'ikkor', an 'invisible power' which controls the spirits of plants. These tubes are hired out as a good luck fetish, or as a charm to cure illness (Felger & Moser 1974).

The rhizomes of P. australis have been bioassayed with successful results in ayahuasca analogues [see *Methods of Ingestion*] in doses of 45g dry and 25-50g fresh, boiled 15-30 minutes in acidified water, and consumed with extracts of **Peganum** harmala seeds. The extract has a sweetish taste, unlike many other analogue plants. Some others have had little or no success with this plant. In some cases this might be attributed to the use of purchased rhizome which was possibly old and relatively inactive. I have communicated with individuals who have bioassayed the rhizome in large amounts with **Peganum** harmala and experienced no effects. It would seem that a great degree of natural variation would be inherent in different strains across the world. Optimum harvest time, in regards to *DMT* content, also needs further investigation (DeKorne ed. 1996; pers. comms.).

P. australis rhizomes showed the presence of 0.003-0.01% alkaloids in an alkaloid screening (Hultin & Torssell 1965); rhizomes from Egypt were shown to contain *gramine*, *DMT*, *bufotenine*, 5-MeO-*N-methyltryptamine* and an unidentified base (Wassel et al. 1985). Swertiajaponin, isoswertiajaponin, 7-O-methylrutin (Buckingham et al. ed. 1994), glycosides, polysaccharides, 5% protein, 0.1% asparagin and vitamins B1, B2 and C have also been found (Hsu et al. 1986; Tierra 1988). Flowers and leaves tested negative for alkaloids in broad alkaloid screenings (CSIRO 1990; Fong et al. 1972).

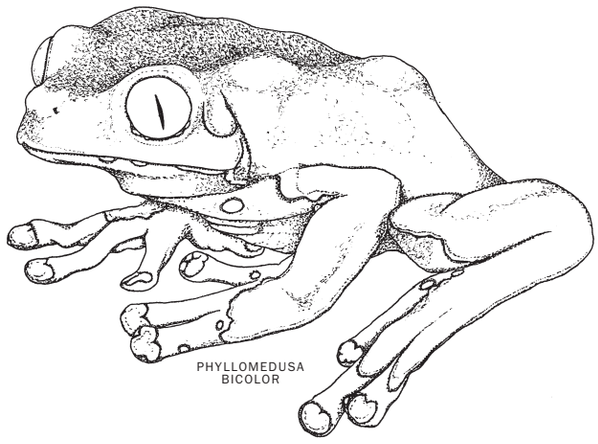
Phragmites australis is a robust, rhizomatous perennial grass to 6m high, with emergent aquatic creeping rhizomes and erect noded stems; lower nodes of stem bare, with complete or incomplete whorls of hairs. Leaves lanceolate, blade rolled in bud, flat, alternate, glabrous, to 3.5cm wide, midrib prominent; ligule a densely ciliate membranous rim with hairs c.1mm long, sometimes scattered with hairs to 10mm long on upper leaves. Spikelets numerous on filiform pedicels, forming a large, terminal, spreading ovoid panicle inflorescence, dense, often drooping, hairy, 15-30cm long, 5-20cm wide, green to purplish-brown and silvery-white at maturity; axils of branchlets with hairs to 7mm long; spikelets pedicellate, solitary, with 3-8 florets, lowest 1 or 2 male, others bisexual, disarticulating above glumes and at base of each lemma; rachilla with hairs c.12mm long; glumes lanceolate, unequal, mucronate or aristate, rounded on back, 3-5 nerved, thin, papery, glabrous, lower ones 3-5mm long, upper ones 6-8mm long; lemmas long-subulate, narrow, 3-5 nerved, papery, glabrous, male lemmas c.12mm long, bisexual lemmas acuminate, 10-16mm long, upper lemmas successively smaller; palea linear to oblong, 2-keeled, 3-4mm long; callus with hairs 10-12mm long. Seeds tiny, reddish. Fl. spring.

In wet places, especially at edges of ponds and streams, and in tid-

al waters; widespread (Harden ed. 1990-1993; Lamp & Collet 1989). Rhizomes harvested for consumption should be taken from the portions growing under mud, rather than those exposed to water (Cribb & Cribb 1981).

PHYLLOMEDUSA [with reference to Dendrobates, Phyllobates]

(Hylidae)



Phyllomedusa bicolor *Boddaert* – dow kiet!, sapo, sapo mono, monkey frog, giant monkey tree frog, giant leaf frog
Phyllomedusa rohdei *Mertens* – Rohde's leaf frog
Phyllomedusa spp. – leaf frogs, monkey frogs

Skin secretions of P. bicolor, known as 'sapo' [the generic Spanish name for toads – see **Bufo**], are used in hunting magic by the Matses, a subdivision of the Mayoruna of Peruvian/Brazilian Amazonia, and possibly also by the Amahuaca, who use an unidentified frog species. The Matses catch the frog by calling it, and keep it for 3 days, in which time the venom is periodically collected. To collect venom from the frog, its limbs are tied to support the animal from 4 small posts. The toes are massaged gently, and secreted venom is collected from the legs and sides with a piece of split bamboo. When covered, the stick is dried near a flame and stored for use (Daly et al. 1992a; Erspamer et al. 1993; Gorman 1993).

Before a hunting trip, sapo may be used to increase chances of a successful hunt. To apply it, the skin is burnt with a stick from the fire, and the skin scraped away; some sapo is scraped from the stick and mixed with saliva to form a paste, which is then rubbed into the wound. Several further applications are usually made, and it may be applied almost continuously for days in times of difficult hunting. Effects manifest within seconds – first, body temperature is raised greatly, accompanied by sweating and intense hypertension and tachycardia with sympathetic stimulation, purging and emesis, and loss of control of motor functions. One westerner [Peter Gorman] who had it applied to him on several occasions, also at this stage experienced the sensation of animal spirits passing through his body and expressing themselves through him, as he crawled growling on all fours. Another westerner [Piers Gibbon] who received applications of the venom did not note any of these particular mental effects. After this period, sympathetic symptoms subside, culminating in an exhausted but brief sleep, with some awareness of outside sounds still maintained. When full consciousness returns several hours later, all perceptive senses are greatly enhanced, particularly those of hearing and vision, and one feels 'god-like' and 'in tune with the environment', full of abundant stamina and agility, as well as diminished need for food. These latter effects reportedly last for several days afterwards, and are an invaluable aid in hunting in the jungle (Amato 1992; Gibbon pers. comm.; Gorman 1993, 1995).

On a similar note, skins of two unidentified frogs are used before hunting by the Patamona, Arecuna and Macusi; the skins are inserted into the nostrils and pulled through with twine, for the purpose of 'increasing sensory acuity'. This practice involves a small yellow frog with black spots, known as 'pa', and a small brown frog known as 'ambak' (Kennedy 1982; Morgan 1995). Indigenous inhabitants of some areas of Guyana also use the skin secretions and spawn of some frogs for the same effects, rubbing them into wounds, or the eyes, nose, mouth and ears (Furst 1976). The Yagua of Peru have been known to snuff the dried venom of an unidentified 'toad' or frog, mixed with **Calliandra** angustifolia seeds and 'pashaco' seeds [see *Endnotes*], to enter a visionary state and to increase the sense of smell for hunting (Bear & Vasquez 2000).

The sapo frog was for a while thought to be a species of Dendrobates or Phyllobates, whose secretions are known to be used as arrow poisons in the Amazon (Furst 1976); these frogs produce highly toxic alkaloids. Phyllobates spp. are known to produce batrachotoxins, highly potent steroidal alkaloids with neurotoxic activity [also found in some birds – see *Endnotes*]. P. terribilis contains high concentrations of batrachotoxins, as well as d-chimonanthine, l-calycanthine [see **Calycanthus**] and noranabasamine [a pyrrolidine alkaloid]. Dendrobates spp. produce pumiliotoxins [which are quinoline-derivatives] and other potent compounds (Daly & Witkop 1971; Daly et al. 1980, 1987; Witkop & Gossinger 1983). Known as 'poison arrow frogs', they are popular as expensive pets in the west, but seem to lose their toxicity when raised captively in terrariums (Daly et al. 1992b). Some species, such as Phyllobates terribilis, can maintain high [although still reduced] concentrations of alkaloids in captivity, even after 6 years. Frogs of this species raised totally in captivity, however, were "relatively nontoxic" (Daly et al. 1980). Frogs of the same species, but from different populations, have shown differences in the types of alkaloids present. It is believed that the biosynthesis of these alkaloids may be dependent on particular aspects of diet, environment, and genetics (Daly et al. 1992b).

P. bicolor venom yielded about 7% potent peptides of the caerulein, tachykinin, bradykinin, bombesin, tryptophyllin, sauvagine and opioid types – 3.2% phyllocaerulein [equivalent activity to caerulein – see *Endnotes*], 1.8% phyllokinin [hypotensive], 0.3% sauvagine [causes corticotropin release from pituitary, activating pituitary-adrenal axis; raises levels of β-*endorphin*, catecholamines and glucose; causes tachycardia and peripheral hypotension], 0.53% ala-deltorphin I [human activity uncertain], 2.2% phyllomedusin [hypotensive; stimulates gastric motility; antidipsogenic], 0.025-0.033% [lys7]-OH-*dermorphin*, similar amounts of [trp4,asn7]-OH-*dermorphin* [dermorphins are potent analgesics, due to selectivity for mu-opioid receptors; levels in venom samples studied are too low to contribute much effect] and adenoregulin [enhances binding at *adenosine* A1 receptors]. The pharmacology of the peculiar CNS effects reported has not been elucidated, but likely result from a complex interaction of the peptides. A single application of sapo may be about 10mg of dried venom; thus the usual 2-3 applications provide about 20-30mg of the drug (Daly et al. 1992a; Erspamer et al. 1986, 1993; Melchiorri & Negri 1996).

P. rohdei skin has yielded 0.001-0.0025% *bufotenine* and 0.0001-0.00015% leptodactyline (Roseghini et al. 1986), as well as large quantities of peptides similar to those found in P. bicolor [0.007-0.013% phyllokinin, 0.0015-0.0035% phyllomedusin, <0.0001% phyllocaerulein, <0.0005% sauvagine, 0.006-0.008% *dermorphins*]. Other species, such as P. burmeisteri, P. edentula, P. hypochondrialis, P. palliata, P. sauvagei and P. trinitatus have also yielded cocktails of peptides similar to those of P. bicolor, in varying relative proportions and total concentrations, though P. bicolor seems to bear particularly rich concentrations. Venom from P. lemur had similar activity to that from P. bicolor when injected into mice (Erspamer et al. 1986, 1993).

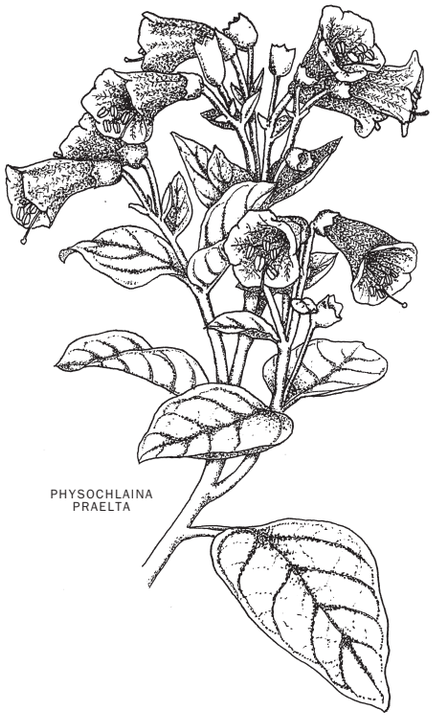
Phyllomedusa bicolor is a large frog, males 91-103mm, females 111-119mm; dark to bright green above, belly white to yellow-white to cream; white spots with dark frames found sparsely on lower lips, chest and front legs, more densely on flanks and hind legs, largely following the 'rim' where the dorsal green colour ends and light belly colour begins, and on each toe [there with a green patch inside the white and dark border]; fingers transparent brown to whitish-grey with large green adhesive discs, opposable first-fingers and toes, allowing a monkey-like grip; prominent gland from behind eye over the tympanum; eyes with dark grey iris, vertical black pupils; extremities whitish-grey, with green fingertips encircled with white and then black. They have a loud, barking call. Found in Amazon Basin, Brazil, Bolivia, Colombia, Peru, Suriname, French Guiana, Guyana and Venezuela (Lima et al. 2007; pers. obs. from photos).

Phyllomedusa spp. are nocturnal tree-dwellers. They are found on perches near streams and ponds in the breeding season, from which they may make their mating call, though P. bicolor sometimes will do this from the forest floor, where it can move only relatively slowly, due to its large toe pads. During the day, they [P. bicolor] retreat to tree perches ranging from 1.5-9m elevation. Good perches are remembered and re-used (De Oliveira 1996). In the wet season, Nov.-May, they mate on a leaf above the surface of a marsh or pond, using their hind legs to hold the edges of the leaf near its tip to form a funnel; into this, the female lays some eggs, which the male then fertilises, and the pair move a bit further along the leaf, repeating the process until the stem is reached. The leaf becomes a bag, held together by the gelatinous fluid of the eggs, and open at each end. When tadpoles hatch 8-10 days later, they fall through the lower opening into the water, where they develop, adhering to stones using their funnel-shaped mouths (Grzimek 1974; Lima et al. 2007).

Diploid and tetraploid species of Phyllomedusa are known to naturally hybridise (Haddad et al. 1994), with possible alterations in chemistry of skin secretions.

PHYSOCHLAINA

(Solanaceae)



Physochlaina alaica *Korotk. ex Kovalevsk*
Physochlaina dubia *Pascher*
Physochlaina infundibularis *Kuang* – hua han shen, hua shan seng
Physochlaina orientalis *(Bieb.) G. Don. fil.*
Physochlaina praelta *(Hook. f.) Miers* – bajar-bang, lang-thang, sholar, nandru, dandarwa

'Hua han shen', the dried root of P. infundibularis, is used in TCM to relax the bronchial muscles and depress the CNS (Huang 1993). In Kashmir, P. praelta leaves, which are said to be poisonous and to dilate the pupils, are applied externally to boils. Eating the leaves is said to "affect the head and the throat, and to cause the mouth to swell". A human accidental poisoning was recorded in 1867 – the man involved "suffered from its narcotic effects for 2-3 days" (Chopra et al. 1965; Kirtikar & Basu 1980).

P. alaica has yielded *hyoscyamine*, *hyoscine*, apo-*atropine*, 6-OH-*atropine*, 6-OH-*hyoscyamine* N-oxide and physochlaine (Buckingham et al. ed. 1994; Evans 1979; Mirzamatov et al. 1975).

P. dubia has yielded *hyoscyamine*, *hyoscine* and 6-OH-*hyoscyamine* (Buckingham et al. ed. 1994; Evans 1979).

P. infundibularis root yielded 0.26% alkaloids, consisting of *hyoscyamine* and *hyoscine*, as well as *scopoletin* and scoplin [I presume this was a printing error and should have been scopolin]; the plant has an LD50 of 43g/kg [i.p.] in mice (Huang 1993).

P. orientalis roots have yielded 0.718% alkaloids when the plant is flowering, consisting mostly [90%] of tropanes including *hyoscine*, *hyoscyamine* and two unidentified alkaloids; aerial parts have yielded *hyoscine* [0.239% in stems], *hyoscyamine*, and what may have been apo-*atropine* (Minina & Aduevskaya 1965); the plant has also yielded cuscohygrine and *chlorogenic acid* (Schermerhorn et al. ed. 1957-1974).

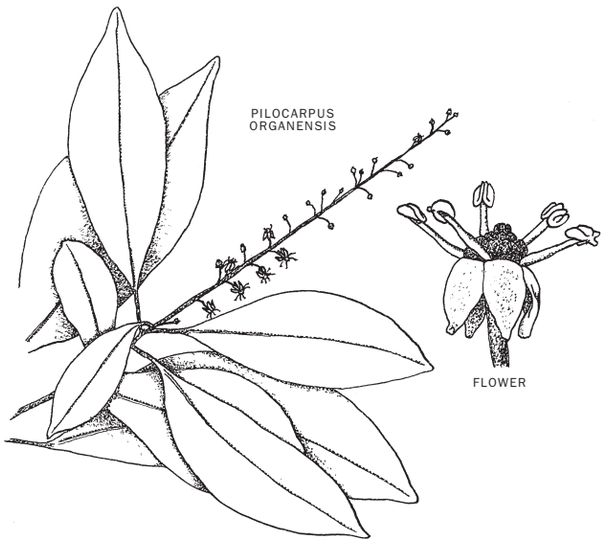
P. praelta has yielded 1.02% alkaloids from the leaves, of which 80% was *hyoscyamine*, with small amounts of *hyoscine*; roots yielded 0.64% alkaloids, mostly *hyoscyamine*, as well as 8% sucrose (Chopra et al. 1965).

Physochlaina praelta is an erect, nearly glabrous herb 60-120cm tall, corymbose upwards. Leaves subentire, 10-15 x 7.5cm, irregular, ovate-oblong, sinuate, base cuneate or cordate on the same branch; petiole 2.5-10cm. Inflorescence a terminal corymbose raceme 5-20cm diam., compound, lax, viscid pubescent; flowers all pedicelled; pedicels 0.6-3.8cm; calyx campanulate, unequal, 5-lobed, lobes lanceolate, 3mm, striate, in flower 8mm, in fruit 4.5 x 0.8cm; corolla elongate, 3.2cm x 5mm, tubular-funnel-shaped in majority of wild samples, sometimes shorter, in cultivated examples wider, subcampanulate, lobes 5, short, imbricate in bud; stamens attached at middle of tube; filaments filiform; stamens and style equalling the corolla, or up to 8mm longer, distinctly exserted in nearly all wild samples; anthers ovate, longitudinally dehiscent. Ovary 2-celled; style linear; stigma obscurely 2-lobed. Capsule 2-celled, 1.3cm diam., circumscissile above the middle; seeds many, compressed, 2mm diam., scrobiculate-reticulate; embryo peripheric (Kirtikar & Basu 1980).

South-western Xizang [China] to Nepal and Kashmir (Hawkes et al. ed. 1991).

PILOCARPUS

(Rutaceae)



Pilocarpus organensis *Occhioni et Rizzini* **(P. breviracemosus** *Cowan***; P. fluminensis** *Casar ex Engl.***; P. pauciflorus** *A. St.-Hil.***)** – pitaguara, do-branco

Although, strictly speaking, the above species is not a 'jaborandi', it is related to the group of plants who share that common name, and which are used medicinally in Brazil. These species are P. jaborandi, P. microphyllus, P. pinnatifolius, P. racemosus, P. spicatus and P. trachylopus. Jaborandi is often used as a powerful hair tonic, as it opens skin pores, presumably allowing the scalp to 'breathe'. A leaf decoction is taken internally as a stimulant, expectorant, sudorific and diuretic; it may also treat asthma, rheumatism, pleurisy, dropsy and diabetes, contracts the pupils and reduces intraocular pressure. In large doses, it is emetic (Bremness 1994; Henry 1939; Morton 1977; Usher 1974).

All of the above jaborandi types [except P. trachylopus] contain the toxic imidazole alkaloid pilocarpine and derivatives; this alkaloid is a muscarinic *acetylcholine*-receptor agonist (Jarv & Bartfai 1988; Kruk & Pycock 1983), exciting parasympathetic nerves. It can cause mental confusion, disturbed vision and increased gland secretions. It also accelerates heart rate [though weakening heart action], increases intestinal peristalsis and promotes uterine contraction. Larger doses can cause nausea, vomiting, diarrhoea, CNS paralysis, bronchial oedema, and can be fatal due to heart failure. It has been used in medicine applied to the conjunctiva of the eye to produce miosis (Henry 1939; Morton 1977).

P. organensis leaves yielded 1.06% alkaloids, of which *5-methoxy-DMT* was the major constituent [0.41%]; the remainder was not identified (Balsam & Voigtlander 1978). Although this is very promising, it has yet to be shown that this species doesn't also contain pilocarpine in toxic amounts. Care should be taken with identification, as P. organensis bears a superficial similarity to P. sanctum, which has flowers of a smaller diameter.

Pilocarpus organensis is a shrub or small tree 1-6m tall, trunk c.7cm diam., dead bark very thin, grey purplish-brown with minute elongate-reticulate cracks, falling off in minute chips; branchlets 2-4mm thick, greyish green-brown, shining when young, pubescent with hairs 0.05-0.1mm long, becoming glabrous with age; perules of terminal buds triangular, strigillose with yellow-tawny hairs c.0.3mm long. Leaves alternate or subopposite, sometimes crowded at apex of branchlets, simple or indistinctly 1-foliolate, blade elliptic to obovate, 5.5-16cm long (-30cm near ends of branchlets), 1.8-5.5cm wide (-9cm near ends of branchlets), long-attenuate or narrowly cuneate towards base, decurrent along petiole, apex obtuse or acuminate, tip retuse, emarginate, or entire, margin revolute, chartaceous or subcoriaceous, greyish-green, shiny, glabrous or pubescent with spreading hairs at base and midvein below, venation brochodidromous, midvein usually plane and longitudinally wrinkled above, principal veins prominulous; petiole semiterete, canaliculate towards base by erect wings, distally sometimes turgid-geniculate, 4-25(-40)mm long, 1mm thick, glabrous or pubescent with hairs 0.05-0.1mm, the wings formed by the decurrent base of the blade, up to 0.2-0.3mm broad. Inflorescence of subterminal racemes 1-2 per branch, erect, 5-40 x 1.5-2.5(-3)cm, in fruit to 45cm long, many-flowered, developing acri- and basi-petally; rachis

1-1.5mm thick, glabrous or puberulous with hairs 0.1mm long; bracts and bractlets depressedly triangular to 0.7mm long, subglabrous, bractlets 2-4, alternate or subopposite at variable height; pedicels 2.5-9(-11) x 0.5-1mm; flowers 7-9mm diam.; calyx rounded, thinly coriaceous, glabrous; petals cochlear to subvalvate, 3-3.9 x 1.7-2.4mm, inflexed at tip through 0.7mm, slightly carinate above, coriaceous, yellowish-green, shining underneath, glabrous but beneath in bud beset with hairs 0.05mm long; filaments truncate, flattened, 2-3 x 0.3-0.5mm, yellowish-green; anthers ovoid, heart-shaped or suborbicular, recurved, with a dorsal gland 0.2-0.5mm; disc 0.5-1mm high, 2-3mm diam., irregularly 10-plicate, glabrous to mostly strigose with yellowish-tawny, hyaline hairs 0.1-0.4mm; carpels 0.7-0.9mm high, protruding 0.3-0.6mm beyond disc, with internal glands. Ovule 1 per carpel; style at anthesis obsolete to 0.1mm long, 7mm thick, after anthesis to 0.2mm long; stigma subsessile, capitate, 0.2-0.5 x 0.5-0.7mm. Mericarps ellipsoidal or obovoid, dorso-apically rounded, blunt or rounded at very apex, with glands to 0.5mm, glabrous, but young and sterile ones are usually sparsely strigillose, dehiscent to 1/3-1/2 below tip; seed 1 per mericarp, ellipsoidal, 7.7-12 x 4.3-8.5 x 3.8-4mm, sometimes curved at apex, ventral axis straight, slightly keeled on back, testa externally flatly colliculate with angular interspaces 0.05-0.1mm. Fl. Mar.-Oct.

In forests and cerrado, 10-850m; Brazil [Bahia, Rio de Janeiro, Sao Paulo (rare), Parana and Santa Catarina] (Kaastra 1982).

PIMENTA

(Myrtaceae)

Pimenta dioica *(L.) Merr.* **(P. aromatica** *Kostel.***; P. officinalis** *Lindl.***; P. pimenta** *(L.) Cockerell***; P. pimenta** *(L.) H. Karst.***; P. vulgaris** *Lindl.***; P. vera** *Raf.***; Caryophyllus pimento** *Mill.***; Eugenia divaricata var. ovalis** *O. Berg.***; E. micrantha** *Bertol.***; E. pimenta** *(L.) DC.***; Myrtus dioica** *L.***; M. pimenta** *L.***; M. piperita** *Sessé et Moc.***; M. tabasco** *Schltdl. et Cham.***)** – pimento, allspice, Jamaica pepper

Pimenta racemosa *(Mill.) J.W. Moore* **(P. acris** *(Sw.) Kostel.***; P. acuminata** *Bello et Espin.***; P. pimento** *(O. Berg.) Griseb.***; Caryophyllus racemosus** *Mill.***; Myrcia pimentoides** *DC.***; Myrtus acris** *Sw.***; M. caryophyllata** *Jacq.***; M. caryophyllus** *Jacq.***; M. pimenta** *Ortega***)** – bay, bay rum tree, West Indian bay, bayberry, wild cinnamon

Still a popular spice today, P. dioica fruits were sometimes used by the Aztecs to flavour their 'cacao' beverages [see **Theobroma**]; in this combination especially, they are said to have aphrodisiac effects. In the Americas, the fruit and leaves of P. dioica are used to treat neuralgia and digestive problems, acting as a warming stimulant. The fruits are now commonly used as a cooking spice in sweet and savoury dishes (Bremness 1994; Rätsch 1990; Simonetti 1990). P. racemosa leaves yield an essential oil called 'bay oil' [not to be confused with the essential oil from **Laurus**], which is mixed with rum to make a hair and scalp tonic called 'Bay Rum', as well as lending its fragrance to commercial soaps, detergents, lotions and perfumes (Opdyke 1973b; Usher 1974).

P. dioica has stimulant, tonic, anaesthetic, analgesic, muscle relaxant, antioxidant, antiseptic, carminative and rubefacient properties. The fruit yields up to 4.5% essential oil, also found in the leaves, consisting of *eugenol* [60-80% in fruit oil; up to 96% in leaf oil], *methyleugenol*, cineol, caryophyllene, phellandrene and other compounds.

P. racemosa has stimulant, analgesic, anticonvulsant, antineuralgic, expectorant, antirheumatic, antiseptic and astringent properties. The fruit yields essential oil containing up to 56% *eugenol*, as well as *methyleugenol*, chavicol, linalool, limonene, myrcene, *pinene*, 1,8-cineole and terpinen-4-ol (Battaglia 1995; Lawless 1995); leaves contain 'bay oil', which consists largely [55-65%] of *eugenol* and chavicol, as well as *citral*, cineol, nerol, α-*pinene*, dipentene and myrcene (Opdyke 1973b).

Pimenta dioica is a fragrant tree to 15m tall; bark pale brown; young branchlets flattened, 4-angled. Leaves opposite, simple, entire, oblong to elliptical, blunt or rounded at apex, usually subemarginate, mostly 6-20cm long, thin-coriaceous, with +- pellucid glandular dots, aromatic when crushed, midrib impressed on upper surface, prominent beneath, nerves and veins only slightly prominent on both sides; stipules absent. Inflorescence a many-flowered compound panicle 4-12cm long, branching in threes, from upper axils; peduncles slender, 0.5-1.2mm thick; calyx tube obconic, adnate to ovary, to 1.5mm long, smooth, puberulous, lobes 4, thick, broadly rounded, c.1.5mm long, wide-spreading at anthesis, persistent on fruits; petals white, 1.5mm long, quickly deciduous; stamens many, originating around margin of thickened calyx-disc, usually inflexed in bud, free; anthers bilocular, opening by longitudinal slits. Ovary inferior, outside powdery-white or shortly silky, 2-celled, placentas axile or parietal; ovules 1(-2) in each cell, hanging from the apex of the inner angle; style simple, elongate; stigma small, capitate, peltate-convex, much thicker than style. Fruit a +- fleshy berry, crowned by calyx, +- globose, 4-6.5mm diam., black, pulpy, slightly sweet, almost tasteless; seeds (1-)2, hot to taste, with spiral embryo, cotyledons very short. Fl. Jan.-Aug.; fr. Aug.-Sep.

Common on wooded hillsides and upland pastures, to c.1050m; Mexico, Central America, Cuba, introduced in Puerto Rico, Barbados and other tropical countries (Adams 1972; Fawcett & Rendle 1926).

PIMPINELLA

(Umbelliferae/Apiaceae)

Pimpinella anisum *L.* **(Anisum vulgare** *Gaertn.***)** – aniseed, anise, anneys

Aniseed is a popular spice in cooking as well as in medicine. Generally used in Arabic, European or Indian foods, the seed may flavour bread, cakes and sauces, or marinate meats and fish. The seed is also used in the preparation of liquors such as 'Anisette', 'arrack', 'ouzo', 'Pernod' and 'Ricard'. Medicinally, a seed tea may be used to treat colic, flatulence, indigestion, nausea and bronchial complaints, due to the relaxant and expectorant actions of the seeds. In accord with this, the Cherokee use it to treat catarrh. The seed also has a mild oestrogenic effect. The essential oil of the fruit is used commercially to flavour toothpastes and mouthwashes, and to add scent to perfumes, soaps, detergents and lotions (Bremness 1994; Hamel & Chiltoskey 1975; Opdyke 1973a; Simonetti 1990).

Aniseed may apparently be burned in magical incenses to call forth spirits, or to drive away evil spirits. It is said that a pillow stuffed with aniseed will promote a nightmare-free sleep (Cunningham 1994). In tests on the psychoactive constituents of 'absinthe' [see **Artemisia**], P. anisum was found to cause drowsiness, and in a strong dose, "provokes drunkenness, trembling, epileptic convulsions, then like opium [see **Papaver**], muscle spasms, analgesia and sleep" (Conrad 1988). The essential oil from the fruits has shown anticonvulsant activity in mice, and motor impairment with greater doses (Pourgholamia et al. 1999).

P. anisum contains an essential oil concentrated in the seeds [2-3.5% essential oil]; this is mostly trans-*anethole* [75-90%], with 2.29% cis-*anethole*, isoanethole, *estragole*, 0.58% *safrole*, *myristicin*, *pinene*, camphene, linalool, acetoanisole, p-MeO-*acetophenone*, acetic aldehyde and anisic aldehyde [p-anisaldehyde; fungistatic]. Also found are coumarins, glycosides and a fixed oil. Some people experience a sensitisation reaction to the essential oil, due to the *anethole* content, but it is not normally irritating to the skin. The oral LD50 of the essential oil, in rats, is 1.82-2.74g/kg (Battaglia 1995; Harborne et al. 1969; Harborne & Baxter ed. 1993; Lawless 1995; Mabey et al. ed. 1990; Morton 1977; Opdyke 1973a; Simonetti 1990). Vietnamese P. anisum yielded 1-3% essential oil from leaves, and 10-13% from fruits; leaf oil contained 55-77% *anethole* and 0.07% cis-*anethole*, whilst fruit oil contained 80-95% *anethole* and 0.04% cis-*anethole* (Phiet et al. 1980).

Pimpinella anisum is a finely pubescent, strongly aromatic annual herb 10-50cm high; stems terete, striate, branched above. Lowest leaves reniform, incise-dentate or shallowly lobed; next leaves pinnate with 3-5 ovate or obovate dentate segments; upper cauline leaves 2-3-pinnate, with linear-lanceolate lobes and narrow, sheathing petioles. Flowers in terminal umbels; rays 7-15, sparsely puberulent; bracts absent or 1; bracteoles usually few, filiform; petals white, 5, apex inflexed; stamens 5. Fruit 3-5mm long, ovoid to oblong, shortly appressed-setose.

In well-drained, alkaline soil with plenty of sun; native to Syria, Egypt (Tutin et al. ed. 1964-1980).

PIPER 1

(Piperaceae)

Piper aduncum *L.* **(P. aduncifolium** *Trel.***; P. anguillaespicum** *Trel.***; P. angustifolium** *Lam.***; P. angustifolium** *Ruiz et Pav.***; P. celtidifolium** *Kunth***; P. cuatrecasasii** *Trel.***; P. cumbricola** *Trel.***; P. disparispicum** *Trel.***; P. elongatiifolium** *Trel.***; P. elongatum** *Vahl***; P. fatoanum** *DC.***; P. flavescens** *(DC.) Trel.***; P. illudens** *Trel.***; P. intersitum** *Trel.***; P. kuntzei** *DC.***; P. purpurascens** *D. Dietr.***; P. reciprocum** *Trel.***; P. submolle** *Trel.***)** – mataco, matico

Piper attenuatum *Buch.-Ham. ex Miq.*

Piper aurantiacum *Wall. ex DC.* **(P. emeiense** *Y.Q. Tseng***; P. henryei** *DC.***; P. ichangense** *DC.***; P. martinii** *DC.***; P. wallichii** *(Miq.) Hand.-Mazz.***; Chavica wallichii** *Miq.***)** – shambhalukabuip, shi nan teng, cheng huang se hu jiao

Piper auritum *Kunth* **(P. alstonii** *Trel.***; P. auritilaminum** *Trel.***; P. auritilimbum** *Trel.***; P. heraldi var. cocleanum** *Trel.***; P. perlongipes** *Trel.***; P. sanctum** *(Miq.) Schltdl.***; Artanthe sanctum** *Miq.***)** – Mexican pepper leaf, Veracruz pepper, sacred pepper, acuyo, anisillo, hinojo sabalero, hoja santa, yerba santa, false kava

Piper betle *L.* **(Piper chavica betle** *Miq.***)** – betel leaf, betel vine, lowland betel pepper, tambula, naagavalli, pan, pan tamboli, sirih, serasa, ju jiang, tu bi ba, tu wei teng, wei zi, wei ye, da feng teng

Piper brachystachyum *Vahl* **(Peperomia filiformis** *Ruiz et Pav.***; Troxirum filiforme** *(Ruiz et Pav.) Raf.***)**
Piper callosum *Ruiz et Pav.* **(P. benianum** *Trel.***; P. poeppigii** *(Klotzsch) C. DC.***; Peltobryon callosum** *(Ruiz et Pav.) Miq.***; Pe. poeppigii** *Klotzsch***; Schilleria callosa** *(Ruiz et Pav.) Kunth***)**
Piper chaba *Hunter* **(P. officinarum** *(Miq.) DC.***; P. retrofractum** *Vahl***; Chavica officinarum** *Miq.***)** – Balinese pepper, Javanese long pepper, chavi, chab, cabo, cavo, bali bors, bi ba, jia bi bo, dâr fulful, lada panjang, lada sulah, poivre des Malais
Piper cryptodon *DC.* – holehole be
Piper cubeba *L. f.* – cubeb, tailed pepper, Java pepper
Piper gibbilimbum *DC.* – kaowan, highland betel pepper
Piper guineense *Schumach et Thonn.* **(P. clusii** *Schum. et Thonn.***; P. guineense** *DC.***)** – benin pepper, false cubeb pepper, Guinea cubeb, West African black pepper, ashanti pepper, ashanti bors, pimienta de Guinea, poivre des Achantis, poivre du Kissi
Piper interitum *Trelease ex MacBride* – tetsi
Piper lanceaefolium *H.B.K.* **(P. friedrichsthalii** *DC.***; P. lanceaefolium** *Aubl.***; P. pseudolanceaefolium** *Aubl.***)** – bamboo pepper
Piper lenticellosum *DC.* **(P. carpunya** *Ruiz et Pav.***; P. colombianum** *DC.***; P. crassinervium var. hartwegianum** *DC.***; P. glabrirameum** *DC.***; P. glanduligerum var. subcoriaceum** *DC.***; P. nieblyanum** *DC.***; P. pallidirameum** *DC.***)**
Piper longum *L.* **(Chavica roxburghii** *Miq.***)** – long pepper, trikana, maghadhi, pipli, pipla-mol, pi-pi-ling, darfilfil
Piper marginatum *Jacq.* **(P. alare** *Ham.***; P. anisatum** *Kunth***; P. catalpaefolium** *Kunth***; P. caudatum** *Vahl***; P. decumanum** *Aubl.***; P. niceforoi** *Trel. et Yunck.***; P. patulum** *Bertol.***; P. pseudomarginatum** *DC.***; P. regressum** *Anders***; P. san-joseanum** *DC.***; P. uncatum** *Trel.***; P. undeninervium** *DC.***; Artanthe marginata** *(Jacq.) Miq.***; Schilleria marginata** *(Jacq.) Kunth.***)** – mavaisco, malvaisco
Piper nigrum *L.* – black pepper, peppercorn vine, vine pepper, hu jiao, maricham, kalimirich, filfiluswud
Piper novae-hollandiae *Miq.* – native pepper [Australia]
Piper plagiophyllum *K. Sch. et Laut.* – kwawan dsaap
Piper regnellii *(Miq.) DC.* **(P. fulvescens** *DC.***; Artanthe regnellii** *Miq.***)**
Piper sarmentosum *Roxb.* **(P. albispicum** *DC.***; P. brevicaule** *DC.***; P. gymnostachyum** *DC.***; P. lolot** *DC.***; P. pierrei** *DC.***; P. saigonense** *DC.***; Chavica hainana** *DC.***; C. sarmentosa** *(Roxb.) Miq.***)** – sirih tanah, bakik, la lot, kado-kado, jia ju, qing ju
Piper schultesii *Yuncker ex Yuncker et Trelease* **(P. obtusilimbum** *DC.***)**
Piper wabagense – makum galua
Piper spp. [for **Piper methysticum** and **P. wichmannii**, see **Piper 2**]

Species of pepper [Piper spp. – not to be confused with **Capsicum**], widespread in tropical regions, have many and varied medicinal and culinary uses, yet some are used in psychoactive contexts and/or contain psychoactive compounds in their essential oils, as well as some interesting amides.

The common peppercorn vine [P. nigrum], from which white, green and black peppercorns are obtained (Bruneton 1995), has been used in Asia for at least 4,000 years, and was used by the Egyptians in embalming. Pliny reported that the spice was more expensive than gold, and would often be accepted as tax payment. The Romans kept huge storehouses of the dried fruits. Both Roman soldiers in Britain, and Buddhist monks in the Himalayas, used it as a stimulant and appetite suppressant for long journeys. It was used in mediaeval England as a poison antidote, and to prevent spread of infections (Lawless 1994). The Cherokee use it as a stimulant, astringent and food-seasoning (Hamel & Chiltoskey 1975), and it has been used as an aphrodisiac across Eurasia (Rätsch 1990).

In TCM, the dried fruit ['hu jiao' ('barbarian ginger')] is decocted in doses of 1.5-3g as a digestive, stomachic, carminative, eliminative and food poisoning antidote, also being noted as having anticonvulsant and sedative effects (Huang 1993; Reid 1995). In rural India, it is inhaled to treat fainting or hysteria (Lawless 1994). Along with P. longum, it is used in Tibetan and Nepalese medicine to treat nervous conditions (Clifford 1984; Ott 1993). Fruits of this latter species are used in India as a stimulant, aphrodisiac, carminative, vermifuge and emmenagogue (Nadkarni 1976). The stem and root ['piplamul'] are used in Indian medicine to treat bronchitis, stomach pains, palsy, flatulence and other disorders (Bisht 1963). In TCM, P. longum fruit spikes ['bi ba'] are used to dispel cold and relieve pain (Huang 1993). In some Ayurvedic preparations, P. nigrum and/or P. longum appear to increase the bioavailability of active constituents of the herbs with which they are combined (Bruneton 1995). Contemporary reports from western psychonauts indicate that P. nigrum is psychoactive (Weil 1969), and its essential oil is used by aromatherapists as an aphrodisiac, analgesic, antiseptic, nerve tonic and mental stimulant (Lawless 1994). In Indonesia, P. cubeb is taken as an aphrodisiac (Rätsch 1990). In India, fruit of P. aurantiacum is said to 'excite the memory'. In Unani medicine, fruit of P. chaba is snuffed to treat epilepsy and hysteria (Nadkarni 1976). In Nepal, the root is an ingredient of psychotropic 'bobkha' cakes [see Spatholobus parviflorus in *Endnotes*] (Müller-Ebeling et al. 2002).

P. betle is well-known for being the leaf in which the betel nut [see **Areca**] is wrapped for chewing, for which large quantities of the male plants are vegetatively cultivated in India. It is considered a milder stimulant than betel nut, and in Indian medicine is used as a carminative, stomachic, anthelmintic, tonic [to the brain, heart and liver], aphrodisiac, laxative, and appetite stimulant – in large doses, it is said to be inebriating. Leaf juice is used as eyedrops, and may treat coughs and catarrh, as well as showing antimutagenic, antitumorigenic (Balasubrahmanyam & Rawat 1990; Kirtikar & Basu 1980; Nadkarni 1976; Ott 1995a; Rawat et al. 1989; Watt & Breyer-Brandwijk 1962) and antioxidant effects (Jeng et al. 2002). Kirati shamans of Nepal use a plant called 'dupsi' [also 'dhupsi' or 'dutsi'] for shamanic travel, with one shaman reporting "You need not even smoke or eat the leaves, the smell alone puts you in a trance". 'Dhupi' is reportedly a Nepalese name for P. betle, but it is unclear whether this is the same species as the shamanic one just mentioned. The similar word 'dhup' refers to numerous incenses and the plants used to make them (Müller-Ebeling et al. 2002).

P. aduncum is used in Peru as a styptic and gonorrhoea treatment; it is stimulant, diuretic and astringent (Watt & Breyer-Brandwijk 1962). The leaves and fruits are used as an aphrodisiac, either decocted or mixed with cacao [see **Theobroma**] (Rätsch 1990). P. attenuatum roots are macerated in water or decocted in n. India as a diuretic, and the Mikir of India use it in worship ceremonies (Kirtikar & Basu 1980; Ott 1993; Usher 1974). In Mexico and other parts of Central America, P. auritum is used as a food seasoning, as well as treating urinary tract and gynaecological disorders. Crushed leaves are used to attract and stun fish in the dry season – the fish are then trapped and fed more of the leaf to pre-season them for cooking. The leaves are also used to wrap fish for steaming (Gupta, M.P. et al. 1985; Usher 1974; pers. obs.). Smoking them produces a "pleasant, mild buzz" (Rätsch 1999a). P. cryptodon is used by the Yanomamo of Amazonia as a tobacco substitute [see **Nicotiana**] (Ott 1993). P. interitum is used by the Kulina of Peru, who pulverise the dried leaves and roots to make a possibly-psychoactive snuff. Various unidentified Piper spp. are utilised in S. America. One unidentified species is used as an ayahuasca additive [see **Banisteriopsis**]. Another, used by the Tanimuka and Yukuna [known to them as 'he-djoo-roo' or 'ne-e-too', respectively], is made into a leaf tea which 'strengthens men'. Piper sp. 'do-pia' is used by Andoke shamans for 'mental blindness', to obtain 'clear thinking'. Piper sp. 'si-ta' leaf is smoked or chewed by the Andoke in shamanic practices. In e. Ecuador, the Canelo use a Piper sp. they call 'guayusa' [see **Ilex**] as a stimulant (Schultes & Raffauf 1990). The Karijona of n.w. Amazonia give leaves and stems of P. schultesii in water or 'chicha' [see *Methods of Ingestion*] to elderly people who "sit without talking all day" (Schultes 1993), presumably as a mental stimulant.

In n. Ghana, the Kusasi make an intoxicating snuff from P. guineense seeds, **Securidaca** longipedunculata root, Tinospora bakis root [see *Endnotes*], Fagara xanthoxyloides root [see *Endnotes*] and red pepper [see **Capsicum**]. Sometimes **Ipomoea** digitata root is also added. This snuff is used during shamanic initiation; the effects may last over an hour, during which time the initiate appears to be unconscious (De Smet 1998).

Stem internodes of an unidentified Piper sp. are used as pipes for smoking ritual tobacco in stages 7-9 of shamanic initiation amongst the Bimin-Kuskusmin of Papua New Guinea (Poole 1987). The Nkopo of PNG chew the leaves of P. gibbilimbum, P. plagiophyllum and P. wabagense as inebriants with betel nut (Schmid 1991). In Australia, P. novae-hollandiae has been chewed by indigenous people to treat sore gums; it has a strong numbing effect, and alcoholic extracts have shown activity against a type of lung cancer in mice (Cribb & Cribb 1981).

Most Piper spp. contain a very wide array of compounds, and to list them all for each of the species covered here would be excessive – hence, the listings below mainly present the information which may be of most interest.

P. aduncum has yielded *elemicin*, *dillapiole* [33% of leaf essential oil, 62% of spike essential oil], *myristicin*, *safrole*, *asaricin*, 2,6-dimethoxy-4-allylphenol, 1,3-dimethoxy-2-acetoxy-5-allylbenzene and α-humulene, as well as chalcones similar to those found in P. methysticum [see **Piper 2**] (Mundina et al. 2001; Parmar et al. 1997). As P. angustifolium, it has yielded 2.5% essential oil, containing *asarone*, *dillapiole*, *apiole*, *methyleugenol*, *camphor*, matico-camphor, cineol, *borneol* and other terpenes (Atal et al. 1975; Parmar et al. 1997).

P. amalago leaves have yielded *dopamine* and *GABA* (Durand et al. 1962).

P. arboricola has analgesic effects, and has yielded 3,4-dimethoxy-phenylpropionic acid and 3,4-dimethoxy-phenylpropylamine, both of which share this activity, though the former compound is more toxic, and less potent as an analgesic (Ho et al. 1981).

P. attenuatum has yielded guineensine and piperolactams A & D (Parmar et al. 1997).

P. auritum fresh leaf yielded 0.71% essential oil, of which c.70% was *safrole*, along with traces of *eugenol*, *myristicin*, *elemicin*, *camphor*, α-humulene and other compounds (Gupta, M.P. et al. 1985); the aporphine alkaloids cepharadione A & B were also found (Hänsel et al. 1975), as well

as *GABA* (Durand et al. 1962). As P. sanctum, the plant yielded kava-lactones [see **Piper 2**] – *methysticin*, 5-MeO-5,6-dehydromethysticin, (+)-(5S,6S)-5-acetoxy-4,6-dimethoxy-6E-styryl-5,6-dihydro-2H-pyran-2-one and (-)-(5S,6S)-5-OH-4,6-dimethoxy-6E-styryl-5,6-dihydro-2H-pyran-2-one; as well as the piperolides [cinnamylidone butenolides] piperolide, methylenedioxypiperolide, 7,8-epoxypiperolide and (-)-threo-(3Z)-5-(2,3-dihydroxy-1-MeO-3-phenylpropylidene)-4-MeO-2-(5H)-furanone (Parmar et al. 1997), and the aphorphine alkaloids cepharadione A and cepharadione B (Hänsel & Leuschke 1976).

P. betle dry leaf yields 0.62-2.4% essential oil. The dominant compound is usually *eugenol*, but this depends on the cultivar type – 'Bangla' [oil yield (w/w) 0.15-0.2%] has c.64% *eugenol*, 19% *eugenol* acetate and 5% isoeugenol; 'Desawari' [oil yield (w/w) 0.12%] has c.45% *safrole*, 20% *eugenol* and 6% *estragole*; 'Kapoori' [oil yield (w/w) 0.1%] has c.33% *eugenol*, 11% isoeugenol and 6% *safrole*; 'Sanchi' [oil yield (w/w) 0.16%] has c.23% *safrole* and 14% *eugenol*; and 'Meetha' [oil yield (w/w) 0.85%] has c.19% *anethole*, 19% *eugenol* and 8% *estragole*. P. betle also may yield *isosafrole*, *methyleugenol*, chavicol, hydroxychavicol, chavibetol, 1,8-cineole, carvacrol, cadinene, caryophyllene and many other terpenoids; as well as vitamins A & E (Atal et al. 1975; Balasubrahmanyam & Rawat 1990; Ott 1995; Parmar et al. 1997; Rastogi & Mehrotra ed. 1990-1993; Rawat et al. 1989; Schermerhorn et al. 1957-1974; Watt & Breyer-Brandwijk 1962). It also reportedly contains a mysterious alkaloid, 'arakene', which was claimed to have similar properties to *cocaine* (Nadkarni 1976).

P. brachystachyum has yielded *apiole* from its essential oil (Atal et al. 1975; Parmar et al. 1997).

P. callosum leaf [from Peruvian Amazon] essential oil was found to contain 35.9% *asaricin*, 20.2% *safrole*, 9.7% *methyleugenol* and 7.8% α-*asarone* (Van Genderen et al. 1999).

P. cubeba seed contains an antioxidant and antimicrobial essential oil with β-cubebene [18.9%], cubebol [13.3%], sabinene [9.6%], α-copaene [7.4%], β-caryophyllene [5.3%] and many other constituents in lesser amounts; oleoresins with the same properties are also found, containing mostly cubebol (Singh et al. 2008). The lignans dihydrocubebin, clusin, dihydroclusin, yatein and hinokinin inhibited cytochrome P450 3A4 enzymes (Usia et al. 2005).

P. guineense has yielded *elemicin*, isoelemicin, *myristicin*, *safrole*, *dillapiole*, *eugenol*, *methyleugenol* and *asaricin* (Parmar et al. 1997).

P. lanceaefolium leaves [from Cuba, harv. Mar.] yielded 0.6-1.2% essential oil, consisting of 24.4% *elemicin*, 11.7% *apiole*, 0.2% *asaricin*, 20.6% β-caryophyllene, 12.5% germacrene D, 4.4% β-*pinene*, 3.5% α-*pinene*, 3.2% α-copaene and small amounts of many other compounds; spikes yielded 0.7% essential oil, consisting of 16.4% *elemicin*, 9.8% *apiole*, 0.2% *asaricin*, 15.8% β-*pinene*, 13.7% α-*pinene*, 6.9% γ-terpinene, 2.4% α-terpinene, 3% terpinolene, 5.1% β-caryophyllene, 3.7% 6-E-nerolidol, 3.2% germacrene D and smaller amounts of many other compounds. There is much variation in this poorly-known species, and essential oils from some leaf samples also contained *dillapiole* as a major constituent (Mundina et al. 2001).

P. lenticellosum has yielded *elemicin*, *methyleugenol* and *asaricin* (Parmar et al. 1997).

P. longum fruit has yielded 0.19-6% piperine, piperidine, and 0.7-0.9% essential oil containing phellandrene, caryophyllene, dipentene, p-MeO-*acetophenone*, zingiberine and other compounds (Atal et al. 1975; Bisht 1963; Handa et al. 1964; Keys 1976; Nadkarni 1976; Parmar et al. 1997). Piperine [which is a major alkaloidal constituent in P. longum and P. nigrum fruits] is 50 times more potent as a releaser of substance P than capsaicin [see **Capsicum**], and also inhibits cytochrome P450 (Koul et al. 2000; Nemeth et al. 1999) and MAO [both MAO-A and MAO-B in mouse brain] (Lee et al. 2008); piperine acts as a CNS-depressant and anticonvulsant in rats (Bruneton 1995). Methylpiperate and guineensine from the plant also inhibit MAO [the former more strongly with MAO-B]. Piperlonguminine has also been found (Lee et al. 2008). The roots have yielded piplartine [piperlongumine], which is effective in relieving asthma and chronic bronchitis (Buckingham et al. ed. 1994).

P. marginatum root has yielded [probably w/w] 0.0006% *apiole*, *croweacin*, 0.0002% isoasarone, 0.0006% *exalatacin*, 0.001% marginatine [3,4-methylenedioxy-1-(2E-octenyl)-benzene] and 0.0005% pipermargine [1-(1E-propenyl)-2,4,6-trimethoxybenzene] (De Oliveira Santos et al. 1997, 1998); aerial parts yielded 0.116% *safrole*, *dillapiole*, *anethole*, *myristicin*, *elemicin*, isoelemicin, *estragole*, *methyleugenol*, *methylisoeugenol*, 0.066% piperonal, 0.133% 3,4-methylenedioxypropiophenone, 0.055% 2-OH-4,5-methylenedioxypropiophenone, 0.0133% 2-MeO-4,5-methylenedioxypropiophenone, stearic acid and α-humulene (De Diaz & Gottlieb 1979; Parmar et al. 1997).

P. nigrum fruit essential oil [c.0.8%] has yielded *methyleugenol*, *eugenol*, *myristicin*, *safrole*, 0.22-3.59% α-*thujone*, larger amounts of *pinene*, and caryophyllene, α-phellandrene, camphene, terpinene, limonene, myricine, sabinene, piperonal, citronellol, α-humulene and other trace components (Atal et al. 1975; Battaglia 1995; Huang 1993; Parmar et al. 1997); the fruit has also yielded 5-9% piperine, 5% piperidine, piperamine, N-trans-feruloyl-piperidine, chavicine, feruperine and dihydroferuperine (Huang 1993; Inatani et al. 1981; Keys 1976; Nadkarni 1976). The whole plant tested positive for HCN (Watt & Breyer-Brandwijk 1962).

P. novae-hollandiae has yielded *dillapiole* and alkaloids [piperine, piperlonguminine, Δ-dihydropiperine, N-isobutyl-2,4-decadienamide, chavicine, N-isobutyl-2,4-octadienamide, 3,4-methylenedioxy-cinnamoylpiperidide and fagaramide] (CSIRO 1990). Stem and bark harvested in April from Mt. Glorious, Queensland [Australia] tested positive for alkaloids; bark gave weaker positive results. Leaf from Rockhampton, Qld. [harv. Jan.] gave the strongest positive results (Webb 1949).

P. regnellii roots yielded 0.048% *apiole*, 0.05% *dillapiole*, 0.024% *myristicin* and 10 different neolignans (Benevides et al. 1999).

P. sarmentosum leaves have yielded 0.078% α-*asarone*, 0.05% γ-*asarone*, 0.017% *asaricin* and 0.004% *exalatacin*; α-*asarone* has also been found in the fruits (Masuda et al. 1991).

Piper betle is a climbing shrub; stems semi-woody, climbing by many short adventitious rootlets, very stout, much thickened at nodes; young parts glabrous. Leaves large, 15-20cm, broadly ovate, slightly cordate and often a little unequal at base, apex shortly acuminate, acute, entire but margin often undulate, usually 7-nerved, glabrous, thick, bright green and shining on both sides; petiole 2-2.5cm, stout. Flowers dioecious (very rarely hermaphrodite), each in the axil of a bract; spikes dense, cylindrical; female 2.5-5cm, pendulous; bracts triangular-rotundate, peltate, yellow; rachis pilose; stamens 2-4 (rarely more); filaments short; anthers 2-celled, cells distinct. Ovary 1-celled; ovule solitary, erect; style short; stigmas 5-6, spreading stellately. Fruit sparingly produced, quite immersed in the fleshy spike, small ovoid or globose 1-seeded berry; seeds usually globose, testa thin.

Cultivated in hotter and damper parts of India and Ceylon, as well as Malay Islands (Kirtikar & Basu 1980).

Requires tropical conditions, with cool shade, high humidity and moist soil; very frost-sensitive. Enjoys loamy, porous soil, pH 7-7.5. Propagate from stem cuttings from the middle of the vine, pieces 6-8 nodes long. Females are often not cultivated as they are more susceptible to disease and adverse conditions. Male plants are often grown in thatch huts with vertical poles inside for vine-support (Balasubrahmanyam & Rawat 1990).

'Peppercorns' from P. nigrum are harvested at different stages of maturity, depending on the type of pepper to be produced. The berries turn from green to red as they mature. For 'green pepper', the fresh berries are harvested when green, and are usually stored in an acidic solution such as vinegar. For 'black pepper', the berries are harvested as soon as they turn red, then dried and separated from their stalks. For 'white pepper', the berries are collected when fully mature; they are soaked in water for a few days to aid in removing the pericarp and outer layers of the mesocarp, before drying the inner portion of the fruit (Bruneton 1995). 'Red peppercorns' are from a totally unrelated plant, Schinus molle (Simonetti 1990).

PIPER 2

(Piperaceae)

Piper methysticum *Forster f.* **var. methysticum** – kava, kava kava, kawa, kawa kawa, awa, pu'awa, yaona, yaqona, yangona, wati, ava pepper

Piper wichmannii *DC.* **(P. arbuscula** *Trel.***; P. erectum** *DC.***; P. methysticum** *Forst. f.* **var. wichmannii** *(DC.) Lebot stat. nov.***; P. schlechteri** *DC.***)** – gisam makum

Kava, a name used to define both a plant [P. methysticum var. methysticum, a sterile cultivar] and the inebriating drink made from its roots, is a very important ceremonial herb across much of Oceania, including w. Polynesia, New Caledonia, Solomon Isl., Hawaii, Fiji, Samoa, Papua New Guinea and Melanesia. It may be consumed for a great variety of reasons – to greet visiting dignitaries, before and after undertaking important work, to settle arguments, celebration of important events etc. A chief is expected to present a visiting chief with a piece of dried kava root. Kava is also used medicinally – in Hawaii, it is considered a nerve tonic, antifatigue agent and relaxant, and it may be used to treat asthma, rheumatism, obesity and congested urinary tract. The leaf is used as a poultice for headaches or to induce sweating. Many Pacific Islanders use it as a remedy against venereal diseases, especially gonorrhoea, and it has also been used to treat stings and inflammations. In Papua New Guinea, women drink freshly masticated kava as an anaesthetic during tattooing. Leaves and stems are also sometimes chewed in PNG as an inebriant. Kava also has some more sinister historical uses. Fijian and Hawaiian sorcerers have used it in enacting harmful magic against others. Usually, however, Hawaiian shamans ['kahuna'] used the plant in a more healing context; many other 'priests' amongst Pacific Island groups drank it to achieve a trance state, and receive ancestral inspiration. Shamans in Vanuatu ['kleva'] drink it for divination.

The kava ceremony was said to have been brought to humanity by Tagaloa Ui, the first Samoan high chief, who was the miscarried child of the union between a mortal girl called Ui, and the sun; the dead foetus was revived and nurtured by a hermit crab, a plover and a shrike. There

are, however many different legends recounting the origins of kava (Cox & O'Rourke 1987; Gatty 1956; Holmes 1967; Lebot et al. 1992; Ott 1993; Paijmans ed. 1976; Singh & Blumenthal 1997).

The root mass, once harvested [often along with the lower portions of the stems] is scraped clean and broken up into smaller pieces. The root used to be largely chewed [either by young girls or boys, depending on the culture] as part of the preparation ['Tongan method']. Chewers were selected for strong teeth and jaws, clean mouths and freedom from ailments. Very little saliva ends up in the resultant brew, but it served to emulsify the active resins from the root into the beverage. Today, the root is usually pounded or grated in a mortar ['Fijian method'], due to sanitation-related pressures from missionaries and government groups; this method also results in a less potent beverage. In either case, the ground kava is kneaded in a special bowl with water, and strained until the drink is clear of root fibres, during which time the chief of ceremonies may sing songs relating to the origins of kava. The participants are seated in a circle or in rows facing each other, and a respectful mood prevails. First, a cup of kava may be offered as a libation to the gods by pouring it on the ground, and then all participants are served one by one, beginning with the chief guest or most important person present. Being served last, however, is considered no less important than being served first. The kava is served in a half-coconut containing c.100mls of the drink – it is offered to each person by name and must be received with thanks in both hands and drunk in one slug, though those who do not partake may raise the cup in salutation and return it to the bearer still full. If it is only partly consumed, the cup must be emptied before being returned. When all have been served, the end of the ceremony is announced, the announcer is thanked and a meal is sometimes commenced. There are, of course, regional variations on the details of the kava ceremonies. Some groups, such as on Tongariki, consume it with much less ritual, as more of a recreational drug (Cox & O'Rourke 1987; Gajdusek 1967; Gatty 1956; Holmes 1967; Marshall 1987; Singh & Blumenthal 1997).

The Melanesian P. wichmannii is the fertile wild ancestor to P. methysticum var. methysticum, and is not known to be consumed as kava, due to its less-desirable effects [believed to be due to the ratios of active constituents present, compared to kava – see below]. The plant is used in New Guinea to counter magic. Also there, the Nkopo of the Madang and Morobe provinces use it to achieve 'gisam', a state of well-being and harmony with nature (Lebot & Levesque 1996; Schmid 1991; Singh & Blumenthal 1997).

The use of kava as an alcohol-substitute has existed in parts of northern Australia since at least 1982, amongst some indigenous Australian groups [see *Questions and Answers*]. It is worth noting that since the recent introduction of legal restrictions on the importation and sale of kava in Australia, herbal-pharmaceutical supplement companies have virtually monopolised the market, and caused a world-wide shortage of kava, as well as the associated increase in price. In Australia, kava is a Schedule 4 prohibited import, though people over 18yrs of age may bring in personally up to 2kg of root. The sale and commercial importation of kava now requires a government-issued license (Australian Bureau of Criminal Intelligence 2000).

The Hawaiian strain known as 'black kava' is said to be very potent; its leaves are claimed to be as potent as roots from strains of ordinary strength! 'Red kava' ['lehua kava'] is said to be even more potent still (Ott 1993). 'White' varieties are generally considered the best, though, but this field is very complex and cannot be generalised so easily. There are more than 72 cultivated varieties of P. methysticum recorded, many of which have not been chemically analysed (Singh & Blumenthal 1997).

Kava-lactones [kava-pyrones], the active agents in kava [see below], are not soluble in cold water, though they form a limited suspension in hot water; they are soluble in alcohol, fats and oils. Today in the west, the root is often prepared as follows – 14-28g dried kava is blended cold or heated with 300ml water [preferably coconut milk], 2 tabs olive oil and 1 tab lecithin. After thorough blending, this should be strained, and consumed at will. Effects are usually felt within 30 minutes, and last several hours. The effects are usually quite mild the first few times one tries kava, and are best appreciated in a dimly-lit, quiet environment. The bitter, soapy drink is astringent and numbs the mouth. Small amounts are gently euphoric; larger amounts induce pleasant relaxation, feelings of sociability, mood elevation, and sedation of the lower limbs. It is similar in some ways to alcohol inebriation, but without mental clouding or incoordination, and is said to give pleasant dreams [though others say it promotes a dreamless sleep]. It stimulates, then slows respiration, reduces cardiac rhythm, and can dilate the pupils. Higher doses still can induce a mildly psychedelic state of delirium. However, with all kava, the exact nature of the effects depends on the proportions of active chemicals in each strain. Daily high-dose use for several months to 1 year or more is known to produce negative physical side-effects such as dry, scaly skin lesions, reduced appetite for food and sex, sleep disorders, stomach pains, bloodshot sticky eyes and extreme lethargy (Baill pers. comm.; Gottlieb 1992; Lebot et al. 1992; Meyer 1967; Miller 1985; Pendell 1995; Singh & Blumenthal 1997). There are some cases of serious liver toxicity known; two women suffered acute necrotising hepatitis which resolved itself after kava consumption was ceased, and a teenage girl [taking normal doses for 3 months to treat anxiety] and a 50 year-old man [taking high doses for 2 months] suffered liver failure and required liver transplants (Campo et al. 2002).

P. methysticum root is c.80% water when fresh; dried root contains c.12% water, 43% starch [20% fibre, 32% sugars], 3.6% amino acids and 3.2% minerals [2.24% K, 0.37% Ca, 0.18% Mg, 0.11% Na, 0.15% Al, 0.11% Fe and 0.09% silica]. Kava contains a blend of resinous sesquiterpene-like compounds called kava-lactones or kava-pyrones. The dried root may yield c.3-20% of these compounds; 1-1.5g of the concentrated resin is considered a strong dose. There are several major kava-lactones – those being *kawain*, *yangonin*, *methysticin*, *7,8-dihydrokawain*, *dihydromethysticin* and *5,6-dehydrokawain* [desmethoxyyangonin; appears to have little effect]. Any given strain of kava may contain about 3 major kava-lactones [more than 70% of total], and others in traces; these variations give different effects from different cultivars. Large doses of the kava-lactones [except *yangonin* and *5,6-dehydrokawain*] can produce ataxia and paralysis without loss of consciousness. They appear to act synergistically, and also have antifungal and MAO-B inhibiting activity. Strains high in *dihydromethysticin* and *7,8-dihydrokawain* are the strongest, and have been known to cause nausea and 'drunkenness for 2 days'; strains high in *kawain* and low in *dihydromethysticin* and *7,8-dihydrokawain* produce what are said to be the most desirable effects. *Kawain* is also absorbed faster than the other kava-lactones. Kava also contains the minor kava-lactones 5,6-dehydromethysticin, 10-MeO-*yangonin*, 11-MeO-*yangonin*, 11-MeO-noryangonin, 11-OH-*yangonin*, 5,6,7,8-tetrahydroxyyangonin, 5,6-dihydroyangonin, OH-*kawain*, 11-OH-12-MeO-dihydrokawain, 7,8-dihydro-5-OH-kawain, 11,12-dimethoxydihydrokawain and 11-MeO-12-OH-dehydrokawain. Also found are the chalcones flavokavain A-C, dihydrokavain-5-ol, cinnamalaketone, N-cinnamoyl-pyrrolidine, 1-(O-MeO-cinnamoyl)pyrrolidine, cepharadione A, *choline* and transphytol. Kava-lactone content decreases from the root to the stump, with basal stems and leaves having even lower concentrations. Lebot et al. (1999) reported that the bark peelings of a Hawaiian cultivar yielded 10.7% kava-lactones; they did not specify whether this was from root bark or stem bark. The leaves of Hawaiian cultivars have yielded 0.4-5.8% kava-lactones, consisting of the 6 major kava-lactones in varying concentrations; *dihydromethysticin* and *7,8-dihydrokawain* were always the major components. Leaves have also yielded an alkaloid, pipermethysticin, which is found in traces in the roots; it is unstable and of unknown pharmacology. Fijian kava leaves have also yielded flavokavains A & B, and β-sitosterol (Buckley et al. 1967; He et al. 1997; Keller & Klohs 1963; Lebot et al. 1992; Lebot et al. 1999; Meyer 1967; Parmar et al. 1997; Pendell 1995; Singh & Blumenthal 1997; Uebelhack et al. 1998).

P. wichmannii root yielded c.8.4% kava-lactones, consisting of 31.84% *dihydromethysticin*, 19.49% *5,6-dehydrokawain*, 18.94% *7,8-dihydrokawain*, 16.95% *methysticin*, 7.28% *yangonin* and 5.19% *kawain* – though, as with the cultivar P. methysticum, different chemotypes have been observed, bearing differing proportions of these major kava-lactones (Lebot & Levesque 1996).

Piper methysticum is a shrub 1.5-3m tall; stems jointed, swollen at nodes. Leaves alternate, cordate, 13-30cm long, 10-23cm wide, palmately veined, principal veins 9-13, spreading from base except the 3 uppermost, +- pellucid-punctate, lower surface minutely puberulent on veins, margin entire; petioles 2-3cm long; stipules accrescent and usually persistent, at ultimate node and sometimes at some of the lower nodes, ultimate stipule forming a lanceoloid sheath enclosing the developing stem, 4.5-5.5cm long, 0.8-2.2cm wide. Plants dioecious; flowers unisexual, in solitary, leaf-opposed spikes, each subtended by a minute glabrous bract; mature spikes white, 3-9cm long including peduncle; peduncles up to 1.5cm long; stamens 2-4. Ovary 2-4(-5)-carpellate; stigmas as many as carpels, essentially terminal. Fruit drupaceous, rarely or not occurring. Female plants are very rare.

Thrives at 150-300m in cool, humid highlands, in stony ground or loose, rich, well-drained soil; native range unknown, widely cultivated in Pacific Islands (Wagner et al. 1990).

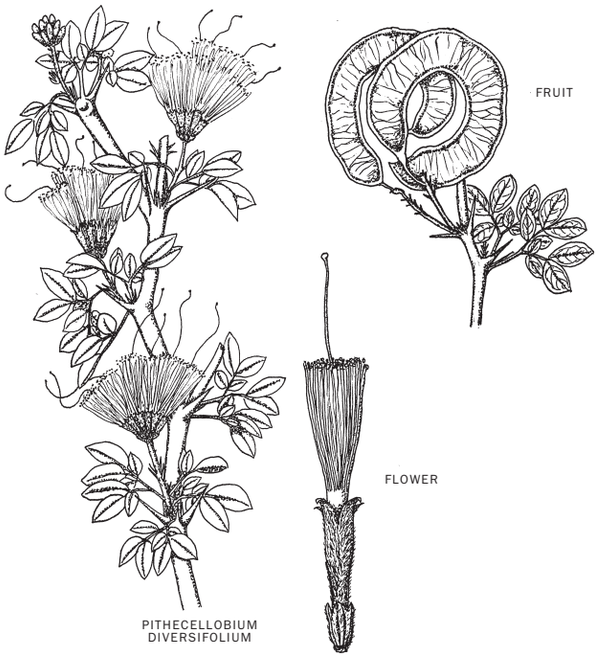
As mentioned earlier, P. methysticum is no longer considered to be a true species, but rather consists of sterile cultivars developed over time from variants or mutants of P. wichmannii (Lebot & Levesque 1996).

Cultivation is usually by cuttings of the firm wood of young branches [2 joints long if >2.5cm diam., 4 joints if less] cut diagonally between the nodes – usually 2 are planted together to produce a bigger plant. Stick cuttings in ground nearly diagonally to bury one node; grow in deep, friable, well-drained soil, rich in organic matter, pH 5.5-6.5. They must be protected from direct sunlight and wind – shade is required for the first 30 months. Requires 20-35°C temperatures, 70-100% relative humidity, an altitude under 400m, and over 2200mm annual precipitation [min. 1800mm at higher altitudes]. Cuttings are most susceptible to damage from lack of water in the first 6 months. The root is considered mature after c.3-5 years of growth, when it may extend to 60cm or more underground and be 5-8cm thick. The root mass and lower stems are dug up and their outer layer scraped off. A 3-year old plant may yield 10kg of fresh rootstock; drying reduces the weight to c.1/5 of original. One 4-year old plant from Pt. Vila, Vanuatu, grown in very sandy soil, had a rootstock

weighing 132kg fresh! Older roots are reputed to be more potent and more flavoursome, as are fresh roots; kava-lactone content is highest after 18 months, and remains +- stable, with little or no seasonal variation (Grubber 1973; Lebot et al. 1992; Singh & Blumenthal 1997). Kava-lactone content is apparently more reliant on chemotype and growing conditions [such as fertile, irrigated soil], than on the age of the plant, though smaller roots often have a higher content. Increased shade has been reported to decrease kava-lactone content (Lebot et al. 1999).

PITHECELLOBIUM

(Leguminosae/Mimosaceae)



Pithecellobium acacioides *Ducke* **(P. foliolosum** *Benth.***; Chloroleucon acacioides** *(Ducke) Barneb. et J.W. Grimes***)** – jurema branca

Pithecellobium arboreum *(L.) Urb.* **(P. filicifolium** *(Lam.) Benth.***; Acacia arborea** *(L.) Willd.***; Cojoba arborea** *(L.) Br. et R.***; Mimosa arborea** *L.***; M. filicifolia** *Lam.***)** – piule, coralillo

Pithecellobium contortum *(Graham) Mart.* **(Archidendron contortum** *(Mart.) I.C. Nielsen***; Inga contortum** *Graham***)**

Pithecellobium diversifolium *Benth.* **(Feuilleea diversifolia** *(Benth.) Kuntze***)** – jurema branca, brinco de saguim, espinheiro

Pithecellobium dumosum *Benth.* **(Chloroleucon dumosum** *(Benth.) G.P. Lewis***; Feuilleea dumosa** *(Benth.) Kuntze***)** – jurema branca

Pithecellobium grandiflorum *Sol. ex Benth.* **(P. tozerii** *F. Muell.***; Abarema grandiflora** *(Sol. ex Benth.) Kosterm.***; Archidendron grandiflorum** *(Sol. ex Benth.) I.C. Nielsen***; Feuilleea tozeri** *(F. Muell.) Kuntze***)** – laceflower tree, pink laceflower, fairy paint-brushes, gin's lips

Pithecellobium laetum *(Peopp.) Benth.* **(P. polycarpum** *Poepp.***; Abarema laeta** *(Benth.) Barneb. et J.W. Grimes***; Feuilleea laeta** *(Benth.) Kuntze***; Inga laeta** *(Benth.) Poepp.***; Klugiodendron laetum** *(Benth.) Br. et Killip***)** – remocaspi, pashaquillo, shimbillo

Pithecellobium tortum *Mart.* **(P. scalare** *Griseb.***; P. vincentis** *Benth.***; Chloroleucon tortum** *(Mart.) Pittier ex Barneb. et Grimes***; C. vincentis** *(Benth.) Br. et R.***; Feuilleea torta** *(Mart.) Kuntze***)** – jurema branca, Brazilian raintree

P. diversifolium roots and bark are used by a number of West African groups in Brazil as 'jurema branca', in a similar way to the true 'jurema' [**Mimosa** hostilis], presumably evoking a similar effect, or taking the role of a less active substitute (Lipp 1995; Rätsch 1992). P. acacioides, P. dumosum and P. tortum are also used in a similar way, as is the unrelated Vitex agnus-castus [see *Endnotes*; see also **Acacia** and **Mimosa**] (Ott 1997/1998, 1999). P. laetum is used in Peru as an ayahuasca additive [see **Banisteriopsis**] (Luna 1984). As 'remocaspi', it is consumed under a strict diet to receive esoteric wisdom. Death may result if the required diet is not kept. There may, however, be some confusion with **Aspidosperma** excelsum (Luna & Amaringo 1991). In Brazil, Pithecellobium spp. are also referred to as 'parica' [see **Anadenanthera** and **Virola**] (Schultes 1955), indicating possible past use as snuff ingredients.

The Mexican P. arboreum is known as 'piule' [see **Rhynchosia**], and is known to be narcotic (Schultes 1937b). In Malaya, P. contortum is reported to be 'stupefying' (Perry & Metzger 1980). P. bigeminum of n. India is used for its seeds, to treat diabetes, and its leaves, decocted as a hair tonic and fish poison. Wood of Pithecellobium spp. is sometimes used in construction and tanning leather, and the barks are often used to stupefy fish. Seeds of some species are used as coffee substitutes [see **Coffea**], and flowers yield a delicious honey (Allen & Allen 1981; Usher 1974).

Indigenous inhabitants of the Pennefather River area in Queensland, Australia, used P. grandiflorum as a kind of aphrodisiac. A preparation made from the inner bark, mixed with charcoal, was smeared on the front of the body [along with stripes of red clay down the outside of each leg] by men to excite and attract women, apparently due to the aroma and visual appearance thus produced (Cribb & Cribb 1981).

The chemistry of this genus is poorly known. Some species contain alkaloids such as pithecelobine (Allen & Allen 1981), which has since been found to be a mixture of several compounds (Buckingham et al. ed. 1994), and has been claimed to be toxic. Seeds of some species also contain the toxin djenkolic acid (Culvenor 1970; Krauss & Reinbothe 1973). However, P. lobatum has been shown to contain both pithecelobine and djenkolic acid, and in Malaysia its leaves, green pods and flowers are eaten as food (Allen & Allen 1981). There may be preparation methods involved which remove the toxins, so that these plant parts can be eaten safely, or perhaps the toxins are not orally active in humans.

P. acacioides [as P. foliolosum] leaf extracts weakly inhibited smooth and striated muscle contraction; this species was the weakest of those tested by Barros Viana et al. (1973), the others being P. multiflorum, P. polycephalum and P. saman (Barros Viana et al. 1973).

P. arboreum from Cuba [harv. Mar.] has yielded a triterpenoid glycoside, O(3)-(2-acetylamino-2-deoxy-β-D-glucopyranosyl)-oleanolic acid [0.06%], which was also found in P. cubense [0.15%; harv. same time and place] (Ripperger et al. 1981); seeds [as P. filicifolium] were shown to contain 4-OH-pipecolic acid, and smaller amounts of pipecolic acid itself (Krauss & Reinbothe 1973).

P. bigeminum has yielded pithecelobine (Allen & Allen 1981).

P. laetum has yielded lupeol, spinasterol and phytomitogenes (Rätsch 1992).

P. leptophyllum [aerial parts] from Mexico tested positive for alkaloids in a broad screening (Fong et al. 1972).

P. lobatum has yielded pithecelobine and djenkolic acid (Allen & Allen 1981).

Several species growing in Queensland, Australia were screened for alkaloids. P. grandiflorum from Tamborine [harv. Jun.] gave positive results from leaf and bark. P. hendersonii from Coolangatta [harv. Jan.] gave positive results from leaf. P. pruinosum from Rockhampton [harv. Jan.] gave weak positive results from leaf and mature seed. P. saman from Mossman [harv. Aug.] gave strong positive results from bark (Webb 1949). This latter species has yielded impure pithecelobine, and has since been renamed as Samanea saman (Allen & Allen 1981). Extracts of the leaves of Brazilian P. saman strongly inhibited smooth and striated muscle contractions [strongest of those tested], activities which appeared to correlate with alkaloid concentration (Barros Viana et al. 1973).

Pithecellobium diversifolium is a shrub to small tree; branchlets tortuose, pubescent, densely foliated; stipules spinescent. Leaves with scattered glands, bipinnate, 2-3 paired or in inferior pinnae with one pair of leaflets; pinnae 1-2-paired; leaflets obovate-oblong, both sides pubescent, upper leaflets mostly 12-19mm long, lower ones mostly smaller; petioles pubescent, smaller towards base. Flower heads terminal or axillary, solitary or clustered, globose, usually whitish, pedunculate; flowers hermaphrodite, pubescent; calyx campanulate, slightly 4-dentate; corolla slightly 4-lobed, tubular or infundibuliform, base united in tube; stamens numerous. Ovary glabrous, stipe elongate. Seed pods dehiscent, coiled, compressed, usually constricted between seeds, minutely tomentose, leathery; seeds thin, embedded in pulp, funicle filiform, aril slightly fleshy.

Province of Piauhy, Brazil (Bentham 1844).

PLUTEUS

(Agaricaceae/Plutaceae)

Pluteus atricapillus *(Secr.) Singer* **(P. atricapillus** *(Batsch) Fayod***; P. cervinus** *(Schaeffer) Kummer***)**

Pluteus atricapillus var. ealensis *Beeli* – abanda, losulu

Pluteus cyanopus *Quelet*

Pluteus glaucus *Singer*

Pluteus nigroviridis *Babos*

Pluteus salicinus *(Pers. ex Fr.) Kummer* **(P. petasatus** *(Fr.) Gillet***)**

Pluteus villosus *(Bull.) Decary et Romagn.* **(P. drepanophyllus** *(Schulz.) Sing.***; P. ephebeus** *(Fr. ex Fr.) Gillet***; P. lepiotoides** *Pears.***; P. murinus** *(Romagn.) Bres.***; P. pearsonii** *P.D. Orton***; P. robertii** *(Fr.) P. Karst***)**

P. atricapillus var. ealensis has been reported to be consumed by the Banza of Central Africa, sub-groups of whom also consume 'iboga' [see **Tabernanthe**]; the mushroom is apparently bitter and acrid-smelling

(Ott 1993).

P. atricapillus from Finland has yielded 0.004-0.005% *psilocybin* [only in 2 out of 5 specimens] (Ohenoja et al. 1987); Russian specimens were not found to contain any *psilocybin* (Gurevich 1995). It would seem to be at least possible that the African variant may contain *psilocybin*, though it has not been chemically analysed.

P. cubensis from Brazil yielded 0.05% *tryptamine*, though no *psilocybin*, *psilocin* or *serotonin* were found (Stijve & de Meijer 1993).

P. cyanopus has been reported to have *psilocybin*-like activity, but has not been analysed (Stamets 1996).

P. glaucus from Brazil has yielded 0.28% *psilocybin* and 0.12% *psilocin*; specimens of another Brazilian Pluteus sp., with a similarity to P. glaucus, yielded 0.15% *psilocybin* and 0.1% *psilocin* (Stijve & de Meijer 1993).

P. nigroviridis from Hungary [very rare] has yielded 0.035% *psilocybin* (Allen et al. 1992; Gartz 1996).

P. salicinus from Finland has yielded 0.21-0.3% *psilocybin* and 0-0.05% *psilocin* (Ohenoja et al. 1987); specimens from Sardinia [Italy] yielded 0.09% *psilocybin* and 0.03% *psilocin* (Ballero & Contu 1998); one analysis from Switzerland gave 0.05-0.25% *psilocybin*, and up to 0.008% *baeocystin* (Stijve & Kuyper 1985), though others [in Germany] have found much higher yields – 1.22-1.57% *psilocybin* in caps, 0.48-1.14% *psilocybin* in stems, 1.4-2.6% urea in caps, and traces to no urea in stems; small amounts of *baeocystin* and *tryptophan* were also found, in the caps only (Gartz 1987, 1996); another in Norway found 0.35% *psilocybin* and 0.011% *psilocin* (Christiansen et al. 1984). *Psilocybin* and *psilocin* have also been detected in samples from Czech Republic (Stríbrný et al. 2003) and Illinois, US. A variety of P. salicinus, P. salicinus var. achloes, does not bruise blue (Saupe 1981). As P. petasatus, this mushroom is often reported to be edible.

P. villosus has been reported to have *psilocybin*-like activity (Stamets 1996), though it was also stated by Singer to be inactive (Allen et al. 1992). Analysis found no *psilocybin*, but did detect unidentified *tryptamine*-derivatives (Toro 2004).

P. xylophilus var. tucumanensis from Brazil "contains several unidentified *tryptamine* derivatives", but no *psilocybin*, *psilocin* or *serotonin* (Stijve & de Meijer 1993).

Pluteus salicinus has a cap 2-5(-7)cm across, convex to broadly convex, then flattened and slightly umbonate, bluish- or greenish-grey, darker at centre, faintly striate when moist, surface smooth to finely scaly near centre. Stem 30-50(-100) x 2-6mm, white, sometimes becoming tinged with cap colour or bluish-green at base. Flesh white with greyish tinge. Gills free, not attached, pallid- to cream-white, then pink. Pleurocystidia fusiform to lageniform, with slightly thickened walls and with or without an apical crown of hooked ends, 58-90 x 10-22µ, apex 5-10µ thick; cheilocystidia pear-shaped to clavate, to cylindrical or slightly lageniform, 30-85 x 8-20µ. Spores pink, elliptic, (7-)8-9 x (5-)6-7µ, smooth. Fr. spring-autumn, frequent.

On dead or living deciduous wood [twigs or stumps; willow (Salix) or alder (Alnus)] in wet, rich habitats; United States, British Isles, northern Europe. Sometimes edible (Christiansen et al. 1984; Phillips 1981; Stamets 1996).

POLASKIA

(Cactaceae)

Polaskia chende *(Roland-Gosselin) Gibson et Horak* **(Cereus chende** *Roland-Gosselin*; **Heliabravoa chende** *(Roland-Gosselin) Backeberg*; **Lemaireocereus chende** *(Roland-Gosselin) Br. et R.*; **Myrtillocactus chende** *(Roland-Gosselin) P.V. Heath*) – chende, chente, chinoa

This Mexican cactus is sometimes used for its edible fruit (Trout & Friends 1999). It is of interest here due to its alkaloid content.

P. chende was found to contain up to 0.01% each of *mescaline*, *DMPEA* and 4-OH-3,5-dimethoxy-*phenethylamine* (Ma et al. 1986); an earlier alkaloid screening found specimens of this species to be rich in alkaloids (Fong et al. 1972).

Polaskia chende is a large, multi-branched cactus to 5-7m tall; trunk often short and indefinite when present. Branches slender, ascending or erect, ribs acute, 7-9; areoles c.1.5cm apart on older growth, sometimes closer together on younger growth; spines needle-shaped, brown to bright yellow, becoming grey with age, radial spines (2-)5, 1-2.5cm long, central spines 0-2, when present slightly longer than radials. Flowers rose-coloured, c.3-4(-5)cm long including ovary. Fruit deep red, very spiny with light-brown hairs, c.4cm diam.; seeds 1mm long.

Puebla and Oaxaca [1500-2200m], Mexico (Backeberg 1960; Britton & Rose 1963). Cultivate in a similar manner to **Stenocereus** (Trout & Friends 1999).

POLYGALA

(Polygalaceae)

Polygala senega *L.* – milkweed, milkwort, senega, seneka, snakeroot

Polygala sibirica *L.* **(P. heyneana** *Wall*) – yuan zhi, yuan chih, Japanese senega, himehagi, hsiao-ts'ao, chodat

Polygala tenuifolia *Willd.* **(P. sibirica var. angustifolia** *Ledeb.*; **P. sibirica var. tenuifolia** *(Willd.) Backer et Moore*) – yuan zhi, yuan chih, yuan chih shu, hsiao-ts'ao, chodat

The roots of these herbs are esteemed medicinally, and have many uses. P. senega is used by the Cherokee as a sudorific, diuretic, emmenagogue, expectorant and cathartic; it is taken for colds, pleurisy, rheumatism and inflammations (Hamel & Chiltoskey 1975). P. sibirica and P. tenuifolia have been used by Taoists as brain tonics, to improve memory and mental powers. In TCM, the root is considered warm, bitter and pungent, with an affinity for the lungs, kidney and heart. It has virtuous properties – known to be tonic, analgesic, antibacterial, uterotonic, expectorant [the root bark more so than the core], sedative and tranquillising, as well as nourishing the semen, improving hearing and vision, promoting muscle and bone growth, and clarifying mental faculties. The dried root of 'yuan zhi' is usually given in decoction in doses of 1.5-9g [or 1 tablespoon], twice a day for several weeks. It has shown synergy with barbiturates (Bone 1996; Gottlieb 1992; Hsu et al. 1986; Huang 1993; Reid 1995). At Mt. Hagen, Papua New Guinea, flowers of P. paniculata are eaten by women to treat infertility (Stopp 1963).

An unidentified plant believed to be a Polygala sp., known as 'bolao ba maqekha', has been referred to as "the charm of the witch-doctors" amongst the Basuto, who add it to a compound herbal drug given to those suffering from hysteria [see *Endnotes*, **Galium**] (Laydevant 1932). In southern Africa, the Suto use P. amatymbica as a 'cattle medicine', and it is known to have stimulant effects (Watt & Breyer-Brandwijk 1932). In Brazil, P. klotzschii has caused fatal intoxications in cattle [fatal dose 1kg/100kg], with pre-death symptoms including strong disequilibrium, laboured breathing and liquid diarrhoea (Pott & Alfonso 2000).

P. senega has yielded 5-10% saponins – senegenin, presenegenin, senegins II, III & IV, tenuifolin, onjisaponin B, 1,5-anhydroglucitol and 2-β,3-β,27-trihydroxyolean-12-ene-23,28-dicarboxylic acid [antiinflammatory]; as well as polygalic acid and methyl salicylate [analgesic] (Bruneton 1995; Buckingham et al. ed. 1994; Farnsworth & Cordell 1976).

P. sibirica and P. tenuifolia have similar chemistry, and are used in the same way. The active principles appear to be the triterpenoid saponins [c.0.7-4% of root], such as tenuifolin [prosenegenin], senegenin, tenuidine, polygalitol, onjisaponins A-G, and 1,5-anhydroglucitol; onjixanthones I & II, 6,8-dihydroxy-1,2,4-trimethoxyxanthone, 1,7-dimethoxy-2,3-methylenedioxyxanthone, 6-OH-1,7-dimethoxyxanthone, 3-OH-1,2,7-trimethoxyxanthone and 1,2,3,6,8-pentahydroxyxanthone are also found. Tenuigenin A1 & B1, as well as senegenin, are products of hydrolysis (Bone 1996; Buckingham et al. ed. 1994; Hsu et al. 1986; Huang 1993; Sakuma & Shoji 1981). P. tenuifolia has also yielded *norharman*, *harman*, 9-formyl-*harman*, 1-carbomethoxy-β-carboline, 1-carboethoxy-β-carboline and 1-carbobutoxy-β-carboline, from unspecified parts (Shulgin & Shulgin 1997). An extract caused 40% inhibition of AChE in rat brain extracts (Park et al. 1996).

Polygala sibirica is a many-stemmed herb, stems slender, 7.5-45cm long and hairy. Leaves alternate, rarely opposite or verticillate, round to elliptic, lanceolate and linear, 1.3-5cm long, shining margins often recurved. Flowers in racemes 2.5-7.5cm long, arising from axils of leaves or outside axils, with few or many flowers; flowers blue, hermaphrodite, 3-bracteate; sepals 5; outer sepals short or long, blunt or pointed, oblong-ovate to lanceolate; 2 inner sepals petal-like, obliquely oblong or inversely ovate, blunt or pointed, rarely long-pointed; petals 3, united at base with staminal sheath, the lower one keel-shaped and crested, crest usually large; stamens 8; filaments united for their lower half into a split sheath; anthers opening by pores. Ovary 2-celled; ovule 1 in each cell, pendulous. Fruit a capsule, 2-celled, loculicidal, smooth, broadly winged, 2-seeded; seeds hairy.

Temperate and subtropical Indian Himalaya, 300-1800m, in Sikkim 2400m, from n.w. frontier and the Punjab to Bhutan, Khasia Hills, 1200-1800m, w. Ghats from the Nilgiris to Tinnevelley, mostly above 1800m; also in China, Japan, Siberia (Kirtikar & Basu 1980; Steward 1958).

PROSOPIS

(Leguminosae/Mimosaceae)

Prosopis africana *(Guill. et Perr.) Taub.* **(P. lanceolata** *Benth.*; **P. oblonga** *Benth.*; **Coulteria africana** *Guill. et Perr.*) – ironwood, tentiera, kembo, ukpehe

Prosopis alba *Griseb.* **(P. atacamensis** *Phil.*; **P. siliquastrum var. longisiliqua** *Phil.*) – algarrobo blanco

Prosopis alpataco *Phil.* **(P. alba fo. fruticosa** *(Hauman) Monticelli***; P. juliflora fo. fruticosa** *Hauman***; P. stenoloba** *Phil.***)**
Prosopis juliflora *(Sw.) DC.* **(P. bracteolata** *DC.***; P. chilensis** *(Molina) Stuntz***; P. cumanensis** *(Humb. et Bonpl. ex Willd.) Kunth***; P. domingensis** *DC.***; P. glandulosa** *Torr.***; P. vidaliana** *Naves ex Villar***; Acacia cumanensis** *Humb. et Bonpl. ex Willd.***; A. juliflora** *(Sw.) Willd.***; A. salinarum** *(Vahl) DC.***; Algarobia juliflora** *(Sw.) Heynh.***; Desmanthus salinarum** *(Vahl) Steud.***; Mimosa juliflora** *Sw.***; M. piliflora** *Sw.***; M. rotundata** *Sessé et Moc.***; M. salinarum** *Vahl***; Neltuma bakeri** *Br. et R.***; N. juliflora** *(Sw.) Raf.***; N. occidentalis** *Br. et R.***; N. pallescens** *Br. et R.***)** – mizquitl, mesquite, honey mesquite, bayahond
Prosopis nigra *(Griseb.) Hieron.* **(P. algarobilla var. nigra** *Griseb.***; P. dulcis var. australis** *Benth.***)** – algarrobillo, algarrobo amarillo, algarrobo negro
Prosopis ruscifolia *Griseb.*
Prosopis sericantha *Gillies ex Hook.*
Prosopis spp. – mesquite, algarroba

Native to the Americas, 'mesquites' have spread over the continents via human introduction, due to their ability to give shade in dry, hot areas, to revitalise near-deserts, and to provide stock fodder in the form of the seed pods (Allen & Allen 1981; Parsons & Cuthbertson 1992; Simpson ed. 1977). The strong wood of many species is valued for building material – wood of P. africana is called 'ironwood', and is hard enough to blunt an axe. Sumerian records from pre-biblical times refer to an Iraqi species, P. stephaniana, as 'eri-tilla' or 'plant of the city of life' (Allen & Allen 1981). P. juliflora, known to the Aztecs as 'mizquitl', was considered a healing plant, and the wood has been used to fuel magical fires. Its pods, rich in sugars, are used to brew alcoholic beverages [such as 'pulqué' and 'chicha'] in Central America [see *Methods of Ingestion*]. Also available in some of these areas are a refreshing drink called 'mesquitatole' or 'pindle', an alcoholic beverage 'vino mesquite', and cakes called 'mesquitamales' (Burkill 1985-1997; Cunningham 1994; Rätsch 1998). In Haiti, P. juliflora has been reported as an ingredient of 'antidote' potions in the zombi phenomenon [see *Methods of Ingestion*] (Davis 1988a).

In n.w. Argentina, seeds of a Prosopis sp. have been found [along with **Anadenanthera** seeds, and puma-bone smoking pipes, the residue from which still contained *DMT*] in an archaeological site dating back some 4,000 years (Torres & Repke 1996).

In some parts of tropical Africa, leaves of P. africana are macerated and ingested as an aphrodisiac and male fertility tonic (Allen & Allen 1981); the wood is also said to be soporific (Watt 1967), and is used in magical practices – to some n. Nigerians, the plant is considered 'tabu'. The pods and seeds have also been used as a fish poison. In Mali, the macerated leaf of a mistletoe [see *Endnotes*] growing parasitically on P. africana is taken as an aphrodisiac and male sexual tonic (Burkill 1985-1997). Many mesquites also may yield quality honeys to bees [Apis spp. – see *Endnotes*] (Allen & Allen 1981).

Prosopis spp. are an excellent source of flavonoids [too numerous to be listed in full], monosaccharides and tannins, and some also contain indole and *phenethylamine* alkaloids. Most found at this point are simple derivatives of minor interest, yet with further searching in this genus alkaloids such as *DMT* may perhaps one day be detected.

P. africana leaves have yielded 3.1% piperidine alkaloids, a mixture of prosopinine [sedative, hypotensive, spasmolytic, vasodilator, local anaesthetic in mice] and prosopine [prosophylline; excitant and mild local anaesthetic in mice; toxic doses cause convulsions and respiratory paralysis; oral LD50 820mg/kg], as well as (-)-prosafrine and prosafrinine; bark yielded prosopine, prosopinine and isopropinines A & B; roots have also yielded prosopine and prosopinine (Bourrinet & Quevauviller 1969a, 1969b; International… 1994; Omnium Chimique 1969).

P. alba leaf has yielded 0.43% *tyramine*, 0.7% *phenethylamine* and 0.73% *tryptamine* (Graziano et al. 1971), as well as the flavonoids vitexin, isovitexin, luteolin, quercetin, quercetin-3-methyl ether and quercetin-7-glucoside (Gianinetto et al. 1975).

P. alpataco bark has yielded *tetrahydroharman*, cassine and N-methylcassine (Chiale et al. 1982).

P. juliflora has yielded *tryptamine* and *serotonin* from unspecified parts (Smith 1977b; Willaman & Li 1970); leaf has yielded juliflorine, julifloriinine, julifloricine, julifloridine, N-methyljulifloridine, juliprosine and juliprosinene (Ahmad et al. 1989; International... 1994). As P. glandulosa, the leaves yielded 0.31% of a mixture of *tyramine* and N-methyl-*tyramine* (Camp & Norvell 1966), as well as rutin, *apigenin*, luteolin, glucoluteolin, narcissin, isokaempferide, thermopsoside, 3',4',5,7-tetrahydroxy-3-MeO-flavone and 3-glucopyranosyloxy-4',5,7-trihydroxy-3'-MeO-flavone (International... 1994). P. juliflora seeds have been shown to contain 4-OH-pipecolic acid, N-acetyldjenkolic acid and smaller amounts of djenkolic acid (Krauss & Reinbothe 1973).

P. nigra bark has yielded cassine and N-methylcassine (Gianinetto et al. 1980; International... 1994); leaves have yielded 2% alkaloids, including [as % of dry plant] 0.15% *harman*, 0.1% *tetrahydroharman*, 0.3% *tryptamine*, 0.2% N-acetyl-*tryptamine*, 0.4% *phenethylamine* and 0.2% *tyramine* (Moro et al. 1975), as well as the flavonoids vitexin, isovitexin, luteolin, luteolin-7-glucoside, quercetin and isorhamnetin-3-galactoside [cacticin] (Gianinetto et al. 1975).

P. ruscifolia bark has yielded *tetrahydroharman*, cassine and N-methylcassine (Chiale et al. 1982; Gianinetto et al. 1980); leaves have yielded the flavonoids quercetin, vitexin, isovitexin, luteolin and luteolin-7-glucoside (Gianinetto et al. 1975).

P. sericantha bark has yielded *tetrahydroharman*, cassine and N-methylcassine (Chiale et al. 1982); leaves have yielded the flavonoids quercetin, luteolin and isorhamnetin (Gianinetto et al. 1975).

Prosopis africana is a tree 4.5-12(-21)m tall, unarmed, with grey, rough, scaly or fissured bark; young branchlets shortly pubescent or puberulous. Leaves bipinnate; pinnae (1-)2-4 pairs, glandular between most pairs of leaflets; leaflets opposite, in (5-)7-15 pairs, oblong-lanceolate or elliptic-lanceolate, (1.3-)1.5-3(-4) x 0.4-1(-1.5)cm, inconspicuously appressed-puberulous on both sides, apex usually acute or subacute; petiole 2.5-6.6cm long, pubescent or puberulous; rachis (0-)2.7-9.5cm long, pubescent or puberulous, glandular at insertion of pinnae. Flowers creamy-white or yellow-green, fragrant, sessile or nearly so, in 3-6cm long spikes borne on 1-3.5cm long peduncles; calyx 1.5-2mm long, puberulous, gamosepalous, with 5 teeth; petals 5, free, 3-4.5mm long, glabrous or nearly so outside; stamens/filaments 10, fertile, 5.5-6.5mm long; anthers with apical gland which is sometimes sessile and inconspicuous. Ovary hairy. Pods 10-20 x 1.5-3.3cm, black or brown, glossy, subcylindrical or slightly compressed, thickened; seeds ellipsoid, 8-10 x 4-9mm, blackish-brown, glossy.

Wooded grassland, 910-1220m; Uganda, Senegal, Gambia, Guinea, Sierra Leone, Ghana, Nigeria, Cameroon, Sudan (Brenan 1959).

PRUNUS

(Rosaceae)

Prunus africana *(Hook. f.) Kalkman* **(Pygeum africanum** *Hook. f.***)** – ol godjuk, ol kajuk
Prunus emarginata *(Dougl.) Walp.* – bitter cherry
Prunus serotina *Ehrh.* **(P. capuli** *Cav.***; Padus serotina** *(Ehrh.) Borkh.***)** – drunk cherry, wild black cherry, napakwijanik, capulin, usábi
Prunus spp. – wild cherry

This genus, including the sweet cherry [P. avium], apricot [P. armeniaca], peach [P. persica], sweet almond [P. amygdalus var. dulcis] and plum [P. domestica], contains some alkaloids of interest as well as possessing sedative qualities that should be approached with caution. Many species are traditionally used to repel evil, such as in China, where children may wear a peach pit around the neck to keep away demons. Some have been used to make magic wands, and have enjoyed varied uses in love magic. Eating almonds [from P. amygdalus] is said to cure fever and give one wisdom, and eating 5 almonds before drinking alcohol is claimed to prevent intoxication (Cunningham 1994). In India, sweet almonds are said to be a stimulant, nervine tonic (Nadkarni 1976). Peaches are said to induce love and give wisdom; the Japanese believe that peaches may increase fertility (Cunningham 1994). Apricots are said to extend one's lifespan (Bremness 1994). In TCM, P. armeniaca, P. manshurica or P. sibirica kernels ['xing ren'] are used as an antispasmodic sedative [dose 3-5g] in cases of asthma. They are considered incompatible with Astragalus spp. [see *Endnotes*] and **Scutellaria** baicalensis. P. persica kernels are used [5-10g] as an antitussive, as well as being applied as a sedative to treat hypertension (Keys 1976).

In Mexico, P. serotina leaves are used as a depressant, antispasmodic and febrifuge (Jiu 1966). The Tarahumara use large quantities of the leaf and bark to stupefy fish; they use the leaves of the introduced P. persica similarly (Pennington 1958). The bark of 'chokecherry' [P. virginiana] is used in cough medicines, and is sedative and astringent; similarly, the inner bark of 'black' or 'wild cherry' [P. serotina] is a sedative, tonic, digestive and expectorant. These two species, as well as P. cerasus and P. pennsylvanica, are known to the Cherokee, who use the bark from them to treat fever, colds, cough and lost voice. They also use P. persica as a purgative and anthelmintic (Bremness 1994; Hamel & Chiltoskey 1975; Hutchens 1973). The Winnebago drink a tea of P. serotina bark as a tonic, and use the inner bark in combination with other herbs as a food seasoning. They call the tree 'drunk cherry', as eating too many of the fruits causes inebriation (Kindscher & Hurlburt 1998). 'Bitter cherry' [P. emarginata] is used by the Hoop of n. California, who make a tea of the dried bark or keep it under the tongue as a tonic. The leaves may be air-dried and smoked [only a few lungfuls] for a pleasant sedative effect. The Hoop also regard apricot kernels to be "only for shamans" (Pendell 1995), alluding to powerful and probably dangerous properties.

In east Africa, the Masai consume P. africana as a stimulant-excitant, along with other plants [see **Acacia** and *Endnotes*] (Lehmann & Mihalyi 1982). In Germany, P. padus has been known as 'hexenbaum' ['witch tree'] and 'hexenholz' ['witch wood'], hinting at past magical uses (De Vries 1991).

All Prunus spp. contain cyanogenic glycosides, such as amygdalin, prulaurasin and prunasin, in all parts; however, flesh from the ripe fruits is usually safe to eat. During ingestion, when plant parts are crushed or when in contact with water, these compounds convert into hydrocyanic acid [HCN] and aldehydes such as benzaldehyde, the former of which produces cyanide salts and causes serious toxicity. Symptoms may manifest without warning, and include vertigo, mental 'dimness', headache, respiratory failure, loss of voice, muscle spasms, coma and death by asphyxiation. Dried material contains much less potential HCN, and the content is often highest within the kernels (Bremness 1994; Conn 1973; Foster & Caras 1994; Hall 1973; Keys 1976; Pendell 1995), which is why bitter almond oil is so hard to find, and why our parents told us never to eat apricot kernels! Bitter almond oil, by the way, contains on average 95% benzaldehyde and 3% HCN [in the form of prussic acid] (Battaglia 1995), though HCN-free bitter almond oil is available commercially for flavouring purposes. Cherry brandies also have cherry seeds added for flavour and to increase the 'kick', and should probably be approached with caution in excess (theobromus pers. comm.).

Seeds of P. amygdalus var. amara, P. armeniaca, P. cerasus, P. domestica, P. manshurica and P. sibirica, as well as the bark, leaf and flower of P. persica have been found to produce HCN (Huang 1993; Watt & Breyer-Brandwijk 1962). In the case of P. armeniaca, P. manshurica, P. mume, P. vulgaris, P. zhidanensis and P. sibirica, the cyanogenic glycoside present is amygdalin [c.5.4% in seed kernels of the latter], along with the enzyme amygdalase; these react to form HCN (Huang 1993; Shen et al. 1992).

P. amygdalus has yielded *phenethylamine* (Smith 1977a).

P. armeniaca fruit jam was found to contain c.0.0000044% trans-1,2,3,4,5-pentahydroxypentyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid, and c.0.0000168% of the cis-isomer (Herraiz & Galisteo 2002).

P. avium, P. cerasus and P. fruticosa young shoots have yielded *tryptamine*, *tryptophan*, *chlorogenic acids* and coumarins (Feucht & Nachit 1976).

P. domestica fruit has yielded [as µg/g from 'red plum', 'blue-red plum', and 'blue plum', respectively] *serotonin* [10, 8, 0], *tryptamine* [0-2, 2, 5], *tyramine* [6, 0, 0] and *norepinephrine* [present, 0, 0] (Udenfriend et al. 1959).

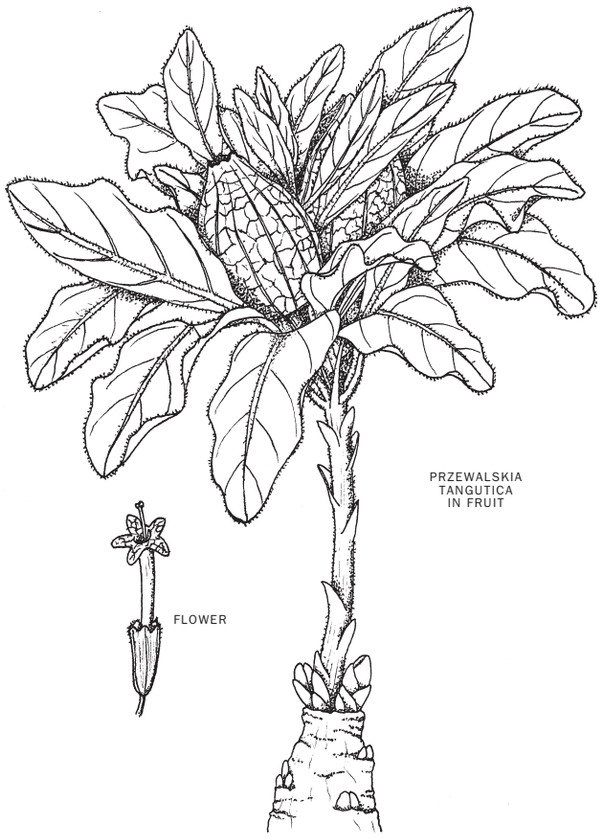
P. padus leaves have yielded *phenethylamine* (Hartmann et al. 1972).

Prunus serotina is a tree to 30m tall, branches reddish-brown, inner bark aromatic, mostly unarmed, deciduous. Leaves simple, oblong-lanceolate to ovate-oblong, apex acuminate to tapered or acute, firm to coriaceous, crenate-serrate with blunt incurved callous teeth, 3.5-15cm long, dark green and lustrous above, pale green beneath; midrib broad and prominent beneath, often villous; petiole 6-25mm long, often 2-glandular. Flowers 7-10mm wide, white or pink, solitary, in slender, elongate racemes 6-15cm long; divergent pedicels 3-10mm long; calyx tube various, partially or completely deciduous in fruit, lobes 5, narrow, acute, often toothed, persistent in fruit; petals 5, spreading; stamens usually 20, perigynous; filaments free, rarely connate; anthers small, 2-celled, opening lengthwise. Carpel 1; style terminal, elongated; ovules 2, collateral, pendulous. Fruit a globose drupe, 7-10mm diam., dark red, becoming purple-black, sweetish to bitter, with an indehiscent or 2-valved smooth or rugged stone; 1-seeded.

Canada, e. & s. U.S., Central & South America (Correll & Johnston 1970; Kirtikar & Basu 1980).

PRZEWALSKIA

(Solanaceae)



Przewalskia tangutica *Maxim.* **(P. roborowskii** *Batalin***; P. shebbearei** *(C.E.C. Fisch.) Grubov***; Mandragora shebbearei** *C.E.C. Fisch.***)** – ma niao pao

This herb, the only representative of its genus (An-ming & Zhi-yu 1986), is used in Tibetan and Chinese traditional medicine as an analgesic, anticonvulsant, antitoxin and treatment for various skin disorders and swellings (An-ming 1986; Peigen & Liyi 1982).

P. tangutica has yielded 0.58-2.72% alkaloids from the leaves – 0.02-0.09% *hyoscine*, 0.33-2.18% *hyoscyamine*, 0.01-0.04% apo-*atropine*, 0.01-0.6% (-)-6-β-OH-*hyoscyamine*, and traces of tropine and cuscohygrine; 0.8-2.72% alkaloids from stems – 0.01-0.09% *hyoscine*, 0.6-1.52% *hyoscyamine*, 0.01-0.03% apo-*atropine*, 0.02-0.14% (-)-6-β-OH-*hyoscyamine*, and traces of tropine and cuscohygrine; 1.82% alkaloids from flowers – 0.08% *hyoscine*, 1.6% *hyoscyamine*, 0.04% apo-*atropine* and 0.1% (-)-6-β-OH-*hyoscyamine*; 0.26-2.07% alkaloids from fruit – 0.02-0.09% *hyoscine*, 0.16-2.07% *hyoscyamine*, 0-0.07% (-)-6-β-OH-*hyoscyamine* and traces of apo-*atropine* and tropine; 0.2-0.27% alkaloids from seeds – almost entirely *hyoscyamine*, with traces of tropine and cuscohygrine; and 2.06-4.01% alkaloids from roots – 0.01-0.05% *hyoscine*, 1.67-3.82% *hyoscyamine*, 0.01-0.02% apo-*atropine*, 0.1-0.68% (-)-6-β-OH-*hyoscyamine*, 0-0.02% daturamine, 0-0.05% tropine and 0-0.03% cuscohygrine (Peigen & Liyi 1982).

Przewalskia tangutica is a herb, rarely a subshrub, densely covered with glandular hairs; stems poorly developed, mostly decumbent and embedded in the soil. Leaves alternate, sessile, often clustering at apex, +-ovate-lanceolate, crenulate, apex rounded, midrib prominent. Flowers usually regular, bisexual, solitary or 2-3 in axillary clusters, on short peduncles 2-3mm long and subfascicled; calyx 5-lobed; corolla infundibuliform, 5-lobed, the lobes usually plaited and imbricate in bud; stamens 5, very short, attached to the limb of the corolla tube. Ovary superior, mostly 2-loculate, with 1 to many ovules in each locule; style 1. Fruiting calyx bladdery, much larger than and enclosing the fruit; capsule globose, slightly elongate, circumsessile from near the middle.

Cold, arid areas at 3200-5000m; in proximity of Qinghai-Xizang Plateau, w. China (An-ming & Zhi-yu 1986; Keng et al. 1993).

PSATHYRELLA

(Agaricaceae/Coprinaceae)

Psathyrella candolleana *(Fr.) Maire* **(P. appendiculata** *(Bull.) Mre. ap. Mre. et al.***; Agaricus appendiculatus** *Bull.***; Hypholoma candolleanum** *(Fr. ex Fr.) Maire***; H. egenulum** *(Berk. et Br.) Sacc.***; H. fragile** *Peck***; Psilocybe albobrunnea** *Lutz non. Beeli***)**

Psathyrella sepulchralis *Singer, Smith et Guzmán* – piule de barda

Psathyrella sp. – kakke chyau ['raven mushroom'], buri chyau ['old ladies' mushroom']

P. sepulchralis was reported to have been used as a 'hallucinogen' by the Zapotecs of Oaxaca, Mexico, though this is suspected of being a confusion with the similar-looking **Psilocybe** zapotecorum, which also grows in the area (Singer et al. 1958; Wasson 1961). It has been presumed to contain *psilocybin* and/or *psilocin*, although the only chemical analysis did not find any. It is worth bearing in mind, however, that the specimens were 8 and 19 years of age (Ott & Guzmán 1976). In Nepal, it was recently discovered that Kirati shamans sometimes consume a [probable] Psathyrella sp. ['kakke chyau', 'buri chyau'] after roasting, "for clarifying the mind" and as "spiritual medicine" (Müller-Ebeling et al. 2002). P. gracilis has been claimed on the Internet to be used as a psychotrope (Toro 2004), but the origin of this information is doubtful.

P. candolleana specimens from Finland were analysed, and only one out of seven samples contained *psilocybin* and *psilocin* [0.004% and 0.005%, respectively] (Ohenoja et al. 1987). Specimens from Sardinia [Italy] yielded 0.007% *psilocybin* and 0.002% *psilocin* (Ballero & Contu 1998). German specimens were shown to contain *psilocybin*, estimated at c.0.05%, as well as *baeocystin* (Gartz 1986b). Japanese specimens yielded 0.08-0.15% *psilocybin* (Koike et al. 1981). Others, however, have found none, in specimens from Switzerland, Canada [Ottawa] and the US [Washington DC] (Stijve & Kuyper 1988). However, the earlier positive reports of *psilocybin* and relatives are now thought by some to have been errors of chemical identification. I am aware of a single bioassay of 10g dry P. candolleana [from Japan], which resulted in no effects (Hoodoo pers. comm.).

Some Psathyrella spp. have been found to contain new *tryptamine* derivatives, psathyrelline I and psathyrelline II (Stijve 2003; Toro 2004).

Psathyrella candolleana has a cap 15-50(-70)mm across, bell-shaped, becoming flattened, convex and expanded when old, surface smooth, dull, hygrophanous, pale ochraceous- or creamy yellowish-brown when moist, cream to almost white, or light lilac-grey, or flushed with brown when dry, centre somewhat darker, radiately wrinkled, faintly translucent-striate when moist, covered with fine, fibrillose white veil when very young, later with fugacious veil-remnants hanging from margin, margin downturned. Stem 40-80 x (3-)4-5(-8)mm, white, apex white-powdered, equal, cylindrical, sometimes enlarged towards base, smooth, shiny, solid when young, hollow when old, sometimes with trace of a ring. Flesh thin, white to grey-brown, watery; taste mild or slightly bitter, smell not distinctive. Gills narrowly adnate, crowded, narrow to broad, white to greyish-lilac when younger, darkening to purplish chocolate-brown and finally brownish-black, edges white-denticulate under hand-lens. Cheilocystidia thin-walled, hyaline, finger-shaped or cylindric; basidia 4-spored; spores light grey-brown to grey-purple to dark brown, almost black, smooth, elliptic or ovate, with a germ pore, 6-8.8 x 3.5-4.5(-5.5)µm. Whole fruiting body fragile. Variable in the field. Spring to late autumn.

Commonly in groups on or near deciduous trees, stumps, buried wood or cut timbers, often in herb-covered places; sometimes on soil amongst grass. Europe, N. America, Australia [Qld, NSW, Vic, SA, WA] (Breitenbach & Kränzlin 1995; Phillips 1981; Shepherd & Totterdell 1988; Young, T. 1994).

PSILOCYBE [including some Hypholoma spp.]

(Agaricaceae/Strophariaceae)

Psilocybe acutipilea *(Speg.) Guzmán*

P. angustipleurocystidiata *Guzmán sp. nov.*

P. antioquensis *Guzmán et al.*

P. aquamarina *(Pegler) Guzmán* **(Stropharia aquamarina** *Pegler***)**

P. arcana *Borovicka et Hlavácek* **(P. cyanescens** *sensu Hlavácek, non Wakefield***)**

P. argentipes *Yokoyama* – hikageshibiretake

P. armandii *Guzmán et Pollock*

P. atlantis *Guzmán et al.*

P. atrobrunnea *(Lasch.) Gillet*

P. aucklandii *Guzmán, King et Bandala* – Auckland Psilocybe, King's Psilocybe

P. australiana *Guzmán et Watling*

P. aztecorum var. aztecorum *Heim emend. Guzmán* – niños, niñitos, apipiltzin ('little children'), niños del agua ('children of the water'), dormilon

P. aztecorum var. bonetii *Guzmán* **(P. bonetii** *Guzmán***)** – niñitos, apipiltzin, dormilon

P. azurescens *Stamets et Gartz* – astoriensis, indigo Psilocybe, flying saucer mushroom

P. baeocystis *Singer et Smith* – baeos, knobbly tops

P. banderillensis *Guzmán*

P. barrerae *Cifuentes et Guzmán*

P. bohemica *Šebek* **(P. coprinifacies** *(Roll.) Pouzar***; P. cyanescens** *sensu A. Pilát, non Wakefield***; P. mairei** *sensu J. Kubicka, non Singer***; Hypholoma cyanescens** *Maire sensu J. Charvát et al.***; H. coprinifacies** *Roll. sensu Herink***; H. worthingtonii** *Fr. sensu K. Kavina***)** – Bohemian Psilocybe

P. brasiliensis *Guzmán*

P. brunneocystidiata *Guzmán et Horak*

P. caerulea *(Kriesl) Noordeloos* **(Stropharia caerulea** *Kriesl***; S. cyanea** *(Bolt. ex Secr.) Tuomikoski***)**

P. caeruleoannulata *Sing. ex Guzmán*

P. caerulescens var. caerulescens *Murrill* **(P. caerulescens var. mazatecorum** *Heim***)** – derrumbes ('landslide'), derrumbe de agua, tsamikishu ('landslide mushroom'), 'nti xi tho ('dear little things that spring forth'), 'nti-xi-tjo-qui-xo, ko:ng ('lord governor'), cañadas, razón-bei, teotlaquilnanácatl ('divine mushrooms that describe or paint')

P. caerulescens var. ombrophila *(Heim) Guzmán, stat nov.* **(P. mixaeensis** *Heim***)** – at-kat, kongk, kee sho, cui-ya-jo-o-su, derrumbe negro, nashwinmush

P. caerulipes *(Peck) Saccardo* – blue foot

P. callosa *(Fr. ex Fr.) Quelet sensu auct., sensu Guzmán* **(P. cookei** *Sing.***; P. semilanceata var. caerulescens** *(Cke.) Sacc.***, var. obtusa** *Bon.* and **var. microspora** *Sing.***; P. strictipes** *Sing. et Smith***)**

P. carbonaria *Sing.*

P. chiapanensis *Guzmán*

P. collybioides *Sing. et Smith*

P. columbiana *Guzmán*

P. coprophila *(Bull. ex Fries) Kummer* **(P. mutans** *McKnight***)**

P. cordispora *Heim* – pi-'tpa ('spindle whorl'), 'ene ti'ic ('thunder's teeth'), atka't, derrumbe negro, dulces clavitos del Señor, nashwinmush

P. crobula *(Fries) Kuhner et Romagnesi* **(P. inquilina var. crobula** *(Fr.) Holland***; P. simulans** *Karst.***; Geophila crobula** *(Fr.) Kuhner et Rom.***)**

P. cubensis *(Earle) Singer* **(P. cubensis var. caerulescens** *(Murr.) Sing. et Smith***; Stropharia cubensis** *Earle***; S. cyanescens** *Murr.***; S. caerulescens** *(Pat.) Sing.***; Naematoloma caerulescens** *Pat.***)** – gold tops, gold caps, cubies, San Insidro, San Insidro Labrador, purple ring, hongos kentesh, di-shi-tjo-le-ra-ja, derrumbe del estiércol de vaca, di-shi-thó-le-nraja, nti-si-tho-yele-nraha, nti-xi-tjole-ncha-ja

P. cyanescens *(Maire) Wakefield* **(Hypholoma cyanescens** *Maire***)** – blue halos, cyans, wavy-caps, Grandote

P. cyanofibrillosa *Stamets et Guzmán* **(P. rhododendronensis** *Stamets nom. prov.***)** – Rhododendron Psilocybe, blue-haired Psilocybe

P. dumontii *Sing. ex Guzmán*

P. eucalypta *Guzmán et Watling* – Eucalyptus Psilocybe

P. fagicola *Heim et Cailleux* – senores principales

P. fagicola var. mesocystidiata *Guzmán*

P. farinacea *Rick ex Guzmán* **(P. albofimbriata** *(Rick) Singer***)**

P. fimetaria *(Orton) Watling* **(P. caesioannulata** *Sing.***; Stropharia fimetaria** *Orton***)**

P. fuliginosa *(Murr.) Smith*

P. furtadoana *Guzmán*

P. galindii *Guzmán*

P. gigaspora *Natarajan et Raman* **(Hypholoma gigaspora** *(Nataraj. et Ram.) Guzmán***; Naematoloma gigaspora** *(Nataraj. et Ram.) Guzmán***)**

P. goniospora *(Berk. et Broome) Sing.* **(P. lonchocarpa** *(Berk. et Broome) Horak ex Guzmán***)**

P. graveolens *Peck*

P. guatapensis *Guzmán et al.*

P. guilartensis *Guzmán et al.*

P. guzmanii *Natarajan et Raman* **(Hypholoma guzmanii** *(Nataraj. et Ram.) Guzmán***; Naematoloma guzmanii** *(Nataraj. et Ram.) Guzmán***)**

P. heimii *Guzmán* – derrumbe negro, pajarito de monte ('little bird of forest')

P. heliconiae *Guzmán et al.*

P. herrerae *Guzmán*

P. hispanica *Guzmán*

P. hooshagenii var. hoogshagenii *Heim sensu lato* **(P. caerulipes var. gastonii** *Sing.***)** – atka:t ('judge'), cihuatsinsintle, pajaritos de monte ('little birds of the woods')

P. hoogshagenii *Heim* **var. convexa** *Guzmán* **(P. semperviva** *Heim et Call.***)** – teotlaquilnanácatl
P. inconspicua *Guzmán et Horak*
P. indica *Sathe et Daniel*
P. isabelae *Guzmán*
P. jacobsii *Guzmán*
P. jaliscana *Guzmán*
P. kumaenorum *Heim* – koull tourroum, koobl tourrum
P. laurae *Guzmán*
P. liniformans *Guzmán et Bas* – blunted grassland Psilocybe
P. liniformans var. americana *Guzmán et Stamets*
P. lonchophorus *(B. et Br.) Horak ex Guzmán, comb. nov.*
P. mairei *Singer* **(P. maire** *Sing. sensu Guzmán***; Geophila cyanescens** *(Maire) Kühner et Romagn.***)**
P. makarorae *Johnston et Buch.*
P. mammillata *(Murr.) Smith*
P. meridensis *Guzmán*
P. mexicana *Heim* – nize ('little birds'), angelito, pajarito, pajaritos, chamaquillos, di-nize, di-shi-tho-nize, cui-jajo-o-ki, 'nti-xi-tjo-qui-zo, pi-'tpa, 'ene ti'ic, piule de churis, amokia, a-mokya, a-mo-kid, a-ni, at-kat, ma-nadje-zuhe, mbey-sant, nashwinmash, ndi-shi-tjo-ni-se, si-thoh, steyi, hongo santo de las praderas, teotlaquilnanácatl
P. moravica *Borovicka* – Moravian Psilocybe
P. moseri *Guzmán*
P. naematoliformis *Guzmán* **(Hypholoma naematoliformis** *(Guzmán) Guzmán***; Naematoloma naematoliformis** *(Guzmán) Guzmán***)**
P. natalensis *Gartz, Reid, Smith et Eicker*
P. natarajanii *Guzmán sensu Natarajan et Raman* **(P. aztecorum var. bononi** *Guzmán***)**
P. neocaledonica *Guzmán et Hora* **(Hypholoma neocaledonica** *(Guzmán et Hora) Guzmán***; Naematoloma neocaledonica** *(Guzmán et Hora) Guzmán***)**
P. novae-zealandiae *Guzmán et Horak*
P. ochreata *(Berk. et Broome) Horak ex Guzmán, comb. nov.*
P. papuana *Guzmán et Horak*
P. paulensis *(Guzmán et Bononi) Guzmán* **(P. banderillensis var. paulensis** *Guzmán et Bononi***)**
P. pelliculosa *(Smith) Sing et Smith*
P. pericystis *Singer*
P. pintonii *Guzmán*
P. pleurocystidiosa *Guzmán sp. nov.*
P. plutonia *(Berk. et M.A. Curtis) Sacc.*
P. portoricensis *Guzmán et al.*
P. pseudoaztecorum *Natarajan et Raman*
P. pseudobullacea *(Petch) Pegler*
P. puberula *Bas et Noordel.*
P. quebecensis *Ola'h et Heim*
P. ramulosa *(Guzmán et Bononi) Guzmán* **(P. zapotecorum var. ramulosum** *Guzmán et Bononi***)**
P. rostrata *(Petch) Pegler*
P. rzedowskii *Guzmán*
P. samuiensis *Guzmán, Allen et Merlin*
P. sanctorum *Guzmán*
P. schultesii *Guzmán et Poll.*
P. semiglobata *(Batsch ex Fries) Noord.* **(Stropharia semiglobata** *(Fr.) Quelet***)**
P. semilanceata *(Fr.) Kummer* – liberty caps, sandy sagerose
P. septentrionalis *(Guzmán) Guzmán* **(P. subaeruginascens** *Höhn.* **var. septentrionalis** *Guzmán***)**
P. serbica *Moser et Horak*
P. silvatica *(Peck) Sing. et Smith*
P. singerii *Guzmán*
P. stuntzii *Guzmán et Ott* **(P. pugetensis** *Harris***)** – Stuntz's Psilocybe, Stuntz's blue legs, blue ringers, blue veil
P. subacutipilea *Guzmán et al.*
P. subaeruginascens *Höhnel* **(P. aerugineomaculans** *(Höhn.) Sing. et Smith***)**
P. subaeruginosa *Cleland* – gold tops, goldies
P. subcaerulipes *Hongo* – aizomeshibafutake
P. subcubensis *Guzmán* – gold tops, San Insidro, San Insidro Labrador, derrumbe del estiércol de vaca, di-shi-thó-le-nraja, nti-si-tho-yele-nraha, nti-xi-tjole-ncha-ja, suntiama
P. subfimetaria *Guzmán et Smith* **(P. sierrae** *Singer***)**
P. subtropicalis *Guzmán*
P. subyungensis *Guzmán*
P. subzapotecorum *Guzmán*
P. tampanensis *Guzmán et Pollock* – Tampa Psilocybe, Pollock's Psilocybe; sclerotia called 'cosmic comote' or 'New Age philosopher's stone'
P. tasmaniana *Guzmán et Watling*
P. thailandensis *Guzmán et Allen*
P. uruguayensis *Sing. ex Guzmán*
P. uxpanapensis *Guzmán*
P. venenata *(Imai) Imazecki* **(P. fasciata** *Hongo***; Stropharia caerulescens** *S. Imai***)** – 'false deadly Psilocybe', bamboo Psilocybe, shibiretake ('benumbing mushroom')
P. veraecrucis *Guzmán et Perez-Ortiz*
P. villarrealii *Guzmán*
P. wassonii *Heim* **(P. mulliericula** *Sing. et Smith***; P. mexicana var. brevispora** *Heim***)** – cihuatsinsintle, mujercitas, nano-catsintli, netochhuatata, niñas, niño, santitos, siwatsitsintli
P. wassoniorum *Guzmán et Poll.* – Wasson's mushroom, niños, mujercitas
P. weilii *Guzmán, Stamets et Tapia*
P. weldenii *Guzmán*
P. wrightii *Guzmán*
P. xalapensis *Guzmán et Lopez*
P. yungensis *Sing. et Smith* **(P. acutissima** *Heim***; P. isauri** *Sing.***)** – hongo adivinador ('divinatory mushroom'), hongo genio ('genius mushroom'), hongo que adormece, atka:t, pi-'tpa, derrumbe negro, pajarito de monte, di-shi-tjo-leta-ja, di-nezé-ta-a-ya
P. zapotecorum *Heim emend Guzmán* **(P. candidipes** *Sing. et Smith***)** – badao zoo, badoo bei, be-meeche, beya zoo, bi neechi, cui-ya-jo-o-tno ('large sacred mushroom'), derrumbes, derrumbe de agua, derrumbe negro, di-nize-taa-ya, zapos, hongo de la razón, honguito adivinador, nche-je-nche-je, piule de barda, piule de churis, cañadas, corona de cristo, mbey sant, razón-bei, razón viejo, reje
Psilocybe spp. – teonanácatl ('divine mushroom'), xochinanácatl ('flower mushroom'), piule, magic mushrooms, 'shrooms, mushies, paddos, hongos, phak shyamu, tephkak

also including:

Hypholoma aurantiaca *(Cooke) Faus* **(Agaricus ceres** *Cooke et Mass.***; Leratiomyces ceres** *(Cooke et Mass.) Spooner et Bridge***; Naematoloma aurantiaca** *(Cooke) Guzmán***; Psilocybe ceres** *(Cooke et Mass.) Sacc.***; Stropharia aurantiaca** *(Cooke) Orton***)** – redlead roundhead, orangerote träuschling
Hypholoma popperianum *(Singer) Guzmán* **(Naematoloma popperianum** *Singer***)**
Hypholoma rhombispora *(Guzmán) Guzmán* **(Naematoloma rhombispora** *Guzmán***)**

Psilocybe spp. have long been a respected shamanic ally amongst native peoples of southern Mexico. What is believed to be caps of P. aztecorum in profile have been observed on the statue of the Aztec deity Xochipilli [see **Turbina**] (Wasson 1973). Their use was first noted by Aztec priests, and after centuries of the practice being driven underground by Spanish Catholicism [post-conquest], their use by the Mazatec and others was rediscovered in Oaxaca, Mexico earlier last century. Healers there have been recorded to utilise P. aztecorum, P. caerulescens, P. caerulescens var. ombrophila, P. caerulipes, P. cordispora, P. cubensis, P. fagicola, P. hoogshagenii, P. hoogshagenii var. convexa, P. mexicana, P. wassonii, P. yungensis and P. zapotecorum [see also **Conocybe**, **Panaeolus** and **Psathyrella**]. For divination on illness or other problems, the mushrooms are eaten raw, sometimes washed down with a few sips of water. Dosage amongst the Mixe is 7 pairs of mushrooms for women, and 9 pairs for men. P. caerulescens is reserved only for elders, as it is considered too strong for others. The mushrooms are taken at night in seclusion, away from distracting sounds and interruptions (Heim 1959, 1963b; Heim & Cailleux 1959; Lipp 1990; Rubel & Gettelfinger-Krejci 1976; Schultes & Hofmann 1980, 1992; Singer 1958a; Wasson 1961, 1963).

Since their introduction to the outside world, some indigenous users of the mushrooms have suffered a variety of troubles, including incarceration [in the case of Maria Sabina, who first revealed the extant mushroom ceremony to Gordon Wasson], related to the influx of 'mushroom tourists' looking for an exotic trip (Ott 1993); hence, it is advised that people stick to searching for Psilocybe spp. in their own area. A piece of Maria's advice is also appropriate here – "whoever does it [eat mushrooms] simply to feel the effects can go crazy and stay that way temporarily, but only for a while" (Allen 1997b). Today, shamanic use of the mushrooms is reportedly dying out in Oaxaca, and the fungi are instead being sold to tourists as a source of income. Near San Pedro Nexapa [State of Mexico], P. aztecorum var. aztecorum and var. bonetii are sold in such a way, as 'niños', 'niños de las aguas' or 'apipiltzin' (Guzmán 1978). Around Palenque [State of Chiapas], P. cubensis is sold to tourists as 'hongos' (pers. obs.), a practice likely to occur elsewhere in Mexico, also. In Guatemala, P. mexicana has been found for sale to tourists by native children (Lowy 1977).

P. cubensis and P. subcubensis are also common, and sometimes consumed or sold to tourists, in S. America. In Peru, P. semilanceata and **Copelandia** cyanescens [see **Panaeolus**] are used (Allen & Gartz 1997). P. subcubensis is used 'recreationally' in the Venezuelan Andes, Merida State (Marcano et al. 1994), and Psilocybe spp. are known to sometimes be used shamanically in Iquitos (Trout ed. 1998). P. yungensis has been proposed to have been used in the preparation of a psychotropic drink in Peru [see **Gymnopilus** for full discussion] (Schultes 1967a).

A Psilocybe sp. [called 'nemeyaap'] that is probably P. kumaenorum is eaten raw by senior ritual elders of the Bimin-Kuskusmin of Papua

New Guinea, during the 12th [and highest] stage of initiation, along with a **Boletus** sp. called 'guukhraan', and many other plants [including **Pandanus** nuts, Lithocarpus sp. nuts, **Castanopsis** nuts, **Galbulimima** leaf and bark, **Kaempferia** rhizome] and skin of a frog [Phyrnomantis lateralis – see *Endnotes*]. This Psilocybe is considered very powerful, and is said to be poisonous if used outside of this ritual context (Poole 1987).

In some parts of s.e. Asia and the Pacific Islands [Philippines, Thailand, Sumatra, Java, Bali, Fiji] Psilocybe spp. are both collected wild and/or cultivated in dung [usually of the cattle Bos indicus, B. guarus and B. sundaicus, and water buffalo Bubalus bubalis] for local consumption, but more often, for sale to tourists. They may be sold as is, or prepared into drinks, soups, omelettes and other meals from many restaurants. The Psilocybe spp. involved are usually P. cubensis, P. subcubensis and P. samuiensis – this latter sp. does not grow directly on dung, but on manured soil [see also **Panaeolus**, **Copelandia**]. In Java, only P. subaeruginascens and **Copelandia** cyanescens have been recorded (Allen & Gartz 1997; Allen & Merlin 1992; Gartz et al. 1994).

The properties of local active Psilocybe spp. are known to some in India today, such as in the Palni Hills, where they have been secretively sold to westerners (Gorman 1995). Their use is also quite prominent in Goa [non-traditionally, mostly in connection with the rave scene there], also occurring in Nepal. Again, they are generally sold to tourists, rather than used by the native populace, with some exceptions. The following visionary species have been recorded from India – P. atrobrunnea [Bhubaneshwar], P. aztecorum var. aztecorum, P. cubensis, P. gigaspora, P. indica [Kerala], P. natarajanii, P. pseudoaztecorum [Madras], P. semilanceata [Pune] and P. subcubensis [see also **Panaeolus**, **Copelandia** and **Inocybe**]. P. cubensis and P. subcubensis are also found in Nepal, and Sri Lanka is home to P. goniospora, P. lonchophorus and P. ochreata. Another unidentified species found in Nepal is very similar to P. cubensis and P. subcubensis, but its spores are intermediate in size; it has been proven to be active by psychonauts of N. American origin (Allen & Gartz 1997; Schroeder & Guzmán 1981). It has been proposed that a Psilocybe sp. such as P. cubensis may have been used as 'soma' by the ancient Hindu Vedists [see **Amanita**] (Ott 1998b). Psilocybe spp. are used by Nepalese shamans for shamanic travel, and as a form of 'amrita'. For this, a handful of mushrooms is roasted with salt before consumption. They are sometimes snuffed with other plants, mixed with dampened lime; other ingredients may include **Cannabis**, **Nicotiana**, **Datura** seeds and **Amanita** pantherina (Müller-Ebeling et al. 2002).

Psychedelic inebriations from accidental [mistaken identity] ingestion of P. argentipes have been recorded in Japan (Koike et al. 1981; Musha et al. 1986). In St Petersburg, Russia, P. semilanceata is known to be consumed "by students and actors" (Gurevich 1995). In the Pacific n.w. US, a number of species have been used by locals in the know since at least the late 1960's, including P. baeocystis, P. cyanescens, P. pelliculosa, P. semilanceata and P. stuntzii. Also to be found in this area, but perhaps not as commonly consumed, are P. callosa, P. cyanofibrillosa, P. fimetaria, P. liniformans var. americana, P. silvatica and P. subfimetaria. A recently discovered species [P. azurescens], which is exceptionally potent, has also begun to be collected and consumed, as well as cultivated, in this area. P. cubensis is more commonly used in the southern states (Allen 1997a; Beug & Bigwood 1982; Guzmán et al. 1976; Stamets & Gartz 1995; Weil 1977b; pers. comms.).

In the British Isles and Europe, Psilocybe spp. have been consumed for psychotropic effects since at least the mid 1970's, probably earlier. The most popular has long been the common P. semilanceata, though P. cyanescens, P. bohemica and some **Inocybe** and **Panaeolus** mushrooms have also been so used (Cooper 1977; Gartz 1996; Hyde et al. 1978; Mills et al. 1979; Peden et al. 1981; pers. comms.). Although the possible historic use of **Psilocybe** in Europe is unknown, P. semilanceata is thought to be represented on magical amulets of the 15th and 17th centuries from Spain (Gari 1991).

Australians have also been discovering their local Psilocybe spp. since at least the late 1960's, reputedly first by 'biker-surfer types' (Allen 1998; McCarthy 1971; Southcott 1974). However, the properties of P. cubensis were known in Australia since at least the late 1950's, through unintentional intoxications (Aberdeen & Jones 1958; Cribb & Cribb 1981; Southcott 1974). Nowadays the use of these fungi is relatively scattered in Australia, as many casual LSD-users or drug-naïve persons have consumed them in ignorance, excess and unsuitable settings, spreading fearful and misguided notions about the states they induce. In e. South Australia, Victoria, s. New South Wales and Tasmania the species used are P. australiana, P. eucalypta and P. subaeruginosa. It is possible that P. collyboides and P. tasmaniana have also been used [the former being a dubious identification, made from "specimens collected by police from a fridge in Tasmania" – this species is otherwise not recorded in Australia], as well as several collections that macroscopically do not seem to match with any known species. Usually, however, mushroom users in Australia are unaware of the Latin identity of their fungi, particularly as P. australiana, P. eucalypta and P. subaeruginosa can often be fairly indistinguishable macroscopically [except perhaps to the expert, and there seem to be few true 'experts' in Australian mycology when it comes to this genus]. The common terms 'gold tops' and 'blue meanies' [the latter referring also to some **Panaeolus** and **Copelandia** mushrooms] are often interchanged at will, and applied broadly to any bluing mushroom with a yellowish or orange cap. Correctly, in northern areas, gold tops refers to P. cubensis and P. subcubensis; in southern areas, this term applies to the native Psilocybe spp. listed above. P. semilanceata has also been found in southern Australia, but is rarely used and does not seem to be common. In an isolated area of WA [Balingup], P. subaeruginosa has recently been found and used for visionary purposes [with extensive police interference]. In mid-north NSW as well as Qld and parts of the top end, P. cubensis and P. subcubensis grow on dung [often along with **Panaeolus** and **Copelandia**] and are not infrequently picked and consumed (pers. comms.; pers. obs.; Davis et al. 1978; Guzmán & Watling 1978; Low 1985; McCarthy 1971; Southcott 1974, 1996).

In New Zealand, patterns of mushroom use similar to those in Australia have been observed, with **Copelandia** cyanescens, Psilocybe aucklandii, P. makarorae, P. novae-zealandiae, P. semilanceata and P. subaeruginosa being consumed (pers. comms.; Johnston & Buchanan 1995).

It has been speculated whether Australia's indigenous inhabitants made use of their psychoactive mycoflora – most Australian ethnobotanists will flatly state that the answer is "no, they didn't!" (eg. Low 1985). With a more realistic approach to the scenario, it would be expected that any existing knowledge of such use would not be imparted to researchers, because if it existed, it would be considered extremely sacred and secret, and thus not to be discussed with outsiders or non-initiates (pers. obs.). At any rate, many aboriginal tribes associated fungi of various types with 'mystical' properties. For example, in parts of Central Australia "the Arunta believe that [some] mushrooms and toadstools are fallen stars, and look upon them as being endowed with arungquiltha ['evil magic'], and therefore will not eat them." Apparently, fungi are also held in association with the dreaming and ancestral beings (Kalotas 1996).

In isolated experiments, species such as P. caerulescens, P. mexicana and P. cubensis have been consumed by westerners in the name of science well before the masses caught on (Heim et al. 1958; Hofmann et al. 1959; Stein 1960). Roger Heim reported fairly strong psychedelic effects from his separate experiments with P. caerulescens ['several pairs'], P. cubensis [5 fresh specimens, 120g w/w], P. mexicana [32 fresh specimens, 18g w/w] and P. aztecorum [amount not mentioned]; unfortunately, his eloquent expressions focussed on describing primarily visual and physiological effects, and did not mention the effects on his thought processes (Heim 1957). Sam Stein reported on his experiment with 5g dried P. cubensis [2 specimens], which resulted in a distressing experience (Stein 1958), possibly the first recorded 'freak-out' on mushrooms! As a comparative note of some Central American species, a Western case of administration of 1.5g P. caerulescens [fried in butter] resulted in psychedelic symptoms deemed by the subject as more 'hallucinogenic' and less pleasant than a similar amount of **Panaeolus** sphinctrinus (Stein 1959). Another administration of 1g oven-dried, powdered P. caerulescens caused intially a strong feeling of tiredness, followed by an increasing intoxication which the subject found more psychologically distressing than similar quantities of **Panaeolus** subbalteatus (Stein et al. 1959).

Thanks largely to the efforts of Oss & Oeric (1991), Paul Stamets and J.S. Chilton (1983, 1993) many species of Psilocybe are under cultivation by underground mycologists, including P. azurescens, P. cubensis, P. cyanescens and P. tampanensis. Until recently, various species of *psilocybin*-containing mushrooms [mostly cultivated] were readily and legally available for purchase from vendors in Japan (pers. comms.). In the Netherlands, a variety of species [including P. cubensis, P. mexicana, P. tampanensis and **Copelandia** cyanescens (see **Panaeolus, Copelandia**)] are cultivated in quantity and sold both fresh and dried in 'Smart Shops'. Care should be taken if purchasing fresh mushrooms, as these are often stored in refrigerators, sealed within plastic containers – thus, there is a slight risk of bacterial infection with poorly-stored batches (pers. obs.). One friend developed what appeared to be a severe liver dysfunction lasting several months after consumption of one batch of such commercially-available psychotropic fungi, although it is uncertain whether the mushrooms were responsible (pers. comm.).

Psilocybe spp. have been consumed in a variety of ways. Traditionally, they have often been crushed on a metate, with the juice collected and drunk straight, or mixed with water. Alternately, they may simply be chewed and swallowed [either fresh or dried]. This is not advisable with species growing from dung. When eaten, mushrooms should preferably not be swallowed as soon as they have been chewed. Continuing to chew them like a cud before swallowing or simply holding them in the mouth against the gums or under the tongue ensures some alkaloids are absorbed first orally, and may often result in a quicker onset of effects. There may be mild pangs of nausea when swallowing and while the effects take hold. The former is generally dealt with by washing down each mouthful with a slug of water, and avoiding much contact with taste buds when chewing. The latter may be relieved by chewing a piece of fresh ginger [see *Endnotes*] and controlled breathing. Today, many people prefer to make a mushroom infusion or decoction. Slight acidification of the water used [eg. with lemon juice] will enhance the efficiency of the extraction. Long

boiling times or high temperatures are not necessary and may serve to degrade some of the alkaloids present. The gentlest way of preparing a liquid solution is to simply chop the mushrooms finely, put them in a teapot [with other herbs to taste, and lemon juice or citric acid], pour in some just-boiled water, and let the teapot [with lid on] sit for at least 30mins wrapped in a blanket to keep the heat in [a method suggested by Stamets (1996)]. This works well, and after drinking the strained brew, more boiling water can be added for a later boost if the initial tea was not sufficiently strong. Ginger, liquorice [see **Glycyrrhiza**], peppermint [see *Endnotes*] and honey blend nicely with such mushroom teas. Alternately, some people prefer to powder their dried mushrooms and ingest them in gelatin capsules (pers. comms.; pers. obs.).

These mushrooms contain as their main active chemicals the indole alkaloids *psilocybin* and *psilocin*, often with *baeocystin* and *norbaeocystin* also present. *Psilocin* is a product of the enzymatic de-phosphorylation of *psilocybin*. *Psilocybin* is quite stable, and whole, dried fungi can be kept at room temperature without much loss of alkaloid [freeze-dried fungi are more porous and their contained alkaloids will decompose more quickly at room temperature]. Exposure to light, as well as powdering mushrooms for storage, results in increased degradation of *psilocybin*, though with corresponding increases in *psilocin* content. Lower storage temperatures decrease the rate of degradation, and the best option would appear to be freezer storage of dried mushrooms in a totally airtight container. These fungi should never be dried with excessive heat [ie. not over 50°C].

Many active species exhibit a greenish-blue to vivid dark blue [even blackish] staining when bruised by handling, or ruptured by age or other natural phenomena. Some species exhibit this almost immediately upon handling, while some take several hours or more – also, some only blue on the stem or at the base of the stem, and some active species sometimes do not blue at all [such as many specimens of P. semilanceata]. Some mushrooms in other genera, such as **Boletus**, blue due to unrelated chemical reactions. In *psilocybin*-containing fungi, the staining appears to be due to a compound or compounds produced from the oxidation of the unstable *psilocin*. The exact chemical process occurring here has not yet been fully evaluated, nor have the pigments been identified. The blue pigment formed initially has been suggested to be the O-quinone of *psilocin*. Perkal (1981) suggested it be named psilocinchrome, analogous to the oxidative products of *epinephrine* and *dopamine* [*adrenochrome* and dopachrome, respectively]. This pigment, when observed spectrophotometrically, was seen to soon polymerise, forming what is probably a melanin pigment. Jochen Gartz has also "observed the bluing reaction following removal of the phosphate group from *baeocystin*". N-methyl-*psilocin* [4-OH-*N*-*methyltryptamine*] produces a green-blue pigment on oxidation (Gartz 1996; Hasler et al. 1997; Horita & Weber 1961; Levine 1967; Perkal 1981; Stamets 1996).

Recent phylogenetic research shows that Psilocybe spp. which produce *psilocybin* and/or *psilocin* are unrelated to those which do not. The former group will most likely be re-named as a separate genus, with Psychedelia spp. appearing to be the favoured option (Ivors pers. comms.; Moncalvo et al. 2002). This has provoked controversy in some circles, with the feeling that the proposed name is both unsubtle and inappropriate, and that it will most likely be used to aid in the prosecution of people in possession of such fungi. One scholar has suggested Sabina spp. as a more attractive alternative, in recognition of the famed shaman Maria Sabina (theobromus pers. comm.).

Dosage suggestions, when given below, refer to fresh mushrooms unless stated otherwise, and can only be considered as approximate guides, especially as mushrooms differ in size and potency. Yields are from dry weight, unless stated otherwise. These fungi have effects characteristic of *psilocybin* or *psilocin*, though users often distinguish between the minor subjective physiological effects of different species; thus, some users will prefer to use one species over another. In most countries, ingestion of mushrooms containing *psilocybin* and/or *psilocin* is illegal; in many countries, even harvesting them is seen as an illicit act. In Victoria, Australia, simple possession of 100mg of *psilocybin* or *psilocin* could be perceived as evidence of trafficking – ridiculous, as a bag of mushrooms from one collection, intended for use by a few friends, could easily contain these quantities of *psilocybin* and/or *psilocin*. Such a situation could be made more serious if prosecutors chose to interpret the weight of the mushrooms as being equivalent to the weight of the prohibited alkaloids. Such questionable reasoning has often been applied to LSD, with the weight of the carrier paper being included in the weight of a drug seizure – resulting in prosecutions for quantities of substance far higher than what was actually seized.

P. aeruginosa [Stropharia aeruginosa] has a brilliant blue colour with whitish undertones. It is suspected of being mildly active (Stamets 1996), and has also been reported to be toxic (Connor 1977). No *psilocybin* or *psilocin* have been found, though traces of *tryptophan* have been observed (Leung et al. 1965). Bioassays have been negative (Stamets 1996).

P. arcana from the Czech Republic is similar in some ways to P. bohemica, P. cyanescens, P. mairei, P. serbica (Borovicka & Hlavácek 2001a) and P. moravica (Borovicka 2003), and has been used as a psychotrope (Borovicka pers. comm. 2003). Czech specimens have yielded 0.01-1.15% *psilocybin* and 0.03-0.85% *psilocin* (Stríbrný et al. 2003). Unpublished analysis of unidentified mushroom specimens from Graz, Austria [initially tentatively identified as P. arcana] found 0.13-1.31% *psilocybin* and 0.28-1.76% *psilocin*, making this one of the most potent 'psilocybian' mushrooms in the world [though see P. moravica below]. However these Austrian mushrooms are now believed to represent a species other than P. arcana, possibly a new or little-known one (Anno pers. comm. 2003; Borovicka pers. comm. 2003). P. arcana differs from P. bohemica in having non-decurrent gills, smaller spores and a yellowish-olive coloured cap when dry; it differs from P. serbica in its non-striate cap margin, shorter-necked cheilocystidia and apparent lack of pleurocystidia (Borovicka & Hlavácek 2001a); it differs from P. moravica with its often umbonate cap without greyish tones, its flattened and unmottled stem usually becoming broader upwards, olive-green tones in the bruising reaction, lack of a well developed fibrillose annular zone on the stem, smaller spores and sterigmata, and virtually absent pleurocystidia (Borovicka 2003).

P. argentipes from Japan has yielded 0.002-1.35% *psilocybin* (Koike et al. 1981; Kusano et al. 1986). Musha et al. (1986) wrote that "from our cases it may be said that three specimens [about 1g dry weight] are the suggested dosage to cause poisoning"!

P. atrobrunnea [from e. US, and c. & n. Europe], a non-bluing species, was reported to be *psilocybin*-active on account of a positive bioassay in Norway, though the Norwegian specimens were noted by Guzmán to be closer to P. serbica or P. callosa [but with cheilocystidia of a different size] than to P. atrobrunnea (Guzmán 1983; Stamets 1996). In general this is not considered a psychoactive species (Guzmán et al. 2000), and no *psilocybin* or *psilocin* were found in one analysis of material from Michigan (Leung et al. 1965).

P. aucklandii, growing around Auckland, New Zealand, is known to be moderately active, and the police there are well-aware of its use and habitat, taking advantage of this to make arrests (Guzmán et al. 1993; Stamets 1996; pers. comm.). It contains *psilocin* and *psilocybin* (Johnston & Buchanan 1995).

P. australiana from s. NSW, Victoria and Tasmania [Australia; often in woodchipped garden beds, looks very similar to P. cyanescens] is known to be moderately to strongly active (pers. comms.; pers. obs.), though one study found no indoles in a c.7 year-old collection from Mt. Wilson, near Sydney (Margot & Watling 1981). From limited experience this species seems to lose hardly any potency on careful drying (pers. obs.). It has also been found in New Zealand [near Oratia, 20km west of Auckland] (Guzmán et al. 1993).

P. aztecorum from c. Mexico yielded only 0.2% *psilocybin* and traces of *psilocin* [from 2-yr old samples], but fresh specimens are potent and strongly bluing (Heim & Hofmann 1958; Hofmann et al. 1959; Stamets 1996). P. aztecorum var. bonetii has also yielded *psilocybin* (Ott & Guzmán 1976).

P. azurescens from n.w. US has yielded 1.17-1.78% *psilocybin*, 0.19-0.42% *psilocin* and 0.19-0.41% *baeocystin*; it bruises very strongly, becoming indigo-black in places. It can be cultivated in wood chips and tall grass (Stamets 1996; Stamets & Gartz 1995) and is very potent, with 1-4 specimens constituting an effective dose (Allen 1997a).

P. baeocystis was shown to contain *psilocin*, and traces of *psilocybin* and *tryptophan* (Leung et al. 1965); this species later yielded 0.15-0.85% *psilocybin*, 0-0.59% *psilocin* (Beug & Bigwood 1982), 0.01-0.1% *baeocystin* and 0.0068-0.0086% *norbaeocystin*, and was tentatively observed to contain 4-OH-*tryptamine* (Leung & Paul 1968; Repke et al. 1977). Some internet sources have claimed the detection of traces of many other indole substances in liquid cultures of this mushroom, including *gramine*, indole, *tryptophan*, N-methyltryptophan, 5-methyltryptophan, *5-hydroxytryptophan*, *tryptamine*, *serotonin* creatine sulfate, *DMT* hydrogen-oxalate, *bufotenine* monooxalate, 5-MeO-2-carboxyindole, 3-indoleacetic acid and many other derivatives. However, this is a misinterpretation of Leung et al. (1965), who gave a table of TLC data for the detection of these compounds, but did not report finding them in the fungi analysed (pers. obs.). *DMT* has only been found in Psilocybe spp. which have been artificially fed this alkaloid in the laboratory, though it is a poor metabolic precursor for *psilocybin* and/or *psilocin*, which normally derive from *tryptamine* (Chilton et al. 1979). From 1-4 specimens are said to constitute an active dose (Allen 1997a). This species was once reported to have caused fatal intoxication in a young child, however it has been established that the identification of the mushroom/s responsible was selective and arbitrary - the extent of the 'science' used in this case being that this species was found in the garden where the child lived, but so were other mushroom species, which were ignored by the investigators; there was no evidence that the girl had ingested any Psilocybe. Also, the identity of the Psilocybe sp. in the garden is doubted because the photo used in the journal report seemed to depict P. cyanescens. On top of this, the symptoms observed before the child died 3 days later were consistent with poisoning from toxins found in some **Amanita** and Galerina spp. (Stamets 1996).

P. bohemica from Europe yielded 0.25-1.14% *psilocybin*, 0-0.07% *psilocin* and 0.01-0.03% *baeocystin* (Semerdzieva et al. 1986; Stijve & Kuyper 1985). Czech samples have yielded 0.11-1.34% *psilocybin*, 0-1.27% *psilocin* and 0.008-0.03% *baeocystin*; caps yielded 0.31-1.02% *psilocybin*, 0-

0.05% *psilocin*, and 0.02-0.03% *baeocystin*; stems yielded 0.14-0.54% *psilocybin*, 0-0.07% *psilocin* and 0.01-0.02% *baeocystin*. Highest *psilocybin* levels were usually found in smaller specimens. Cultivated mycelium was shown to contain 0.15-0.21% *psilocybin*, but no other alkaloids were detected (Borovicka & Hlavácek 2001b; Gartz & Müller 1989; Stríbrný et al. 2003; Wurst et al. 1984, 1992). Some European mycologists believe P. bohemica is synonymous with P. cyanescens. It appears to be a separate species, as Gartz demonstrated reproductive barriers between them (Stamets 1996). It also differs from the similar P. moravica with its lack of greyish tones in the cap, relatively narrow and subdecurrent gills, and narrower spores (Borovicka 2003). It can be cultivated in the same way as P. cyanescens and P. azurescens (Gartz & Müller 1989; Stamets 1996).

P. brasiliensis from Brazil is presumed to be active due to its bluing reaction (Guzmán 1983).

P. caerulea from Europe and n.w. US is closely related to P. aeruginosa, but exhibits a more distinct bluing reaction, rather than just a bluish colour, and is presumed to be active (Stamets 1996).

P. caeruleoannulata from Brazil yielded 0.055-0.3% *psilocybin* and 0.2-0.23% *psilocin* (Stijve & de Meijer 1993).

P. caerulescens from Mexico yielded only 0.2% *psilocybin* and no *psilocin* [from aged specimens] (Heim & Hofmann 1958; Hofmann et al. 1959); Brazilian specimens yielded 0.1-0.22% *psilocybin* and 0-0.25% *psilocin* (Stijve & de Meijer 1993). Fresh specimens are moderately to highly active; this species is very bitter. Also found in Venezuela, and once reported from Alabama, though it has not been found there since (Stamets 1996; Stein et al. 1959). P. caerulescens var. ombrophila is known to be active (Ott 1993).

P. caerulipes has been found to contain *psilocybin* and *psilocin* (Leung et al. 1965), and is moderately active (Stamets 1996).

P. callosa from Scotland tested positive for the presence of *psilocybin* (Benedict et al. 1967), as did specimens from other countries. It is found in n.w. US, n. & c. Europe, Siberia and Chile, and is moderately active (Guzmán 1983; Leung et al. 1965; Stamets 1996), with 20-30 specimens constituting a dose (Allen 1997a).

P. collyboides found in a freezer in Tasmania [Australia] has yielded *psilocybin*, but identification of the specimen may have been in error (Guzmán 1983; Southcott 1974).

P. coprophila from Japan yielded 0.08-0.15% *psilocybin* (Kusano et al. 1986); specimens from Europe yielded over 0.1% of an unknown indole compound, but no *psilocybin*, *psilocin* or *baeocystin* (Margot & Watling 1981); Brazilian specimens contained no *psilocybin*, *psilocin* or *serotonin* (Stijve & de Meijer 1993); and specimens from Pacific n.w. US contained no *psilocybin* or *psilocin* either (Beug & Bigwood 1982). Others have occasionally found it to be weakly psychoactive, but losing potency soon after picking (Cooper 1977; Stamets 1996).

P. cordispora is known to be active, but has not been analysed (Guzmán 1983).

P. crobula from n.w. US, Europe and Russia is said to be active, but many have failed to isolate any active tryptamines; it also resembles the deadly Galerina spp. [see *Endnotes*] (Stamets 1996).

P. cubensis is widespread on dung [of cattle, oxen, yaks, water buffalo, horse and elephant] in tropical and semitropical zones worldwide [although oddly, P. cubensis has reportedly been found in Tasmania (Australia) by amateur mycologists, and spores reputed to be from this strain are commercially available] and is extensively cultivated by underground growers in some countries. Strains are of quite variable potency, and 0.2-1.3% *psilocybin* and traces-over 0.35% *psilocin* have been detected (Heim & Hofmann 1958; Hofmann et al. 1959; Stamets & Chilton 1983; Stamets 1996). Samples growing on buffalo dung in Koh Samui, Thailand, yielded 0.042-0.08% *psilocybin*, 0.19-0.58% *psilocin*, less than 0.01% *baeocystin*, 0.007-0.02% *tryptamine* and up to 0.003% urea (Allen & Merlin 1992); others found 0.001-0.01% *baeocystin* (Repke et al. 1977). There is usually more *psilocin* in the stems than in caps (Gartz et al. 1994). Wild Brazilian specimens yielded 0.1-0.36% *psilocybin*, 0.2-0.6% *psilocin* and 0-0.025% *baeocystin*. A cultivated Amazon strain yielded 0.12-0.15% *psilocybin* and 0.1-0.33% *psilocin*; a cultivated Mexican strain yielded 0.12-0.15% *psilocybin* and 0.05-0.5% *psilocin* (Stijve & de Meijer 1993). Specimens cultivated on rice grains yielded 0.95% *psilocybin* and 0.2% *psilocin* (Gartz 1989c). Mycelium has yielded 0.3% *psilocybin* and 0.1% *psilocin* (Gartz 1990a). In submerged culture, up to 1.06% *psilocybin* was produced, but no *psilocin* (Catalfomo & Tyler 1964); saprophytic mycelial cultures yielded up to 0.2% *psilocybin* and 0.02% *psilocin* (Neal et al. 1968). Mycelial cultures have been shown to metabolise tryptamines that are foreign to them, when introduced to the culture – addition of the potent synthetic psychedelic N,N-diethyltryptamine [DET] led to the formation of up to 3.3% 4-OH-DET and 0.01-0.8% 4-phosphoryloxy-DET in the fruiting bodies (Gartz 1989a). An extract of P. cubensis was shown to inhibit *glutamic acid* neurotransmission in rat hippocampus, resulting from activation of 5-HT receptors (Moldavan et al. 2002). The basidiospores have been shown to cause allergic reactions in some people (Lehrer et al. 1994); the cyclophilin Psi c 2 is at least partly responsible for the allergenic activity (Horner et al. 1995).

P. cyanescens from Europe yielded 0.1-0.8% *psilocybin*, 0.04-0.47% *psilocin* and 0.01-0.03% *baeocystin* (Stijve & Kuyper 1985; Wurst et al. 1992); specimens from Czech Republic have yielded 0.13-1.84% *psilocybin* and 0.28-1.81% *psilocin* (Stríbrný et al. 2003); specimens from Sardinia [Italy] yielded 1.24% *psilocybin* and 0.72% *psilocin* (Ballero & Contu 1998). Specimens from the Pacific n.w. US have yielded 0-1.68% *psilocybin*, 0.06-0.96% *psilocin* (Beug & Bigwood 1982; Wurst et al. 1992), 0.004-0.04% *baeocystin* and [tentatively identified] 4-OH-*tryptamine* (Repke et al. 1977). Specimens from Seattle, Washington, also earlier tested positive for *psilocybin*, *psilocin*, and an unidentified compound (Benedict et al. 1962) which was probably *baeocystin*. It can be cultivated on wood chips (Stamets 1993, 1996; Unger & Cooks 1979). Mycelial culture grown on a medium of fallen vegetation from **Tilia**, Quercus, Picea, Pinus and/or **Urtica** yielded 0.35% *psilocybin* (Gartz 1990c). Addition of *tryptamine* to the growth medium can enhance *psilocybin*, *psilocin* and *baeocystin* production [this also works with **Inocybe**, **Pluteus** and **Panaeolus**]. Mycelium cultivated in such a fashion yielded 0.92% *psilocybin* and traces of *psilocin*, compared with unsupplemented mycelial cultures, which yielded 0.21% *psilocybin* and no detectable *psilocin* (Gartz 1990b). Saprophytic mycelial cultures have not yielded detectable levels of psychoactive indoles in other studies (Neal et al. 1968). From 1-3 specimens are said to constitute an active dose (Allen 1997a). Though usually restricted to the northern hemisphere (Guzmán 1983), its presence has been suspected in Australia. One collection of suspected P. cyanescens [growing in woodchips in Melbourne, Australia] was supplied to Gaston Guzmán, who identified the specimens as P. australiana, which is quite similar macroscopically (pers. obs.). P. cyanescens as described by Wakefield is now believed by many mycologists to be a N. American species which has spread to the U.K. and western Europe (Borovicka 2003).

P. cyanofibrillosa from coastal n.w. North America is strongly bluing, but loses most of its *psilocin* in handling; it has yielded up to 0.21% *psilocybin*, and 0.062% *psilocin* (Stamets 1996). Over 70% of the potency is lost after drying; 1-5 specimens may constitute an active dose (Allen 1997a).

P. eucalypta harvested in Talaganda Forest Res., NSW [Australia], was found to contain over 0.1% *psilocybin*, and similar amounts of an unknown indole [specimens about 7 years old] (Margot & Watling 1981); it has also been found in New Zealand [n.w. of New Plymouth] (Guzmán et al. 1993). This species is generally moderately potent (pers. obs.).

P. fimetaria from Scotland tested positive for *psilocybin* (Benedict et al. 1967); it is found in n.w. North America, Chile and Europe (Guzmán 1983). 15-30 specimens are said to constitute an active dose (Allen 1997a).

P. gigaspora [now considered Hypholoma gigaspora] has been shown to contain *psilocybin* and *psilocin*.

P. guzmanii [now considered Hypholoma guzmanii] has been shown to contain *psilocybin* and *psilocin* (Guzmán et al. 2000).

P. herrerae from Chiapas and Veracruz, Mexico, is strongly bluing, and presumed to be active (Guzmán 1983).

P. hoogshagenii is found in Oaxaca, Chiapas and Puebla, Mexico, as well as in Brazil and Colombia; it has yielded 0.15-0.3% *psilocybin*, 0.2-0.3% *psilocin* and 0-0.014% *baeocystin*. P. hoogshagenii var. convexa [which grows near Huautla de Jiménez, Mexico], as P. semperviva, yielded 0.6% *psilocybin* and 0.1% *psilocin* (Guzmán 1983; Heim & Hofmann 1958; Hofmann et al. 1959; Stijve & de Meijer 1993). This latter variant has also been shown, in culture form, to metabolise ergoline alkaloids which are not found in the fungus itself. When treated with *elymoclavine*, the mushroom culture hydroxylated the compound to form *penniclavine* and isopenniclavine; when *agroclavine* was used, *chanoclavine* and isochanoclavine resulted, via the same hydroxylation pathway (Brack et al. 1962).

P. inquilina [P. ecbola] from Europe yielded over 0.1% of an unknown indole, but no *psilocybin*, *psilocin* or *baeocystin* (Margot & Watling 1981); specimens from Pacific n.w. US also contained no *psilocybin* or *psilocin* (Beug & Bigwood 1982).

P. kumaenorum from Papua New Guinea and New Zealand is known to be active (Guzmán 1983).

P. liniformans from Europe yielded 0.16% *psilocybin* and 0.005% *baeocystin* (Stijve & Kuyper 1985); others found 0.59-0.89% *psilocybin* and no *psilocin* in var. americana [which grows in w. US and Chile] (Stamets 1996). 10-20 specimens of var. americana are said to constitute an active dose (Allen 1997a).

P. mairei from n. Africa is strongly bluing, and estimated to be moderately active (Stamets 1996). Specimens from Sardinia [Italy] were found to contain no detectable *psilocybin* or *psilocin* (Ballero & Contu 1998), though it is believed that European specimens identified as P. mairei are in fact P. serbica, and in some cases P. atrobrunnea (Guzmán 1983).

P. makarorae from New Zealand is strongly bluing and contains *psilocybin* and *psilocin* (Johnston & Buchanan 1995), though an earlier study [when this species was still unnamed] found no indole alkaloids in the collection examined. However, the collection was c.12 years old at the time of analysis, and the same study found no indoles in P. australiana and P. subaeruginosa (Margot & Watling 1981). See also the entries for those two species, and the comments for P. aucklandii.

P. mammillata from Florida [US], Jamaica, Mexico and Bolivia bruis-

es blue and is believed to be active (Guzmán 1983).

P. mexicana is found in subtropical Mexico and Guatemala; 0.2-0.4% *psilocybin* and 0.05% *psilocin* have been found in dried fruiting bodies; mycelium yielded 0.2-0.3% *psilocybin*, and traces or no *psilocin* (Guzmán 1983; Hofmann et al. 1958, 1959; Stein et al. 1959). Consumption of 0.5g of sclerotial mass was sufficient to produce the expected effects in one human bioassay (Heim et al. 1958).

P. montana [P. atrorufa] from Europe yielded no *psilocybin*, *psilocin* or *baeocystin*, but it gave over 0.1% of an unknown indole compound (Margot & Watling 1981); others found no indoles in specimens from the Venezuelan Andes (Marcano et al. 1994) or Pacific n.w. US (Beug & Bigwood 1982); some British strains are said to be weakly active (Cooper 1977). It is also found in Russia, Japan (Guzmán 1983) and Australia (May & Wood 1997).

P. moravica has recently been described from Moravia [Czech Republic], and fruits from late September to mid December [although some specimens have been found in late July]. This species is similar to P. arcana and P. bohemica. It has yielded 0.22-0.58% *psilocybin* and 0.61-1.39% *psilocin*, though specimens from lower altitudes yielded an extraordinary 2-2.95% *psilocybin* and 1.18-1.45% *psilocin* (Borovicka 2003).

P. naematoliformis [now considered Hypholoma naematoliformis] has been shown to contain *psilocybin* and *psilocin* (Guzmán et al. 2000).

P. natalensis from Natal, S. Africa bruises blue and is estimated to be moderately active; crude analysis revealed the presence of *psilocybin*, *psilocin* and *baeocystin* (Gartz et al. 1995).

P. neocaledonica [now considered Hypholoma neocaledonica] has been shown to contain *psilocybin* and *psilocin* (Guzmán et al. 2000).

P. novae-zealandiae from New Zealand has been said to be *psilocybin*-active (Ott 1993), though it does not bruise blue (Guzmán 1983; Johnston & Buchanan 1995), and others state it to be 'non-hallucinogenic' (Guzmán et al. 1993).

P. pelliculosa from Pacific n.w. US yielded 0.12-0.71% *psilocybin* (Beug & Bigwood 1982; Tyler 1961) and 0.006-0.05% *baeocystin* (Repke et al. 1977). 20-40 specimens are said to constitute an active dose (Allen 1997a).

P. pseudobullacea from the Venezuelan Andes contains mostly *psilocin*, with some *psilocybin* (Marcano et al. 1994). It is thought that the specimens used in this analysis might represent another species (Guzmán et al. 2000), as P. pseudobullacea is not known to bruise blue (Guzmán 1983).

P. quebecensis from Quebec has yielded *psilocybin* and *psilocin* (Ola'h & Heim 1967).

P. samuiensis from Koh Samui, Thailand yielded 0.23-0.9% *psilocybin*, 0.05-0.81% *psilocin* and 0.01-0.5% *baeocystin*; caps contained more *psilocybin* than stems. Cultivated on a mixture of rye, horse dung, and water, and cased with 2:1 peat/chalk, specimens yielded 0.36-0.73% *psilocybin*, 0.21-0.52% *psilocin* and 0.02-0.05% *baeocystin* (Gartz et al. 1994).

P. semiglobata, a common species in temperate regions long thought to be inactive, has recently been demonstrated to contain *psilocybin* in specimens from n. Italy (Calligaris 1996). Earlier analysis of material from Michigan did not detect any *psilocybin* or *psilocin* (Leung et al. 1965).

P. semilanceata from Norway yielded [w/w] 0.17-1.96% *psilocybin*, 0-0.002% *psilocin*, 0.05-0.34% *baeocystin*, and at least 3 unidentified compounds – smaller specimens had greater *psilocybin* concentration than larger specimens, and *baeocystin* was more concentrated in caps than stems (Christiansen & Rasmussen 1982, 1983; Christiansen et al. 1981a, 1981b, 1984). Finnish samples yielded 0.93-2.37% *psilocybin* [smaller mushrooms again yielding highest levels] and up to 0.02% *psilocin* (Gartz 1996; Jokiranta et al. 1984). Swiss specimens yielded 0.39-0.47% *psilocybin*, 0.088-0.14% *baeocystin* and no *psilocin* (Stijve & de Meijer 1993). German samples yielded 0.44-2.02% alkaloids, consisting of *psilocybin* [0.19-1.45%], *baeocystin* [0.02-0.42%] and no *psilocin*. As with other studies, smaller specimens contained greater concentrations of *psilocybin*, whilst larger specimens gave greater yields in mg per mushroom only because of their greater mass. Bluing was not observed to correlate with *psilocybin* concentrations (Gartz 1986a, 1991). Czechoslovakian samples have yielded 0.76-1.05% *psilocybin*, 0.09-0.12% *psilocin* [caps and stems of separate samples yielded 0.74-0.83%/0.08-0.68% and 0.33-0.45%/0.04-0.1% *psilocybin*/*psilocin*, respectively] (Wurst et al. 1984, 1992); a later study of Czech Republic samples found only 0.12-0.51% *psilocybin* and 0.06-0.27% *psilocin* (Stríbrný et al. 2003). British specimens contained c.0.15% *psilocybin*, but no detectable *psilocin* (Mantle & Waight 1969). Scottish samples also contained *psilocybin* (Benedict et al. 1967). New Zealand samples contained *psilocybin* and *psilocin* (Johnston & Buchanan 1995); and samples from Pacific n.w. US have yielded 0.62-1.28% *psilocybin*, and no *psilocin* – caps contained higher levels than stems (Beug & Bigwood 1982). Samples of unspecified geographic origins have also yielded *psilocybin* [0.003-1.7%], *psilocin* [0.003-0.025%], *baeocystin* [0.02-0.36%] and traces of *norbaeocystin* (Ohenoja et al. 1987; Repke et al. 1977; Semerdzieva et al. 1986; Stijve & Kuyper 1985; White 1979). Swedish samples of this species have also yielded variable levels [up to 0.0146% wet weight] of *phenethylamine* which has been proposed to contribute to tachycardia, anxiety, nausea and vomiting from consumption, through some vague hypothetical mechanism [pure *psilocybin* produced the same effects in some people, though tachycardia was not frequently observed] (Beck et al. 1998); perhaps the weak MAOI activity of *psilocybin* and *psilocin* enables this, as *phenethylamine* is usually orally-inactive. Others have noted that N. American specimens do not appear to exhibit these side effects (Trout pers. comm.). Unidentified indoles and steroidal compounds have also been detected in the species (Toro 2004). Although some collections may be very potent, with weaker strains, 20-40 [or c.4g dry] specimens may be needed for a strong effect, bearing in mind the small stature of this species (Allen 1997a; Hyde et al. 1978; Mantle & Waight 1969). However, doses of 100 and up to 250 [potent, fresh] specimens have been reported (Peden et al. 1981; pers. comm.). In one case, a young man ingested 50-60 specimens; on admission to hospital, tachycardia, mydriasis, hyperreflexia, hypotonia and facial flushing were observed. This person took "between 96 and 120 hours" to return to his previous state of consciousness, with hallucinations and confusion persisting up until this time. Follow-ups on the patient found "no symptoms of a schizophrenic illness" (Hyde et al. 1978). I know several people who have also experienced such extended 'trips' after ingestion of very high doses of P. subaeruginosa, and in these cases also, recovery was complete after approximately 1 week. See also McKenna (1993). There is one report of a young man dying after consuming a large number of P. semilanceata specimens (Gerault & Picart 1996), although the conclusion that this species was responsible for 'death by overdose' has been strongly and convincingly criticised on many points; it seems most likely that in his pickings he inadvertently ate some deadly species as well, with symptoms suggesting muscarine poisoning [see **Amanita**, **Inocybe**] (Gartz et al. 1996). As well as in Europe, P. semilanceata is also found in N. America [n. Cal. to British Columbia], S. Africa, Chile, n. India, Australia [uncommon], New Zealand (Guzmán 1983; Guzmán & Watling 1978) and the UK (Cooper 1977; Gartz 1996).

P. serbica from Serbia, Slovakia and the Czech Republic has yielded *psilocybin* and *psilocin* (Guzmán 1983).

P. silvatica from n. Europe, n. US, and s. Canada [Ontario] contains *psilocybin* and/or *psilocin* (Stamets 1996), and 0-0.02% *baeocystin* (Repke et al. 1977). 20-40 specimens may constitute an active dose (Allen 1997a).

P. stuntzii from Pacific n.w. US yielded 0-0.36% *psilocybin*, 0-0.59% *psilocin* (Beug & Bigwood 1982; Guzmán & Ott 1976) and 0.002-0.02% *baeocystin* (Repke et al. 1977). 20-30 specimens may constitute an active dose (Allen 1997a).

P. subaeruginascens is found in Japan and Java (Guzmán 1983); Japanese cultivated mycelium has yielded 0.017-0.018% *psilocybin* (Koike et al. 1981). Material found growing in n.e. New South Wales [Australia] in 'lantana' mulch, and in association with **Acacia** melanoxylon, is believed by its collectors to be P. subaeruginascens, and has proven very potent when fresh, less so when dry (Recher pers. comm.; pers. obs.). Fragments of dry material [in poor condition] bearing gills were sent to Gaston Guzmán, who identified them as P. subaeruginosa [based partly on the fact that P. subaeruginascens has not been recorded in Australia] (pers. obs.). However, the collector noted their appearance when fresh to be different to that of P. subaeruginosa [and very similar to the photo of P. subaeruginascens in Stamets (1996)], and is not convinced by this diagnosis (Recher pers. comm.).

P. subaeruginosa from Australia and New Zealand is moderately to strongly active (pers. obs.); it has yielded 0.01-0.45% *psilocybin*, with traces of *psilocin* and other compounds that were not identified (Johnston & Buchanan 1995; Perkal et al. 1980; Picker & Richards 1970; Wurst et al. 1984). Specimens from around Melbourne [Victoria], believed to be P. subaeruginosa, yielded 0.03-1.81% *psilocybin* and 0.02-0.18% *psilocin*. One specimen contained 69.4mg *psilocybin* and 16.7mg *psilocin*, which would be sufficient to produce strong effects in at least 2-3 people. Analysed separately, caps yielded 0.05-1.93% *psilocybin* and 0.06-0.32% *psilocin*; stems yielded 0.04-1.52% *psilocybin* and 0.01-0.15% *psilocin* (Perkal 1981). A recent analysis found 0.107-0.112% *psilocybin* and only 0.0011-0.0019% *psilocin* (Anastos et al. 2006). One study found no indoles in a collection of this species from Mt. Lofty, near Adelaide [SA] (Margot & Watling 1981). Specimens contain, on average, 90% water (Perkal 1981).

P. subcaerulipes from Japan has yielded 0.34-0.81% *psilocybin* (Kusano et al. 1986).

P. subcubensis has an appearance and distribution similar to that of P. cubensis, and has yielded 0.37% *psilocybin*, 0.26% *psilocin*, 0.006% *baeocystin* and 0.01% *tryptophan* in samples from Koh Samui, Thailand (Allen & Merlin 1992); Venezuelan Andean specimens contained mainly *psilocybin*, with smaller amounts of *psilocin* (Marcano et al. 1994). There is a report of a young man dying after consuming cultivated P. subcubensis, although the title of the article is misleading; he was found in an irrigation canal and is believed to have died from hypothermia [the abstract does not state whether there was any evidence of drowning], not from any toxic effect of the mushroom (Gonmori & Yoshioka 2002).

P. subfimetaria from n.w. US and Chile contains *psilocybin* (Guzmán 1983).

P. cf. subyungensis from Brazil yielded 0.5% *psilocybin*, 0.4% *psilocin* and 0.033% *baeocystin* (Stijve & de Meijer 1993).

P. tampanensis cultivated on 6% malt agar and **Lolium** seed yielded 0.34-0.68% *psilocybin*; sclerotia on **Lolium** yielded 0.11-0.32% *psilocin*; and sclerotia on malt agar yielded 0.41-0.61% *psilocybin*, 0.21-0.52% *psilocin* (Gartz et al. 1994). It is native but rare in Florida, known only from the type location [near Tampa] (Guzmán 1983), and is now widely cultivated (Stamets & Chilton 1983).

P. tasmaniana from Australia and New Zealand has been suggested to contain *psilocybin* based on its psychoactivity (Stamets 1996).

P. thailandensis has yielded 0.055-0.075% *psilocybin* and 0.1-0.6% *psilocin* (Stijve & de Meijer 1993).

P. uruguayensis from Brazil yielded 0.085-0.14% *psilocybin*, 0-0.01% *psilocin* and 0.015-0.02% *baeocystin* (Stijve & de Meijer 1993).

P. venenata from Japan bruises blue and has caused human inebriations (Guzmán 1983; pers. comms.).

P. wassonii from Mexico is strongly bluing and estimated to be strongly active; only 0.02% *psilocybin* and 0.01% *psilocin* were found in aged specimens (Heim 1958; Stamets 1996; Tamm 1962).

P. wassoniorum from Veracruz, Mexico, bruises blue and is thought to be active (Guzmán 1983).

P. weilii from n. Georgia [US] has yielded 0.61% *psilocybin*, 0.27% *psilocin*, 0.05% *baeocystin* and 0.32% *tryptophan* (Stamets 1996). It is very similar in appearance to P. caerulescens, except for the presence of pleurocystidia in P. weilii (Guzmán et al. 1997).

P. yungensis from Colombia, Ecuador and Mexico is known to be active; despite its known psychoactivity, repeated analyses by Albert Hofmann found no *psilocybin* or *psilocin* (Guzmán 1983; Heim & Cailleux 1959).

P. zapotecorum from s. Mexico and subtropical S. America has yielded 0.3-0.5% *psilocybin* and 0-1.0% *psilocin* (Guzmán 1983; Heim & Hofmann 1958; Hofmann et al. 1959; Ott & Guzmán 1976); Brazilian specimens yielded 0.06-0.3% *psilocybin*, 0.05-1.0% *psilocin* and 0-0.02% *baeocystin* (Stijve & de Meijer 1993).

Other species listed at the head of this entry are bluing species that are believed to be psychoactive, yet are not known to have been chemically analysed (Guzmán 1983, 1995; Guzmán et al. 2000, 2002; Ott 1993).

Also, the closely related Hypholoma popperianum and H. rhombispora have been shown to contain *psilocybin* and *psilocin* (Guzmán et al. 2000). H. aurantiaca from Australia was found to contain 0.097-0.099% *psilocybin* but no *psilocin*, as well as an unidentified compound (Anastos et al. 2006). The few psychoanuts who have eaten this species reported diarrhoea but no psychedelic activity. Based on this some people suspect the analysis to have given a false result (pers. comms.). It is widespread [also found in Europe and N. America] and might have regional differences in chemistry.

H. fasciculare [Naematoloma fasciculare; 'sulphur tuft'] was claimed by one author to have caused 'hallucinations' ["especially auditive ones"] as well as more serious toxicity (Toro 2004, quoting Giacomoni); it is generally reported to be bitter and poisonous. There have been fatal cases, in which post-mortem examination revealed damage to the liver, cardiac muscle and brain cells. An ethanolic extract given to rats [i.p.] had diuretic and parasympathetic activity. The species has yielded triterpenes called fasciculols [some of which caused paralysis and death when injected i.p. into mice], compounds called hypholomins and fasciculins (Bresinsky & Besl 1989; Connor 1977; Diak 1977), small amounts of muscarine and epi-muscarine [see **Amanita**] (Stadelmann et al. 1976), the amines *choline*, amylamine, methylamine, propylamine, cadaverine, putrescine, *phenethylamine* and betaine, the amino acids arginine, alanine, *GABA*, *glycine*, *tryptophan*, leucine, lysine, ornithine and valine, the purines alantoine and *guanine*, the sterols cerewisterol, ergosterol, ergosterol peroxide and stigmasterol, and the sugars glucose, mannitol, mannose, trehalose and xylose (Diak 1977).

Psilocybe cyanescens has a cap (1-)2-5(-7.5)cm diam., subconic or convex to campanulate, becoming irregularly expanded plano-convex or applanate to depressed, sometimes subumbonate, glabrous, margin slightly striate when moist, viscid, hygrophanous, orangish-brown or chestnut colour, fading to yellowish, straw-colour, or ochraceous; easily bruising blue. Stem (4-)6-9(-11)cm x (3-)4-6(-7)mm, equal, cylindrical, or bulbous at base, straight or flexuous, hard and cartaliginous, solid to hollow, surface white to whitish, silky-fibrillose or scabrous towards base, base with conspicuous white rhizomorphs; readily bruising blue. Gills adnate to sinuate, yellowish- or orangish-brown to violaceous-brown, sometimes mottled, edges concolorous or nearly whitish. Spore print dark brown-violet or fuscous; spores (8.8-)11-13.2(-15.4) x (6-)6.6-7.7(-8.5) x 5.5-7µm, elongate-ellipsoid, thick-walled, dark yellowish-brown, with distinct broad apical germ pore; basidia (2-)4-spored, hyaline, vesiculose-subpyriform, sometimes with slight median constriction; pleurocystidia more frequent near edge of gill; cheilocystidia abundant, with a long neck, bifurcate or simple. Fr. Oct.-Dec. or later [though Sep. fruiting has been reported in Scotland (pers. comm.)].

Usually gregarious, sometimes forming rings, on very rotten wood mixed with soil, on sawdust or soil mulch containing wood chips or bark, in deciduous forests, also very common in gardens under bushes, very rarely in grasses; Great Britain, Netherlands, Germany, n.w. North America [Vancouver to Cal.] (Guzmán 1983).

The Australian species P. australiana, P. eucalypta, P. subaeruginosa and P. tasmaniana can appear very similar to one another macroscopically, and can vary greatly in appearance; they can also overlap to varying degrees in their choice of substrate, with the possible exception of P. tasmaniana. Some researchers have attempted to show that these species [or at least some of them] are all synonymous (Chang & Mills 1992), an opinion shared by some amateur mushroom enthusiasts with extensive picking experience and access to a good microscope (Bluemeanie pers. comm.). Stamets (1996) disputed the validity of this argument based on inconsistencies in the identification of the purported P. subaeruginosa studied by Chang & Mills (1992). Recent independent studies have found that P. subaeruginosa and P. australiana [collected from a wide variety of locations in southern Australia] are indistinguishable microscopically and should probably be regarded as the same species (Bluemeanie pers. comm.). Furthermore, Guzmán's description of P. subaeruginosa, describing chocolate-brown pleurocystidia and cheilocystidia for that species (Guzmán 1983), was based on analysis of only a small collection of samples, and later studies have found no coloured cystidia in collections of P. subaeruginosa. This brings doubt to the actual identity of the material studied by Guzmán (Johnston & Buchanan 1995).

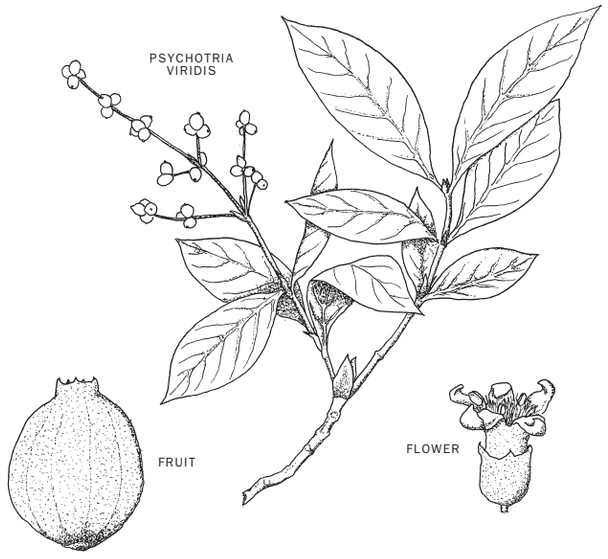
To aid in attempted separation of collections from s.e. Australia [assuming these species are in fact all separate], the following comparison is given (from Guzmán & Watling 1978):

	P. australiana	P. eucalypta	P. subaeruginosa	P. tasmaniana
Habitat	woody or leafy debris	soil with wood debris, or in moss	decaying leaves or debris mixed w. dung	dung [usually kangaroo]
Spore				
- length µm	(10-)12-14(-15.9)	(9.3-)9.9-12(-13)	(11-)13.2-14.3(-16.5)	(10-)12-13(-15.4)
- breadth µm	(5.5-)6.6-7(-7.7)	(6-)6.6-7.1	6.6-7.7	7.1-7.7(-8.8)
- width µm	6-7	5.5-6.6	6.7	7.1-7.7(-8.8)
Pleurocystidia	hyaline	hyaline	hyaline, brownish-grey	hyaline
- length µm	22-33	17-30	24-47.3	19-24
- breadth µm	7.7-11	5.5-7.7	8.8-16.5	6.6-8.8
Cheilocystidia	neck short, 4µm or less, simple	neck short, 5µm or less, simple	neck short, 4µm or less, simple	neck long, >5µm, often bifurcate
- length µm	17-23	15-25	26-29	22-33
- breadth µm	5.5-7.7	4.4-6.6	8-11	4.4-9.9

Special care should be taken when harvesting wood-decaying Psilocybe spp., as some may be confused with potentially deadly Galerina spp. [such as G. autumnalis] which share the same habitat. Fortunately, the rusty brown spores of the latter fungi help distinguish them from the dark purplish spores of the former.

PSYCHOTRIA

(Rubiaceae)



Psychotria alba *Ruiz et Pav.* **(Mapouria alba** *(Ruiz et Pav.) Müll.-Arg.***; M. rigida** *Rusby***; Uragoga alba** *(Ruiz et Pav.) Kuntze***)** – yagé, tupamaqui, ucumi-micuna

Psychotria brachybotrya *Müll.-Arg.* **(P. iquitosensis** *Standl.***)** – tan'-su

Psychotria carthaginensis *Jacq.* **(P. ficigemma** *DC.***; P. fockeana** *Miq.***; P. foveolata** *Ruiz et Pav.***; P. sagraeana** *Urb.***; Uragoga carthagenensis** *(Jacq.) Kuntze***)** – wy-soo-dö, yagé, yagé-chacruna, rami appane, rani appani, sameruca

Psychotria colorata *(Willd. ex Roem. et Schult.) Müll.-Arg.* **(Cephaelis amoena** *Bremek.***; C. colorata** *Willd. ex Roem. et Schult.***)** – perpetua do mato

Psychotria horizontalis *Sw.* **(Myrstiphyllum horizontalis** *(Sw.) Millsp.***; Uragoga horizontalis** *(Sw.) Kuntze***)** – tupamaqui

Psychotria marginata *Sw.* **(P. nicaraguensis** *Benth.***; Myrstiphyllum marginatum** *(Sw.) Hitchc.***; Uragoga marginata** *(Sw.) Kuntze***)** – yagé, sanaguillo

Psychotria poepiggiana *Müll.-Arg.* **(Callicocca tomentosa** *(Aubl.) J.F. Gmel.***; Cephaelis hirsuta** *M. Martens et Galeotti***; C. tomentosa** *(Aubl.) Vahl***; C. vultusmimi** *Dwyer***; Evea tomentosa** *(Aubl.) Standl.***; Tapogomea tomentosa** *Aubl.***; Uragoga tomentosa** *(Aubl.) K. Schum.***)** – oreja del diablo ['devil's ear'], chacruna, picho e mula, boca pintada, bimichëxë

Psychotria stenostachya *Standl.* – yagé, rumo sacha

Psychotria viridis *Ruíz et Pav.* **(P. glomerata** *Kunth***; Palicourea viridis** *(Ruiz et Pav.) Roem. et Schult.***)** – chacruna, sami ruca, amiruca panga, o-pri-to, kawa, rami appane, suija, tupamaqui, yagé

P. viridis is the most common *DMT*-containing plant admixture in ayahuasca brews of Amazonia [see **Banisteriopsis**], used in Colombia, Ecuador, Peru, and some isolated areas of Brazil. It is the favoured additive amongst the modern ayahuasca churches, Santo Daime and União do Vegetal [UDV]. The UDV are also said to use P. alba, though it is apparently only c.60% as potent. The leaves of the chosen Psychotria sp. are added to the brew to create the majority of entheogenic effects. Sometimes, P. carthaginensis, P. horizontalis, P. marginata or P. stenostachya are used instead. Reports of P. psychotriaefolia being used in ayahuasca, and containing *DMT*, were in error, and should have referred to P. viridis. Several unidentified species have also been added to ayahuasca – including 'batsiwaka' and 'pishikwa' of the Sharanahua, 'matsikawa' and 'naikawa' of the Cashinahua [thought to be the same species as 'batsikawa'], and 'urubambashi' of the Machiguenga. The latter tribe also separately use a species known as 'sampakatishi' – its leaf juice is applied as eyedrops before hunting. After initial burning sensations subside, the senses are said to be sharpened. The drops are also used to treat migraine. The Andoke use P. brachybotrya in a similar way, though prepared differently. The crushed leaves are infused in water, which is then used as eyedrops a few drops at a time. It is said to give "clear vision...to see with understanding" (Duke & Vasquez 1994; Ott 1993, 1994; Pinkley 1969; Prance 1970; Russo undated; Schultes 1969a, 1969c, 1972; Schultes & Raffauf 1990; Trout pers. comm.).

The Makuna say of P. carthaginensis that the fruits, if eaten, cause a poisoning resulting in several days of weakness, fevers, nausea and disturbed vision. Fruits of P. involucrata and P. nudiceps are also said to be toxic when eaten (Schultes 1969a). Still in the Amazon, flowers of P. colorata are used to treat earache, and the roots and fruits treat abdominal pain (Elisabetsky et al. 1995; Verotta et al. 1998). The Peruvian P. poepiggiana is used medicinally by the Yahua, and its leaves have proven highly active as a non-traditional ayahuasca-additive. Though the Yahua do not use this species as an entheogen, they do use two other unidentified species as ayahuasca-additives – P. 'huarmi chacruna' [of which roots are regarded most active, though leaves are also highly active] and P. 'lucero sanango' [considered dangerously potent] (pers. comm.).

In Queensland, Australia, P. fitzalani is used as an aphrodisiac in the same way as **Pithecellobium** grandiflorum (Cribb & Cribb 1981). In Malaya, P. sarmentosa and other unidentified Psychotria spp. are used for their roots or juice in the manufacture of dart-poisons (Bisset & Woods 1966). P. insularum leaves and stems are used in Samoa to treat fever, abdominal disturbances and incontinence, amongst other complaints. Extracts showed CNS-depressant effects in mice (Cox et al. 1989). In the West Indies, seeds of P. brachiata, P. laxa, P. marginata, P. nervosa and P. uliginosa have been used as coffee substitutes [see **Coffea**] (Von Bibra 1855). Finally, the root of the Brazilian P. ipecacuanha is the herbal drug 'ipecac', or 'ipecacuanha', used in many parts of the world as an emetic, expectorant and diaphoretic (Chopra et al. 1965).

Psychotria spp. seem to be quite variable in alkaloid content, and some psychonauts in the US have had difficulty in obtaining a full-strength ayahuasca experience using locally grown material.

P. carthaginensis has yielded from 0-0.66% alkaloids, when present being made up of 99% *DMT*, and traces of *N-methyltryptamine* [*NMT*] and 2-methyl-THβC. Some samples containing no alkaloids were from sterile collections, and thus identification may have been in error. Leaf-extract from an alkaloid-free sample was sedative in mice at very high doses [1g/kg, i.p.] (Leal & Elisabetsky 1996; McKenna et al. 1984a; Rivier & Lindgren 1972).

P. colorata flowers yielded 0.51-0.8% alkaloids, mostly (8-8a),(8'-8'a)-tetradehydroisocalycanthine 3a(R),3'a(R), as well as (-)-calycanthine, isocalycanthine [see **Calycanthus**], hodgkinsine, quadrigenine C and (+)-chimonanthine. Leaves yielded 0.2% alkaloids, consisting of calycanthine, isocalycanthine and quadrigenine C. The flower alkaloids showed marked opioid-like analgesic activity, acting on both mu- and kappa-opioid receptors (Elisabetsky et al. 1995; Verotta 1998).

P. viridis leaves have yielded 0.11-0.34% alkaloids, of which c.99% may be *DMT*; some contain traces of *NMT* and 2-methyl-THβC. One sample tested contained no *DMT* in its 0.11% alkaloids, only 85% *NMT* and 12% 2-methyl-THβC (McKenna et al. 1984a; Rivier & Lindgren 1972). Apparently, the root bark is considerably higher in alkaloid content (pers. comm.). On occasion in the past, P. viridis has been misidentified as P. psychotriaefolia, both in the chemical and ethnobotanical literature (Ott 1994).

P. sp. 'matsikawa' is said to contain no alkaloids. P. sp. 'naikawa' yielded 0.16-0.22% *DMT*. A brew made using P. sp. 'batsikawa' and P. sp. 'pishikawa' also contained *DMT* (Ott 1993, 1994).

Some potentially toxic and probably non-psychoptic species from continents and countries other than South America are discussed below.

P. beccaroides from New Guinea, P. forsteriana from Vanuatu, and P. lyciiflora and P. oleoides from New Caledonia contain complex indole alkaloids called psychotridines – *NMT*-derived alkaloids made by linking 2-8 pyrrolidinoindoline groups. They are potently cytotoxic against rat hepatoma and human leukaemia cell lines, inhibit platelet aggregation, and are antibacterial, strongly sedative and analgesic in mice (CSIRO 1990; Jannic et al. 1999; Saad et al. 1995). P. beccaroides stem bark yielded 0.44% alkaloids, mostly psychotridine. The alkaloids had little effect in animals when given orally, except in very high doses; 15mg/kg [i.p.] in cats caused "emesis and tachypnea; 35mg/kg caused a broad spectrum of activity including CNS depression of long duration, dyspnea, ataxia and deep respiration." (CSIRO 1990). P. forsteriana has yielded vatine and vatine A. P. lyciiflora leaves yielded hodgkinsine, meso-chimonanthine and N-desmethyl-meso-chimonanthine. P. oleoides leaves yielded psychotridine, isopsychotridine B, isopsychotridine E, hodgkinsine, quadrigemine, quadrigemine C [antagonises growth hormone secretion in rat pituitary], caledonine and oleoidine (Jannic et al. 1999; Saad et al. 1995).

P. coelospermum leaves and stems yielded a complex mixture of alkaloids [which were specifically noted as not similar to those of P. beccaroides], which were +- inactive orally in animals. In cats and dogs, 1mg/kg [i.v.] caused "salivation, defaecation and lacrimation; 5mg/kg produced decreased activity, convulsions, and death." In cats, 0.5mg/kg [i.v.] had prolonged hypotensive effects (CSIRO 1990). Leaves and root-bark of P. daphnoides, and leaves, roots and bark of P. loniceroides [both from Queensland, Australia] tested negative for alkaloids (Webb 1949). Caution should be exercised with untested species, as some of these non-entheogenic alkaloids, as listed above, are highly toxic.

Psychotria viridis is a shrub or small tree to 4.3m tall, glabrous throughout; stems erect, terete, much-branched; branches terete, obsoletely 4-angled above, compressed. Leaves short-petiolate, opposite, entire, obovate or obovate-oblong, acute or short-acuminate, base long-cuneate, 8-15 x 2.5-5cm, underside minutely pitted, veins near base minutely pitted, bent inward; stipules opposite, large, thin, lanceolate, acuminate, connate, caducous, brownish; petiole longitudinally grooved. Inflorescence a terminal spike-like subpaniculate raceme, pedunculate, shorter than leaves, up to 10-12cm long, lower branches +- verticillate; peduncles 4-angled, compressed, brachiate; flowers sessile in distant glomerules, very small, crowded, usually 4mm long; calyx very small, 5-lobed, lobes acute, persistent; corolla small, greenish-white, funnel-shaped, not basally gibbous, upper part of throat hirsute, expanded, 5-limbed, limbs ovate, acute, spreading, apex reflexed; stamens 5, filiform, filaments short, inserted below throat of corolla; anthers included, linear, incumbent, basally bifid, bilocular. Ovary subrotundate, unilocular, umbilicus prominent; style filiform; stigma bilobed, lobes oblong, moderately thick, obtuse. Fruit small, drupaceous, crowned, globose, ovoid, 2-seeded; seeds bony, ovate, convex, 5-grooved, smooth on other surface.

In forests throughout Amazon Basin, north to C. America and Cuba (Ruiz & Pavon 1799; Schultes & Hofmann 1980).

'Ayahuasqueros' may sometimes identify Psychotria spp. suitable for use by the presence of a double line of tiny spine-like swollen glandular structures on the midrib of the underside of the leaf. According to preliminary testing, these structures seem to be an indicator of strains containing *DMT*, at least for P. viridis (Leal & Elisabetsky 1996; McKenna et al. 1984a).

To cultivate from seed, all traces of fruit pulp must first be removed – this is sometimes aided by soaking in hydrogen peroxide. Germinate seeds in sterilised seed-raising mix or sand in a humidity chamber; bottom-heat may be needed. Seeds may take many months to germinate. Plants prefer warm, moderately humid conditions; frost sensitive. Water regularly. Some species may respond well to leaf-propagation [sometimes, fallen leaves from a plant will root and re-shoot without any help]. For this purpose, the leaves may be folded 'concertina-style' to slightly break the midrib in several places, and then placed on soil or slightly buried. Each leaf may grow roots and sprout new plants using this method. A humidity chamber may aid this process (pers. comms.).

PTEROCEREUS

(Cactaceae)

Pterocereus gaumeri *(Br. et R.) MacDougall et Miranda* **(Anisocereus gaumeri** *(Br. et R.) Backeb.***; Pachycereus gaumeri** *Br. et R. sp. nov.***)**

P. gaumeri has been shown to contain less than 0.01% *mescaline*, c.0.1% *DMPEA* and c.0.01% 3,5-dimethoxy-4-OH-*phenethylamine* (Ma et al. 1986), as well as 0.062% pterocereine [6,7-dimethoxy-5-glucosyloxy-1-hydroxymethyl-2-methyl-THIQ], 0.164% deglucopterocereine [probably an artefact of extraction; formed from acid hydrolysis of pterocereine; similar structure to *gigantine*] (Mohamed et al. 1979) and 0.038% deglucopterocereine N-oxide (Pummangura et al. 1982b).

Pterocereus gaumeri is a long, slender cactus, somewhat tree-like, to 7m tall, greyish blue-green in colour, stems with 3-4 almost wing-like thin ribs, 3-4cm high; areoles large, yellowish-brown, 1-2.5cm apart, each bearing 3-6 brown slender spines 1-3cm long. Flowers borne laterally, diurnal in early summer, short and fat, petals curving backwards, c.5cm long, yellowish-white to yellowish-green; scales of flower tube and ovary more or less foliaceous, drying black and thin, with brown-felted areoles; ovary scales linear, puberulent. Fruit 3-4cm diam., becoming dry and globose, with small scales at base with felted axils, scales +- foliaceous, drying black and thin; seeds numerous, brown, 4mm long.

Yucatan; Mexico.

Needs bright light and enriched mineral compost, min. temp. 15°C (Britton & Rose 1963; Innes & Glass 1991; Trout & Friends 1999).

PTYCHOPETALUM

(Olacaceae)

Ptychopetalum olacoides *Benth.* **(Liriosma ovata** *Miers***; Dulacia inopiflora** *(Miers) Kuntze***; D. ovata** *(Miers) Kuntze***)** – muira puama, mara puama, potence wood, potency wood

Ptychopetalum uncinatum *Anselmino* – muira puama

'Muira puama' is a popular aphrodisiac in parts of Brazil, particularly in the Orinoco basin and parts of the Amazon. Natives either chew the bark of the tree, or boil 2-4 tablespoons of root and bark shavings for 15 min. in a pint of water, each partner drinking a cup of the liquid 1-2 hours before sexual intercourse. P. olacoides is considered interchangeable with P. uncinatum (Miller 1985; Mors & Rizzini 1966), and in the herbal trade they are sometimes adulterated with the roots of the guava tree, Psidium guajava [see *Endnotes*]. In the Rio Negro and other parts of the Brazilian Amazon, P. olacoides stem and root [of young plants] are used to treat neuromuscular problems. A bath of the root decoction treats paralysis and beri-beri, and is said to prevent baldness. Taken internally, the tea is an aphrodisiac that treats impotence, rheumatism, dysentery, grippe, neuraesthenia and cardiac and gastrointestinal aesthenia (Da Silva 1927; Schultes & Raffauf 1990). 'Caboclos' [Portuguese/indigenous inhabitants] in the Amazon use the roots in alcoholic tincture as a nervous stimulant and aphrodisiac (Siqueira et al. 1998).

The effects of muira puama may be so subtle as to be unnoticeable, yet most people do notice the effects, which are similar to those of yohimbe [see **Corynanthe**]. Some people have described very mild 'LSD-like' symptoms accompanying the spinal tinglings, and some people experience mild nausea or gastric discomfort. Some people may have an allergic reaction to this herb. This may be tested for by shallowly scratching the skin with a sterilised pin, and applying a small sample of muira puama to the scratch – irritation within the hour indicates a likely allergic reaction (Miller 1985; pers. comm.). From 0.6-1.2g of the bark may be effective as a nerve tonic. Apparently, the wood-chips have even sometimes been added to psychotropic smoking mixtures (Rätsch 1998), though it is questionable whether any of the [undetermined] active principles would survive combustion.

P. olacoides contains resinous principles with CNS-stimulating effects, which are best extracted in alcohol (Miller 1985). Constituents include liriosmin (Schermerhorn et al. ed. 1957-1974), muirapuamine [0.055% of root; found mostly in bark, traces in wood], two abietic acids [0.6 and 0.7% of root], 0.38% fats, an "amorphous bitter substance" and an essential oil (Da Silva 1927). The essential oil [1.5% yield from root bark] contained 25.9% α-*pinene*, 7.8% β-*pinene*, 6.2% *camphor*, 6.6% camphene, 7.7% β-caryophyllene, 5.1% elixine, 9.2% α-humulene, 3.2% α-copaene and traces of many other constituents. The root bark has also yielded lupeol, methyl esters of arachidic, behenic and lignoceric acids, lipids, tertiary alkaloids and 0.4-0.5% of a mixture of compounds which is mostly the behenic acid ester of an α-sterol (Auterhoff & Pankow 1968; Bucek et al. 1987). A water/alcohol extract of the roots appeared to act on *dopamine* and/or *norepinephrine* receptors, based on animal studies (Siqueira et al. 1998). More information regarding this interesting plant may be found at http://www.rain-tree.com/muirapuama.htm.

Ptychopetalum olacoides is a loosely branched tree, sometimes slightly flexuose when young; branches terete, glabrous, dark; branchlets slightly longitudinally sulcate. Leaves obscurely green, pallid beneath, adult foliage subcoriaceous, glabrous and opaque on both sides, oblong-elliptic, long and narrowly acuminate, base acute, 9-11 x 2-2.5cm, with obtuse acumen 1-1.5cm long, midrib on upper side lightly sulcate, strongly prominent beneath, lateral nerves horizontal, becoming connected near margin, barely prominent; petiole 2-3cm long, subterete, canaliculate, subtended. Racemes alternate, flexuose, glabrous, sulcate, 1-3 from axils, 2-2.5cm long, 5-8-flowered; flower bud oblong-cylindric, 1-1.3cm long, 2mm thick; prophyll subtending the pedicel linear, reflexed; pedicel 2.5-3mm long; calyx small, 1mm high, subcoriaceous; petals externally glabrous, with white hairs inside near 2/3 of the way up, upper margin membranaceous, crenulate, inflexed, brownish; stamens numerous, but in some 10, with 5 short stamens alternating with petals, and with 5 short stamens opposite petals; anthers yellowish, filaments dorsally affixed. Fruit a drupe.

Habitat in n. Brazil, near Amazon River in insular forest; also in French Guiana (Fridericus & De Martius ed. 1965-1975).

PUERARIA

(Leguminosae/Fabaceae)

Pueraria lobata *(Willd.) Ohwi* **(P. argyi** *Lév. et Vaniot***; P. bodinieri** *Lév. et Vaniot***; P. caerulea** *Lév. et Vaniot***; P. chinensis** *(Benth.) Ohwi***; P. hirsuta** *(Thunb.) Matsum.***; P. koten** *Lév. et Vaniot***; P. pseudohirsuta** *Tang et Wang***; P. thunbergiana** *(Sieb. et Zucc.) Benth.***; P. triloba** *Makino***; Dolichos hirsutus** *Thunb.***; D. lobatus** *Willd.***; D. trilobus** *L.***; Neustanthus chinensis** *Benth.***; Pachyrhizus thunbergianus** *Sieb. et Zucc.***)** – kudzu vine, kudzu, kuzu, geh gen, ge gen

Pueraria mirifica *Airy-Shaw et Suvatabandhu* – kwao, kwao keur, paukse

Pueraria phaseoloides *(Roxb.) Benth.* **(Dolichos phaseoloides** *Roxb.***; D. viridis** *Buch.-Ham. ex Wall.***; Neustanthus phaseoloides** *(Roxb.) Benth.***; Phaseolus decurrens** *Graham***)** – tropical kudzu

Pueraria thomsonii *Benth.* **(P. lobata ssp. thomsonii** *(Benth.) Ohashi et Tateishi***; P. lobata var. thomsonii** *(Benth.) Maesen***; Pachyrhizus trilobus** *DC.***)** – kudzu, kuzu, geh gen, ge gen

In New Britain, Papua New Guinea, P. phaseoloides leaves are chewed as an intoxicant (Paijmans ed. 1976).

The edible roots of P. lobata and P. thomsonii are used in cooking as a starchy thickener. They are also used in TCM to treat poisoning from alcohol and other drugs (Reid 1995). As I write, an 'anti-hangover' drink containing 'kudzu' as the main ingredient has been on supermarket shelves in Australia for some years (pers. obs.). Medicinally, the roots of P. lobata and P. thomsonii have muscle relaxant, antipyretic, antihypertensive and antidysenteric actions (Tang & Eisenbrand 1992). In TCM [as 'geh gen'], they are considered neutral, sweet and bitter in energy, with an affinity for the stomach and spleen meridians. A decoction of 4-10g relieves fevers, headache, pains and tension in neck and shoulders, tones the skin, and treats urine retention, as well as acting as a nervine tonic, promoting a feeling of well-being (Reid 1995). American studies have shown that vine extracts may help suppress the craving for alcohol in alcoholics (Bremness 1994; Keung & Vallee 1997). P. mirifica roots are used in Thailand and Burma as a rejuvenative for the elderly; it is said that young people should not take it (Cain 1960; Chansakaow et al. 2000).

P. lobata root collected at the proper time [autumn & winter] has yielded 0.02-2% isoflavone derivatives [puerarin, daidzin, daidzein, daidzein-7,4'-diglucoside]; isoflavones [formononetin, 3'-OH-puerarin, 6"-O-D-xylosylpuerarin, 3'-MeO-puerarin, puerarin 4'-O-D-glucoside, and the 8-C-apiosyl-(1→6)-glucosides of diadzein and genistein]; aromatic glycosides [puerosides A & B]; the coumestan derivative puerarol; sapogenins [kudzusapogenols A-C, sophoradiol, cantoniensistriol, soyasapogenols A & B]; and 6,7-dimethoxycoumarin, 5-methylhydantoin, β-sitosterol, *choline* and *acetylcholine* (Tang & Eisenbrand 1992).

P. mirifica root has yielded the phenols deoxymiroestrol [a potent phytoestrogen, promotes growth of MCF-7 human breast cancer cells] and isomiroestrol; miroestrol itself was detected earlier, but appears to be an artefact of extraction. The roots has also yielded isoflavones and coumestans (Cain 1960; Chansakaow et al. 2000).

P. phaseoloides leaflets contain flavonoids such as genistein [MAOI (Hatano et al. 1991)], luteone, calopocarpin, phaseollidin and wighteone; stem contains vanillin, syringic acid, caffeic acid, ferulic acid, 4-OH-benzaldehyde, 4-OH-benzoic acid, 4-OH-3-MeO-benzoic acid and (*E*)-3-(4-OH-phenyl)-2-propenoic acid (International… 1994).

P. colletii and P. wallichii have been found to contain canavanine [see **Canavalia**] (Bell et al. 1978).

Pueraria phaseoloides is a robust, slender-stemmed twiner, climbing high, suffruticose, covered with spreading or ascending (sometimes reflexed) hairs, reddish, or lower surface of leaves subcanescent, +- vestite. Leaves alternate, entire or usually 3-foliolate, broadly rhomboid-ovate, apex acute, with long appressed and very short erect hairs adaxially, densely whitish sericeous-villous beneath, 2.5-12 x 1.5-9cm; stipule ovate-lanceolate, acuminate, striate, c.5mm long; stipel fairly long setaceous. Inflorescence elongate axillary racemes 10-20cm long, many-flowered, with swollen nodes; peduncles stout; bracteoles inconspicuous; flowers zygomorphic, to 8(-15)mm long; perianth biseriate; sepals usually 5, connate; calyx 4mm long, 4-5-lobed or -dentate, at summit triangular 2-

dentate, laterally small, at base quite long, acuminate tube long, otherwise short; standard petal deep mauve-pink, drying to bluish, obovate-orbiculate; keel fairly straight, or apex curved or rostrate, shortly beaked on top; wings falcate; auricles inflexed, usually appendiculate; stamens usually 10; anthers 2-locular, uniform, all fertile, usually dehiscing lengthwise. Ovary superior, subsessile, 1-locular; ovules many, anatropous; style simple, incurved above, filiform, beardless; stigma small, capitate. Legumes 5-9cm long, 3-4mm wide, narrow, compressed or subterete, linear, curved towards tip (not hook-like or oblique), pilose, glabrescent when ripe, 2-valved, dehiscent; seeds 10-15 per pod, small, transversely oblong, hilum lateral. Fl. May, Aug.-Dec.; fr. Aug.-Dec.

In damp areas, roadsides, riverside thickets, c.6-60m; native to tropical Asia, common in n. & e. India, Malacca, s. China; a weed in s. US, Caribbean, and parts of Africa, after being introduced as a cover crop (Adams 1972; Bentham 1867; Keung & Vallee 1997); also found in Papua New Guinea (Paijmans ed. 1976).

RANUNCULUS

(Ranunculaceae)

Ranunculus acris *L.* **(R. acer** *auct.***; R. acris var. latisectus** *Beck***)** – crowfoot, mao-ken, shui lang ['water lang']

Ranunculus quelpaertensis *(Léville) Nakai* **var. quelpaertensis (R. hakkodensi var. quelpaertensis** *(Lév.) Ohwi et Okuyama***; R. repens var. quelpaertensis** *H. Lév.***; R. ternatus var. quelpaertensis** *(Lév.) Ohwi***; R. vernyi var. quelpaertensis** *(Lév.) Nakai***)** – yama kitsune no botan, kitsune no botan

Ranunculus scleratus *L.* – marsh crowfoot

These 'buttercups' may have potential for use as inebriants, for those who like taking risks. R. acris is thought to be the plant referred to by Kohung and Li Shih-chen in 320AD – "...the Shui Lang [a kind of mao-ken], a plant with rounded leaves which grows along water and is eaten by crabs. It is poisonous to man and when eaten by mistake, it produces a maniacal delirium, appearing like a stroke and sometimes with blood-spitting. The remedy is to use liquorice" [see **Glycyrrhiza**]. Medicinally, it is applied only externally for inflammation and irritation. The Chinese term 'mao-ken' refers generically to Ranunculus spp. (Li 1978). The Cherokee use R. acris, R. abortivus and/or R. recurvatus to make a sedative tea; this is also used as a gargle for sore throats, and as a poultice for abscesses. The green parts are cooked and eaten as a vegetable (Hamel & Chiltoskey 1975). In Ladakh, India, R. sarmentosus ['chubansa'] is used as fodder for sheep, in order to promote their health (Bhattacharyya 1991).

R. scleratus causes contact-dermatitis and blistering. It was once used by some beggars in n. India for this property, to create or maintain skin sores in order to attract sympathy (Bhargava et al. 1965).

The irritating properties of Ranunculus spp. are lost on drying, and are due to an oily lactone, protoanemonin [5-methylene-2-oxodihydrofuran], which is formed from degradation of ranunculin [the β-D-glucoside of protoanemonin; the 'bound form' of protoanemonin in the plant], probably by the action of the enzyme β-glucosidase (Bai et al. 1996). Protoanemonin is converted to anemonin on drying. See **Clematis** for discussion of these compounds.

R. acris roots contain catechol phenols (Scott & Peterson 1979); aerial parts [harv. May, Canada] have yielded 2.75-2.87% ranunculin (Bai et al. 1996); flowers yielded volatile constituents, mostly trans-β-ocimene; pollen yielded protoanemonin (Bergstroem et al. 1995).

R. cymbalaria aerial parts [harv. Apr., May in Canada] have yielded 19.87-19.94% ranunculin (Bai et al. 1996).

R. quelpaertensis stems and leaves yielded the kava-lactone *yangonin* [see **Piper 2**], as well as protoanemonin, fumaric acid, palmitic acid, stearic acid, hexacontanol, stigmasterol and β-sitosterol (Shibata et al. 1972).

R. sceleratus has been shown to contain 7 *tryptamine*-derivatives, including 0.000016% *serotonin*; the other 6 were not identified. Also present were two compounds with anti-*serotonin* activity (Bhargava et al. 1965).

Ranunculus quelpaertensis is a nearly glabrate or sparsely hairy perennial herb; stems suberect to ascending, 15-80cm long, rather stout, branched; without stolons. Radical and lower cauline leaves petiolate, ternate, the leaflets petiolulate, broadly ovate to ovate-orbicular, 2-6cm long, 1.5-4cm wide, acute to subobtuse, 2-3-cleft, incised and acutely toothed, sessile. Flowers 8-12mm across, solitary or in terminal panicles, yellow, white to orange-red; sepals 3-5 or more, reflexed, ovate, concave, greenish; petals 5, free, ovate-oblong, slightly longer than sepals, flat, petaloid, with a nectariferous spot often covered by a small scale near base inside; stamens usually many, free; anthers introrse, longitudinally split; heads of carpels globose, 8-10mm across, receptacle short, short-pilose, carpels 1-locular; styles distinct; stigma terminal or oblique; ovules solitary, ascending. Achenes many, obovate, flat, glabrous, c.3.5mm long, with an indistinct ridge along the upper margin, the style prominent, distinctly recurved. Fl. Apr.-Jul.

Wet places in mountains; Kuriles, Korea, Japan, China, Ryukyus (Ohwi 1965).

RAUWOLFIA [Rauvolfia]

(Apocynaceae)

Rauwolfia caffra *Sond.* **(R. natalensis** *Sond.***)** – msesewe

Rauwolfia cubana *DC.*

Rauwolfia densiflora *Benth. ex Hook. f.*

Rauwolfia inebrians *K. Schum.*

Rauwolfia obliquinervis *Stapf*

Rauwolfia pentaphylla *Huber ex Ducke* **(R. duckei** *Markgr.***)**

Rauwolfia rosea *K. Schum.*

Rauwolfia sellowii *Muell. et Argov.*

Rauwolfia serpentina *(L.) Benth. ex Kurz* **(Ophioxylon majus** *Hassk.***; O. serpentinum** *L.***)** – Indian snakeroot, sarpaganda, sarpagandha, chandrika, chota-chand

Rauwolfia tetraphylla *L.* **(R. canescens** *L.***; R. heterophylla** *Roem. et Schult.***; R. hirsuta** *Jacq.***; R. tomentosa** *Jacq.***)** – American serpent wood, devil pepper, borrachera, boboro, cocotombo, matacoyote, veneno, guataco colorado, comida de culebra, viborilla, amatillo, chalchupa, yerba de San Jose

Rauwolfia verticillata *(Lour.) Baill.* **(R. brevistyla** *Tsiang***; R. cambodiana** *Pierre ex Pit.***; R. chinensis** *(Hance) Hemsl.***; R. latifrons** *Tsiang***; R. perakensis** *King et Gamble***; R. superaxillaris** *Li et Huang***; R. taiwanensis** *Tsiang***; R. yunnanensis** *Tsiang***; Cerbera chinensis** *Spreng.***; Dissolena verticillata** *Lour.***; Ophioxylon chinensis** *Hance***)** – luo fu mu

Rauwolfia viridis *Roem. et Schult.*

Rauwolfia vomitoria *Afzel.* **(R. senegambiae** *DC.***)** – African serpentwood, swizzle-stick tree, penpen

R. serpentina root has long been a valued herb in India and the Malay Peninsula, often used to treat venomous bites or stings [for which it is probably not very effective], and insanity; it has also been put to use as a hypnotic and uterine-contractant. Other traditional applications include uses as a vermifuge, and remedy for diarrhoea, dysentery, cholera and fever. R. serpentina and *reserpine* [one of the major active constituents] have more recently been used in the west for insomnia, high blood pressure, mental disorders, mania and epilepsy. *Reserpine* is now little-used in modern medicine due to the fact that some people may develop depression [sometimes suicidal] after prolonged use, as well as the strong likelihood of adverse reactions with other drugs, including psychiatric medications. The root may be made into a tea, or chewed. It is reputedly used by some saddhus to enter a tranquil state conducive to meditation, and was endorsed and used by Mahatma Gandhi. A number of Rauwolfia spp. are used medicinally in China for their roots, including R. verticillata, as antihypertensives, tranquillisers, and treatments for dermatitis and malnutrition (Blackwell 1990; Chopra et al. 1965; Emboden 1979a; Huang 1993; Morton 1977; Nadkarni 1976).

Rauwolfia spp. are widespread and much used in parts of Africa. In the Kilimanjaro region of Tanganyika, the Chaga add bark of R. caffra, roots or other parts of R. obliquinervis, and/or unspecified parts of R. inebrians to their **Musa**-based beer ['mbege'] to increase its potency [see *Methods of Ingestion*]. There is some incidence of death amongst people who regularly drink such fortified mbege. In Kenya, R. caffra stems are similarly added to beer. The fruits of R. caffra have caused a kind of mania followed by convulsions in dogs who have eaten them. Some species are used to kill dogs on purpose, such as R. mombasiana and R. obliquinervis. R. mombasiana roots have also been used by humans as a suicidal poison. Roots of R. rosea are aphrodisiac, and are used by the Shambala to treat venereal diseases. In Madagascar, aerial parts of R. capuroni and R. obtusiflora have been used as ordeal poisons (De Smet 1998; Watt & Breyer-Brandwijk 1962). Many species are emetic and purgative, and are used medicinally in cases where this is a virtue. Root of R. vomitoria is tonic and purgative, and the bark treats fever, indigestion and scabies (Watt & Breyer-Brandwijk 1962). It has been given in decoction to control tetanus spasms and suppress maniacal behaviour; it may also induce a deep sleep for several hours. It is sometimes given as an enema in the Ivory Coast for aphrodisiac effects, after evacuation (Morton 1977; Watt 1967). As 'sarna de perro', Rauwolfia spp. are used in Mexico to treat mental illness (Heffern 1974).

Rauwolfia spp. are known for their indole alkaloids, especially *reserpine*, which is a hypotensive sedative, hypnotic and tranquilliser [see *Chemical Index*]. Root barks yield greater alkaloid levels than the whole root, containing up to 90% of the total alkaloids.

R. caffra root bark has yielded *reserpine*, ajmaline [AChEI], *ajmalicine*, serpentine [AChEI, also inhibits histaminase, inhibits cancer cell replication], *rescinnamine*, raucaffrine, and traces of *yohimbine*, aricine, renoxidine and sarpagine (Beljanski & Beljanski 1982; Habib & Court 1973; Orgell 1963a; Sachdev et al. 1965); stem bark has yielded 0.025% alkaloids, consisting mostly of ajmaline, norajmaline, *ajmalicine* and ajmalicinine (De Smet 1998).

R. cubana stem bark has yielded tetrahydroalstonine, ajmaline, 16-epi-affinine, aricine, amerovolfine and amerovolficine (Martinez et al.

1989a).

R. densiflora roots and leaves showed sedative effects in rats (Weerakoon et al. 1998).

R. pentaphylla from Brazil has yielded up to 0.45% *reserpine* (Mors & Rizzini 1966).

R. sellowii, also from Brazil, yielded [from root bark] 1.2% ajmaline, 1.5% aricine, 0.0056% tetrahydroalstonine, 0.0009% *ajmalicine*, and small amounts of *reserpine* and tetraphyllicine. The alkaloid fraction containing *reserpine* was weakly sedative and hypotensive in animals; this activity was not exhibited by the other alkaloid fractions (Pakrashi et al. 1955).

R. serpentina root may contain 0.5-7.0% alkaloids – 0.05-0.2% *reserpine*, 0.02% rauwolfinine [hypertensive], 0.1% isoajmaline [hypotensive, causes drowsiness], 1.0% neoajmaline, *ajmalicine*, ajmalinine [hypotensive], ajmaline [stimulates respiration and intestinal movement, cardiac depressant], ajmalicidine, ajmalimine, ajmalinimine, serpentine [hypotensive, inhibits intestinal movement], serpentinine [hypotensive, purgative], rauwolfine, isorauwolfine, *rescinnamine*, *deserpidine*, chandrine [antiarrhythmic], rauwolscine [hypotensive, cardiovascular depressant, hypnotic], raujemidine [half as tranquillising as *reserpine*], rescinnamidine, sandwicoline, sandwicolidine, alstonine [antipsychotic-like effects in animals, inhibits replication of cancer cells], indobine, indobinine, isorauhimbine, N-methylraumadine, *papaverine*, raucaffricine, raumacline, renoxydine, reserpenediol, seredine and yohimbinine. Also present are oleoresins with hypnotic and sedative activity; steam distillation of the oleoresins yielded 0.22% essential oil, with serpoterpine the major constituent. The powdered root is taken orally as a tranquilliser in 100-150mg doses, twice daily; the effect is delayed in onset, and may be long-lasting [up to several weeks]. Do not take for extended periods. It can also have purgative actions, and supresses sexual desire and performance (Beljanski & Beljanski 1982; Bruneton 1995; Buckingham et al. ed. 1994; Chopra et al. 1965; Costa-Campos et al. 1998; Morton 1977; Siddiqui et al. 1987a, 1987b).

R. tetraphylla root has yielded 0.1-6.34% alkaloids – 0.04-0.17% *reserpine*, 0.1% rauwolscine, *deserpidine*, heterophylline, *ajmalicine*, ajmaline, alstonine, corynantheine, isoraunescine, raunescine, raujemidine, reserpiline, reserpinine, reserpoxydine, serpine, serpentine, *yohimbine* and β-*yohimbine*; and serposterol. Fruit is poisonous, and latex can cause blistering. The crude alkaloid extract of the root bark has sedative properties at 50mg/kg in rats – toxic effects only appeared at twice this dose (Madawala et al. 1994; Morton 1977). Leaf and fruits [both mature and immature] from Rockhampton, Queensland [Australia], harvested in December, tested strongly positive for alkaloids (Webb 1949).

R. verticillata root has yielded 1.31-2.7% alkaloids [0.04-0.107% *reserpine*] (Huang 1993).

R. viridis root bark and root wood have yielded (+)-ajmaline, (+)-quebrachidine, (-)-rauviridine, (+)-serpentine, (+)-sorpagine, (-)-*vobasine* and (+)-*yohimbine* (Martinez et al. 1989b).

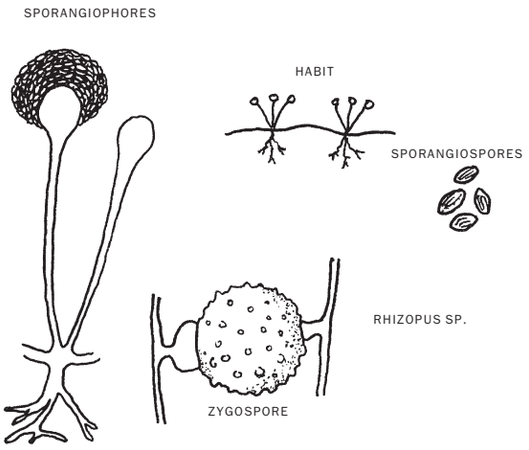
R. vomitoria leaves [harv. in Ghana] have yielded [w/w] 0.012% carapanaubine, 0.0005% isocarapanaubine, 0.006% aricine, 0.0015% reserpiline, 0.003% isoreserpiline, 0.0025% rauvoxine, 0.0008% rauvoxinine, 0.00175% tetrahydroalstonine, 0.0002% α-*yohimbine*, 0.00025% raucaffrinoline, 0.0002% perakine, 0.0002% peraksine, 0.00013% picrinine, 0.0001% normacusine B, 0.00028% akuammiline, 0.0003% deacetylakuammiline, 0.00013% desacetyldesformoakuammiline and 0.00008% geissoschizol (Amer & Court 1980). Root has yielded 0.79-10% alkaloids; 0.01-0.02% *reserpine*, ajmaline, alstonine, isoreserpiline, mitoridine, purpeline, rauvanine, rauvomitine, rescidine, reserpiline, *rescinnamine*, sarpagine, seredamine, serpentenine and *yohimbine*. Large doses may cause paralysis and death (Bruneton 1995; Morton 1977).

Rauwolfia serpentina is an erect, glabrous shrub, 30-60cm(-1m) high; roots tortuous, often yellowish, cross-section showing a substantial proportion of finely radiated wood, cortex thin. Leaves whorled, in cymes of 3-4, 8-18cm long, thin, lanceolate or oblanceolate, acute or acuminate, tapering gradually into the petiole; peduncles alternating with terminal leaves, becoming lateral. Flowers white or pinkish; peduncles 5-13cm long; pedicels red; calyx red, 5-lobed, lobes 2.5mm long, lanceolate, eglandular within; corolla salver-shaped, about 1.2cm long, tube cylindric, slender, inflated a little above the middle around the stamens, throat usually hairy within, lobes much shorter than tube, obtuse, overlapping to the left; stamens included. Disc cupular or annular; carpels 2, distinct or connate; ovules 2 in each carpel, collateral. Ripe carpels drupaceous, single or didymous and more or less connate, c.6mm diameter, purplish-black when ripe, usually 1-seeded. Seeds ovoid; albumen fleshy.

Native to India, found up to 1219m; Sub-Himalayan tracts, plains near foothills from Sirhind east to Assam; also in Konkan, n. Kanara, s. Mahratta Country, w. & e. Ghats, Bihar, n. & c. Bengal (Bruneton 1995; Chopra et al 1965). Also in Malaysia and Indonesia; cultivated in India and the Philippines (Chevallier 1996).

RHIZOPUS

(Mucoraceae)



Rhizopus nigricans *Ehrenb.* **(R. stolonifer** *(Ehrenb. ex Fr.) Vuill.***)** – soft rot, ear rot

This is a mould found on some vegetables [sweet potato (see **Ipomoea**), carrots (**Daucus**), beans, onions, lettuce (**Lactuca**), strawberries, **Citrus** fruits, pears, peaches (see **Prunus**) and avocado], infestation being noticed by the foul-smelling, watery liquid that exudes from the fruit or vegetable, which turns soft (Hocking & Pitt 1996). 'Tempeh' products are prepared using Rhizopus spp., especially R. oryzae [see also **Aspergillus**] (Kinosita & Shikata 1965), which is very similar to R. nigricans. These moulds may also be found in soil (Gilman 1957).

R. nigricans tested strongly positive for alkaloids; these have been shown to include the ergot alkaloids [see **Claviceps**] *agroclavine*, ergosine and ergosinine (El-Refai et al. 1970; Sallam et al. 1969; Spilsbury & Wilkinson 1961). Rhizopterin, fumaric acid, androstane-3,6,17-diol, 11,17,21-trihydroxypregnane-3,20-diol and 3,11-dihydroxyandrostan-17-one have also been found (Buckingham et al. ed. 1994). Some of the compounds known to be produced by R. nigricans are powerful toxins (Kinosita & Shikata 1965), and the fungus should not be directly consumed. R. arrhizus has also tested positive for alkaloids, mostly fumigaclavine B (Spilsbury & Wilkinson 1961).

Rhizopus nigricans has mycelium of 2 kinds – one submerged in the substratum, and the other aerial, arching filaments or stolons; stolons creeping, recurving to the substrate in the form of arachnoid hyphae, strongly raised and distant from the substrate, implanted at each node by means of rhizoids; internodes often to 1-3cm, hyphae +- branched; sporangiophores rarely single, united in groups of 3-5 or more, 0.4-4mm tall, 24-42µ diam., summit of sporangiophore enlarged into an apophysis with columella inserted above the point where the spherical bend attaches to the filament, apophysis broad and cuneiform; sporangia white at first, bluish-black at maturity, hemispheric, 100-350µ; columellae broad, hemispheric, depressed, 70(-250)µ diam. x 90(-320)µ tall, forming after dehiscence by collapse; spores unequal, irregular round or oval, angular, striate, 9-12µ long x 7.5-8µ diam., grey-blue; zygospores formed in substratum and on stolons, round or oval, 16-220µ diam.; exine brown-black, verrucose; suspensors straight, swollen, usually unequal, azygospores present.

Found in soil; recorded from northern hemisphere (Gilman 1957).

RHUS

(Anacardiaceae)

Rhus aromatica *Aiton* – oak-leaf sumac [also spelt 'sumach'], fragrant sumac, skunkbrush sumac, skunkbush

Rhus copallina *L.* **(Schmaltzia copallina** *(L.) Small***; Toxicodendron copallinum** *(L.) Kuntze***)** – copal sumach, dwarf sumac, winged sumac, flameleaf sumac, shining sumach, Texas sumac

Rhus glabra *L.* **(Schmaltzia glabra** *(L.) Small***; Toxicodendron glabrum** *(L.) Kuntze***)** – red sumac, smooth sumac, dwarf sumac, upland sumac, mountain sumac, vinegar tree, maw-ko-la ['tobacco mixture'], no'-anio-ni-mai'-ki ['mixing ingredient'], haz-ni-hu ['water fruit bush'], chanzi ['yellow wood'], nuppikt ['sour top'], pekwana' nomishi, dimeyov

Rhus radicans *L.* **(Toxicodendron radicans** *(L.) Kuntze***)** – zumaque, poison ivy

Rhus trilobata *Nutt. ex Torr. et A. Gray* **(R. aromatica ssp. trilobata** *(Nutt. ex Torr. et Gray) W.A. Weber***; R. aromatica var. trilobata** *(Nutt. ex Torr. et Gray) Gray***; Schmaltzia trilobata** *(Nutt. ex Torr. et Gray) Small***)** – aromatic sumac, ta-n-pai-a

Rhus typhina *L.* **(R. hirta** *(L.) Sudw.***; Toxicodendron typhinum** *(L.) Kuntze***)** – stag's horn sumach, velvet sumac, Virginian sumach, vinegar sumac, vinegar tree

The leaves, and sometimes the bark of R. glabra are used by some N. American tribes [such as the Omaha, Zuni and Kiowas] as a smoking herb, to be used alone or mixed with tobacco [see **Nicotiana**] or other herbs. The Cheyenne smoke R. aromatica with tobacco, 'dogwood' [see **Cornus**] and 'bearberry' [see **Arctostaphylos**]. The Kiowa mix the leaves of R. glabra with tobacco to add to the purifying effects of the tobacco; the mixture is smoked at the beginning of a peyote [see **Lophophora**] ceremony. It was noted by R.E. Schultes that "this blending of sumac and tobacco is so well liked by men and women generally that it is common in everyday social smoking". The Cheyenne believe R. glabra was given to them by the great spirit. R. glabra also has many medicinal uses. The Cherokee chewed the berries to stop bedwetting and vomiting; the berries also make a red-black dye. The astringent root yields a yellow dye, and is used to treat urine retention and painful urination. Leaves and berries may be applied externally to wounds and irritations. The Ozarks use the twigs as chew-sticks, to prevent tooth-decay. The Comanche and Kiowa also smoke R. trilobata with or without tobacco. In the vicinity of Missouri and the Mississippi, R. copallina leaves have been smoked as a tobacco substitute, and in Virginia, R. typhina leaves are similarly used. R. aromatica fruits were chewed by the Cheyenne as an analgesic for toothache; the Kiowa ate them to treat flu and stomach ache. The Comanche chewed the bark and swallowed the juice to treat colds (Cooke 1860; Hamel & Chiltoskey 1975; Kindscher 1992; Schultes 1937a; Winter 1998). Resin from Rhus spp. may also be used as 'copal' incense [eg. see Bursera and Protium in *Endnotes*] (Case et al. 2003).

In Tanganyika, the Shambala use the root of R. natalensis to relieve fits in children (Watt 1967), and in Basutoland, R. erosa is used as an ash added to snuffs, often based on tobacco (Watt & Breyer-Brandwijk 1962).

Care should be taken not to confuse any sumac with poisonous species, now generally transferred to the genus Toxicodendron. Representatives include 'eastern poison oak' [T. toxicarium], 'western poison oak' [T. diversilobum], 'poison ivy' [R. radicans] and 'poison sumac' [T. vernix]. They have whitish fruits in axillary pendulous clusters; the 'good' sumacs have red fruits. The toxic species release an oily sap [most abundant in spring and summer] when bruised or even brushed past lightly; this sap is highly irritating and results in severe dermatitis, as does the fruit when eaten. The sap may contain toxins such as urushiol and toxicodendrol. Inhaling smoke from the burning plant may apparently result in the same symptoms of toxicity (Foster & Caras 1994), though in Mexico, R. radicans is used with caution when dry as a 'stimulant narcotic'. Its toxic properties are believed by locals to exist mainly in the fresh plant (Heffern 1974).

Although generally safe in low doses, high doses of R. glabra tincture [30-120 drops] have produced toxic reactions such as gastric pain, headache, ulceration of the mouth, diarrhoea, water retention and night sweats. R. glabra caused an unintentional intoxication of sorts in one 19th century plant enthusiast. After manual contact with fresh branches of the plant [being used to swat mosquitoes] and eating some of the berries, vivid dreams of flying through the air were experienced over the next three nights (Millspaugh 1892). When smoked, R. glabra induces a mild and pleasant alteration of consciousness that is difficult to adequately describe. The lady who sold me the sample that I tried has since claimed to a friend of mine that it "opens the third eye" (Baill pers. comm.), yet such extravagant claims abound in many naïve New Age circles.

R. glabra contains the flavonoid fustin [antibacterial, antiviral; inhibits NADH-oxidase and succinoxidase], methylgallate, gallic acid, gallotannic acid, 4-MeO-3,5-dihydroxybenzoic acid, calcium bimalate, resins, sugars, starch and a gum; leaves also yield 15-27% tannic acid. The plant has antibacterial properties (Buckingham et al. ed. 1994; Harborne & Baxter ed. 1993; Kindscher 1992; Saxena et al. 1994) and inhibits human plasma AChE (Orgell 1963b).

Rhus glabra is a sparsely-branched shrub to 6m tall; younger branches and petioles glabrous and somewhat glaucous. Leaves alternate, pinnately compound; leaflets 11-31, lanceolate to narrowly oblong, 5-10cm long, apex acuminate, margin commonly serrate, upperside dark green and shiny, leaflet paler beneath; rachis of leaf not winged. Flowers small, in large terminal panicles to c.20cm long, sometimes male and female flowers separate; calyx 5-lobed; petals 5, greenish; stamens 5, inserted beneath a disc surrounding the ovary; pistil 1, with 3 carpels. Ovary 1-celled, sessile on disc, with single ovule; styles 3, terminal; ovule basal, inverted from apex of its funiculus. Fruit a bright red drupe, densely covered with minute obovoid hairs c.0.2mm long, rounded, 3.5-4.5mm diam. Fl. May-Jun.; fr. Aug.-Sep.

Abundant in upland soil, old fields, roadsides, wood margins; New England to British Colombia, south to Florida, Texas and Mexico (Gleason 1952).

RHYNCHOSIA

(Leguminosae/Fabaceae)

Rhynchosia longiracemosa *Martens et Galeotti* **(Dolicholus longiracemosus** *(Martens et Galeotti) Rose***)** – peyote

Rhynchosia phaseoloides *(Sw.) DC.* **(R. bicolor** *Micheli***; R. erythrinoides** *Cham. et Schltdl.***; R. phaseoloides var. precatoria** *(DC.) Griseb.***; R. precatoria** *DC.***; R. pyramidalis** *(Lamarck) Urban***; Dolicholus phaseoloides** *(Sw.) Kuntze***; D. pyramidalis** *(Lam.) Britton et P. Wilson***; D. vailiae** *Rose***; Glycine phaseoloides** *Sw.***)** – piule, bejuco culebra, coralito, favinha, huayruru-huasca, kokriki, mulungu, olho de onca, pega-palo ['virility vine'], guatabe, pimande, oja de cangrejo, atecuxtli, crab-eye

What are believed to be seeds of a Rhynchosia sp. are depicted in the Mexican Tepantitla fresco [dating from approximately 300-400AD], falling from the hand of Tlaloc, the Aztec rain god. The context of their representation has caused some to suggest that they may have visionary properties. Today in Oaxaca, the seeds are known as 'piule', a word used also to refer to visionary **Psilocybe** mushrooms, and some species of morning glory [see **Ipomoea** and **Turbina**] (Emboden 1979a; Ott 1993; Schultes 1969c; Schultes & Hofmann 1980, 1992). R. longiracemosa is known to be 'narcotic', and is referred to in some areas of Mexico as 'peyote' [see **Lophophora**], further alluding to psychotropic properties (Schultes 1937a, 1937b). Its seeds are recorded as having been used magically. R. phaseoloides seeds are known to be 'narcotic' and toxic, as well as causing 'insanity'. Accordingly, they have been powdered and given to the unsuspecting to cause harm. In northern Mexico, the plant is used as a topical analgesic. In the Dominican Republic, a stem decoction or alcohol extract is used as an aphrodisiac for males. It is reputed to increase sexual desire and strengthen performance, though animal studies have so far not confirmed these properties (Diaz 1979; Farnsworth et al. 1967; Jiu 1966). As R. precatoria, it has been claimed that the seeds are used in some areas of Mexico to prepare a 'sinicuichi' beverage [see **Heimia**] (Blomster 1964a).

Rhynchosia sp. seeds have shown a curare-like action in animals similar to, but weaker than that of **Erythrina** spp. (Diaz 1979).

R. phaseoloides seed has yielded an un-named alkaloid [Rhynchosia alkaloid A] and ethyl gallate; the foliage contains the flavonoids cajanin, genistein [MAOI (Hatano et al. 1991)] and 2'-OH-genistein (International… 1994; Ristic & Thomas 1962). Stems were estimated to contain 0.19% crude alkaloids, which were not identified, as well as saponins, tannins, phenols and inorganic acids; flavonoids appeared to be absent. The stem extract acted as a CNS-depressant in mice. An extract of the seeds showed some curare-like activity in animals (Farnsworth et al. 1967).

R. suaveolens leaves have yielded *mangiferin*, isomangiferin, luteolin, orientin, isoorientin, vitexin, isovitexin, vicenin-2 and (+)-pinitol (Adinarayana & Ramachandraiah 1985).

R. australis [leaf], R. cunninghamii [leaf, stem, seed] and R. minima [leaf, stem], all growing in Queensland, Australia, gave negative results in alkaloid screening (CSIRO 1990).

Rhynchosia phaseoloides is a perennial climbing herbaceous vine; stems to 6m or more from a woody base, velvety-pubescent throughout, subterete or ribbon-like. Leaves pinnately trifoliate; leaflets broadly ovate to rhomboid, obtuse to shortly acuminate, somewhat attenuate, 5-10(-13) x (1.5-)3-7(-8)cm, velvety-puberulent but green on both sides, subglabrous adaxially, tomentellous beneath, bearing small resinous glands at least beneath; petioles stoutish, 1-5cm long; stipules small, very early deciduous; stipels absent. Flowers in axillary racemes 10-30cm long or less; bracts caducous, linear-lanceolate to ovate-lanceolate, 2-3.5mm long, early deciduous; pedicels 2-3mm long; calyx 5mm long, campanulate, 4-5-toothed, puberulent, tube 1.5-2mm long, lower teeth linear-subulate, 4-5mm long, upper ones about ½ as long; corolla 7-10mm long; standard yellow streaked with dark crimson, obovate or orbicular, erect or reflexed, puberulent and resinous-dotted on back; wings narrow, ovate; keel green, falcately curved upwards, obtuse; stamens diadelphous; anthers alike, 2-locular. Ovary superior, subsessile, 1-locular; ovules 2; style simple, filiform, glabrous. Pods oblong, compressed, constricted between seeds, 2-2.5cm x 8-15mm, puberulent, 2-valved, dehiscent; seeds 1-2, compressed-subglobose, 5-6mm diam., bright red around hilum, shining black on upper part, proportions of black and red areas variable. Can flower all year round, depending on location.

Climbing over shrubs, in thickets and woodland margins, 300-1200m; central Sonora [Sonoran Desert] to San Luis Potosi and tropical Central and South America, including Caribbean (Adams 1972; Shreve & Wiggins 1964).

Propagate by nicking the seed, and sowing in damp peat moss with bottom heat. Transplant into rich, well-drained soil. Grow outdoors in warm-hot climates; cut back and bring indoors for winter in colder climates (Grubber 1973).

ROEMERIA

(Papaveraceae)

Roemeria refracta *(Stev.) DC.* **(R. rhoeadiflora** *Boiss.***; Glaucium refracta** *Stev.***; Papaver refractum** *(DC.) K.F. Ginther***)**

This Eurasian poppy does not seem to have any traditional uses – however, its chemistry warrants our interest, being the only poppy so far known to contain *ephedrine* and pseudo-*ephedrine*.

R. refracta has yielded 0.016% l-*ephedrine* and 0.024% d-pseudo-*ephedrine* (Konovalova et al. 1940), as well as a great variety of isoquinoline alkaloids – including roemerine [0.01%], roemeramine, roemerenine, remrefidine, remrefine, roemeroline, roefractine [0.0002%], roemecarine [0.0003%], armepavine, pseudolaudanine [0.0002%], eschscholtzinone, reframidine, reframine, reframoline, norefamidine, refractamine, amurine [0.003%; tranquilliser, analgesic, expectorant], noramurine and aporheine. Flavinantine has also been found in the plant (Buckingham et al. ed. 1994; Gözler 1988, 1990; Gözler et al. 1990; Guinaudeau et al. 1975; Harborne & Baxter ed. 1993; Konovalova et al. 1939).

R. hybrida has yielded two new proaporphine-*tryptamine* alkaloids, (-)-roehybramine-β-N-oxide and (-)-roehybridine-α-N-oxide (Günes & Gözler 2001).

Roemeria refracta is a slender, annual herb with foetid yellow sap; stems up to 50cm or more tall. Leaves usually alternate, 2-3-pinnatisect with narrow, +- linear segments, the lower petiolate, the upper sessile, segments terminated by bristles. Flowers actinomorphic, showy, solitary on short peduncles; buds narrowly pyriform, apex obtuse, c.1cm long; sepals 2, separate, soon deciduous; petals 4, free, undivided; filaments of the stamens dilated. Ovary linear-cylindrical, superior; stigmas stalked, 3-4, not borne on a disc, capitate. Fruit a siliquiform capsule, linear, cylindrical, more than 10 times as long as wide, opening by 3-4 valves, unilocular, glabrous except for 4 setae which extend above and between the stigma lobes, attenuate at apex; seeds numerous, unappendaged. Fl. Jun.

Turkey, Iran, Afghanistan, w. Pakistan; reported as a weed in Utah and California (Bailey & Bailey 1976; Davis ed. 1965).

SALVIA

(Labiatae/Lamiaceae)

Salvia amarissima *Orteg.*
Salvia apiana *Jeps* – white sage, sage brush
Salvia argentea *L.*
Salvia carnosa *Dougl. ex Benth.*
Salvia chinensis *Benth.* **(S. japonica var. chinensis** *(Benth.) E. Peter***; S. japonica var. integrifolia** *Franch. et Sav.***; S. prenia; S. tashiroi** *Hayata***)** – Chinese sage, shih-chien-chuan, shi-jian-chuan, hsiao-tan-shen
Salvia coccinea *Jussieu ex Murray* **(S. coccinea** *Buc'hoz ex Etl.***; S. galeottii** *Martins***; S. glaucescens** *Pohl.***; S. pseudococcinea** *Jacq.***)** – tropical sage
Salvia divinorum *Epling et Jativa* – diviner's sage, seer's sage, hierba Maria, ska Pastora, hojas de la Pastora, ska Maria Pastora
Salvia elegans *Müll.-Arg.* – pineapple sage
Salvia farinacea *Benth.* – mealy sage
Salvia greggii *A. Gray*
Salvia guaranitica *St.Hilaire ex Benth.* **(S. caerulea** *Moc. et Sessé ex Benth.***)** – anise-scented sage
Salvia haematodes *Wall.* **(S. pratensis** *L.***)** – meadow clary, meadow sage, red sage, behen, lal-bahamana, hexgimaie
Salvia 'indigo spires'
Salvia leucantha *Cavanilles* – Mexican bush sage
Salvia lyrata *L.* – lyre-leaf sage, cancer weed
Salvia mellisodora *Lagasca* – grape-scented sage
Salvia miltiorrhiza *Bunge* **(S. yunnanensis** *C.H. Wright***)** – dan shen, tan shen, tan sêng, scarlet sêng, red rooted sage
Salvia officinalis *L.* – common sage, garden sage, Dalmatian sage, herba sacra
Salvia persepolitana *L.*
Salvia plebeia *R. Br.* – kokaburadi, bhui-tulsi, shati, nirvisham, chin-khing-kai, Australian sage
Salvia purpurea *Cavanilles*
Salvia sclarea *L.* – clary sage, clear eye
Salvia sonomensis *Greene* – creeping sage, Sonoma sage
Salvia splendens *Sell. ex Roem. et Schultes* – scarlet sage, splendid salvia
Salvia x superba *Stapf.*
Salvia triloba *L. f.* **(S. fruticosa** *Mill.***)** – three-lobed sage, Turkish sage, Dalmatian sage, Greek sage, faksomilo
Salvia tubiflora *Smith* **(S. biflora** *Ruiz et Pav.***)** – nucchchu
Salvia uliginosa *Bentham* – bog-marsh sage, bog sage
Salvia spp. – sage

Common sage [S. officinalis] is well known for its culinary uses, though it has long been said to give longevity; its genus name comes from the Latin 'salvere', meaning 'to save'. It is also renowned as a nerve tonic, said to restore failing memory, quicken the senses and promote wisdom. The Romans treated it with great reverence and gathered it with respect and ritual in mind, wearing a white tunic and bare feet, after washing and offering food sacrifices to the plant. In TCM, it is used as a yin tonic to calm and simultaneously stimulate the nervous system; it also acts as a muscle relaxant. The Cherokee used it alternately with S. lyrata to treat nervous debility, as well as other common disorders. In s. Italy, S. officinalis is sometimes smoked with **Datura** stramonium to treat asthma. It is useful in treating menstrual irregularities due to its content of oestrogen precursors. The herb is astringent, antiseptic, tonic, digestive and intoxicating – it also treats asthma, sore throats and intestinal gas (Bremness 1988, 1994; Chevallier 1996; Chiej 1984; Cunningham 1994; Hamel & Chiltoskey 1975; Lawless 1994; Ody 1993; Ott 1993; Simonetti 1990; Tierra 1988). The herb has been described as having a 'narcotic' action (Pammel 1911). In commerce, S. triloba is frequently substituted for S. officinalis. In Crete and other parts of Greece it is popular as a tea, made using a shoot 15-20cm long per cup. It is reputed to give "a feeling of well-being" and to act as a blood purifier (Tucker 2004; Tucker et al. 1980).

S. sclarea ['clary sage'] seeds were once used to treat eye problems, and powdered and mixed with wine they were said to help incite lust. The Germans used it in wine, and the English used it around the 16th century to make their beer more intoxicating. Clary sage is also an excellent nerve tonic, and is much used in aromatherapy, where it is said to be aphrodisiac, euphoric, sedative, relaxing, rejuvenating and inspiring; its use seems to inspire vivid dreams. If taken with alcohol, it can cause nausea or nightmares. In herbal medicine, it is used to treat period pain, menstrual disorders, menopausal complaints, gas, indigestion and asthma (Bremness 1994; Chevallier 1996; Cooke 1860; Lawless 1994). The psychotropic properties of S. sclarea are also felt when the dried foliage or flower buds are smoked; S. sclarea var. 'Turkestanica' is also active when smoked (pers. obs.). One person who took a bath with clary sage essential oil, having also just consumed a small vodka, experienced open-eye hallucinations, though otherwise, the mental effects were no stronger than the essential oil alone (theobromus pers. comm.).

S. miltiorrhiza is valued in TCM for its roots, which act primarily as a heart and circulation tonic. It clears blood congestion and treats angina, palpitations, menstrual problems, impact injuries, liver disease and inflammations. It is an antioxidant, mild vasodilator, hypotensive, analgesic,

antibacterial and sedative, and treats insomnia and nervous exhaustion or irritability (Bone 1996; Bremness 1994; Bruneton 1995; Chevallier 1996; Hsu et al. 1986; Huang 1993). It should not be taken with warfarin, as it interferes with the elimination of that toxic coumarin (Fugh-Berman 2000).

S. apiana, 'white sage', is used as a smudging plant by native N. Americans in s. California, due to the purifying properties of its smoke. However, it often seems to be confused in the literature with **Artemisia** ludoviciana, which is also called white sage, and used in the same way. It is unfortunate that the 'true' sage of the two plants is the one that is usually overlooked! S. apiana leaves are psychotropic when smoked (pers. comms.).

S. carnosa is smoked or drunk as a stimulant, and to treat epilepsy and faintness by the Hopi. S. haematodes root is used in Indian folk medicine as a tonic aphrodisiac, and to prevent premature ejaculation, as well as to promote erection, properties which have been confirmed in rats. It also acts as a *diazepam*-like anxiolytic, cerebral tonic and cardiotonic. As S. pratensis, it has been claimed to be 'narcotic', as has the Mexican S. amarissima. S. persepolitana may not be psychoactive, but was once proposed to be the identity of 'haoma' [see **Peganum**]. S. sonomensis is a mild stimulant when smoked (Heffern 1974; Islam et al. 1991; Nadkarni 1976; Ott 1993; Pammel 1911; Pendell 1995), and in S. Africa, S. chamelaeagnea leaf is infused to relieve convulsions (Watt 1967). The Soto of Africa smoke S. repens, S. runcinata and S. stenophylla with their tobacco [see **Nicotiana**], and burn them to cleanse a hut after a sickness (Watt & Breyer-Brandwijk 1932). In Basutoland, Salvia spp. are used as ash with snuffing tobacco (Watt & Breyer-Brandwijk 1962).

Interestingly, Moroccan legends tell of Sidi Hidi, who lived at an uncertain time in history, and was said to have introduced 'kif' [**Cannabis**] to Morocco. It has been claimed, however, by an informant from the small town named after him [as it is believed to have been his final resting place], Sidi Hidi did not smoke kif, but a mixture of two local sages – a similar leaf is engraved on the stem of many sebsi pipes [long, thin Moroccan pipes for smoking kif] of the region (Clarke 1998). Obscurely, the Nahuatl of the Sierra de Puebla of Mexico use an unidentified Salvia sp., 'xiwit', which is smoked, and an infusion drunk, before going to sleep in order to experience vivid and prophetic dreams (Diaz 1979; Mayagoitia et al. 1986). S. mellisodora has been claimed to be sacred to the Tarahumara (Gruber 1997), however this was an error resulting from a miscommunication (Glass pers. comm.). S. tubiflora flowers are often depicted on wooden cups and pottery from Incan times, in Peru. The Incans used the flowers and a flower infusion in rituals to placate the forces responsible for causing earthquakes, a practice still observed recently in Cuzco (Towle 1961).

S. splendens has been found by some humans to be a mild antidepressant and anxiolytic with some persistent effects lasting for up to several days [at least for some of my correspondents]. More immediate effects when smoked or taken sublingually may include relaxation, slight heightening of visual perception, and a mild dissociative state. Many horticultural varieties of this herb exist, and the most effective of several types investigated was the 'Blaze of Fire' cultivar (Christian & Simon pers. comm.). The 'Sizzler' varieties have been observed to be completely inactive by some; these varieties are very common in horticulture, at least in Australia (Torsten pers. comm.). Still, some believe this species is not active at all. Following this interest, and the confusion between people who said the species was active and others who said they didn't notice any effects, Daniel Siebert conducted a small-scale double-blind experiment with 31 volunteers to determine whether S. splendens leaf was psychoactive at all. Viola odorata leaf was the chosen placebo, and the S. splendens samples used had been claimed to be active by others who had previously noted some effects from consuming the leaf. The results indicated that S. splendens performed similarly to the placebo, and therefore was considered non-psychoactive, or at least possessing some kind of very mild activity that was not detected by this study (Siebert1999). On the other hand, I have given active strains to friends to smoke, without telling them what it would do or indeed if it would do anything at all, just asking for them to describe any reaction that occurred - and these people described similar effects to those I had experienced from my own experiments. Also, the genus Viola may not be entirely devoid of psychoactivity, either [see *Endnotes*]. There still seems to be more to learn about the pharmacology of S. splendens and its many horticultural variants, and it may be that effects of active strains are only noticed by some people at some times, depending on their state of physiological balance. Adding to the confusion of such matters of subjective pharmacology, I know someone who smoked **Cannabis** for many years socially, before ever noticing any effects from it, and from then on, he got stoned every time he smoked it (pers. obs.).

S. uliginosa was found to be weakly psychoactive, similar to weak **Cannabis** leaf, in the form of a dried alcohol extract of the leaf [see *Producing Plant Drugs*], which was smoked through a water pipe. Also active by this method or by simply smoking the leaves and/or flowers were S. 'indigo spires' [a spontaneous cross between S. farinacea and S. longispicata], which roughly 1 minute after smoking produced a relaxing effect with mild dissociation, as did S. 'Huntington's red', S. involucrata, S. leucantha, S. purpurea, S. coccinea, S. elegans, S. guaranitica and S. haematodes (pers. obs.). Others have found S. argentea, S. chinensis [as S. prenia], S. farinacea, S. greggii, S. lyrata and S. superba to also be similarly psychoactive (friendly 1997; friendly pers. comm.). Of these, the whole plant of S. chinensis is used in TCM to treat asthma due to phlegm congestion, hepatitis, scrofula, carbuncles, dysphagia and leucorrhoea (Hsu et al. 1986). S. coccinea has been implicated in causing abortion in pregnant cows in Queensland, Australia (Webb 1948).

S. plebeia, of Australia and Malaysia, has been claimed to possess similar properties to S. divinorum [see below] (pers. comm.), though it is unclear how much broad generalisation or assumption was involved in this observation. I believe the person who passed on this information had probably not actually tried S. divinorum. In Australia, it is suspected of being poisonous to stock animals (Hurst 1942). In India, the seeds of S. plebeia are taken to treat seminal weakness and to "promote sexual powers". S. pumila apparently shares the same uses (Nadkarni 1976).

S. divinorum of Oaxaca, Mexico, is far removed from any of these sages in its effects. Medicinally, several leaves may be infused or applied as a poultice. They act as a tonic, treating diarrhoea, excessive urination, anaemia, headache and rheumatism. It has been proposed to represent the unidentified Aztec entheogen 'pipiltzintzintli' ['most noble prince' or 'venerable little children'], but it is now considered to be very unlikely that they could have been the same plant. However, besides the known traditional medicinal uses of S. divinorum in low doses, the herb is also traditionally employed by the Mazatec as a sacred shamanic ally. This is usually when **Psilocybe** mushrooms are out of season, or in early stages of shamanic tuition. Its use is not usually discussed casually or with strangers, and some of its names show an association with the Virgin Mary, most likely a remnant of earlier times when the plant was hidden and linked with Catholicism to avoid the wrath of the Spanish conquistadores. The plant is gathered with great respect, and its location kept secret. The leaves are usually taken in pairs when fresh – this may be from 20-80 pairs, with lower doses [4-6 pairs] reserved for non-psychotropic medicinal use. They may be wrapped in other leaves to keep them fresh – they are said to lose their strength on drying, but this is not true. After cleansing in incense smoke they are crushed on a metate and the juice drunk neat, or infused into water before drinking. A potent drink is said to have a good head of froth, which may signify an effective emulsion of the active compounds with the water [as they are not generally water-soluble] and ensure better absorption [as the non-emulsified compounds do not appear to be absorbed well through the stomach]. Alternately, and for a stronger effect using less plant matter, they are chewed as a whole quid kept in the mouth, without swallowing the saliva. The plant and its juices are very bitter, though today some 'palatable' strains [which are less bitter] have been cloned and made available commercially. The plant is taken shamanically in darkness and quiet, as light and sound distractions can greatly dissipate the intensity of the experience [this is not so with enriched smoking preparations, or vapourised *salvinorin A* – see below] (Diaz 1979; Ott 1993, 1996a; Siebert 1994; Valdés 1994; Valdés et al. 1983, 1987a; Wasson 1962, 1963).

More recently, Mexican youths have been observed smoking the dried leaves for a mild **Cannabis**-like effect. With continued use, however, this would be expected to give way to far stronger effects than anything comparable with **Cannabis**! For many years westerners investigating the effects of this plant believed it to be inactive or so weak, inconsistent and bad-tasting as to be barely worth pursuing, and attempts at isolating an active compound from the leaves had proven fruitless. The former was largely due to inappropriate methods of ingestion; the latter to the fact that researchers were searching for an alkaloid, as all previously known plant 'hallucinogens' contained alkaloids as their major active components [and S. divinorum does not]. It has recently been found that a simple denatured alcohol extract, evaporated onto ¼ the amount of the original leaf mass [see *Producing Plant Drugs*] and smoked in one deep inhalation, held in the lungs for as long as possible, is strongly active, so much so that many have described it as being 'too strong'. The dried leaf itself can also be quite strongly effective, provided the smoke is properly inhaled and the material is potent.

Effects at low dosage were compared by R.G. Wasson to the early stages of a **Psilocybe** mushroom experience. There may be vivid colour hallucinations, mild perceptual distortion and activation of thought processes [even lower doses may be milder and vaguely **Cannabis**-like – see above]. Some may dispute any similarity to **Psilocybe** – in truth, the activity of this plant is quite unique, especially at higher doses. Such doses can be intensely hallucinogenic, with the user losing motor co-ordination and awareness of physical surroundings, and entering extremely bizarre states of subjective reality. Effects last 1-2 hours when taken orally, or 20-30 minutes when smoked, though residual effects [usually pleasant] may linger. The most intense part of the experience is usually much shorter [ie. around 5 minutes when smoked]. When taken orally, particularly by drinking rather than chewing, the peak may be indistinct and can come and go over the course of the experience (Pendell 1995; Siebert 1994; Turner 1997; Valdés 1994; Valdés et al. 1987a; Wasson 1962; pers. comms.; pers. obs.). The plant has also had an obscure use as an antide-

pressant. One Australian suffering chronic depression, which had resisted prescribed treatments, chose to self-medicate with a chewed quid of 2-3 leaves taken three times a week. She experienced a complete remission of symptoms (Hanes 2001). The plant should be approached with care and respect, as it is truly a diviner's plant and does not appreciate being used casually or for idle recreation. Since the rediscovery of its remarkable activity, the plant has entered widespread cultivation [mostly from cuttings, as they rarely set seed], and both dried leaf and enriched extracts have become widely available. Following this, in 2002 the plant and products derived from it became illegal in Australia, and it appears the US may shortly follow suit (pers. obs.). Currently, the plant and *salvinorin A* are restricted for sale to minors in St Peter's, Missouri; illegal in Louisiana [along with a whole list of psychoactive plants, many of which contain no prohibited substances]; pending probable banning in several other US states; illegal/controlled as a category B drug in Denmark; illegal in Italy; controlled substance [*salvinorin A*] in Belgium; the herb prohibited for sale only, in Spain; illegal to import without doctor's prescription in Finland; and controlled in S. Korea (http://www.sagewisdom.org/new.html).

It would seem at this stage that most members of the genus will prove to possess varying degrees of psychoactivity, though so far none have been found with any great subjective similarity to S. divinorum. Many other Salvia spp. have been sampled and found to be psychoactive, and the distribution of diterpenoids [which seem to be the main active chemicals in Salvia spp.] including clerodanes, neo-clerodanes, labdanes, abietanes, etc. is widespread in the family Labiatae [eg. see also **Leonotis**, **Lagochilus**, **Scutellaria**] (friendly 1997; Lamius pers. comm.; pers. comms.; pers. obs.).

S. apiana roots have yielded cryptotanshinone, miltiodiol, salvicanol, ferruginol, 6,7-didehydroferruginol, 16-OH-6,7-didehydroferruginol, 6,7-didehydrosempervirol, lanugon Q, 6-deoxo-5,6-didehydrolanugon Q, 16-hydroxyroyleanone and other diterpenes; 16-OH-carnosic acid, oleanolic acid, ursolic acid, α-amyrin and an essential oil have also been found in the plant (González et al. 1992).

S. argentea has yielded salvigenin, *apigenin*, genkwanin, chrysoeriol, luteolin, hispidulin, eupatorin, 5-OH-7,4'-(MeO)2-flavone, rosmarinic acid and caffeic acid (Adzet et al. 1988).

S. coccinea aerial parts [harv. June, Italy] have yielded 0.055% salviacoccin, a neo-clerodane diterpenoid (Savona et al. 1982).

S. divinorum contains *salvinorin A* [divinorin A] as its main active constituent, a neoclerodane diterpenoid found at concentrations of 0.056-0.37% in dry leaf; 0.0015-0.007% salvinorin B [divinorin B] has also been found in the pharmacologically-inactive TLC fraction of the extract. Stems have yielded <0.063% *salvinorin A* (Bigham et al. 2003; Gruber 1997; Gruber et al. 1999; Lee et al. 2005; Munro & Rizzacasa 2003; Ortega et al. 1982; Valdés et al. 1984). More recently, a minor constituent of the active TLC fraction [banding together with *salvinorin A*] was identified as salvinorin C [divinorin C], present at c.10% of the active fraction; it is difficult to isolate without decomposing, though 0.0065-0.025% has been isolated. This compound may prove to be potently psychoactive, or synergistic with *salvinorin A*, based on the greater subjective effects experienced with the whole active fraction, as opposed to purified *salvinorin A*. This increased activity might instead be due to contamination of the salvinorin C extract with *salvinorin A* (Lee et al. 2005; Munro & Rizzacasa 2003; Valdés et al. 2000, 2001). The leaf also yielded the antrepellant loliolide [0.0004%] (Valdés 1986); terpenoids (-)-hardwickiic acid [0.0005-0.0006%], oleanolic acid [0.0003%], presqualene alcohol [0.006-0.01%], peplusol [0.0027%] and (E)-phytol [0.0026-0.005%]; and additional neoclerodane diterpenoids - divinatorins A [0.0042%], B [0.0048%], C [0.0004-0.0027%], D [0.0003%] & E [0.0002%], salvinorins D [0.0004-0.013%], E [0.0003%], F [0.0001%] and G [0.0002%], and salvinicins A & B; neophytadiene and stigmasterol were tentatively identified but not isolated (Bigham et al. 2003; Harding et al. 2005; Lee et al. 2005; Munro & Rizzacasa 2003). The diterpenoids produced by this species have been found to be concentrated in a resin accumulated in peltate glandular trichomes [1 of 4 types of trichomes observed on the plant] on undersides of leaves, stems and floral organs (Siebert 2004). As well as the potent κ-receptor agonist properties of *salvinorin A* which are now well-known, salvinorin B, salvinorin G and divinatorin D have been found to be weak agonists at the same receptor (Lee et al. 2005).

S. elegans showed strong binding affinity for muscarinic *acetylcholine* receptors (MacKenzie 2000; Wakea et al. 2000).

S. haematodes has yielded 7β-OH-20(29)-lupen-3-one (Buckingham et al. ed. 1994), flavonoids, glycosides, sterols, tannins (Islam et al. 1991) and c.0.14% *choline* (Balansard & Rizzo 1934).

S. mellisodora leaf contains an unidentified terpenoid which reacted similarly to *salvinorin A* in analysis; however, it did not seem to be identical and remains unidentified (Gruber 1997). Numerous neoclerodane-diterpenoids and mellisodoric acid have been found (Buckingham et al. ed. 1994).

S. miltiorrhiza contains a wide array of constituents, the most important being the diterpene ketones called tanshinones, which interact with BZ-receptors to varying degrees. The main constituent is tanshinone IIA [up to 0.5%] – also found are tanshinone I, 1,2-dihydrotanshinone I, cryptotanshinone, methylene cryptotanshinone, methylene tanshinquinone, tanshinol I & II, miltirone [a partial BZ-receptor agonist], 1,2-didehydromiltirone, 4-methylenemiltirone, Ro 09-0680, salvianolic acid, salviol and vitamin E, as well as essential oil. It is decocted in a dose of 2-15g or more a day. The tanshinones are extracted most efficiently with diethyl ether. Indole-3-butyric acid can increase tanshinone concentration in the roots. Aerial parts have yielded a new germacrane sesquiterpene, as well as abietane diterpenes (Bone 1996; Buckingham et al. ed. 1994; Chevallier 1996; Hsu et al. 1986; Huang 1993; Lee et al. 1991; Liu et al. 1995; Shimomura & Kitazawa 1991).

S. officinalis has yielded 0.7% [spring] to 1.5% [autumn] to 2% [summer] essential oil. For best results, leaf should be harvested when it has turned silvery, from its younger green stage. Essential oil yield is highest when plants receive regular harvesting [at least twice a year, once in summer], containing the psychoactive *thujone*s in some strains [highest in winter and summer, lowest in spring]; 17-43% α-*thujone*, 1.7-8.5% β-*thujone* [or up to 66.83% total *thujones*], 0-33.3% *camphor* [highest in spring], 3.7-4.5% *borneol*, 0-14% 1,8-cineole, 10.8-30.3% caryophyllene, 8.45-33.7% humulene, 0.9-10.2% eucalyptol, 0.5-1% linalool, 0.5-3% limonene, 1.7-6.5% α-*pinene* and others have been found. It also contains oestrogens, as well as tannins, mucilage and vitamins, and bitter diterpene diphenol lactones called picrosalvins. As picrosalvin, dry leaves have yielded 1.8%, and fresh leaves yielded 1.3%. Contains more α-*thujone* after flowering (Battaglia 1995; Bianchi et al. 1989; Brieskorn & Fuchs 1962; Brieskorn et al. 1961; Bruneton 1995; Chiej 1984; Ivanić & Savin 1976; Putievsky et al. 1986a; Tucker et al. 1980). Also, c.0.14% *choline* has been found (Balansard & Rizzo 1934). The herb causes slight inhibition of plasma AChE (Orgell 1963b).

S. plebeia has been shown to contain nepetin, neopitrin, hispidulin, homoplantaginin, 4-OH-phenyllactic acid and caffeic acid (Jiang et al. 1987).

S. sclarea has yielded 0.1% essential oil, consisting of mainly linalool, with linalyl acetate, *pinene*, citronellol, limonene and others; and the labdane diterpenoids sclareol and 13-episclareol (Chevallier 1996; Lawless 1994; Popa & Lazur'evskii 1963), which are mostly found in the residue after distillation of the essential oil; as well as salvigenin, *apigenin*, genkwanin, luteolin, chrysoeriol, 5-OH-7,4'-(MeO)2-flavone, rosmarinic acid and caffeic acid (Adzet et al. 1988); c.0.14% *choline* has also been found (Balansard & Rizzo 1934). *Thujone* is found in seeds, and in 5-day old seedlings (Balansard & Rizzo 1934; Popa & Lazur'evskii 1963; Verzár-Petri & Then 1974).

S. sonomensis contains a *camphor*-like substance (Pendell 1995).

S. splendens contains the diterpenoids salviarin [0.007%] (Savona et al. 1978), splendidin [0.04%] (Savona et al. 1979), splenolides A, B and C (Hu et al. 1997), as well as salvianin, bisdemalonyl-salvianin, monodemalonyl-salvianin, salviadelphin, bisdemalonyl-salviadelphin, monodemalonyl-salviadelphin, dimalonylawobanin, monardein and monodemalonyl-monardein (Buckingham et al. ed. 1994).

S. triloba leaf bore the most essential oil during summer [1.4-3.8%], though yield of total herbage is highest in spring, and autumn harvests gave +- intermediate results. Inflorescences have yielded 0.22% essential oil. Oil from all parts is rich in 1,8-cineole [42.4-64%], also containing α-*pinene*, *camphor* [3.3-9.1%] and 1-7% *thujones*. Roots have yielded the abietane diterpenes sugiol, royleanone and 7α-acetoxyroyleanone (Liu et al. 1995; Putievsky et al. 1986b; Tucker et al. 1980). The plant has also yielded trilobinol, trilobinone and carnosol (Buckingham et al. ed. 1994; Bruneton 1995).

Many other Salvia spp. contain diverse diterpenoids, such as S. cyanescens, S. recognita, S. reflexa and S. thymoides (Gökdil et al. 1997; Maldonado & Ortega 1997; Nieto et al. 1996; Tan et al. 1998), which only comprise a very small selection. *Thujone* is also found in trace amounts in the essential oils of S. aethiopis [1.1%], S. glutinosa [0.3%], S. nemorosa [0.7%] and S. verticillata [0.6%], growing wild in Yugoslavia (Ivanić & Savin 1976).

Salvia divinorum is a perennial herb, 0.5-1.5m tall, with flowering stems 1-3m long. Stems hollow, quadrangular, with flanged angles, hirtellous, green, translucent, crisp. Leaves opposite, elliptic to ovate, apex acuminate to caudate, base attenuate, up to 10-30cm long, 5-10cm wide, glabrous above, glandular-punctate below, irregularly crenate-serrate margins. Racemes erect, simple, 30-40cm long, internodes 2-4cm; cymules with 3-12 flowers; rachis hirsute, glabrate; bracts ovate, concave, sessile, basally rounded, apex acuminate-cordate, 1-3cm long, 0.6-1cm wide, tardily deciduous, mainly violet; pedicels hirsute, slender, straight, violet, 4-9mm long. Calyx 10-12mm long, lips subequal, glabrate to glandular-puberulent, violet; upper lip 1.5mm long with 3 major veins. Corolla 28-32mm long, sigmoid, densely villous with translucent hairs 0.5-2mm long, white, glabrous within, lips becoming tinged with blue in age; tube 19-22mm long, 2mm high, 1.2mm wide at narrowest near throat; galea 8-10mm long; lower lip cupped, 5mm long and 7mm wide when flattened, middle lobe emarginate. Stamens glabrous, white, slightly arcuate, 15-16mm long, rudders 10-11mm long, entire; anthers 2mm long; pollen white. Style 27-32mm long, densely bearded below stigma, white. Gynobase horn 3mm long, 1.2mm wide, white, glabrous. Nutlets 1.8-

2mm long, 1-1.2mm wide at maturity, dark brown. Fl. Sep.-May [though I have seen it flowering in August in NSW, Australia (pers. obs.)].

Endemic to the Mazatec zone of the Sierra Madre Oriental, Oaxaca, Mexico; on black soil in ravines close to primary or secondary cloud and tropical evergreen forest, 300-1800m (Epling & Játiva-M. 1962; Ott 1996a).

The plants only flower when stems have grown to 2m or more, and very rarely set viable seed. Spreads by rooting at the nodes where the stems bend to touch the ground. Plants are grown in discrete locations in the forest, and are not overtly maintained, being more or less free to grow wild, which they do readily. It is uncertain whether it exists in a truly wild state. It is a cultivar, the parents of which are unknown, and some inhabitants of Oaxaca say it is not native to that area.

S. divinorum does not tolerate strong direct sunlight for extended periods [if not yet hardened, it may not withstand even short periods of direct sunlight]; requires a warm, humid, moist environment, though not so moist as to cause rotting of the stems. Outside of semi-tropical areas, it should be grown in a greenhouse or humidity tent [with good air circulation] and regularly misted. Although frost protection is required, some growers have managed to adapt their plants to grow in well-chosen outdoor locations in temperate zones [such as Oakland, California and Sydney, Australia]. In such areas, it is sometimes best to keep them in pots so they can be brought inside during winter; however, some misting should be maintained at this time as the dry atmosphere inside a house may adversely affect the health of the plants. Soil should be kept moist on top, though take care not to over-water. Roots easily from cuttings. Grow in soil with pH 6.1-6.6. A successful soil mixture for this plant consisted of 1 part aged grass cuttings; 1 part compost; 1 part coarse sand; ½ part aged steer manure; 3 parts rich soil. When watering and misting, avoid using water more than 150ppm hardness, or with sodium levels above 50ppm. Plants may be victim to attack by whiteflies [attracted to yellow traps], aphids [prey to ladybugs], spider mites, scale insects [hand remove] and snails. Whiteflies, aphids and scale insects may also be killed and removed by application of a spray made from 4 parts water, 1 part rubbing alcohol and 1 part liquid castile soap, which is harmless to the plant and to the human consumer, though the plants should be rinsed afterwards. Leaves that drop from the plant naturally can still be used sacramentally, though they may only have c.2/3 the potency of leaves harvested whilst still attached to the plant (Ott 1996a; Sociedad 1998; Turner 1997; Valdés et al. 1987a; pers. comms.; pers. obs.).

SANTALUM

(Santalaceae)

Santalum album *L.* **(S. myrtifolium** *Roxb.***; S. verum** *L.***)** – Indian sandalwood, white sandalwood, yellow sandalwood, white saunders, santal, anindita, chandan, chandanam, srighanda, t'an hsiang, t'an xiang, t'an muh

Santalum lanceolatum *R. Br.* **(S. oblongatum** *R. Br.***)** – sandalwood, northern sandalwood, Queensland sandalwood, bush plum, plum bush, plumwood, black currant tree, bolan, tharragibberah, gumamu, yarnguli, birmingal

Santalum murrayanum *(Mitchell) Gardner* – bitter quandong, ming

S. album, used in India for thousands of years, is valued for the scent of its essential oil, as well as for its medicinal properties. The ancient Egyptians imported the tree from India for use in embalming, perfume and cosmetics; in Ceylon it was also used in embalming. Temples and carvings were often made of sandalwood, partly because it is immune to termite attack. The wood is burned as incense in funeral pyres and during some religious ceremonies in India, as it is believed to repel evil and invite forces of protection and healing. The Parsi use sandalwood, pomegranate wood, and frankincense [see **Boswellia**] to feed the sacred fire in Zoroastrian observance. The Japanese sometimes burn it for Shinto ceremonies, and at Buddhist shrines. Yogis say that the fragrance of sandalwood is that of the "subtle body, centre of the highest insight and enlightenment", and male practitioners of tantric yoga use it to help awaken the kundalini energy. Therapeutically, S. album is 'uplifting', 'exhilarating', aphrodisiac, sedative, nerve tonic, diuretic, antipyretic, diaphoretic, astringent, antiseptic, antiphlogistic, antispasmodic, carminative, emmolient and expectorant. In Unani medicine, it is said to be good for the memory. The wood is also used in TCM in a dose of 2-3g, as an analgesic, stomachic and carminative, and to treat nervous gastralgia (Battaglia 1995; Bremness 1994; Cunningham 1994; Haug 1884; Keys 1976; Kirtikar & Basu 1980; Lawless 1994; Nadkarni 1976).

The berries of the Australian S. lanceolatum are edible, though not as pleasant-tasting as 'quandong' fruits from S. acuminatum (Glowinski 1997). S. lanceolatum berries are said to be slightly narcotic or soporific when eaten in large quantities. The leaves are burnt by some indigenous peoples to 'smoke themselves' before going on a long trip, in order to gain strength for the journey. Newborn babies are also smoked in such a fashion, to make them "strong and placid" [see also **Acacia**, **Eremophila**]. The leaves are used to treat sores, boils and gonorrhoea; leaf and bark decoction is purgative; outer wood decoction treats chest problems; and root infusion is applied externally for rheumatism and itching (Aboriginal Communities 1988; Lassak & McCarthy 1990; Low 1990). The leaves have also been burned to repel mosquitoes (Cribb & Cribb 1981; Low 1990). Indigenous people at Lake Boga reportedly used the bark and roots of S. murrayanum to prepare a 'stupefying' drink (Low 1990). The seeds and roasted rootbark may be used as food (Low 1991a). A decoction of S. obtusifolium bark has been consumed to treat pains and constipation (Lassak & McCarthy 1990). The Australian S. spicatum is sometimes used to make an inferior quality sandalwood oil, as well as to make 'joss sticks' and cheap perfumes in China (Lawless 1994). In TCM, the heartwood is sometimes substituted for that of S. album (Huang 1993).

S. album oil is distilled from the roots and heartwood of trees at least 30-50 years old, yielding c.5.5% essential oil. Good quality oil contains large amounts of santalols [89-90%], 3.5% santyl acetate, 2-3% santalenes; as well as norecasantalal, norecasantalic acid, norecasantalol, α- and β-santalal, β-santenol, santalone, teresantalal, teresantalol, α-teresantalic acid, tricycloekasantal, tricycloekasantalol and many other compounds (Battaglia 1995; Lawless 1995; Nadkarni 1976; Simonetti 1990). One of the constituents is very similar to androsterone [a male pheromone hormone] (Lawless 1994).

S. lanceolatum leaves yield traces of essential oil, rich in lanceol [a sesquiterpenoid alcohol] and many unidentified components; the leaves also contain saponins, and high levels of calcium and potassium (Aboriginal Communities 1988; Lassak & McCarthy 1990). Leaf from Miles, Queensland [harv. Jun.] tested strongly positive for alkaloids (Webb 1949).

S. murrayanum leaves yielded 0.076% pyrrolizidine alkaloids – laburnine benzoate ester, laburnine thioacrylate ester and laburnine tiglate ester [see **Laburnum**]. In cats, 10mg/kg [i.p.] alkaloids caused pupil dilation and relaxation of the blinking membrane; 35mg/kg caused prostration. I.v. doses in dogs caused laboured breathing and scratching. 50mg/kg [oral] produced analgesia in 80% of test animals (CSIRO 1990).

S. obtusifolium leaves have yielded *glutamic acid*, proline and OH-proline (Lassak & McCarthy 1990).

Santalum album is a small, evergreen glabrous tree with slender, drooping branches; sapwood white and odorless; heartwood yellowish-brown, strongly scented. Leaves opposite, subcoriaceous, 3.8-6.3 x 1.6-3.2cm, elliptic-lanceolate, subacute, glabrous, entire, thin, base acute; petioles 1-1.3cm long, slender. Flowers hermaphrodite, brownish-purple, inodorous, in terminal and axillary 3-chotomous paniculate cymes shorter than the leaves; bracts minute; perianth tube campanulate, adnate to base of ovary, limb of 4 valvate triangular segments with a tuft of hair on the face; stamens 4, exserted, adnate to base of perianth lobes, alternating with 4 rounded obtuse scales; filaments slender, short; anthers ovate, cells distinct, parallel. Disc of fleshy spathulate scales, projecting between stamens; ovary at first free, ultimately ½-inferior; ovules 2-3, inserted below summit of long acuminate free central column; style elongate; stigma 2-3 lobed. Fruit a globose drupe, 1.3cm diam., purple-black; endocarp hard, ribbed. Seeds subglobose.

Well drained soil in forests; w. peninsula of India; cultivated elsewhere (Kirtikar & Basu 1980). Suckers on natural host trees to obtain its nutrients (Simonetti 1990).

S. acuminatum is cultivated from seed. The stone of the fruit is cracked in a vice, and the seed coat removed, before soaking the seed in chlorinated bleach for c.30min. Wash seed in boiled water; some choose to dust with fungicide before planting in sterile, moist vermiculite in brand-new [ie. clean] plastic bags, tied at the top. Leave bags in a dark and warm place [16-20°C]; germination should occur within 3 weeks. Plants require roots of a host plant; plant out seedlings in a pot with another plant growing in it, such as lucerne; poke a thin hole with a pencil to feed the roots into carefully, so as not to disrupt the required root contact (Glowinski 1997).

'Red sandalwood' [Pterocarpus santalinus] is a tree from the Leguminosae, unrelated to true sandalwoods, though its heartwood is also burned as an incense (Bremness 1994). The 'bitter quandong' S. murrayanum should not be confused with Elaeocarpus spp., some of which are also known as types of 'quandong' in Australia.

SASSAFRAS

(Lauraceae)

Sassafras albidum *(Nutt.) Nees* **(S. officinale var. albidum** *(Nutt.) S.F. Blake***; S. officinalis** *Nees et Eberm.***; S. sassafras** *(L.) H. Karst.***; S. variifolium** *(Salisb.) Kuntze***; Laurus albida** *Nutt.***; Laurus sassafras** *L.***)** – sassafras tree, fennel wood

Sassafras is a popular herb with native N. Americans, who had many medicinal uses for it as well as using it for its aphrodisiac properties. The Cherokee use a tea of sassafras to purify the blood, wash sore eyes, apply to wounds, and to treat skin diseases, rheumatism, venereal disease,

diarrhoea, colds and obesity – and, combined with other herbs, as an anthelmintic. They mix the flowers with beans for planting, and use the wood for furniture (Hamel & Chiltoskey 1975). All parts of the tree have been utilised for medicine, though the root bark is the strongest. Dried root bark was smoked ritually in smoking mixtures by many tribes [see **Nicotiana**, **Arctostaphylos**], and the Ojibway boiled the root pulp specifically for its 'narcotic' properties (Rätsch 1992). The ground leaves ['file powder'] are used to thicken Cajun soups, and the essential oil ['sassafras oil'] has been used to flavour tobacco [see **Nicotiana**] and toothpaste, and to scent soap and perfumes (Bremness 1994; Simonetti 1990). Sassafras oil is also effective for killing head lice (Battaglia 1995; pers. obs.).

Until recently sassafras was used to flavour root beer, though it is now banned as a food additive by the FDA on the premise that *safrole* [the main constituent of the essential oil] is carcinogenic and hepatotoxic (Hall 1973; Segelman et al. 1976). Because *safrole* is only 1/14th as carcinogenic as the ethanol in an alcoholic beverage [which is, of course, also hepatotoxic with continued exposure] (Ames et al. 1987), and as it is well known that no pure essential oils should be taken internally in quantity due to risk of hepatotoxicity, it may be more likely that this is a thinly veiled attack on the psychoactive potentials of the herb. Perhaps more seriously, from a legal perspective, the essential oil has been a favoured starting-point for illicit synthesis of MDA and MDMA. Sassafras oil is now very difficult to obtain in Australia, most likely for similar reasons (pers. obs.). Commercial sassafras oil has also been obtained from Ocotea pretiosa ['Brazilian sassafras oil' – see *Endnotes*] and **Cinnamomum** camphora ['Chinese sassafras oil'] (FAO 1995). See also **Atherosperma**, **Doryphora**.

The root bark may be brewed as a tea [28g/pint water is one suggested dose] (Gottlieb 1992), which would rely on the hydrophobic oils being suspended in the hot water, and water-solubility of some of the alkaloids. An alcohol extract may be a more viable approach. If you can obtain sassafras oil, it can be dropped under the tongue in small amounts only [10-15 drops] (pers. obs.). It has been suggested that the dried essential oil [presumably dried at low temperature] may be ingested [100-200mg] (Gottlieb 1992). I have not attempted this latter method, nor do I know of anyone who has. The effects of the essential oil taken sublingually may be perceived as mildly euphoric and stimulating, taking up to several hours to become particularly noticeable. I have also had very good effects from adding sassafras oil [again, c.10-15 drops] to sassafras-free root beer, combined with smoked **Cannabis** (pers. obs.). The essential oil may also be applied by muscular massage [see **Myristica**] (Torsten pers. comm.). There is at least one death on record – one man who ingested 1tsp of sassafras oil suffered "CNS depression, vomiting and nausea" before death. According to some, even "a few drops" has been lethal. In any case, extended or high-dose internal use would be expected to induce degeneration of the liver and possibly carcinogenesis (Battaglia 1995).

S. albidum essential oil [for commerce steam-distilled from the inner rootbark, which is harvested in summer and autumn] is found in all plant parts, but concentrated in the rootbark. One fresh sample yielded 3% essential oil by solvent extraction. The essential oil may contain [12.7-]70-90% *safrole*, 0-16.38% *asarone*, 0.57% *eugenol*, 1.1% *methyleugenol*, 0.61-27.4% 5-MeO-*eugenol*, 0.78% *elemicin*, 0.39% *myristicin*, 0.53% *apiole*, 0.6% *estragole*, 3.25-4.52% *camphor*, 0.1% *thujone*, α-*pinene*, traces of *anethole*, 10.17% piperonylacrolein, 6.5% coniferaldehyde and many other trace components. Also found in the root bark are heliotropin [piperonal], the aporphine alkaloids magnolol [antidepressant, muscle relaxant, sedative; see **Magnolia**], isomagnolol and boldine [hypnotic sedative], and the benzyl-tetrahydroisoquinoline alkaloid reticuline, as well as sassafrasine, sassafrasinine and (+)-3-(3,4-methylenedioxyphenyl)-propane-1,2-diol (Harborne & Baxter ed. 1993; Kamdem & Gage 1995; Lawless 1995; Segelman et al. 1975, 1976a; Sethi et al. 1976; Simonetti 1990).

Sassafras albidum is a shrub or tree up to 30m tall, aromatic. Leaves long-petioled, variable even on the same plant from ovate to deeply 2-3(-5)-lobed, 3-nerved, c.12cm long, at first silky beneath, pubescence either persistent or deciduous. Flowers greenish-yellow, produced from the apex of the branches of the previous year, appearing with the young leaves of the season in 5cm long racemes; peduncles and pedicels at first short, at maturity red and up to 10cm long; calyx 6-parted, persistent; stamens 9, the inner 3 each bearing a pair of stalked glands at base; anthers when mature splitting open towards the centre of the flower, 4-celled, opening by 4 valves; pistillate flowers with 6 short staminodia; pedicels expanded at apex at maturity, forming with the persistent calyx a cup-like base below the fruit. Drupe dark blue, ellipsoid, c.1cm long. Fl. Apr.-May.

In dry or rich woods, roadsides and old fields; Massachusetts and s. Ontario to Michigan, south to Florida and Texas (Gleason 1952).

May be easily cultivated in almost any soil. Sow seeds as soon as they are ripe; they become dormant once dry (Torsten pers. comm.). May also be propagated from suckers, or from root cuttings. In colder areas prefers a warm, sunny position (Grubber 1973).

SCELETIUM and some other similar Aizoaceous herbs

(Aizoaceae/Mesembryanthemaceae)

Aptenia cordifolia *(L. f.) Schwantes* **(Mesembryanthemum cordifolium** *L.***)** – brakvygie, ibohlololo
Bergeranthus scapiger *(Haw.) N.E. Br.*
Carpobrotus acinaciformis *(L.) L. Bol.* **(Mesembryanthemum acinaciforme** *L.***)** – Hottentot fig, sour fig, elandsvye, gouna, strandvy, suurvy, gaukum, hotnotsvy
Carpobrotus edulis *(L.) L. Bol. ex N.E. Br.* **(Mesembryanthemum edule** *L.***)** – Hottentot fig, kaffir fig, marine fig, Sally-my-handsome, choroes, balsamo, widdana, vyerank, gaukum, hotnotsvy, perdevy, suurvy
Drosanthemum bicolor *L. Bol.*
Drosanthemum floribundum *(Haw.) Schwant.* **(D. candens** *(Haw.) Schwant.***; Mesembryanthemum candens** *Haw.***; M. floribundum** *Haw.***)**
Drosanthemum hispidum *(L.) Schwant*
Khadia acutipetala *N.E. Br.* – khadi
Lampranthus aureus *(L.) N.E. Br.*
Lampranthus blandus *(Haw.) Schwantes*
Lampranthus coccineus *(Haw.) N.E. Br.*
Lampranthus roseus *(Willd.) Schwant.*
Lampranthus spectabilis *(Haw.) N.E. Br.* **ssp. spectabilis 'Mesembryanthemum arachnoideum'**
Mesembryanthemum cristallinum *L.* **(Crytophytum cristallinum** *(L.) N.E. Br.***)** – ice plant, diamond fig, brakslaai, slaai, soutslaai, slaaibos
Mestoklema tuberosum *(L.) N.E. Br. ex Glen* **(Mesembryanthemum tuberosum** *Harv.***)**
Sceletium anatomicum *(Haw.) L. Bol.* **(S. dejagerae** *L. Bol.***; S. emarcidum** *(Thunb.) L. Bol. ex H.J. Jacobsen***; Mesembryanthemum anatomicum** *Haw.***; M. emarcidum** *Thunb.***; Tetracoilanthus anatomicus** *(Haw.) Rappa et Camarrone***)** – kanna, channa, guena, skeleton-leaved fig-marigold
Sceletium expansum *(L.) L. Bol.* **(S. regium** *L. Bol.***; Mesembryanthemum expansum** *L.***; Pentacoilanthus expansus** *(L.) Rappa et Camarrone***)** – kanna, channa, kou, kougoed
Sceletium joubertii *L. Bol.*
Sceletium strictum *L. Bol.*
Sceletium tortuosum *N.E. Br.* **(S. boreale** *L. Bol.***; S. compactum** *L. Bol.***; S. concavum** *(Haw.) Schwantes***; S. framesii** *L. Bol.***; S. gracile** *L. Bol.***; S. namaquense** *L. Bol.***; S. ovatum** *L. Bol.***; S. tugwelliae** *L. Bol.***; Mesembryanthemum concavum** *Haw.***; M. namaquense** *Sond.***; M. tortuosum** *L.***; Tetracoilanthus concavus** *(Haw.) Rappa et Camarrone***)** – kanna, channa, kou, kougoed

Sceletium varians *(Haw.) Gerbaulet comb. nov.* **(S. subvelutinum** *L. Bol.***; Mesembryanthemum varians** *Haw.***)**
Trichodiadema bulbosum *(Haw.) Schwant.* **(T. stellatum** *Mill.***; Mesembryanthemum stellatum** *Mill.***)** – kieriemoer, koeriemoer, karremoer

For convenience, many different Aizoaceous plants will be discussed here, due to their similar ethnobotanical usages, or due to possessing similar chemistry. Many plants once classified as Mesembryanthemum spp. have since been reclassified, and are now known by some of the synonyms listed above. See also **Delosperma** and **Nananthus**. Sceletium spp. have been regarded as a subgenus of Phyllobolus, though Sceletium has since been revised, and retained as a genus. The name derives from the 'skeletonised' appearance of the persistent leaves of prior season's growth (Gerbaulet 1996).

It was first reported in the 1600's that the Hottentot and other S. African groups [eg. the Namaquaa] made use of small herbs called 'kanna' [or slight variations on that term], recorded to consist particularly of Sceletium expansum and S. tortuosum, as well as other members of the group, such as S. anatomicum and Carpobrotus edulis. They are still used today under that name, but confusion exists as to the identity of some of the earlier reported kannas, due partly to early descriptions of the effects of the drug [probably exaggerated] which are yet to be adequately demonstrated from Aizoaceous plants. Kanna is often associated with the eland, a shamanic animal also associated with fertility, healing, divination and trance. The herbs are usually prepared to make a product called 'kougoed', which is ready for chewing. Older texts indicate that around October, when Sceletium spp. are fruiting, might be the preferred time of year for harvest. The whole plant, or aerial parts only, are beaten together and then twisted into a 'pig-tail' and left in the sun to ferment for 8 days in a skin, canvas or [today] plastic bag [with turning after 2-3 days]; it is then dried, and usually chewed straight afterwards. For a quicker process, the fresh herb is buried in a sand oven for 1 hour before being removed and dried. Sometimes it is chewed without fermentation, though many native users attest it is not psychoactive until fermented; sometimes the residue is smoked after chewing, and may be consumed with **Cannabis**; occasionally, it may be snuffed, a route by which it is more potent. The primary reasons for employing kougoed are to quench thirst, increase strength, and to inebriate, either recreationally or in religious rites (Festi & Samorini 1995; Schultes 1966, 1967a; Smith, M.T. et al. 1996, 1998; Tyler 1966; Watt & Breyer-Brandwijk 1932, 1962). Some undetermined species, presently in commercial circulation as Sceletium sp. 'nova' or S. aff. tortuosum and Sceletium sp. SB661, have been found to have similar properties to the above species (friendly pers. comm.; Sacred Succulents 2002).

Leaf of S. tortuosum is also chewed by the Hottentot as an analgesic for toothache and abdominal pain; it was also once used by Cape farmers as a sedative, in the form of a decoction or tincture. The juice of S. anatomicum is consumed as a sedative in the Willowmore district, and indigenous mothers may give drops of the fresh juice to their children to help them sleep peacefully. Mesembryanthemum cristallinum has also been reported as causing intoxications, and M. arachnoideum [for which I can find no other mention of its existence as a species name] is said to possess 'very powerful properties'. C. edulis fruit was once infused and given by the Hottentot to ease birth; they also smeared the leaf juice over the newborn to make it strong and nimble. The astringent, diuretic leaf juice has also been gargled for sore throats and digestive problems. Roots [occasionally fruits] of M. acutilobum, Khadia acutipetala, Mestoklema tuberosum and Trichodiadema bulbosum have been used in brewing beer or 'khadi' mead [see also **Delosperma**, *Methods of Ingestion*], and sometimes as a yeast substitute in bread-making. The roots are said to cause intoxication and delirium. The Zulu use a leaf infusion of a Mesembryanthemum sp. to "relieve fearful dreams accompanying heart weakness", and other unidentified members of this genus have been applied for a variety of purposes – to treat skin sores, stomach troubles, cystitis, syphilis [with juice of a Tragia sp.], and as an emetic (Festi & Samorini 1995; Hargreaves 1999; Smith, M.T. et al. 1996; Steyn 1934; Watt & Breyer-Brandwijk 1932, 1962).

Several members of the genus Carpobrotus grow in Australia, where they are known as 'pigface' [C. glaucescens, C. modestus, C. rossii and C. virescens]. The fruits, and rarely also the leaves are eaten as food (Low 1989, 1991a). The leaf juice of C. glaucescens is reputedly effective in relieving the pain and irritation of bites from both biting midges and the Portuguese man-of-war ['bluebottle'] (Cribb & Cribb 1981). C. edulis is also naturalised in some coastal areas of southern and eastern Australia (Prescott & Venning 1984), and contemporary bioassays of this species growing in the US have [in some instances] revealed it to sometimes be more potent than Sceletium tortuosum, though of similar quality (pers. comms.). C. rossii, which is much more common than C. edulis in Australia [and looks very similar], has been prepared and ingested in the same manner as S. tortuosum, and appears to be inactive (pers. obs.).

Aptenia cordifolia is used by Zulu healers in S. Africa as one of their important medicinal plants. The leaves may be infused to relieve sore throat and perspiration; the herb is also anxiolytic, and acts as an antiinflammatory when applied externally. Interestingly, a black powder prepared from the plant is reputedly endowed with magical properties, and is used to protect against sorcery (Van Wyk & Gericke 2000; Van Wyk et al. 1997). Prepared in the same manner as Sceletium spp., this common and attractive ornamental herb has been found to have similar effects to S. tortuosum, but is of lower potency (pers. comms.).

These herbs contain *mesembrine*-type alkaloids [structurally similar to the crinane-type alkaloids found in plants of the Amaryllidaceae – see **Narcissus**]. They are divided into 4 subgroups – *mesembrine*, joubertiamine, pyridine-pyridone and tortuosamine, collectively known as Mesembryanthemum or Sceletium alkaloids (Jeffs 1981; Popelak & Lettenbauer 1967; Smith, M.T. et al. 1996). In earlier literature they have been compared to *hyoscyamine* or *cocaine* in action, though this is misleading, as the CNS effects are not equivalent, only some common properties being shared. Recently, *mesembrine*, mesembranol, mesembranone, and related alkaloids have been found to act as *serotonin*-reuptake inhibitors [SRIs]. These compounds, and synthetic derivatives of them [as well as prepared S. tortuosum and extracts of it], are being investigated for their potential in treating "depressive states, psychological or psychiatric disorders with an anxiety component, alcohol and drug dependence, bulimia nervosa and obsessive-compulsive disorders" (Gericke & Van Wyk 1997). Some people have experienced toxic symptoms resembling *serotonin* syndrome [see *Influencing Endogenous Chemistry*] from combining S. tortuosum with **Griffonia** simplicifolia extracts rich in *5-hydroxytryptophan*. Caution is advised when consuming *mesembrine*-type alkaloids with anything that may boost *serotonin* levels (friendly pers. comm.).

Traditionally kanna has been said to cause an excited intoxication, though until recently, earlier contemporary experiments [with 5g chewed plant; 15g decocted plant; or 150mg *mesembrine*] had produced inconclusive results – mydriasis, analgesia, loss of appetite, tingling in mouth, gagging reflex, congested feeling in the head and noises in the ears. Recently, distribution of kanna plants and kougoed preparations has become more widespread, and modern psychonauts have rediscovered that, besides chewing or smoking, snuffing the powdered material can produce strong effects, consisting of some or all of the above, as well as calm euphoria or mood-enhancement with clear thoughts, accompanied by a state of relaxed alertness and anxiolysis. For snuffing purposes it is best to powder the prepared herb in an electric coffee grinder, and snuff the fine powder that collects on the inside of the lid. For some, the prepared, powdered herb may be active sublingually in doses as small as 30mg. A more common dosage may be 50-200mg via this route; as little as 20-30mg may be required for snuffing. Kanna also synergises well with **Cannabis** and alcohol. The plants also are usually rich in oxalates [3.6-5.1% or more], which are highly acidic and astringent, and can have toxic effects in large amounts; this is the reason for the fermentation or heat-treatment of kanna, as this process degrades the oxalates (friendly pers. comms.; Smith, M.T. et al. 1996; Steyn 1934; Watt & Breyer-Brandwijk 1962; pers. obs.). However, oxalate-bearing species used in brewing fermented beverages or in bread making have been known to result in toxicity (Hargreaves 1999).

All species tested by M.T. Smith et al. (1998) were cultivated in Natal, S. Africa, and harvested at 3-4 years of age in winter, before flowering.

Aptenia cordifolia may contain significant levels of *mesembrine*-type alkaloids, as compared to many other Aizoaceae, though still only 13.6% of the levels found in Sceletium tortuosum. *Mesembrine* [c.9.7% of extract], 4'-O-demethylmesembranol [c.14.4% of extract] and 3 unidentified compounds were observed; 2 of these, comprising c.4.8% of the extract, appear to be indoles (Smith, M.T. et al. 1998); A. cordifolia also earlier tested positive for alkaloids (Steyn 1934).

Bergeranthus scapiger was shown to contain small amounts of mesembrenone [mesembrenine, or mesembrinine] and 4'-O-demethylmesembranol (Smith, M.T. et al. 1998).

Carpobrotus acinaciformis is said to contain *mesembrine* in leaves and fruits, as well as malic acid and citric acid [and their calcium salts] in the leaves (Watt & Breyer-Brandwijk 1932).

C. edulis has not been examined for alkaloids, but has yielded up to 17.1% catechol tannins, as well as malic acid and citric acid [and their calcium salts] (Watt & Breyer-Brandwijk 1962). Independent psychonauts have sometimes found it to be more strongly active than Sceletium tortuosum (pers. comms.).

C. rossii has given negative tests for alkaloids (CSIRO 1990).

Drosanthemum bicolor has been shown to contain small amounts of mesembrenone, 4'-O-demethylmesembranol, and an unidentified indole compound.

D. hispidum var. hispidum has been shown to contain small amounts of mesembrenone and 4'-O-demethylmesembranol.

Lampranthus aureus has been shown to contain small amounts of mesembrenone and 4'-O-demethylmesembranol, as well as 2 unidentified compounds, one of which [present in large relative quantities] appears to be an indole.

L. blandus contained small amounts of mesembrenone, as well as 2 unidentified compounds, one of which appears to be an indole.

L. coccineus contained small amounts of mesembrenone and an unidentified compound.

L. roseus contained small amounts of mesembrenone and an unidentified indole.

L. spectabilis contained small amounts of mesembrenone, 4'-O-demethylmesembranol and 2 unidentified compounds, one of which appears to be an indole (Smith, M.T. et al. 1998).

Mesembryanthemum cristallinum has yielded large quantities of oxalic acid, 43%[!] sodium and potassium salts [including potassium oxalate], as well as an uncharacterised alkaloid (Steyn 1934; Watt & Breyer-Brandwijk 1932).

Sceletium anatomicum aerial parts have yielded *mesembrine* (Rimmington & Roets 1938).

S. expansum has yielded *mesembrine* from the whole plant [up to 0.3% in leaves; up to 0.86% in roots and stems], and *mesembrine* and mesembrol from the leaf wax (Hartwich & Zwicky 1915).

S. joubertii has yielded 0.033-0.1% crude alkaloids, including (S)-joubertiamine, dehydrojoubertiamine [trace], dihydrojoubertiamine and joubertinamine [0.009% w/w], as well as *hordenine* (Arndt & Kruger 1970; Psotta et al. 1979). Gerbaulet (1996) regarded S. joubertii as a synonym of S. tortuosum, though this would seem unlikely on the basis of their quite different chemistry.

S. strictum [3yr-old cultivated plant] has yielded 2.65% crude alkaloids; over half was 4'-O-N-demethylmesembranol and 4'-O-N-demethylmesembrenol, as well as containing mesembranol [mesembrinol], mesembrenol, O-acetylmesembrenol, *mesembrine* and mesembrenone (Jeffs et al. 1970). Sceletenone, channaine [thought to be an artefact of extraction] and N-demethylformyl-mesembrenone have also been found (Abou-Donia et al. 1978; Trout & Friends 1999).

S. tortuosum stem and root have yielded 1.43% alkaloids, including 0.86% *mesembrine*; leaves yielded 0.3% *mesembrine* (Hartwich & Zwicky 1915; Rimington & Roets 1938), probably measured as a crude mixed alkaloid. As S. namaquense, up to 1% *mesembrine* has been reported (Jeffs 1981), and up to 4.6% crude alkaloids, including [besides *mesembrine*] mesembrane, mesembrenone, mesembranone [may be mesembrenone?], mesembranol, sceletenone, tortuosamine, formyltortuosamine, N-acetyltortuosamine, channaine [probably an artefact of extraction], 3'-MeO-4'-O-methyljoubertiamine and Sceletium alkaloid A4. Mesembrol and *mesembrine* are found in the leaf wax (Bodendorf & Krieger 1958; Capps et al. 1977; Jeffs et al. 1971; Smith, M.T. et al. 1996; Snyckers et al. 1971; Watt & Breyer-Brandwijk 1962). In another test, the whole plant [fresh] was shown to contain predominantly *mesembrine*, followed by large amounts of mesembrenone, as well as 4'-O-demethylmesembranol and traces of 2 unidentified compounds, one of which appears to be an indole (Smith, M.T. et al. 1998).

S. varians has yielded O-methyljoubertiamine and 2,3-dihydrojoubertiamine methyl ester (Smith, M.T. et al. 1996; Trout ed. 1997a); as S. subvelutinum, it has yielded joubertiamine, dehydrojoubertiamine, dihydrojoubertiamine, O-methyljoubertiamine, O-methyldehydrojoubertiamine, O-methyldihydrojoubertiamine and *hordenine* (Herbert & Kattah 1989).

Sceletium spp. have been shown to contain highest alkaloid levels in woody stems, followed by [in decreasing order] roots, green stems and leaves (Smith, M.T. et al. 1998).

Trichodiadema bulbosum has been reported to contain an 'intoxicating' alkaloid, possibly *mesembrine* (Watt & Breyer-Brandwijk 1932), though in an alkaloid screening the plant tested negative (Steyn 1934).

A sample of 'kougoed', probably consisting of either S. anatomicum, S. expansum or S. tortuosum, yielded 0.7% *mesembrine* and 0.2% mesembrenone; 1-1.5% total alkaloids were found (Popelak & Lettenbauer 1967). In samples prepared either by crushing and immediate drying, or the fermentation method, the levels of mesembrenone were doubled, *mesembrine* levels were halved, and 4'-O-demethylmesembranol levels were much reduced. It would seem, then, mesembrenone would be a major active component of kougoed (Smith, M.T. et al. 1998).

Drosanthemum floribundum, Glottiphyllum linguiforme [M. linguiforme], G. longum var. longum, Lampranthus deltoides, L. glomeratus [M. glomeratum], L. scabrum [M. scabrum], Mestoklema tuberosum, Nycteranthus splendens [M. splendens], N. umbelliflorus [M. umbelliflorum], Oscularia caulescens [M. caulescens][traces], O. deltoides, Prenia relaxata [M. relaxatum], Ruschia congesta [M. congestum], R. lineolata, R. multiflora [M. multiflorum], R. rubicaulis [M. heteropetalum, M. rubricaule][traces], R. tumidula [M. tumidulum] (Jeffs 1981; Steyn 1934), Tetragonia expansa (Webb 1949), Trichodiadema barbatum [M. barbatum] (Festi & Samorini 1995) and T. intonsum [M. intonsum] contain alkaloids which were not identified (Jeffs 1981; Smith, M.T. et al. 1998; Steyn 1934). See also **Delosperma** and **Nananthus**.

Sceletium expansum is a slightly succulent decumbent or scrambling herb or subshrub; stem diffuse; branches lax, slender, reflexed, 15-30cm long, often robust with age and erect, weakly lignified; bladder cell idioblasts small. Leaves weakly succulent, connate, not imbricate, flat, apex recurved, much-spreading, broad-lanceolate, acute, base attenuate, flat, keeled by the prominent middle nerve, rather glittering, subcarinate, papulose, marcescent, nerves and veins persistent, 2.5-3.8(-6.5)cm x 5-10mm, with +- straight secondary veins parallel to midvein, when young thickish, green, minutely papillate, when old marcescent and membranaceous, dried nerves persistent. Flowers large, bigeminate, ternate or bitternate in a terminal, elongated, thick peduncle, pale yellow, c.4cm diam.; pedicels 5-10mm long, bracteated; tepals 5; calyx 5-cleft, three of the lobes very large, two subulate, calyx tube adnate with ovary; petals very numerous, linear, as long as the longer calyx lobes, pale yellowish; stamens innumerable, in many rows united at base; petaloid staminodes to 2mm broad, emarginate, filamentous staminodes concealing stamens and stigmas. Ovary (4-)5(-20)-celled; stigmas 4-5, obtuse, to 2mm long; styles 5, short. Fruit c.1cm diam., 5-locular, many-celled, dehiscing in a star-like manner at summit, valve wings present; seeds many, brown, crested.

Karroid areas in wetter parts of Western Cape Province [S. Africa] from Malmesbury to Clanwilliam (Gerbaulet 1996; Harvey & Sonder 1984).

S. tortuosum and S. strictum are becoming rare in the wild due to over-harvesting.

Cultivate from seed in sterile seed-raising mix and humidity chamber; seeds are germinated in the same manner as cactus seeds. May also be grown from cuttings. Plants require good sunlight, dry air, and well-drained soil. Water frequently, allowing to dry out between waterings; water less in dormancy. Does not like excess nitrogen; tolerates temperatures as low as 5ºC (Festi & Samorini 1995). S. anatomicum enjoys lots of phosphate and potassium, and in periods of active growth, regular watering, without allowing the soil to dry out between waterings (theobromus pers. comm.).

Carpobrotus edulis is a prostrate subshrub with several long, branched, trailing stems to 2m long, 8-13mm thick, at length woody, angles +- marginate, rooting at the nodes; flowering branches 3-8 noded with elongated, ancipitous, +- 2-winged internodes 1-5cm long, the penultimate one to 13mm thick, lower ones c.5mm thick. Leaves very succulent, opposite, sessile, acutely triquetrous, dull green, glabrous, slightly incurved, gradually acute from the middle, in profile the keel +- parallel with edges and shortly upturned to apex, mostly as thick as wide, thicker near tip, all faces slightly concave, keel permanently serrulate (at least in upper part), most 4-8cm long, 8-17mm wide, 8-15mm thick. Flowers 7-8.5cm diam., pedicellate; pedicel slightly compressed, 10-20mm long, ancipitous, with acute serrulate edges; calyx tube turbinate or oblong-turbinate, or with convex edges, passing gradually into pedicel, slightly compressed, edges acute, serrulate-crenulate, (15-)20-25mm long and wide, (13-)17-22mm thick; sepals 5, the 2 longest 20-45mm long with serrulate keels, others short with leafy green points, densely dotted almost to edge of membranous margins; petals c.120-130, 3-5-seriate, yellow at first, later flesh-pink and becoming nearly white at base, obtuse to +- acute in outline, 30-35 x 1.5-2.5mm, densely streaked throughout when dry; stamens c.400-600, c.6-7-seriate, filaments 3.5-7mm long; anthers yellow, 1.8-3.5mm long. Ovary convex at apex with a central depression, becoming depressed in fruit; styles 8-10, 7-15mm long. Fruit dull yellowish, pedicellate, nearly hemispherical to subglobose or obovoid, slightly compressed, depressed on top, c.2.5-3cm long, 2.5-3.5cm wide and thick; seeds obovate-lenticular, nearly symmetrical, 1.15-1.55mm long, 0.7-1.05mm wide.

S. Africa [coastal regions of Cape Province and Natal]; grown as a sand-binder and ornamental in s. Europe, US [California] and Australia [coastal regions in WA, SA, Vic., NSW and Tas.] (Blake 1969).

Very similar to C. rossii (pers. obs.), which is distinguished by the keel of the leaf and larger sepals being mostly smooth, and by its light purple or deep pink petals, which later fade (Blake 1969).

SCHISANDRA [Schizandra]

(Schisandraceae/Magnoliaceae)

Schisandra chinensis *(Turcz.) Baill.* **(Kadsura chinensis** *Turcz.***; Maximowiczia chinensis** *(Turcz.) Rupr.***)** – wu wei zi, wu wei dze, wu wei tzu, pei wu wei tzu, fruit of five flavours, magnolia vine

Schisandra sphenanthera *Rehder et E.H. Wilson* **(Kadsura peltigera** *Rehder et E.H. Wilson***)** – nan wu wei tzu, nan wu wei zi ['southern five flavour fruit']

The dried berries of S. chinensis [and the less often used S. sphenanthera] are a prized tonic stimulant in TCM, with many medicinal virtues. They are considered to have a sour and warm energy, with an affinity for the kidneys and lungs – their wide array of effects is believed to be due to possessing all five flavours or energies of TCM. The berries are tonic, adaptogenic, rejuvenative, aphrodisiac, CNS-stimulant, respiratory stimulant, astringent, antitussive, demulcent and antidiarrhoeic, as well as improving mental function and learning skills, promoting a sense of well-being, increasing stamina, stimulating the immune system, improving oxygen absorption, promoting semen production, slowing aging, stabilising blood pressure and controlling perspiration. They can improve the sensitivity of vision and hearing, enlarge the visual field, and increase the speed of adaptation to dark. Goldi hunters once chewed the berries to

strengthen themselves on sable hunts, sometimes taking only a handful of the berries and no other provisions. Although chewing several of the pungent-tasting dried berries at a time is the best method of consumption, they may also be decocted in a dose of 2-6g (Bone 1996; Bremness 1994; Halstead & Hood 1984; Hsu et al. 1986; Huang 1993; Komarov & Shishkin ed. 1985b; Reid 1995).

The flesh of S. chinensis berries contains high levels of sugars as well as citric acid, ascorbic acid [vitamin C], tartaric acid, malic acid, fumaric acid, sorbic acid and protocatechuic acid; the inner seed coat contains a large amount of essential oil [with *citral*, β-chamigrene and β-chamigrenol]. Essential oil content is higher in spring [0.6%] than in autumn [0.2%]. Berries also yield vitamin E, triterpenic acids, triterpene lactones, and up to 4.19% lignans – such as schizandrin, schizandrin B, deoxyschizandrin, γ-schizandrin, schizandrol, gomisins A-T, wuweizisu C, 6-O-benzoylgomisin O, sesquicarene and 5-OH-methyl-2-formaldehyde. The lignans have CNS-depressant activity, but the total extract acts as a stimulant. The fruit antagonises the respiratory depressant activites of *morphine*, and the central convulsant effects of *caffeine*, as well as potentiating the stimulation caused by *strychnine*. It also has synergy with **Eleutherococcus** (Bone 1996; Brekhman & Dardymov 1969b; Bruneton 1995; Chen et al. 1994; Halstead & Hood 1984; Hsu et al. 1986; Huang 1993; Senov 1940; Slanina et al. 1997). S. sphenanthera berries are less effective as a tonic and nutrient, but are still effective in relieving coughs (Bensky & Gamble 1993).

Schisandra chinensis is a liana with woody stems, climbing to 8m; bark rugose, dark brown; branches ascending, often winding around main stem, young stems flexuous with smooth, yellowish bark. Leaves elliptic, obovate or obovate-elliptic, c.10 x 5cm, cuneate, gradually tapering to the apex, with few, often obscure teeth, somewhat fleshy, slightly hairy beneath along veins, dark green, often with red petioles and prominent midribs beneath; petioles c.3cm. Pedicels 1-4cm, slender, pendulous; flowers dioecious, c.2cm diam.; perianth petaloid, white, wax-like, with a pleasant aroma, sometimes becoming pink before the end of flowering; tepals 6-9, the outer drooping, the inner convergent, oval-oblong, obtuse, often narrower than the outer; staminate flowers with 5 unusually short filamented stamens fused into a short, stout column; antherous column half as long as perianth. Pistillate flowers with very short-pedicelled, subcylindrical receptacle, densely covered with pistils; pistils numerous, rounded, with short style and crest, becoming dark red after ripening; ovary 2-celled; stigma oblique, stout, broad, with 2 narrow crests inside the margin; ovules 2 in each cell, pendulous. Fruit globular or obpyriform; during ripening, the fruiting receptacle elongates up to 50 times, causing the aggregate fruit produced from one flower to appear like an erect, unbranched raceme densely covered with red, globular berries; seeds reniform, surface verruculose. Fl. May-Jun.; fr. Sep. [though some of the chemical studies above suggest that it fruits beyond this range].

In mixed forests, particularly forest margins, streams and brooks, sometimes on unbroken steppes, and coastal forests confined to sandy soil – also in clearings where trees have been felled, and frequently climbing on trees; Japan, China, Siberia (Komarov & Shishkin ed. 1985b).

SCHUMANNIOPHYTON

(Rubiaceae)

Schumanniophyton klaineanum *Pierre ex A. Chev.* **(S. magnificum** *(K. Schum.) Harms***; Tetrastigma magnificum** *K. Schum.***; Randia immanifolia** *Wernham***)** – mgba mmiri, waka, akpuko ozò ['skin of the ape'], titimoto

Schumanniophyton problematicum *(A. Chev.) Aubrév.* **(Assidora problematica** *A. Chev.***)**

The bark of S. klaineanum is used by some natives of Gabon and Congo for its psychotropic properties. It is also considered a 'fetish' plant in Congo. The bark is chewed in small amounts as a stimulant to prevent unwanted sleep, but in higher doses it is said to act as a powerful aphrodisiac, with some harmful side-effects if taken frequently. In Congo, the bark is also macerated in palm wine, and taken with a ripe banana [see **Musa**] (Burkill 1985-1997; Watt 1967). In east Nigeria, it is used to treat insanity (Okogun et al. 1983). S. klaineanum bark, as well as that of S. arboreum, has been used as a stimulant for travellers and hunting dogs. The bark is also used to stupefy fish, as well as being eaten with fish and other meat, for obscure reasons (Usher 1974). In Nigeria, S. problematicum root is used by healers in treatment of insanity and agitated psychosis. Preliminary tests in mice of the ethanolic root extract [i.p.] showed effects such as sedation, nervous depression, hypothermia and decreased rate of respiration (Amadi et al. 1991).

S. klaineanum bark and root have yielded up to 1% alkaloids, with 0.3% found in the leaves; the root also contains a small amount of saponins, which are also found in the leaf, with tannins (Burkill 1985-1997); root bark yielded 0.0075-0.03% schumannificine, 0.0125-0.042% N-methylschumannificine, 0.0054% anhydroschumannificine, 0.0075% N-methylanhydroschumannificine, 0.021% schumanniophytine, 0.03% isoschumanniophytine and 0.036-0.0375% noreugenin [5,7-dihydroxy-2-methylchromone] (Houghton & Hairong 1985; Okogun et al. 1983).

S. problematicum root bark [harv. late Jun., Amitiora] yielded 0.175% of a crystalline mixture, which contained [as % of root bark] 0.03% schumanniophytine [a new pyridine alkaloid] and *scopoletin* combined; the remaining extract gave 0.00175% and 0.00035% each of 2 new piperidines, as well as noreugenin, and further yields of *scopoletin* and schumanniophytine. Stem and leaf gave positive tests for the presence of alkaloids (Schlittler & Spitaler 1978). An extract of the root had an LD50 of 2.37g/kg [i.p.] in mice (Amadi et al. 1991).

Schumanniophyton klaineanum is a shrub or small tree 3.6-4.9m tall, with soft-wooded stems. Leaves usually opposite, very large, sessile with lamina cuneate to the base, elongate-obovate, 60-120 x 30-45cm, with c.30 pairs of lateral nerves, minutely pubescent on nerves beneath. Flowers white or yellow, sessile, in a dense cluster subtended by broad bracts and borne at ends of shoots opposite a single leaf and just above a pair of leaves; calyx adnate to ovary; corolla tube 6-7cm long, densely tomentellous, lobes 7-10, narrowly lanceolate, contorted (rarely imbricate), overlapping to the left, 2cm long; stamens epipetalous, as many as petals, and alternating with them, included; anthers 2-celled. Ovary 3-4 celled; ovules numerous in each cell, placentation axile; style head 4-6-lobed. Fruit indehiscent; seeds not winged.

In forest; s. Nigeria, Cameroon, Gabon and Cabinda (Hutchinson & Dalziel 1954-1972).

SCIRPUS

(Cyperaceae)

Scirpus sp. – bakana, bakánoa, bakánawa, bulrush

An unidentified Scirpus sp., known as 'bakana', is a feared and respected shamanic plant among the Tarahumara of Mexico. The root tubers ['bolitas'] are first sung to, and offered food, before being ingested. They are eaten or rubbed on the body to induce a deep sleep-like state, in which the shaman experiences brilliantly coloured visions, travels over large distances in other realms, and communicates with spirits of the dead. It is said caution must be taken when ingesting this plant, as it can make one 'jump into fires'. If the plant is mistreated in any way, it is said to cause the person responsible to become sick and even die. Paradoxically, the Tarahumara see the plant as a protector of the mentally ill, able to cure insanity, yet it is considered that anyone who cultivates it will become insane, due to the sound the plants are said to make. The Tarahumara who use it will instead either buy it from mestizos who cultivate it, or travel to where it grows to collect it. The plant is also credited with analgesic properties (Bye 1979b; Diaz 1979; Pendell 1995; Schultes & Hofmann 1980).

The Cherokee use the related S. validus ['great bulrush'] as an emetic (Hamel & Chiltoskey 1975). In India, S. articulatus root is used as a mild purgative, though the roots of S. grossus taken in milk are used as a nourishing beverage for those suffering from diarrhoea and/or vomiting. The root may also be chewed to allay sickness and mask bad-tasting medicines. S. tuberosa bears edible tubers known as 'water chestnuts' or 'ground chestnuts' (Nadkarni 1976). In Nepal, seeds of S. kysoor ['kaancho laae'] are used in ritual incense, but not by the Kirati (Müller-Ebeling et al. 2002). S. maritimus rhizomes have been used in China as an astringent and diuretic (Powell et al. 1987).

Alkaloids of the β-carboline type have been detected in an unspecified Scirpus sp. (Diaz 1979), yet the species used by the Tarahumara has not been chemically analysed, and its pharmacology is still unknown.

S. maritimus [whole plant] has been reported to contain an alkaloid (Hultin & Torssell 1965); the seeds have yielded stilbenes [piceatannol, resveratrol, scirpusin A and scirpusin B] and ε-viniferin. The scirpusins have also been found in S. fluviatilis rhizomes (Powell et al. 1987).

Scirpus atrovirens is a caespitose perennial sedge grass; stems erect, jointed, slender or stout, to 1.5m. Leaves broadly linear, grass-like, with membranous ligule; principal blades to 18mm wide, mostly on lower half of stem. Inflorescence a terminal panicle with many rays, once or usually twice branched, subtended by leaf- or bristle-like bracts; spikelets stalked or in clusters on rays, ovoid or short-cylindric, 2-8mm long, densely crowned in subglobose glomerules; flowers hermaphrodite, minute, spirally arranged, subtended by a scale-like bract (glume); scales broadly elliptic or obovate, the body obtuse or acute, pale midvein prolonged into a conspicuous mucro usually 0.5-0.8mm long; sepals and petals represented by 6 rough bristles; stamens 3; style 3-branched. Fruit a nut, smooth, very pale to white, compressed-trigonous, obovate, 0.8-1.2mm; bristles pale and inconspicuous, straight or nearly so, shorter to barely longer than the achene, or rudimentary, or lacking.

Damp, preferably acidic soils in light woodland, bogs and shallow water; N. America (Darke ed. 1994). This species was depicted by Schultes & Hofmann (1992) as a representative of the genus, which has produced some confusion as it was unclear whether they were suggesting it as a possible identity for the Tarahumara 'bakana'.

SCOPOLIA

(Solanaceae)

Scopolia carniolica *Jacq.* **(S. hladnikiana** *Nyman***; S. viridiflora** *Frey. ex Koch***; Scopolina atropoides** *Schult.***; Sc. hladnikiana** *W.D.J. Koch***; Hyoscyamus scopolia** *L.***)** – scopolia, krainer tollkraut
Scopolia carniolicoides *Wu et Chen* **(Anisodus carniolicoides** *(Wu et Chen) D'Arcy et Zhang***)**
Scopolia caucasica *Kolesn. ex Kreyer*
Scopolia japonica *Maxim.* – làng dàng, lang tang
Scopolia lurida *(Link) Dunal* **(S. anomala** *(Link et Otto) Airy-Shaw***; S. mairei** *H. Lév.***; S. stramonifolia** *(Wall.) N.P. Balakr.***; Anisodus fischerianus** *Pascher***; A. luridus** *Link***; A. mairei** *(H. Lév.) Wu et Chen***; A. stramonifolius** *(Sweet) G. Don***; Nicandra anomala** *Link et Otto***; Physalis stramonifolia** *Wall.***; Whitleya stramonifolia** *(Wall.) Sweet***)** – Himalayan scopolia, lurid scopolia, ghanti phul, vangale, langdang
Scopolia sinensis *Hemsl.* **(Atropanthe sinensis** *(Hemsl.) Pascher***)**
Scopolia tangutica *Maxim* **(Anisodus tanguticus** *(Maxim) Pascher***)** – zang qie, san long zhi, yellow anisodus

S. carniolica root is used in extraction of tropane alkaloids for the European pharmaceutical industry, and is sometimes used as an adulterant or substitute for deadly nightshade [see **Atropa**] or mandrake root [see **Mandragora**]. It has been suggested that the herb may have been an ingredient in mediaeval witches potions and salves [see *Methods of Ingestion*]. It was reputedly used in Alpine areas as a poison, and to make magical drinks. Its CNS effects are considered to be +- narcotic [probably more accurately described as hallucinogenic in high enough doses], and have been compared to the effects of henbane [see **Hyoscyamus**]. S. carniolicoides is used medicinally in China, as is the root ['san long zhi' or 'shan lang dong'] of S. tangutica, which is used as an analgesic and anticonvulsant, treating conditions of shock and potentiating the action of barbiturates. S japonica is used medicinally in Japan and Korea (D'Arcy ed. 1986; Festi 1996; Hawkes et al. ed. 1979; Huang 1993; Rätsch 1990, 1992; Usher 1974). During the 'Black Mountain Campaign' in Nepal, S. lurida was mistaken for an edible plant by Gurkhas, who ate it and suffered an intoxication similar to that produced by deadly nightshade (Chopra et al. 1965). In Nepal, roasted seeds have sometimes been eaten in 'dhal' [a lentil dish] by Kirati shamans, for the purpose of shamanic travel (Müller-Ebeling et al. 2002).

S. carniolica [whole plant] has yielded 0.45-0.55% alkaloids, consisting of *hyoscyamine*, *hyoscine*, tropine, solanidine, scopine, cuscohygrine [bellaridine], *scopoletin* and methylesculetin; roots yielded 0.43-0.51% alkaloids, consisting mainly of *hyoscine* and *hyoscyamine*, as well as pseudotropine and 3-α-tigloyloxytropane (An-ming & Zhi-yu 1986; Festi 1996; Gheorghiu et al. 1961; Henry 1939; Schermerhorn et al. ed. 1957-1974; Willaman & Li 1970).

S. caucasica roots and rhizomes contain *hyoscine*, *hyoscyamine* and *atropine* (Willaman & Li 1970).

S. japonica leaves have yielded 0.18% alkaloids, mostly *hyoscyamine*, as well as *hyoscine*, nor-*hyoscyamine*, *atropine*, scopoleine, *scopoletin*, scopolin, methylesculin, rotoin, dimethylamine and *choline*; roots also contain solanine [see **Solanum**] (Henry 1939; Schermerhorn et al. ed. 1957-1974).

S. lurida was found to contain *hyoscine*, *atropine*, tropine and cuscohygrine in the whole plant; root also contained *hyoscyamine*, and scopine was found in all parts except the root (Willaman & Li 1970). As S. anomala, roots have yielded 1.09-2.8% alkaloids, of which c.18% was *hyoscine*, as well as *hyoscyamine* and cuscohygrine. Aerial parts contained tropanes in similar concentrations, though cuscohygrine was not present (Chopra et al. 1965; Skymanska 1988).

S. sinensis has yielded *hyoscine*, nor-*hyoscine* (Ripperger 1995), *hyoscyamine*, anisodamine, anisodine and cuscohygrine (An-ming & Zhi-yu 1986).

S. tangutica root has yielded up to 2.63% alkaloids during flowering, and 2.93% from aerial parts harvested at the same time; at the beginning of flowering, 2-year old plants yielded 1.73% alkaloids from leaves, 0.58% from stems, and 0.587% from roots; others reported yields from 2-year old plants harvested in the beginning of July – 1.22% from roots, 1.5% from leaves, and 0.49% from stems. The major alkaloids are *hyoscine*, *hyoscyamine* and *atropine*; these tropanes comprise [during flowering] 83% of total leaf alkaloids, 87% of total stem alkaloids and 47% of total root alkaloids; anisodine and anisodamine are also present. Levels of the tropane alkaloids are higher in older plants (Alexandrowa 1961; Huang 1993; Semenova 1954; Sokolov & Aleksandrowa 1964).

Scopolia carniolica is a glabrous, perennial herb with a fleshy, horizontal rhizome; stems 20-60cm tall, simple or branched above. Leaves alternate, simple; lower leaves scale-like, oblong-spathulate; upper leaves to 20 x 8cm, elliptical to ovate or obovate, somewhat acuminate, cuneate at base, entire, petiolate. Flowers solitary in leaf axils; pedicels 2-4cm, filiform, nodding; calyx c.1cm, campanulate, shallowly 5-lobed, accrescent; corolla cylindrical to campanulate, 1.5-2.5cm, shallowly 5-lobed, lobes convolute in bud, dark brownish-violet outside, yellowish to brownish-green within; stamens 5, included, inserted at base of corolla. Ovary superior, 2-locular; style simple; stigma capitate, entire to 2-lobed; fruiting calyx tightly including fruit. Fruit a circumsessile capsule, surrounded by calyx, c.1cm diam., globose.

Ravines, moist broadleaf forests, especially beech; central and s.e. Europe, extending to Italy, c. Ukraine and Lithuania; rare.

Sow seed in trays in spring, later transplanting stout seedlings to a fertile position, partially shaded (Festi 1996; Hawkes et al. ed. 1979; Tutin et al. ed. 1964-1980).

SCUTELLARIA

(Labiatae/Lamiaceae)

Scutellaria alpina *L.* – alpine skullcap
Scutellaria baicalensis *Georgi.* **(S. grandiflora** *Adams***; S. lanceolaria** *Miq.***; S. macrantha** *Fisch.***)** – huang-qin, Chinese skullcap, baical skullcap
Scutellaria galericulata *L.* – marsh skullcap, river skullcap
Scutellaria indica *L.* – tatsu-nami-so
Scutellaria lateriflora *L.* – Virginian skullcap, Quaker bonnet, helmet flower, blue pimpernel, mad dog weed
Scutellaria nana *A. Gray* – dwarf skullcap, desert skullcap, mad dog skullcap
Scutellaria racemosa *Pers.* **(S. bonariensis** *Willd. ex Benth.***; S. hastata** *Larrañaga***; S. heterophylla** *Willd. ex Benth.***; S. rojasii** *Briq.***; S. rumicifolia** *Kunth***)** – chayuts, contento, alegria
Scutellaria spp. – skullcap, scullcap

In Ayurvedic medicine, Scutellaria spp. are used to treat insomnia, neurosis, nervous tension, tremors, incontinence and arthritis. Combined with **Centella** asiatica [1tsp of each, infused], they may be taken to improve awareness and promote perception. Combined with **Withania** somnifera [1:4], they are used as a nerve tonic (Frawley & Lad 1986). In magical practices, skullcap is used in spells for relaxation and peace, and for visualisation in psychic dream-work; it has also been used in potions for tantric sex magic (Cunningham 1994; Tierra 1988).

In Cauca, Colombia, indigenous inhabitants consider S. racemosa a magical herb. Paez shamans there chew it during divinatory sessions to control the experience and reduce its intensity if necessary. Likewise, the fresh herb is often chewed to balance the stimulant action of 'coca' leaves [see **Erythroxylum**]. The best samples are often traded amongst Paez shamans for coca leaves from the lower, sub-tropical zones (Antonil 1978).

In North America, S. lateriflora has long had a reputation for treating epilepsy and rabies (Polunin & Robbins 1992). It acts as a calming sedative, antispasmodic and nerve tonic, and is used by herbalists to treat anxiety, depression, stress, fatigue, pre-menstrual tension, rheumatic pain,

neuralgia and severe hiccoughs. Its bitterness is also strengthening and stimulating to the digestive system. It has shown some potential in easing the pain of multiple sclerosis, as well as reducing withdrawal symptoms from barbiturates and alcohol. Commercial skullcap [referring to S. lateriflora] may sometimes be adulterated with 'germander' [Teucrium spp. – see *Endnotes*]. In TCM 'huang qin', the dried root of S. baicalensis [may be substituted with S. amoena, S. ikoninkovii or S. viscidula], is used to treat respiratory tract and bacterial gastrointestinal infections. It has sedative, antihypertensive, antiinflammatory, antibacterial, diuretic, vasodilatory and antiallergic properties (Bremness 1988, 1994; Fraser 1995; Huang 1993; Hutchens 1973, 1992; Mabey et al. ed. 1990; Tierra 1988).

S. lateriflora can be infused into a tea [which is very bitter], and is quite effective when smoked; sublingual usage is also effective. Many species produce an experience somewhat similar to that felt with many **Salvia** spp., probably due to their content of neo-clerodane diterpenoids, which appears to be +- generic (pers. obs.). S. galericulata, which grows across the northern temperate zones, has sedative properties, and has been suspected of poisoning stock animals (Pammel 1911). When smoked, the leaves have been observed to give much stronger psychotropic effects than does S. lateriflora; the effects have been compared to good quality **Cannabis** leaf. S. nana has been found to be even stronger, reputedly comparable to good quality **Cannabis** flower buds, though "it will cloud your head and make you tired" (Brounstein 1995; friendly pers. comm.). S. indica is also claimed to be psychoactive (Simon pers. comm.). An experiment with smoking a small aged sample of S. indica var. parvifolia leaves was inconclusive, further investigation so far hindered by lack of material. S. alpina herbage is also psychotropic when smoked in small amounts. Another species, awaiting proper identification, has proven to be moderately and pleasantly psychoactive when smoked. Like some of the **Salvia** spp., the flowers of this species seem to be more potent than the leaves, and both synergise well with **Psilocybe** mushrooms (pers. obs.). This species is sometimes sold in Australian nurseries labelled as either S. indica or S. formosa. After submitting a flowering sample to the Royal Melbourne Botanic Gardens for identification, I was told that it was neither species. These gardens have several specimens of this Scutellaria sp. in their collection labelled as S. indica, and the incorrect labelling has still not been changed at the time of writing. This plant seems to bear some affinity to published descriptions of S. formosana *N.E. Brown*, though without fully fitting the descriptions.

S. adenostegia shoots have yielded *apigenin* and chrysin [see **Passiflora**]; roots yielded chrysin, 2'-MeO-chrysin, baicalein, 5,2',6'-trihydroxy-6,7,8-trimethoxyflavone and 5,2',6'-trihydroxy-7,8-dimethoxyflavone (Chemesova et al. 1995).

S. baicalensis has yielded the neo-clerodane diterpenoids scutebaicalin [0.018%, presumably w/w], baicalin, baicalein and 7-MeO-baicalein; the flavonoids wogonin [5,7-dihydroxy-8-MeO-flavone; anxiolytic, BZ-receptor agonist in *GABA*-A complexes], 7-MeO-norwogonin, wogonoside, skullcapflavones I & II (Esquivel et al. 1997; Huang 1993; Hui et al. 2003; Hussein et al. 1996), oroxylin A [5,7-dihydroxy-6-MeO-flavone; selective BZ-receptor antagonist] and 5,7,2'-trihydroxy-6,8-dimethoxyflavone [anxiolytic, non-sedative BZ-receptor agonist] (Huen et al. 2003a, 2003b); and *melatonin* [0.0007%] (Murch et al. 1997). The water extract of the root has anticonvulsant activity, and has an affinity for BZ receptors (Wanga et al. 2000).

S. columnae has yielded the neo-clerodane diterpenoids 11-epi-scutecyprin [0.0066%] and scutegalin D [0.0058%] (Malakov & Papanov 1997).

S. drummondii has yielded the neo-clerodane diterpenoid scutedrummonin (Esquivel et al. 1997).

S. indica has yielded scutelarin (Nadkarni 1976).

S. lateriflora has yielded the neo-clerodane diterpenoids scutelarins A, B & C, ajugapitin and scutecyprol A (Bruno et al. 1998), as well as *melatonin* [0.000009%] (Murch et al. 1997), flavonoid glycosides, iridoids, volatile oil and tannin (Polunin & Robbins 1992); epicuticular wax contains n-tritriacontane, n-pentatriacontane, n-hentriacontane and other alkanes (Yaghmai & Khayat 1988).

S. orientalis ssp. pinnatifida has yielded the neo-clerodane diterpenoids scutorientalins A, B [0.0057%], C, D [0.01%] and E [0.018%] (Malakov & Papanov 1996; Malakov et al. 1997).

S. polydon has yielded the neo-clerodane diterpenoids scupolins A-I [0.064% total], jodrellin B [0.0025%] and scutecolumnin A [0.0003%] (De la Torre et al. 1997).

S. pontica has yielded the neo-clerodane diterpenoids scupontins A [0.042%], B [0.0012%], C [0.014%], D [0.084%], E [0.002%], F [0.0048%] and G [0.002%], scutalbin A and scutalpin M (Rodriguez et al. 1997).

S. rivularis aerial parts yielded the neo-clerodane diterpenoid scutellone A (Lin et al. 1987).

S. seleriana has yielded the neo-clerodane diterpenoid scuteselerin [0.001%] and the flavone oroxylin A (Esquivel et al. 1997).

Scutellaria indica is a perennial herb spreading by creeping rhizomes; stems erect, 20-40cm long, prominently white-pilose. Leaves loosely few-paired, deltoid-cordate to broadly ovate, obtuse, cordate at base, obtusely toothed, spreading-hairy, often prominently pubescent on both sides, minutely uneven on surface, upper leaves sometimes orbicular, 1-2.5cm diam.; internodes longer than leaves; petioles 5-20mm long. Inflorescence a terminal spike 3-8cm long, with prominent spreading hairs; flowers paired in verticils; calyx campanulate, bilabiate, c.3mm long in anthesis, 6-7mm long in fruit; corolla 18-22mm long, geniculate at base, becoming erect above, pale purple, limb bilabiate, upper lip erect, galeate, lower lip spreading; stamens 4, under upper lip of corolla; anthers approximate in pairs, lower ones +- reduced and unilocular. Ovary 4-lobed. Nutlets orbicular, slightly compressed, c.1mm long, densely mammillate. Fl. May-Jun.

Common on sunny hills; Korea, China, Indochina, Formosa, Ryukyus, Japan [Honshu, Shikoku, Kyushu].

S. indica var. parvifolia [S. parvifolia, S. indica var. japonica] is differentiated by its shorter stems (5-20cm long), and smaller leaves (c.1cm long and wide) with margins toothed more sparsely.

S. indica var. tsusimensis [S. tsusimensis] is a larger plant (10-30cm tall), with leaves 2-4cm long and wide, shallowly cordate to truncate at base, with impressed nerves above (Ohwi 1965).

SECURIDACA

(Polygalaceae)

Securidaca longipedunculata *Fresen* **(S. longepedunculata** *Fres.***; S. longepedunculata** *Hochst.***; Lophostylis angustifolia** *Hochst.***; L. oblongifolia** *Hochst.***)** – violet tree, Rhode's violet, wild wisteria, Senegal-root tree, fibre tree, tchúnfki, foudara, foudaraye, diouto, fouf, bwazi, mpesu, chwehweha, ipeta, arbre à serpent

The roots of this plant [as 'tchúnfki'], collected in winter or in the dry season, are prepared into an aqueous infusion by the Balanta of Guinea-Bissau in w. Africa. The drink thus made is important in religious rites, due to its supposed entheogenic effects (Costa et al. 1992a).

In Zimbabwe and Malawi, a root infusion is applied as a body wash to 'arouse spirits' (De Smet 1998). The plant is used by the !Kung of South Africa in healing ceremonies. Also in S. Africa, the Chopi take it mixed with Sphedamnocarpus pruriens [Malpighiaceae] to treat people possessed by spirits [see *Endnotes*]. Conversely, the roots are snuffed in the Nsanje district of Malawi [mixed with Annona senegalensis, Asparagus africanus and Chenopodium ambrosioides – see *Endnotes*] to induce spirit possession. Another composite snuff containing S. longipedunculata is discussed under **Piper 1**. In Gambia, a root decoction is used to relieve fatigue, and smoke from the smouldering bark is inhaled to relieve dizziness. In Senegal, the root is powdered and snuffed to keep awake at night; it also treats migraine used in this manner. However, the powdered root extract is known to cause 'violent sneezing'. In s. Nigeria, the seeds are snuffed for the same effect, as well as to treat rheumatism. The seeds are rich in a toxic, purgative oil, which is used as an antidote to Strophanthus spp. arrow-poison, and snake-bite. Leaves have also been decocted to treat poisoning, due to their purgative action. A leaf wash is used to bathe the eyes after attack by a spitting-cobra [see **Naja**, **Ophiophagus**]. In Nigeria and Tanganyika, the plant is used as an anticonvulsant for children, and in S. Africa as an aphrodisiac and bronchitis treatment. A root decoction has sedative actions, and may result in several hours of sleep. The roots are also generally considered toxic, and purgative in small amounts, and have been used for homicidal or suicidal means. Women sometimes take them vaginally to commit suicide, though death is slow by such means, often taking up to 2 weeks to eventuate. It is claimed that the inner root-bark is only purgative, whereas the rest of the root is toxic. The bark can also cause blindness if brought into contact with the eyes (Burkill 1985-1997; Olajide et al. 1998; Samorini 1996b). As unspecified parts of the plant have been used as an ordeal poison applied to the eyes, with ocular damage signifying guilt, the chances of a charge of innocence could be slim indeed. The bark and roots have also been used internally as ordeal poisons (De Smet 1998).

Fresh roots have been described as 'foul-smelling', and are used in huts to repel snakes and rodents; others report the fresh roots to have an odour of 'wintergreen' [see **Gaultheria**], a sweetish taste, and a numbing after-effect. In small amounts [1/6 tsp] the powdered root is taken with 5 other powdered plant roots in equal amounts [Cenchrus biflorus, Olax subscorpioidea, **Piper** guineense (see **Piper 1**), Psorospermum guineense and **Syzygium** aromaticum] as a common Nigerian preparation called 'gakini', which is used to treat asthma and respiratory disorders (Akah et al. 1997; Burkill 1985-1997; Costa et al. 1992a).

S. longipedunculata roots harvested in winter [in the dry season] yielded 1.45% [w/w] crude extract, containing ergoline alkaloids [*elymoclavine*, dehydroelymoclavine, 3 unidentified ergot alkaloids, and a new ergoline have been found]; roots harvested in the wet season have yielded cis- and trans-derivatives of cinnamonic acid, and no alkaloids (Costa et al. 1992a, 1992c, 1994; Samorini 1996b; Wrobel et al. 1997). Roots have also yielded aromatic constituents, such as valerianic ether, methylsalicylate

[c.0.1%], methyl 4-OH-benzoate [antimicrobial preservative], methyl 4-OH-3-MeO-benzoate [methyl vanillate], methyl 2,6-dihydroxybenzoate, phenyl 3-amino-5-nitrobenzoate, phenylmethyl 2-OH-benzoate [benzyl salicylate], methyl-2,6-dihydroxybenzoate [ingestion can cause nausea, vomiting, acidosis, pulmonary oedema and death], 4-bromophenyl 4-cyanobenzoate, N-diphenylene benzenamine, 4-(3-OH-prop-1-enyl)-2-MeO-phenol [coniferyl alcohol], 1,2-dihydrocyclobuta(b)-quinoline-4-carboxylic acid and 7,8,10-trimethylbenzo(g)pteridine-2,4-(3H,10H)-dione (Burkill 1985-1997; Costa et al. 1992b). Roots have also yielded glycosides of oleanic acid, which are thought to be responsible for the anticonvulsant effects of the roots (Burkill 1985-1997). Early tests showed the presence of saponins and starches in the root bark (Nihoul-Ghenne et al. 1967). A root extract was shown to increase sodium currents in rat skeletal muscle [cell culture], and has been hypothesised to interact with skeletal dihydropyridine receptors (Mouzoua et al. 1999). A methanol extract of the root [harv. Aug. 1996 from Aebokuta, Nigeria] showed analgesic, antiinflammatory, sedative and anticonvulsant effects in mice [given i.p.] (Olajide et al. 1998). Bark has been claimed to contain the alkaloid *securinine* (Buckingham et al. ed. 1994; Harborne & Baxter ed. 1993), though myself and colleagues have not been able to locate any primary reference to verify this.

This is the first time ergot alkaloids [see **Claviceps**] have been found outside of the fungi and the morning glories [Convolvulaceae – eg. see **Ipomoea**]. However, the roots in w. Africa are often parasitised by a mould, and it is uncertain at this stage whether this mould is the producer of the alkaloids (Samorini pers. comm.).

Securidaca longipedunculata is a shrub or small tree up to 6m tall; bark light grey, smooth, becoming yellowish to grey, finely scaly; branchlets inconspicuously softly pubescent, becoming glabrous. Leaves alternate, rarely opposite, oblong to linear-lanceolate or ovate-oblong, 2-5.5(-9)cm long, 0.5-2cm wide, coriaceous, glabrous above, glabrous or very minutely pubescent beneath, apex obtuse or rounded, base pointed; petiole 2-10mm long; stipules none. Inflorescence a terminal or axillary simple raceme to 15cm long; pedicel 1-1.8cm long, pubescent; flowers hermaphrodite, zygomorphic, purple, fragrant; bracts and bracteoles minute, lanceolate, deciduous; sepals 5, free, imbricate, posterior and anterior sepals 3-6 x 2.5-5mm, lateral sepals 2.7-9 x 8-9.5mm wide; petals 3, the lateral ones free from the abaxial (keel) one, upper 2 petals obovate, 5-6 x 2.5-4mm; stamens 8, filaments fused into a sheath 6-7mm long, split above, the free part 4mm long; anthers erect, 1-2-celled, opening by an apical pore. Ovary free, usually 2-celled; style simple, 8-10mm long; stigma 1.5-2mm long; ovules usually solitary in each cell, pendulous. Fruit smooth, rugulose, notched at base on side of aborted carpel, indehiscent, samaroid, 5-7cm long, wing 1.5-2cm broad, variable, sometimes with a very small second imperfect wing, ventral margin nearly straight or curved, gradually or abruptly narrowed with numerous curved, parallel, forking nerves; 1-seeded, seed 8 x 6mm. Fl. & fr. all year, though with less flowers in May-Jul. S. longipedunculata var. parvifolia flowers Sep.-Jan.

Widespread in savannah vegetation, sea level to c.1700m. S. longipedunculata var. longipedunculata has been recorded from Angola, Bennin, Burundi, Cameroon, Ethiopia, Gabon, French Guiana, Kenya, Malawi, Mali, Mozambique, Niger, Rwanda, Senegal, Sierra Leone, S. Africa, Sudan, Tanzania, Togo, Uganda, Upper Volta, Zaire and Zimbabwe; S. longipedunculata var. parvifolia has been recorded from Angola, Botswana, Malawi, Mozambique, Namibia, S. Africa, Tanzania, Zaire, Zambia and Zimbabwe. [Oddly, Guinea-Bissau was not listed amongst these reported occurrences.]

S. longipedunculata var. parvifolia [syn. S. longipedunculata var. parviflora, S. oblongifolia, S. spinosa] is differentiated by its young branches, which are transformed into leaf- and raceme-bearing spines; the young shoots are densely pubescent, whereas those of var. longipedunculata are only slightly pubescent (Hutchinson & Dalziel 1954-1972; Johnson 1987).

SENECIO

(Compositae/Asteraceae)

Senecio albo-lutescens *Schulz-Bipontinus* – peyote
Senecio calophyllus *Hemsley* – peyote
Senecio canicidus *Sessé et Moc.* – yerba de la puebla, ytzcuinpahtli ['dog medicine'], itzcuimpatli
Senecio cardiophyllus *Hemsley* – peyote
Senecio cervariaefolia *Schulz-Bipontinus* – peyote
Senecio elatus *Kunth* – hornamo amarillo
Senecio grayanus *Hemsley* – peyote, matrique
Senecio hartwegii *Benth.* – peyote de Tepic, sopépari
Senecio neomexicanus *A. Gray* **(S. blumeri** *Greene***; S. encelia** *Greene***; S. mutabilis** *Greene***; S. papagonius** *A. Nels.***; S. toumeyi** *Greene***; S. willowensis** *Greenm.***; Packera neomexicana** *Weber et Löve***)** – New Mexican groundsel, born for water's tobacco, tobaz iscini binat'oh
Senecio ovatifolius *Schulz-Bipontinus* – peyote
Senecio petasitis *DC.* – peyote
Senecio praecox *DC.* – peyote, palo loco ['crazy stick']
Senecio tephrosioides *Turz.* – hornamo amarillo
Senecio toluccanus *DC.* – peyote, guantlapatziinzintli
Senecio spp. – ragwort, groundsel, fireweed, squaw weed

The Tarahumara of Mexico refer to many of these species as 'peyote' [see **Lophophora**]. They are used medicinally, and in most cases it is unclear whether they have psychotropic effects. The Tarahumara use S. hartwegii in infusion as a purgative, and use the powdered plant as an insecticide. The leaves and roots are used to stupefy fish. S. canicidus is referred to in the Badianus Codex, Ramirez's Materia Medica of Mexico, and other works; it was used to relieve chest pains, and as a narcotic. It is reputed to be a convulsant in high doses, and is known today as a dog-poison. S. praecox, used in Mexico for wounds and rheumatism, is said to produce delirium. S. toluccanus has been used as a poison by sorcerers, to 'madden' their victims (Diaz 1979; Emboden 1979a; Pennington 1958; Salmón 1995; Schultes 1937a, 1937b).

In Peru, S. elatus or S. tephrosioides are sometimes added to brews prepared from the San Pedro cactus, **Trichocereus** pachanoi. S. elatus is said to be 'hallucinogenic' by itself, and aerial parts are also used as a potent ritual purgative (De Feo 2003; Ott 1993; Rätsch 1998). In n. Argentina, S. hieronymii stalks ['amaicha'] and/or S. bomanii stems ['cosillo blanco'] are sometimes used to prepare the alkaline reagent for chewing with coca [see **Erythroxylum**] (Hilgert 2001).

The Navajo smoke S. neomexicanus as an antidote to narcotics (Winter 1998). In Germany, S. vulgaris has been known as a witch's herb ['hexenkraut'] (De Vries 1991). In southern Africa, the Southern Sotho use S. asperulus as a charm to ward away bad dreams amongst their children; they also smoke the leaf of S. coronatus and S. erubescens with their tobacco [see **Nicotiana**], and decoct the root of S. dregeanus var. discoideus to treat madness and chest colds, also acting as an emetic. The juice from S. vulgaris is used to treat epilepsy. In Basutoland, S. coronatus is used as an ash with snuffing tobacco; in Transvaal, S. longiflorus is similarly used (Watt & Breyer-Brandwijk 1962).

Many Senecio spp. have long been associated with stock poisonings; they are toxic to the liver and can produce motor nerve paralysis, contractions of the uterus and digitalis-like cardiac activity, as well as emaciation (Keeler 1975; Watt & Breyer-Brandwijk 1962). Experiments with Senecio extracts from Mexican specimens were shown in humans and animals to produce excitation, and later irritability, followed by delirium. In the animal experiments, some became paralysed and later died (Emboden 1979a). Senecifoline nitrate, an alkaloid from S. latifolius, appears to be a 'hallucinogenic' CNS-excitant in cats [100-200mg/kg injected; route not given], though clonic convulsions, vomiting, extreme respiratory acceleration and pupil dilation were also observed. Symptoms subsided after about 2 hrs, though within the next week, the test animals lost appetite and gradually fell into stupor, dying 4-6 days after the injection. The smallest fatal dose tested was 16mg/kg. Post-mortem revealed lots of internal damage and does not make pretty reading! S. sylvaticus [harv. Aug., Yorkshire] and S. jacobaea [harv. Jun. & Aug., England] were non-toxic under the same conditions, though in Canada and New Zealand, this latter species is regarded as toxic to livestock (Cushny 1910/1911).

Senecio spp. contain alkaloids of a neurotoxic nature which, on alkaline hydrolysis, split into necine alkanolamines [which mostly have a pyrrolizidine ring] and necic acids. Other acids are formed on hydrolysis, which are similar to the necic acids, but are isoprene monoterpenes. A representative example is retrorsine, which on acid hydrolysis yields retronecine and retronecic acid. Senecio alkaloids are also considered to be carcinogenic. Sometimes, symptoms of poisoning from subtoxic doses do not develop for several weeks or more, consisting of appetite loss, exhaustion, abdominal pain and swelling, and progressive liver damage. In rats, extracts have produced mutations, and stock poisonings have resulted in debility and death (Cushny 1910/1911; Foster & Caras 1994; Henry 1939; Keeler 1975; Watt & Breyer-Brandwijk 1962). These plants, in general, should be regarded as too toxic for human experimentation unless proven otherwise, except for the exceptionally brave or foolhardy.

Senecio neomexicanus is an erect, herbaceous perennial, with 1 to several erect or ascending branches 15-60cm tall; rootstock stoutish. Herbage +- white-tomentose throughout, or sometimes stems and upper sides of leaves glabrate; stems finely striate under tomentum, often reddish-tinged. Leaves alternate; basal and lower leaves obovate to oblanceolate, 2-10 x 0.5-3cm, subentire to slightly lyrate, margins usually irregularly dentate, thick and firm in texture, often tinged purple, on slender petioles 1-6.5cm long; upper leaves sessile, oblong to lanceolate, dentate, gradually reduced towards inflorescence, usually persistently tomentose. Flower heads numerous on corymbosely-arranged inflorescences, each head 10-12mm high, radiate; involucres campanulate, sparingly caliculate, main bracts usually 21, linear-lanceolate, 6-8mm long, apex acute, margin scarious, tomentose toward base, usually glabrate above; bracteoles 0.5-2mm long, subulate; ray flowers 10-13 in a single whorl, yellow, ligules 7-10mm long, spreading and conspicuous, terminally 3-toothed; disc flowers numerous, perfect, slender, 5-6mm long, tube gradually expanding into very narrow, slender throat which +- equals tube, 5-toothed;

anthers obtuse to slightly sagittate at base; filaments of stamens inserted at or very near base of corolla tube; style branches not thickened above, rounded-obtuse to truncate, narrowly appendaged; stigmatic lines approaching or reaching summit of style branches. Achenes 2-2.5mm long, brownish, strongly 5-nerved and usually with a smaller rib in each interval between main ones, latter sparsely and minutely hirtellous with rather stiff, short hairs; pappus bristles numerous, silky, 6-10mm long. Fl. Apr.-Aug.

Mountain slopes and canyons; from Santa Catalina Mts [Pima County, Arizona] to New Mexico, Colorado, Canada (Correll & Johnston 1970; Shreve & Wiggins 1964).

SHEPHERDIA

(Elaeagnaceae)

Shepherdia argentea *Nuttall* **(Lepargyraea argentea** *(Nutt.) Greene***)** – bull berry, silver buffalo berry, thorny buffalo berry

Shepherdia canadensis *Nuttall* **(Lepargyraea canadensis** *(Nutt.) Greene***)** – Canadian buffalo berry, Russett buffalo berry

Native North American and Inuit peoples make the fruits of these plants into jams, or dry them in cakes for winter provisions (Usher 1974). Due to their content of β-carboline alkaloids, these plants might prove useful as MAOIs, though some of the other alkaloids present may have unknown toxic properties.

S. argentea root bark has yielded 0.2% crude bases, consisting of *tetrahydroharmol*, N-O-diacetyl-*tetrahydroharmol*, N-acetyl-pyrrolidine and N-acetyl-p-anisidine (Ayer & Browne 1970); leaves have yielded 4% quebrachitol (Plouvier 1951); seeds tested positive for alkaloids (Fong et al. 1972). The plant inhibits human plasma AChE (Orgell 1963b).

S. canadensis root bark has yielded 0.3-0.46% crude bases, consisting of *tetrahydroharmol*, N-O-diacetyl-*tetrahydroharmol*, *serotonin*, 6-OH-*tryptamine*, plectocomine [6-OH-THβC], shepherdine [6-OH-*tetrahydroharman*] and N-O-diacetyl-shepherdine (Ayer & Browne 1970); methyl apo-6'-lycopenate has also been found in the plant (Buckingham et al. ed. 1994).

Shepherdia canadensis is an unarmed shrub 1-3m tall. Leaves opposite, ovate-lanceolate to ovate, varying to narrowly-lanceolate or elliptic, 3-5cm long, obtuse, base obtuse to rounded or subcordate, green and nearly glabrous above, densely lepidote beneath. Flowers dioecious, in small clusters on twigs of the previous season, the pistillate ones usually few; hypanthium in staminate flowers saucer-shaped to cup-shaped, in pistillate flowers prolonged into a tube and persistently enclosing the ovary; staminate flowers 4-6mm wide; disc 8-lobed, at summit of hypanthium; sepals 4, ovate, greenish-yellow within, spreading, much exceeding the stamens; pistillate flowers similar, the mouth of the hypanthium closed by a dense tomentum; stamens 8, alternating with lobes of disc, inserted at or just below summit of hypanthium. Ovary 1-celled with 1 erect basal ovule. Fruit drupe-like, yellowish-red, 5-7mm long. Fl. Apr.-May.

In dry, sandy or stony calcareous soil; Newfoundland to Alaska, south to New York, n. Indiana, S. Dakota, and west to New Mexico and Arizona (Gleason 1952).

SIDA

(Malvaceae)

Sida acuta *Burm.* **(S. carpinifolia** *L.***; S. herbaceae** *Cav.***; S. lanceolata** *Willd. et Retz.***)** – spinyhead sida, broomweed, cheeseweed, huang hua ren, bala, pranijivika, bariaca kareta, dukong anak, kesar-belila, gas-bevila, mai-kward, taaiman, chichibe, malva de platanillo

Sida cordifolia *L.* **(S. althaefolia** *Swartz.***; S. rotundifolia** *Cav.***)** – Indian country mallow, malva branca, bala, batyalaka, kungyi, khareti, simak, chikana, wal-bevila, sudu-bevila, suluboo-bevila, huang hua zi [also a name for S. mysorensis]

Sida humilis *Willd.* – junka, bhumibala, palam-pasi

Sida rhombifolia *L.* **(S. canariensis** *Willd.***; S. compressa** *Wall.***; S. retusa** *L.***; S. rohlenae** *Domin.***)** – paddy's lucerne, shrub sida, common sida, arrowleaf sida, broomstick, jellyleaf, Queensland hemp, Canary Island tea, yellow barleria, huang hua mu, sidratusa, escobilla, buinar, huinar, bala, atibala, mahabala, svetberela, kheriti, kotikan-bevila, romamkap

Sida spinosa *L.* – nagabala, khar-yashtika, gulsakari, kattu-ventiyam, shamlethe-dashti

Sida urens *L.* **(S. boivinii** *Hochr.***; S. congensis** *D. Dietr.***; S. debilis** *Don.***; S. margaritensis** *Hassl.***; S. pseudo-urens** *Baker***; S. rufescens** *A. St.-Hil.***; S. sessiflora** *G. Don.***; S. verticillata** *Cav.***)**

Shamans of Veracruz, Mexico, know of the psychoactive properties of S. acuta ['male'] and S. rhombifolia ['female'], which have been reported to be smoked there as a **Cannabis** substitute. These herbs are also used locally as antiinflammatories (Diaz 1979). S. rhombifolia is also used in Mexico as a sedative, and to treat 'stomach disease' (Jiu 1966). The Cuna of Panama use S. acuta as a 'mystical medicine', and the Miskito of Nicaragua use a root extract to promote labour in pregnancy. The Marama of Bangladesh consume a masticated wad of the plant as a tranquillising remedy for 'uneasiness' (Ott 1993). S. acuta, S. humilis, S. rhombifolia and S. spinosa are used in Ayurvedic medicine as tonics and asthma treatments (Prakash et al. 1981). S. acuta is considered tonic, aphrodisiac, rejuvenative, stimulant, nervine, analgesic, vulnerary, demulcent and diuretic, having more of a tonic action on the heart than some of the other species. The whole plant is used, but usually the root ['balas'] is the item of medicine – 0.25-1g of powdered root is a medicinal dose (Frawley & Lad 1988; Ghosh & Dutt 1930). Roots of many Sida spp., not only of S. acuta, are known in India as 'balas'.

In w. Africa, the Yoruba use S. urens leaf as a virility medicine, and to relieve suffocation (Verger 1995). Hakims of India have used the seeds and perhaps other parts of S. cordifolia as an aphrodisiac, and the root has been used in Indian medicine in preparations for "increasing sexual power"; leaf and root of S. rhombifolia are also used as an aphrodisiac (Nadkarni 1976). At Mt. Hagen, Papua New Guinea, locals believe that if one eats the seeds of S. rhombifolia they "will grow smaller and smaller and finally die" (Stopp 1963)! S. rhombifolia is reputedly very effective in treating diarrhoea, for which the young tips are chewed. One person has reported that if you chew more than a couple of shoots "you'll never go again" (Cribb & Cribb 1981)! In Australia [Qld and NSW], some indigenous people use S. rhombifolia to treat diarrhoea and indigestion, either chewed or decocted. Early settlers in Queensland tried to make cord from the tough stems, hence the common name 'Queensland hemp' (Low 1990). More recently, extracts of S. rhombifolia [as S. retusa] and S. acuta have been used as ingredients in some so-called 'herbal ecstasy' products (pers. comms.).

These species have been found to contain *phenethylamines*, quinazolines and carboxylated *tryptamines*. In species studied [with some exceptions], the *phenethylamines* are the major alkaloids in the aerial parts, and the quinazolines are the major root alkaloids. Roots from 2-year old plants contained quantities of *tryptamines* equivalent to, or greater than quinazoline concentrations. Roots from 6-month old plants contain quinazolines as the major constituents. Total alkaloid yields decrease with plant age.

S. acuta roots have yielded >0.066% alkaloids – including 0.0007% *phenethylamine*, 0.0002% *ephedrine*, 0.0002% pseudoephedrine, 0.0004% vasicinol, 0.0011% vasicinone, 0.0011% vasicine [see **Peganum**], 0.08-0.35% cryptolepine [hypotensive, antimicrobial; when present, it is the sole alkaloid], 0.0015% *choline*, 0.00048% betaine and 0.00036% hypaphorine [N,N,N-trimethyltryptophan – see **Erythrina**]. Aerial parts yielded 0.0034% *phenethylamine*, 0.0015% *ephedrine*, 0.001% pseudoephedrine, 0.00008% vasicinol, 0.00036% vasicinone, 0.00044% vasicine, 0.05-0.45% cryptolepine [see above], 0.00084% hypaphorine, 0.0013% N,N-dimethyltryptophan methyl ester, 0.00124% *choline* and 0.00088% betaine. Seeds have yielded 0.26% alkaloids; the whole plant has also yielded 0.11-0.66% in plants from Negombo, India (Dutta 1964; Gunatilaka et al. 1980; Prakash et al. 1981). Ecdysterone has also been found (Rastogi & Mehrotra ed. 1990-1993).

S. chinensis root has yielded c.0.053% alkaloids, as well as steroid compounds and fatty oils (Dutta 1964).

S. cordifolia [whole plant] has yielded an average of 0.085% alkaloids; highest yields were from flowering plants. Seeds contain nearly 4 times the alkaloid levels found in other parts. Roots yielded 0.0012% *phenethylamine*, c.0.0009% *ephedrine*, c.0.0007% pseudoephedrine, 0.0016% abrine methyl ester [N-methyltryptophan methyl ester], 0.0004% hypaphorine, 0.0036% vasicinone, 0.001-0.62% vasicine, 0.0009% vasicinol, 0.002% *choline* and 0.0024% betaine; aerial parts have yielded 0.01-0.6% vasicine. The plant also contains fatty oil, phytosterols, resins and resinic acids, mucins and potassium nitrate (Ghosal et al. 1975; Ghosh & Dutt 1930; Gunatilaka et al. 1980). *Ephedrine* has not been found in Australian specimens (Cribb & Cribb 1981). In rodents, an aqueous extract of the leaves [collected before flowering] was of low toxicity, and showed analgesic and antiinflammatory activity (Franzotti et al. 2000).

S. glutinosa root has yielded 0.064% alkaloids, as well as steroid compounds and fatty oils (Dutta 1964).

S. humilis roots yielded 0.0009% *ephedrine*, 0.0007% pseudoephedrine, 0.00042% N-methylpseudoephedrine, 0.00024% N-methylephedrine, 0.00336% *phenethylamine*, 0.00016% vasicinol, 0.00048% vasicinone, 0.00036% vasicine, 0.0018% *choline* and 0.0023% betaine. Aerial parts yielded 0.01% *phenethylamine*, 0.003% *ephedrine*, 0.0026% pseudoephedrine, 0.0013% N-methylpseudoephedrine, 0.00056% N-methylephedrine, 0.00016% vasicinol, 0.00066% vasicinone, 0.0004% vasicine, 0.0029% *choline* and 0.0017% betaine.

S. rhombifolia roots yielded 0.0007% *phenethylamine*, 0.00034% N-methylphenethylamine, 0.0006% *ephedrine*, 0.00034% pseudoephedrine, 0.00076% abrine methyl ester, 0.0006% vasicinol, 0.00148% vasicinone, 0.00096% vasicine, 0.00046% hypaphorine, 0.00036% hypaphorine methyl ester, 0.00124% *choline* and betaine. Aerial parts yielded 0.0094% *phenethylamine*, 0.0038% N-methylphenethylamine, 0.0027% *ephedrine*,

0.001% pseudoephedrine, 0.00024% vasicinol, 0.00072% vasicinone, 0.00064% vasicine, 0.11% cryptolepine, 0.0017% *choline* and 0.0019% betaine (Gunatilaka et al. 1980; Prakash et al. 1981). *Ephedrine* has not been found in Australian specimens (Cribb & Cribb 1981). Leaf, stem and seed from Queensland, Australia [harv. Apr.] tested negative for alkaloids (Webb 1949).

S. spinosa roots yielded 0.00062% *phenethylamine*, 0.00056% *ephedrine*, 0.00044% pseudoephedrine, 0.00036% vasicinol, 0.00092% vasicinone, 0.00064% vasicine, 0.00066% hypaphorine, 0.00074% hypaphorine methyl ester, 0.00156% *choline* and 0.0015% betaine. Aerial parts yielded 0.003% *phenethylamine*, 0.002% *ephedrine*, 0.0016% pseudoephedrine, 0.00012% vasicinol, 0.00036% vasicinone, 0.00024% vasicine, 0.00096% hypaphorine, 0.00056% hypaphorine methyl ester, 0.0019% *choline* and 0.00166% betaine (Gunatilaka et al. 1980; Prakash et al. 1981).

S. veronicaefolia root has yielded c.0.053% alkaloids, as well as steroid compounds and fatty acids (Dutta 1964).

These alkaloid-containing species have sometimes been found to be alkaloid free, or to contain only a single major alkaloid (Gunatilaka et al. 1980; Watt & Breyer-Brandwijk 1962).

Sida rhombifolia is an erect, much-branched perennial subshrub to 1m tall; stems dull whitish-green, twiggy, fibrous with a tough stringy bark, densely hairy. Leaves alternate, shortly stalked, with narrow stipules 5-10mm long at base, blade oblong to narrow-lanceolate, 2-5 x 0.3-0.8cm, irregularly toothed, dull-green above, ashy-green below, hairy both sides. Flowers axillary, solitary on slender peduncles 1-3cm long, peduncles usually slightly longer than leaves, bent above middle; flowers yellow, 1.5-2cm diam.; calyx ashy-green, 5-lobed, 10-ribbed with stellate hairs outside, simple hairs inside, 5 sepals valvate, connate below for up to ½ their length; corolla of 5 petals, 7-8mm long, 8-12mm across, united at base, small, yellow or white; staminal tube divided at apex into numerous filaments. Ovary of 5-12 cells; ovule 1, pendulous in each cell; styles as many as carpels; stigmas terminal; carpels 7-10 with 2 short awns. Fruit enclosed by calyx, dark brown, globular, 6mm diam., vertically ribbed, dividing into 8-10 seeds; carpels separating; seeds dark brown, roundly wedge-shaped, c.2mm long, smooth, vertically 2-ribbed, bearing 2 erect, finely backward-barbed awns.

Endemic throughout tropics, commonly on moist disturbed sites in paddocks, waste places and roadsides; common along e. & n. coast of Australia, sporadically inland (Kirtikar & Basu 1980; Parsons & Cuthbertson 1992).

SILER

(Umbelliferae/Apiaceae)

Siler divaricatum *(Turcsz.) Benth. et Hook. f.* **(Ledebouriella divaricata** *(Turcsz.) Hiroë***; L. seseloides** *(Hoffm.) Wolff.***; Saposhnikovia divaricata** *(Turcsz.) Schischk.***; Stenocoelium divaricatum** *Turcsz.***; Trinicia dahurica** *Turcz. ex Bess.***)** – fang-feng ['guard against wind'], bofu, bangp'ung, saposhnikova

This herb has been used in TCM since ancient times, all parts of the plant having medicinal properties, though the leaves have been eaten as food. The spicy root is the part usually used for medicine. It has warm, pungent and sweet properties, with an affinity for the liver, spleen and bladder. Decocted in doses of 4-15g, taken in two doses, the root is used to treat headache, blurry vision, common cold, rheumatoid arthritis and bloodshot eyes. It is antipyretic, analgesic, antibacterial, expectorant, antitussive and tonic to the respiratory tract. The root is often taken together with the root of **Angelica** dahurica, 'bai zhi', and is said to be incompatible with ginger [Zingiber spp.] and aconite [Aconitum spp.] [see *Endnotes*] (Huang 1993; Keys 1976; Read ed. 1946; Reid 1995). It may also be used to treat aconite poisoning (Li 1978).

It has been written that a 'fang-feng' root that bifurcates at the top "produces madness", and one that bifurcates at the bottom "causes reversion of old ailments", though the root is generally considered non-toxic. It is uncertain as to whether this reference had any basis in fact, or indeed, if it even referred to S. divaricatum, which is known as fang-feng today (Li 1978). **Peucedanum** ledebourielloides and P. wawrii may have been used as fang-feng in the past (Wang & Lou 1989). The roots of several other herbs are also used today as varieties of fang-feng – Carum carvi ['xibei fang-feng', 'caraway'], Ligusticum brachylobum ['chuan fang-feng'], and Seseli mairei ['yun fang-feng'] (Baba et al. 1990). Glehnia littoralis ['bei sha shen' ('northern sand root')] (Bensky & Gamble 1993) is sometimes used as a substitute, known as 'shi fang-feng' in China (Wang & Lou 1989), and in Japan, the root ['hama-bofu'] is used for the same purposes as that of S. divaricatum ['bofu'] and is sometimes confused with it. The two also share similar chemistry (Okuyama et al. 2001).

S. divaricatum root has yielded chromones [0.0007% divaricatol, 0.0002% hamaudol, 0.044% sec-O-glucosylhamaudol, 0.0006% ledebouriellol], coumarins [0.001% *scopoletin*, 0.0005% fraxidin, 0.0015% isofraxidin], furanocoumarins [0.024% cimifugin, deltoin, 0.00007% (3'S)-OH-deltoin, bergapten, imperatorin, isoimperatorin, psoralen, xanthotoxin], polyacetylenes [0.092% panaxynol, 0.044% falcarindiol, 0.0078% falcarinone], 1-acylglycerols [0.0012% glycerol monooleate, 0.0004% glycerol monolinoleate] (Baba et al. 1990; Okuyama et al. 2001; Wang et al. 2000), acidic polysaccharides [saposhnikovans] (Shimizu et al. 1989a, 1989b), and 0.3-0.6% essential oil (Huang 1993). Extracts of the roots have shown CNS-inhibitory, sleep-prolonging, analgesic, anticonvulsant and antiinflammatory effects, as well as inhibiting peptic ulcers and nitrite production. The analgesic properties, at least, were attributed to a synergy of the root constituents, rather than any one group of compounds, though the chromones were the most effective (Okuyama et al. 2001; Wang et al. 1999, 2000).

Siler divaricatum is a perennial herb, with a root 1.5-2cm thick, vertical, its neck densely covered with brown leaf remnants; stem usually single, 30-80cm tall, branching from base with obliquely ascending branches nearly as long as or longer than main stem, ribbed, flexuose, stem and leaves glabrous. Radical leaves numerous, their short flattened petioles abruptly dilated into sheaths, blade oblong, 6-20 x 2-4cm, 2- or nearly 3-pinnatipartite; primary lobes oblong or ovate, petioluled, lower secondary lobes also petioluled, pinnatisect into acute narrow ovate sessile lobules; cauline leaves similar to radical but smaller, upper leaves sessile on expanded sheath, with undeveloped blade or blade obsolete. Umbels 4-6cm across, numerous, forming corymbiform panicle of 6-7 glabrous, angular, unequal rays; involucre absent; umbellets 4-10-flowered; calyx teeth short triangular, conspicuous; petals white, glabrous, broadly oval, obtuse, not notched. Ribs of ovary densely covered with transverse white excrescences becoming obliterated in fruit; stylopodium conical; styles straight at first, becoming recurved, nearly as long as stylopodium. Ripe fruit glabrous, ovoid, 5-6 x 3-3.5mm, slightly compressed dorsally, mericarps with acute prominent dorsal ribs, each with 1 large canal, valleculae broad, with 1 canal, 2 canals towards commissure. Fl. Jun.-Jul.

Pebbly steppe slopes, shrubby thickets, birch forests; e. Siberia [Dauria, Zeya-Bureya, Ussuri], Mongolia, Manchuria, China, Korea (Shishkin ed. 1986b).

SMENOSPONGIA and POLYFIBROSPONGIA

(Thorectidae)

Smenospongia aurea *(Hyatt) Wieden.* **(Aplysina aurea** *Hyatt***; A. fenestrata** *(Duchassaing et Michelotti) Carter***; Spongia fenestrata** *Duchassaing et Michelotti, non. Lamarck***; Stelospongos cribriformis var. typica** *Hyatt***)**

Smenospongia echina *(Laubenfels) Wieden.* **(S. cerebriformis** *Duchassaing et Michelotti***; Polyfibrospongia echina** *Laubenfels***; Spongia cerebriformis** *Duchassaing et Michelotti***)**

Polyfibrospongia maynardii *Hyatt*

These Caribbean sea sponges are known to have antimicrobial properties – S. aurea and S. echina extracts inhibited the growth of Staphylococcus aureus and Candida albicans (Djura et al. 1980). They are more interesting due to their occasional content of the pharmacologically-unexplored indole alkaloids 5-bromo-*DMT* [thought to probably be psychoactive when taken in a similar fashion to *DMT*] and 5,6-dibromo-*DMT* [thought to probably be inactive as a psychedelic, but has not been tested] (Trout ed. 1997e). In animals, the former alkaloid has shown sedative activity, and the latter has shown anxiolytic and antidepressant activity. The sponge indole alkaloid 6-bromo-aplysinopsin is known to bind to human 5-HT2 receptor subtypes (Kochanowska et al. 2008). There is the possibility that these alkaloids may be of dietary origin, as is thought to be the case with Verongula gigantea [see *Endnotes*] (Ciminiello et al. 2000).

S. aurea yielded 0.88% 5-bromo-*DMT* [which yielded *DMT* on hydrogenation] and 0.036% aureol [a sesquiterpene hydroquinone ether] from one sample; another sample yielded 2.2% 8-epichromazonarol and traces of a new, un-named brominated indole alkaloid (Djura et al. 1980). Yet another sample yielded 5-bromo-*DMT*, 5,6-dibromo-*DMT*, aureol, 6-bromoaplysinopsin and 6-bromo-4'-N-demethylaplysinopsin (Tymiak et al. 1985). Specimens from Florida Keys yielded 0.2% 5,6-dibromo-*DMT*, 0.36% aureol, 0.0054% 6-bromo-aplysinopsin, 0.0068% 2'-des-N-methyl-aplysinopsin, 0.0045% makaluvamine O, 0.015% uracil and 0.009% thymine (Kochanowska et al. 2008).

S. echina has yielded 0.88-0.95% 5,6-dibromo-*DMT* and 0.04% of a new phenol (Djura et al. 1980), as well as amino acids – *taurine*, *glycine*, alanine, threonine, serine, *glutamine*, *glutamic acid*, arginine, *aspartic acid*, lysine, histidine, valine, leucine, isoleucine and pipecolic acid (Bergquist 1978). As S. cerebriformis, specimens from Key Largo, Florida yielded 0.9615% ilimaquinone; 5,6-dibromo-*DMT* was detected but not isolated (Kochanowska et al. 2008).

P. maynardii yielded 5,6-dibromo-*tryptamine* and 5,6-dibromo-*N-methyltryptamine*; it has shown antibacterial properties (Van Lear et al. 1973). It has been suggested, based on chemistry combined with mor-

phology, that P. maynardii be reclassified as a Smenospongia sp. (Djura et al. 1980), though as far as I am aware this reclassification has not yet formally taken place.

Smenospongia aurea is a sea sponge, semi-incrusting to massive, amorphous, tending to lobate; consistently stiffly spongy, rubbery, very slimy after death, rigid and brittle when dry; interior often coarsely cavernous or hollow; large cavities communicate with the surface through invaginations; body c.2-25cm wide, 2-5cm high, light brown, often with reddish and purplish tinges, especially towards base; incrusting base light yellow to off-white; surface olive to yellow-green in some specimens; turns black after exposure to air. Ostia contractile, 25-200µ wide, crowded in the superficial depressions; oscules large and conspicuous, 5-10mm diam., usually on top of mounds which occasionally become conical protruberances, and have a membranaceous diaphragm; ectosome is a fleshy skin, not detachable; choanosome bright lemon yellow, fleshy, coarsely cavernous, with cavities and canals 0.5-2cm wide. Skeleton with wide, trellised primary systems; crowded primary fibres 40-180µ diam., regularly stratified, dark amber to dark brown (axial region darker, devoid of pith), connected by very short secondaries – primaries frequently branching at very low angles, often band-shaped and corrugated longitudinally; secondaries arranged in continuous planes, outlining triangular to hexagonal prisms, giving dried specimens a characteristic honeycombed surface, frequently branching near junction with primaries, occasionally anastomosing.

Coral reefs, w. Bahamas (Wiedenmayer 1977).

SOLANDRA

(Solanaceae)

Solandra brevicalyx *Standley*
Solandra grandiflora *Sw.* **(Datura sarmentosa** *Lam.***; Swartsia [Swartzia] grandiflora** *(Sw.) J.F. Gmel.***)**
Solandra guerrerensis *Martinez*
Solandra guttata *D. Don.* **(Swartsia guttata** *(D. Don.) Standl.***)**
Solandra hartwegii *N.E. Br. ex C.F. Ball* **(S. maxima** *(Sessé et Moc.) P.S. Green***; S. selerae** *Dammer ex Loes.***; Datura maxima** *Sessé et Moc.***)**
Solandra hirsuta *Dunal*
Solandra macrantha *Dunal* **(S. grandiflora var. macrantha** *(Dunal) generic VOSS***)**
Solandra nitida *Zucc.* **(Swartsia nitida** *(Zucc.) Standl.***)** – perilla, t'ima wits
Solandra spp. – chalice vine, kiéri, kiéli, tecomaxochitl, hueipatl

These plants, both revered and feared in parts of Mexico, are associated with the Huichol god of wind and sorcery, Kiéri Tewiari. According to Huichol mythology, when this god was killed, he was not permitted by the Great Spirit to die and enter the afterlife, because of his evil nature. He was thus forced to spend eternity on Earth in the rocky cliffs, growing as the 'kiéri' plant. The Aztecs once drank a leaf decoction of a Solandra sp. with 'cacao' [see **Theobroma**], as an aphrodisiac. S. guerrerensis is still used as a shamanic inebriant in the Mexican state of Guerrero. In some areas, tea made from the juice of young branches of S. brevicalyx or S. guerrerensis is consumed for the same purpose. S. nitida is also known to be 'narcotic'. The Huichol often deny knowledge of these plants, and are unwilling to discuss them with strangers. To them, a malevolent god resides within the plant, who must not be upset. The most powerful plants are considered to be those growing on cliff-edges, as opposed to those growing in forests. Of these cliff-dwelling plants, the most powerful are said to be those with a slightly reddish tinge in the throat of a mostly white flower. The most potent part of Solandra spp. is considered to be the fruit. Huichols who wish to gain favour from kiéri travel to the nearest plant, bringing all kinds of offerings, which are touched to the plant and then tied to a branch or placed at the base. The plant is then sung to or fed, and candles are lit and left to be blown out by the wind. The plants are rarely consumed, due to their dangerous effects and links to sorcery, as well as an understandable cultural preference for the more positive effects of peyote [see **Lophophora**]. Admission of using these plants is in effect an admission of guilt of practising witchcraft. Sorcerers may use them to cure damage done through offensive witchcraft (Furst 1976, 1995; Jiu 1966; Knab 1977; Rätsch 1992; Schultes & Hofmann 1980, 1992).

S. grandiflora roots yielded 0.4% *hyoscyamine*, 0.004% *hyoscine*, 0.07% cuscohygrine, 0.03% valtropine, 0.004% littorine, 0.02% tigloidine, 0.03% 3α-tigloyloxytropane, 0.02% 3-α-acetoxytropane, 0.04% cuscohygrine decomposition products, tropine and pseudotropine. Aerial parts yielded 0.08% *atropine*, 0.06% nor-*atropine*, 0.002% *hyoscine*, 0.004% valtropine, 0.004% tigloidine, 0.005% 3-α-acetoxytropane, 0.002% 3-α-tigloyloxytropane, cuscohygrine, tropine and pseudotropine.

S. guttata roots yielded 0.08% nor-*atropine*, 0.02% of a mix of *atropine* and *hyoscyamine*, 0.007% *hyoscine*, 0.003% tigloidine, 0.002% valtropine, 0.005% 3-α-acetoxytropane, 0.01% 3-α-tigloyloxytropane, tropine, pseudotropine, cuscohygrine and possibly littorine. Stems yielded 0.09% nor-*atropine*, 0.012% dl-nor-*hyoscine*, 0.004% of a mix of *atropine* and *hyoscyamine*, 0.006% tigloidine, tropine, pseudotropine, and two unidentified bases [0.001% and 0.012%]; leaves were shown to contain *atropine*, nor-*atropine*, *hyoscyamine*, nor-*hyoscyamine*, *hyoscine*, tropine, pseudotropine, and valtropine or 3-α-tigloyloxytropane.

S. hartwegii roots were shown to contain *atropine*, *hyoscine*, *hyoscyamine*, tigloidine, valtropine, tropine, pseudotropine and cuscohygrine; aerial parts contained similar alkaloids, but without cuscohygrine or tigloidine, and with nor-*atropine*, nor-*hyoscyamine* and 3α-tigloyloxytropane.

S. hirsuta roots yielded 0.16% *atropine*, 0.04% of a mix of nor-*atropine* and nor-*hyoscyamine*, 0.06% tigloidine, 0.04% cuscohygrine, 0.003% *hyoscine*, 0.02% valtropine, 0.013% 3-α-acetoxytropane, 0.016% 3-α-tigloyloxytropane, tropine, pseudotropine and littorine. Aerial parts yielded 0.15% *atropine*, 0.08% nor-*atropine*, 0.01% *hyoscine*, 0.004% tigloidine, 0.004% valtropine, 0.003% 3-α-acetoxytropane, 0.004% 3-α-tigloyloxytropane, pseudotropine, tropine and cuscohygrine.

S. macrantha roots were shown to contain mainly a mix of nor-*hyoscyamine* and nor-*atropine*, as well as *atropine*, *hyoscyamine*, *hyoscine*, tigloidine, 3α-tigloyloxytropane, 3α-acetoxytropane, valtropine, pseudotropine, tropine and cuscohygrine; aerial parts had a similar profile, but without 3α-acetoxytropane or cuscohygrine (Evans et al. 1972b).

Solandra guttata is a woody, climbing or sprawling shrub, sometimes growing epiphytically, glabrous or pubescent. Leaves alternate, entire, subcoriaceous or somewhat succulent, pubescent with simple or tree-like hairs. Inflorescences in the apices of secondary branches, with 1-several flowers; pedicels stout, generally short; calyx tubular-campanulate, pubescent, 2-5-lobed, lobes irregular; corolla gradually enlarged above, large and showy, white to yellowish, often with purplish striations, campanulate-infundibuliform, the lobules overlapping in bud, bud inflated; stamens 5, equal, the inserted ones in the upper part of the narrow portion of the tube, others exserted; filaments long, straight or curved; anthers oblongate, longitudinally dehiscent. Ovary partially inferior, 4-locular; ovules numerous; embryo curved.

Veracruz, Mexico (Nee 1986).

SOLANUM

(Solanaceae)

Solanum dimidiatum *Raf.* **(S. perplexum** *Small***; S. torreyi** *A. Gray***)** – western horsenettle, potato weed, Torrey's nightshade
Solanum dulcamara *L.* – bittersweet, woody nightshade, kakmachi, bhalu-mash
Solanum ellipticum *R. Br.* **(S. lithophilum** *F. Muell.***)** – wild tomato, native tomato, wild gooseberry, potato bush, kulypurpa, tawal-tawalpa, yuralpa, wangki
Solanum esculentum *Dunal* **(S. melongena var. esculentum** *(Dunal) Nees***)**
Solanum hirtum *Vahl* – papaya des jaguars
Solanum hypomalacophyllum *Bitter ex Pittier* – borrachera ['intoxicant']
Solanum inaequilaterale *Merr.*
Solanum kwebense *N.E. Br. ex C.H. Wright*
Solanum melongena *L.* – eggplant, aubergine, berenjena, vartaku, baigun
Solanum nigrum *L.* – black nightshade, blackberry nightshade, glossy nightshade, poisonberry, physalis, strychnos kêpaion
Solanum renschii *Vatke* – laibalayok
Solanum spirale *Roxb.* – bagua, mungas kajur
Solanum tuberosum *L.* – potato, batata, pomme de terre, kartappe, golalu, alu
Solanum villosum *Mill.* **(S. alatum** *Moench***; S. luteum** *Mill.***; S. miniatum** *Bernh. ex Willd.***; S. nigrum var. villosum** *(L.) Mill.***; S. rubrum** *Mill.***)** – tomate de la bruja ['tomato of the sorcerer'], tomatillo del diablo, hierba mora
Solanum spp. – nightshades

Nightshades are herbaceous plants, including the common eggplant [S. melongena] and potato [S. tuberosum], both of which have toxic as well as edible parts (Chevallier 1996). Nightshades were reported as a common ingredient in witch's flying ointments [see *Methods of Ingestion*] (Rätsch 1992), but it is doubtful that this refers to Solanum spp. Many Solanaceae are referred to as nightshades, and often erroneous identifications are made by laypeople. For example, in Britain, S. dulcamara is often pointed out to children as 'deadly nightshade' [see **Atropa**] (theobromus pers. comm.), and in Australia, the same applies to S. nigrum (pers. obs.).

Many people believe the berries of S. nigrum to be poisonous, but this only applies to green, unripe berries; black, ripe berries are good for making an edible jam. However, this does not apply to berries of all Solanum spp. In many parts of the world, the cooked leaves are eaten as a vegetable – when fresh, they act as an analgesic and tranquilliser. The plant has poisoned animals, sometimes causing death. In humans, the plant is claimed to cause stupefaction, staggering, mydriasis, difficulty in speaking, anaesthesia, cramps and sometimes convulsions. These symptoms may be due

to confusion with those of 'deadly nightshade', **Atropa** belladonna. A water infusion or decoction of S. nigrum may cause transient stimulation, followed by CNS-depression; low doses increase cardiac output, and large doses depress it. Plasma cholinesterase is also inhibited (Bremness 1994; Low 1991b; Roddick 1986; Watt & Breyer-Brandwijk 1962). An extract of the herb was once regarded as having narcotic properties of "the same power as lettuce-opium" [see **Lactuca**] (Bailey 1880).

In Africa, S. nigrum has been used to divine the whereabouts of lost objects or criminals (Rätsch 1992). 'Rain doctors' of the Southern Sotho and Tswana use the ripe berries in magical preparations to bring rain; this use is apparently due to the black colour of the fruits, in symbolic relation to dark rain-clouds (Mehra 1979). In Italy, S. nigrum has been used as a sedative, diaphoretic, antispasmodic and emollient (Watt & Breyer-Brandwijk 1962). In India, it is known as an aphrodisiac and laxative tonic, and the unripe fruits have caused deliriant and fatal poisoning in children. Also in India, S. dulcamara berries, decocted in a dose of c.60g, are known to be mildly narcotic, sedative, cardiotonic, diaphoretic and diuretic. Shepherds used to hang the plant around the necks of sheep thought to be under the influence of the 'evil eye', as a charm. Leaves of S. esculentum are also narcotic, and are given to relieve intoxication. The root of S. spirale also has narcotic properties (Grieve 1931; Kirtikar & Basu 1980; Nadkarni 1976).

In Spain, S. villosum is known as 'tomate de la bruja', hinting at use by sorcerers (Rätsch 1998). The Lacandon Maya of Chiapas, Mexico, refer to S. hirtum [which is similar in appearance to the eggplant, S. melongena] as 'papaya of the jaguar', indicating knowledge of possible psychotropic effects, the jaguar being a shamanic animal. Chewing the de-spined leaves produces a numbing effect, with larger amounts causing a 'strange inebriation' (Rätsch pers. comm.). In Mexico the flowers of S. melongena are used as a hypnotic and hypotensive (Heffern 1974); in India, the leaves are considered narcotic, the seeds stimulant and cardiotonic, and the fruit hypnotic (Nadkarni 1976; Vohora et al. 1984). S. hypomalacophyllum from Venezuela may also be intoxicating, as its common name suggests. S. topiro seeds are sometimes dried, powdered, and added to coca powder [see **Erythroxylum**], when the tongue and mucous membranes have been irritated by over-use. The leaves are applied externally to treat headache (Schultes & Raffauf 1990). In n.e. Peru S. oblongifolium var. soukupii ['tululuche'] leaf is infused to treat colds and bronchitis, yet a concentrated decoction is used to poison animals (De Feo 2003). In the Peruvian Amazon, S. kioniotrichum ['siuca-huito'] is sometimes used by sorcerers to inflict harm upon others (Luna & Amaringo 1991).

In e. Africa, the Samburu consume S. renschii for strength; a fruit extract was shown to "diminish the power of conductivity of nerves, and temporarily stimulate cardiac action" (Lehmann & Mihalyi 1982). In w. Africa, S. verbascifolium is used as an ordeal poison (De Smet 1998). The South African S. kwebense is known to cause an intoxication in cattle known as 'crazy cow syndrome', as does the Texan S. dimidiatum (Griffin & Lin 2000). In Queensland [Australia], berries of S. armatum have caused narcotic poisoning in horses (Webb 1948). The leaves of S. ellipticum are sometimes used by the Pitjantjatara as a 'pituri' substitute [see **Duboisia**, **Nicotiana**] (Latz 1995); some aboriginal groups have been reported to chew the leaves as a tobacco substitute (Low 1990), which may refer to the same useage. In the Philippines, S. inaequilaterale leaves are smoked as a tobacco substitute (Lewis & Elvin-Lewis 1977). In Tari, Papua New Guinea, S. torvoideum is used in rituals for fighting and battle [see **Galbulimima**] (Paijmans ed. 1976).

S. tuberosum has caused poisonings in humans, after ingestion of green potatoes [the alkaloids mentioned below are concentrated in the green parts]. Symptoms included hallucinations, confusion/delirium, abdominal pain, vomiting, diarrhoea, anorexia, cyanosis and coma; deaths have occurred on occasion (Roddick 1986). Children who ate the berries of S. sodomaeum in Australia suffered "congestion of the blood vessels, sweating, dimness of sight, dizziness, vomiting and purging", followed by death (Webb 1948).

Many Solanum spp. contain steroidal glyco-alkaloids such as solanine, concentrated in the unripe berry, and also found in aerial parts. Solanine is quite toxic, and is an AChE-inhibitor (Patil et al. 1972).

S. melongena has yielded 0.00005-0.0003% *tryptamine*, 0.0002% *serotonin*, and 0.0003% *tyramine* from its fruit (Udenfriend et al. 1959). The plant also contains calystegines (Griffin & Lin 2000) and the coumarins *scopoletin* and aesculetin [0.0008% in leaves, 0.0004% in root, w/w] (Kala 1958); HCN was detected in the whole plant (Watt & Breyer-Brandwijk 1962). An alkaloid fraction from the leaves acted as an analgesic and slight CNS-depressant in rats and mice (Vohora et al. 1984); components of the plant also inhibit AChE (Whitaker & Feeney 1973).

S. nigrum has yielded solanine, solamargine, solasodine [4-6% in fruit], solasonine, solanigridine and vitamin C. HCN was also detected in the fruit. Frying or boiling does not destroy the alkaloids, and frying can actually concentrate them (Roddick 1986; Watt & Breyer-Brandwijk 1962). The plant inhibits human plasma AChE; S. tuberosum and S. chacoense were much more potent in this regard, and S. melongena and S. rostratum much less so (Orgell 1963b).

S. sodomaeum leaves were shown to contain calystegines B2 & B3 (Bekkouche et al. 2001).

S. torvum aerial parts contain *GABA* (Durand et al. 1962).

S. tuberosum tuber [the potato itself] has yielded *diazepam* [0.003-0.01ng/g], N-desmethyldiazepam, lorazepam, delorazepam, 2'-chlorodiazepam (Unseld et al. 1989; Wildmann et al. 1988), 0.00006% *narcotine* (Rimpler 1965), 0.0001% *tyramine*, *dopamine* and 0.00001-0.0002% *norepinephrine* (Smith 1977a; Udenfriend et al. 1959), as well as 0.01% [w/w] calystegines in the skin of the tuber (Griffin & Lin 2000). Solanine is concentrated in the green parts of potatoes that form when the tubers have been exposed to light (Patil et al. 1972). When bruised, the tubers form dopachrome [see *Neurochemistry*, and *adrenochrome* in *Chemical Index*] as an intermediate product; it may be formed less than 6 hours after initial bruising, and can be recognised by its orange colour. The dopachrome is formed from tyrosine, by the enzyme tyrosinase. The black discolouration that later develops is due to the formation of melanin from dopachrome (Boyer 1977; Friedman & Daron 1977; Muir & Ross undated). Some constituents of S. tuberosum inhibit AChE (Whitaker & Feeney 1973). Leaves have yielded 0.0002% *serotonin*, and fruits 0.00075% *serotonin* [both w/w] (Engström et al. 1992).

Calystegines [see **Convolvulus**] have also been found in S. dimidiatum, S. dulcamara and S. kwebense (Griffin & Lin 2000).

Solanum nigrum is a variable annual herb; stem erect, glabrous or +- pubescent, much divaricately branched. Leaves numerous, alternate or subopposite, 2.5-9 x 2-5cm, ovate-lanceolate, subacute or acuminate, glabrous, entire, sinuately toothed, tapering to the petiole; petioles 2cm long. Flowers small, in extra-axillary subumbellate 3-8-flowered cymes; peduncles 6-20mm long, slender; pedicels 6-10mm long, very slender; calyx 3mm long, glabrous or nearly so, 5-lobed, lobes oblong, obtuse, 1.25mm long, not enlarged in fruit; corolla 4-8mm long, divided more than ½ way down into 5 oblong subacute lobes; stamens (4-)5(-6) in corolla-throat; filaments short, flattened, hairy at base; anthers 2.5mm long, yellow, oblong, obtuse, often narrowed upwards, notched at apex. Ovary globose, glabrous, 2-celled; style cylindric, columnar, hairy; stigma small. Berry c.6mm diam., globose, purplish-black when ripe, smooth, shining; seeds discoid, 1.5mm diam., minutely pitted, yellow.

Temperate and tropical regions of the world; a widespread introduced weed (Kirtikar & Basu 1980).

A very variable species that can be confused with similar Solanum spp., such as S. americanum [which probably has similar pharmacology].

SOPHORA

(Leguminosae/Fabaceae)

Sophora flavescens *Aiton* **(S. angustifolia** *Sieb. et Zucc.***; S. macrosperma** *DC.***; S. tetragonocarpa** *Hayata***)** – ku sheng

Sophora japonica *L.* **(S. mairei** *H. Lév.***; S. pubescens** *Tausch***; S. sinensis** *Forrest***; Ormosia esquirolii** *H. Lév.***; Robinia mitis** *Lour.***; Styphnolobium japonicum** *(L.) Schott***)** – pagoda tree, Chinese scholar tree, huai hua, long zhao huai

Sophora secundiflora *(Orteg.) Lag. ex DC.* **(S. sempervirens** *Engelm.***; S. speciosa** *Benth.***; Agastianus secundiflora** *(Orteg.) Raf.***; Broussonetia secundiflora** *Orteg.***; Calia erythrosperma** *Teran et Berland.***; C. secundiflora** *(Orteg.) Yakovlev***; Cladrastis secundiflora** *Raf.***; Dermatophyllum speciosum** *Scheele***; Virgilia secundiflora** *Cav.***)** – mescal bean, Texas mountain laurel, frijolitos

Sophora spp.

Mescal bean, S. secundiflora, is cultivated for its beautiful flowers, yet the plant has a more interesting history of use. The small red 'mescal beans' have reportedly been used as a ritual intoxicant in n.e. Mexico and adjacent US, possibly for thousands of years [though little used today, if at all], as well as being made into necklaces for adornment [the predominant form of use]. They have been discovered in cave excavations dating back to 7000BC, often together with seeds of Ungnadia speciosa [Sapindaceae; 'Texas buckeye']. Texas 'Indians' have used the seeds as barter money – it has been reported that a 15cm string of the seeds could buy a pony. The name mescal bean probably originated from confusion with peyote [see **Lophophora**] and the Agave spp. liquor 'mezcal', which are used in the same general area as S. secundiflora. Apparently, the beans have sometimes been added to mezcal to make it stronger. The Wichita used the seeds in initiations, to produce vomiting and visions. The Omaha used it as a powerful medicine before hunting or battle; the seeds were consumed, or in the latter case, rubbed on the body, to produce a 'strengthening' effect. The Iowa would harvest the beans in spring, roasting them until they turned yellow, then grinding them and infusing in water with other herbs; this infusion was then strained and drunk. Some groups, such as the Kiowa, had mescal beans adorning the leader of the peyote ritual – the Kickapoo say this is because S. secundiflora 'shades and protects' peyote in the wild. The mescal bean ritual of central and southern Plains Indians was called the 'Red Bean Dance' [also 'deer dance' or 'Wichita dance'], which shares many common traits with peyote rituals. For the dance, the beans were brewed with unidentified herbs, which made the drink 'milder'. Many scholars believe that use of the mescal bean was an early form

of worship which decreased in practice when the safer properties of peyote were discovered. Today, many doubt that the beans were ever used as an intoxicant at all (Adovasio & Fry 1976; Allen & Allen 1981; De Rios 1990; Diaz 1979; Emboden 1979a; Furst 1976; Hatfield et al. 1977; Ott 1993; Schultes 1937a, 1937b, 1969c).

S. japonica, common in temple gardens, is used medicinally in China for its flowers to stop fever and bleeding, as well as to control high blood pressure, nervousness and dizziness. The leaves and pods have been used to adulterate 'opium' [see **Papaver**], and a yellow dye made from the pods was once much-valued for dyeing silk in the Orient (Allen & Allen 1981; Bremness 1994; Huang 1993). S. flavescens is used medicinally in China as 'ku sheng' ['bitter root'], and acts as an antiarrhythmic, antiasthmatic, expectorant, anthelmintic and diuretic. Side effects may include gastric pain, nausea, vomiting and constipation (Huang 1993).

S. secundiflora seeds [the 'beans'] are highly toxic – one thoroughly chewed seed has been known to kill a child [though adults and some children may tolerate more], and the plant has caused poisonings in stock animals. Whole seeds may pass through the digestive tract harmlessly. The intoxicating dose is usually ¼-3 seeds. Symptoms may include nausea, vomiting, diarrhoea, convulsions, headache, excitement, hallucinations and delirium; overdose will produce a comatose state sometimes ending in death due to respiratory failure, though often a sub-lethal dose will end in a prolonged sleep state lasting several days. The effects are due to the *nicotine*-like *cytisine* and related quinolizidine/pyrrolizidine alkaloids, which affect *acetylcholine*-receptors [see also **Cytisus**, **Laburnum**, **Lupinus**] (Allen & Allen 1981; Barlow & McLeod 1969; Blackwell 1990; De Rios 1990; Emboden 1979a; Foster & Caras 1994; Hatfield et al. 1977; Schmeller et al. 1994; Turner & Szczawinski 1991). Despite this, their use has been suggested as a potential legal 'high' (Gottlieb 1992), and have very rarely been ingested for such purposes in more recent times (Keller 1975). There is one clinical report of a young man who consumed an unknown amount of S. secundiflora seeds, before being arrested and taken to an emergency ward. Symptoms observed included "fluctuating level of consciousness with intermittent agitation", delirium, sweating, mydriasis, and high temperature, heart rate and blood pressure. He had largely recovered 3 hrs after admission [and with benzodiazepines] (Wiegand & Smollin 2007).

S. flavescens root has yielded d-matrine, d-oxymatrine, l-anagyrine, l-baptifoline, *cytisine*, N-methylcytisine, d-sophoranol, l-13-ethylsophoramine, kuraridin, norkurarinone and trifolirhizin; when consumed, many of the alkaloids apparently convert to d-matrine, which is considered the main active component of the herb (Huang 1993). The methanol extract of the root yielded oxymatrine, trifolirhizin, β-sitosterol and the flavonoids formononetin and kushenol F; the latter two compounds inhibited mouse brain MAO, affecting MAO-B slightly more than MAO-A (Hwang et al. 2005).

S. japonica stems and leaves [harv. Jan., New Zealand] were found to contain *cytisine*; no sparteine was detected. Seeds appeared to contain no alkaloids (White 1951), but do contain saponins which yield sophorins A-C, sophoradiol and betulin on hydrolysis (Huang 1993).

S. secundiflora seeds have yielded 0.15-0.25% *cytisine*, 0.026-0.04% N-methylcytisine, 0.018-0.03% sparteine [CNS depressant], 0.003% epilupinine, Δ5-dehydrolupanine, 0.001% anagyrine, thermopsine [not found in some tests], 4-OH-2-piperidinecarboxylic acid and N-γ-glutamyltyrosine; unripe pods also contain lupanine [CNS depressant], 11-allylcytisine, β-isosparteine and rhombifoline. Leaves have yielded argentine, *cytisine*, N-methylcytisine, lupinine, sparteine and thermopsamine. Leaves in one test contained no alkaloids. Seeds had an LD50 of 1.4g/kg [oral] in mice (Harborne et al. ed. 1971; Hatfield et al. 1977; Henry 1939; International… 1994; Keller 1975; Nucifora & Malone 1971).

Sophora secundiflora is an evergreen shrub, 0.5-3.5m tall, usually with dense dark-green glossy foliage. Leaves alternate, glabrous or slightly pubescent at maturity, once-imparipinnately-compound; leaflets very firm, 5-11(-13) per leaf, often 17mm or more wide, and glabrous above, +- ovate; stipules minute, deciduous. Flowers in terminal or axillary, usually densely flowered racemes 5-15cm long, 5-10cm wide, individual flowers bluish-purple and very showy, 1-2cm long, the banner external to the others in bud; calyx of 5 sepals united above the floral cup; corolla strongly bilaterally symmetrical and papilionaceous; stamens 10, the filaments free above the top of the floral cup. Fruit a 1-several-seeded indehiscent or very tardily dehiscent woody pod, 2-12cm long, 11mm or more thick, equally as wide, moderately constricted between seeds; seeds red.

Frequent in bushy vegetation; Texas, New Mexico, n. Mexico (Correll & Johnston 1970).

Grow outdoors in hot climates, indoors in cold; prefers hot sun and a well-drained alkaline soil. Nick and soak seeds before planting; may also be propagated from cuttings. Keep soil on the dry side, except when in flower (Grubber 1973).

SPATHIPHYLLUM

(Araceae)

Spathiphyllum cannaefolium *(Dryand.) Schott* **(S. bonplandii** *Schott***; S. candicans** *Poepp.***; S. cannaeforme** *(Curtis) Engl.***)** – djê'-gaí-rê, fruit-fly plant
Spathiphyllum sp. – nampiá
Spathiphyllum spp. – peace lily, spathe flower, white anthurium

A Spathiphyllum sp. known as 'nampiá' is used by the Hupda-Maku of the north-western Amazon as an additive to their ayahuasca brews [see **Banisteriopsis**]. It is said to strengthen the brew and give very bright visions. Men of this group may also sometimes rub the leaves of the plant on their bodies, as a magical scent to 'conquer' women (Leite da Luz undated). S. cannaefolium has been reported to be used to flavour tobacco [see **Nicotiana**] by natives of Venezuela, Colombia and Guyana (Plowman 1969). It is used by the Witoto to produce an alkaline powder for coating the orally-active pills that they prepare from **Virola** theiodora. To make the powder, the root, leaves, and inflorescence are burnt, and the ash leached out with cool water, which is later evaporated to yield the alkaline powder ['hê'-rog']. S. cannaefolium is considered one of the best sources for this powder. The Tukano and Gwanano rub the inflorescence of S. floribundum on the forehead, to relieve headaches (Schultes & Raffauf 1990; Schultes & Swain 1976). Stem-sap from S. cochlearispathum is considered poisonous by the Chimantec of Mexico (Plowman 1969).

The chemistry of this genus is still relatively unknown, though the flowers of some species have been analysed for flavonoids (Schultes & Raffauf 1990). As with many Araceae, S. cv. clevelandii has been shown to contain calcium oxalate raphides [see **Tillandsia**], which can cause intense irritation when ingested (Schmidt 1984). Apparently, human poisonings from eating Spathiphyllum spp. are relatively common, as various species and cultivars are often encountered as house plants (Oregon Poison Centre 1996). Preparing a filtered decoction would eliminate the water-insoluble raphides, though many plants containing calcium oxalate raphides also contain soluble oxalic acids, which can be toxic in excess [see **Delosperma**, **Sceletium**].

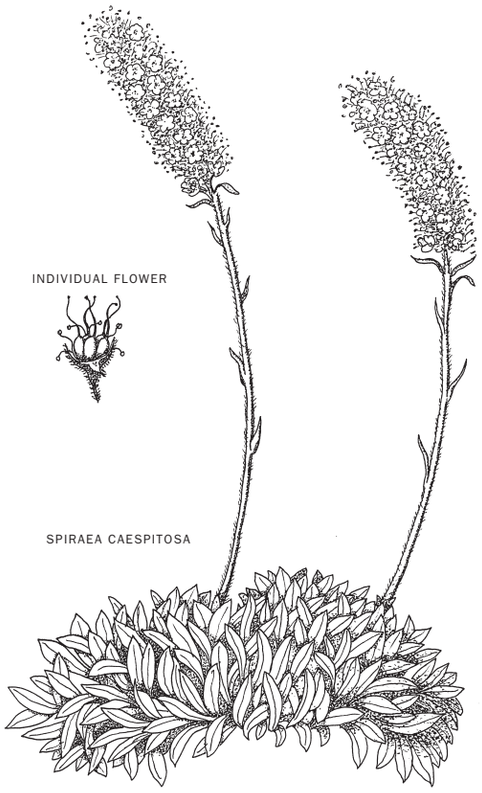
S. cannaefolium mature flower spikes have yielded an essential oil containing mostly benzyl acetate [59%], *methyleugenol* [20%], *estragole* [relative quantity not given], propyl/isopropyl tetradecanoate [6%] and p-MeO-benzyl acetate [c.3%]. Spikes lose their fragrance with age. Benzyl acetate and *methyleugenol* have been shown to be responsible for the fly-attracting powers of this plant, giving rise to one of its common names [see above] (Lewis et al. 1988).

Spathiphyllum spp. are stemless or shortly-stemmed aromatic herbs; leaf petioles equitant, long, apex usually geniculate, terete, subthickened, sheathed up to or beyond middle; leaf oblong, cuspidate-acuminate, middle nerve strong, lateral nerves subparallel, close, adscending or spreading, curved near margin. Peduncle leaves +- same length; spathe cuspidate, in peduncle +- decurrent, membranaceous, at first convolute, then at base becoming flattened out, vegetation persistent; spadix sessile or stipitate, cylindroid, erect, spathe short, densely multiflowered, flowering first below then continuing upwards; flowers hermaphroditic, perigoniate; tepals 6, apex arched, nearly truncate, coherent or in cyathium, truncate, connate; stamens 6[-8], opposite tepals; filament short, apex becoming dilated and incrassate, planar on front, humped on back, apex abruptly narrowing in connective; anther filaments long, ovoid, laterally semi-oblong, connective longer, locules subopposite, externally variable, longitudinal fissure barely extending near base, dehiscent. Ovary oblong, 3-4-locular; ovules in locule 8-6-4-2 side by side or one above the other, anatropous, micropyle situated towards base, funicle shortly erect, mid-axially affixed; style continuous with ovary, conic-elongate, moderately thick, beyond perigonii phylla long exserted or +- entirely lacking; stigma 3-4-lobed, sessile. Fruit a berry, vertex rotundate or conical-attenuate, 3-locular, locules 1-2-seeded; seeds oblong, curved, pallid yellowish, attenuate towards micropyle, funicle shortly minutely verrucose, rhaphe laterally thick and slightly raised, testa sparsely striate-verrucose, when dried provided with longitudinally-arranged pits; embryo axil slightly curved, narrowly cylindrical in copious albumen.

Tropical central and S. America (Fridericus & De Martius ed. 1965-1975), Philippines, tropical s.e. Asia (Schultes & Raffauf 1990).

SPIRAEA

(Rosaceae)



Spiraea caespitosa *Nutt.* **(Petrophytum caespitosum** *(Nutt.) Rydb.***)** – caespitose rock spiraea

This small herb is used as a narcotic by the Kayenta Navajo, but there seems to be little other information regarding the plant (Ott 1993). The analgesic drug aspirin was named in derivation from Spiraea, due to its natural precursor [salicylic acid] being found in the genus (Lewis & Elvin-Lewis 1977). In China, S. blumei is drunk as a tea (Usher 1974).

S. bracteata contains *phenethylamine* (Hartmann et al. 1972).

S. caespitosa contains salicylic acid [analgesic] (Lewis & Elvin-Lewis 1977).

S. japonica contains a variety of diterpene alkaloids called spirasines (Sun et al. 1987).

S. prunifolia gave positive tests for hydrocyanic acid [HCN] (Watt & Breyer-Brandwijk 1962).

Spiraea caespitosa is a densely caespitose woody plant with prostrate branches, forming low, depressed mats. Leaves persistent, canescent, crowded, entire, spatulate, 5-12mm long, 1-nerved, densely silky-pubescent. Flowers racemose, perfect; raceme narrow, 1-4cm long, usually simple; peduncles 3-10cm long, silky, with small bract-like subulate leaves; sepals 5, valvate, ovate-lanceolate, acute; petals 5, imbricate, white, spatulate or oblanceolate, 1.5mm long; stamens c.20; pistils 3-5. Ovary 1-celled, densely pubescent; style filiform. Fruit follicles, dehiscent along both sutures. Fl. Jun.-Sep.

On rock ledges; Montana and Black Hills, South Dakota, to California [southern Sierra Nevada, Panamint, Providence Mts], Arizona and New Mexico (Abrams 1940-1944).

STELIS

(Orchidaceae)

Stelis sp. – kemishitsa

'Kemishitsa', tentatively identified as a Stelis sp., is known to the Machiguenga of e. Peru as a powerful hallucinogen. It is used to help attain status as a 'seripegari', or shaman (Russo undated). Little else appears to be known of the chemistry or useage of this genus, though unidentified alkaloids have been detected in four unidentified Stelis spp. (Lüning 1967).

Stelis spp. are epiphytic or rock-dwelling herbs; stems caespitose or repent, occasionally producing offsets, unifoliate, not pseudobulbous. Leaves coriaceous, base often contracted in petiole. Inflorescence an elongate raceme, never uniflorous; bracts alternate, often arranged in two opposite rows, imbricate; flowers very small or minute, very often secund; sepals equal to subequal, generally spreading, shortly or deeply connate, occasionally urceolate, rarely entirely converging synsepalous, tissue thin or fleshy; petals generally fleshy, many times shorter than sepals, wide, apex +- thickened; labellum concave, fleshy; disc transverse, biparted, entire at base, 6 lamellae obliquely inserted laterally; column shortened, generally sessile, dilated upwards, very fleshy, bibrachiate; clinandrium prominent, stigmas 2, in brachiis distinct, lateral; rostellum very much extended; anthers terminal, operculate, incumbent; pollinia 2, waxy, apex often viscid, sparingly connected (Dunsterville & Garay 1979).

Cultivate in small pots with sphagnum moss or fine bark mix; can be propagated by division. Keep moist, humid and shaded; cold tolerant (Banks & Perkins 2005).

STEMMADENIA

(Apocynaceae)

Stemmadenia donnell-smithii *(Rose) Woodson* **(Tabernaemontana donnell-smithii** *Rose***; T. donnell-smithii var. costaricensis** *Donn.-Sm.***)** – cobal, cojón, cojón de puerco

Stemmadenia galeottiana *(A. Rich.) Miers* **(S. bella** *Miers***; S. bignoniiflora** *(Schltdl.) Miers***; S. galeottianum** *B.D. Jackson***; S. insignis** *Miers***; Echites bignoniiflora** *Schltdl.***; Odontostigma galeottiana** *A. Rich.***; Tabernaemontana laurifolia** *Schott non L. ex Miers***)**

Stemmadenia glabra *Benth.* **(S. calycina** *Brandegee***; S. mollis** *Benth.***; S. obovata** *(Hook. et Arn.) K. Schum.***; S. pubescens** *Benth.***; Bignonia obovata** *Hook. et Arn.***)**

Stemmadenia grandiflora *(Jacq.) Miers* **(S. pauciflora** *Woodson***; S. pennellii** *Woodson***; Malouetia riparia** *(Kunth) DC.***; Tabernaemontana grandiflora** *Jacq.***; T. riparia** *Kunth***)** – yellow laurel

Stemmadenia minima *A.H. Gentry* **(S. macrophylla** *Greenm.***)**

Stemmadenia tomentosa *Greenm.* **(S. decipiens** *Woodson***; S. palmeri** *Rose ex Greenm.***; S. sinaloana** *Woodson***)**

These obscure plants have only several recorded uses that I could find. S. donnell-smithii is used in Central America to treat rheumatism, toothache and eye inflammation (Valencia et al. 1995). S. galeottiana [of Cuba and s.e. Mexico] bleeds a latex that is used as a chewing gum in Mexico (Usher 1974).

As with many other Apocynaceae [eg. see **Tabernaemontana**, **Tabernanthe**, **Voacanga**], Stemmadenia spp. are known to contain some interesting indole alkaloids.

S. donnell-smithii wood has yielded 0.09% *voacangine*; bark yielded 0.001% *tabernanthine*, 0.003% isovoacangine, 0.0086% (+)-quebrachamine and 0.0004% *voacamine*; fruits yielded 0.015% stemmadenine.

S. galeottiana wood yielded 0.02% *ibogamine* (Walls et al. 1958).

S. glabra has yielded *ibogamine* and tabersonine (Ganzinger & Hesse 1976); leaf contains traces of bis[11-OH-coronaridin-12-yl], 11-OH-*coronaridine* and *voacristine*, as well as obovatine and a sarpagine-type alkaloid, N-methyl-11-OH-macusine A (Madinaveitia et al. 1995; Valencia et al. 1995).

S. grandiflora has yielded 14-β-OH-quebrachamine, 3-oxovincadifformine and 14,15-dehydrotetrastachynine (Buckingham et al. ed. 1994; Ganzinger & Hesse 1976).

S. minima has yielded 16-epi-panarine from the bark (Achenbach et al. 1991), heyneanine and *voacristine* from the branches, and 0.64% 13-OH-*coronaridine* from the leaves. Roots yielded 0.6% alkaloids, which was mostly *coronaridine* and *voacangine*, with decreasing amounts of *ibogamine*, heyneanine, 19-oxo-*coronaridine*, *voacristine*, *ibogamine*-OH-indolenine, *coronaridine*-OH-indolenine and *voacangine*-OH-indolenine. Stem and stem bark contain the same alkaloids in similar proportions, but at a lower yield [0.02% and 0.31%, respectively] (Gupta, M.P. et al. 1991).

S. tomentosa has yielded vinervine (Buckingham et al. ed. 1994); S. tomentosa var. palmeri has yielded tabersonine (Ganzinger & Hesse 1976).

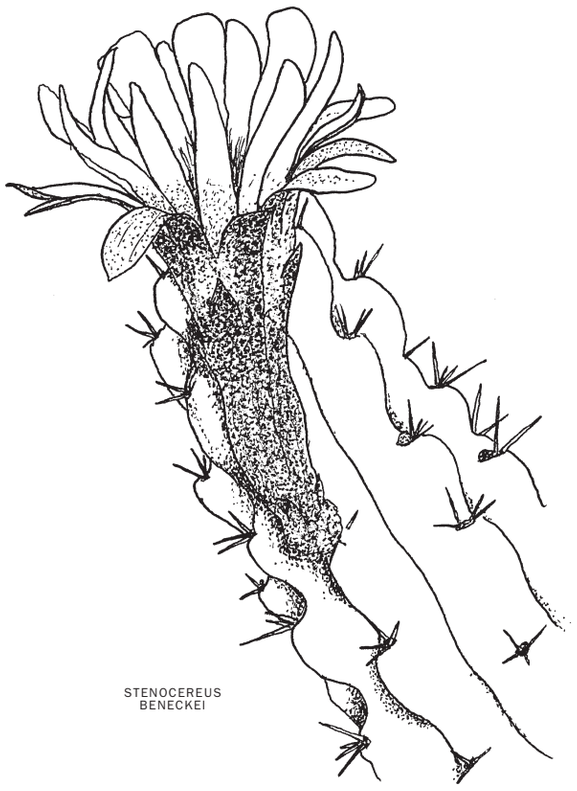
Stemmadenia donnell-smithii is a shrub or small tree, yielding a latex. Leaves entire, opposite, 6-8cm long, 3-3.5cm wide, spatulate, minutely glandular-puberulent or glabrate above, underside conspicuously barbate in axils of mid-vein; petioles 1-2mm long; sheaths of petioles meeting in shallow ring around stem, sheltering many small, fusiform glands. Inflorescence a terminal reduced raceme, 1-4-flowered; bracts placed midway on pedicels; corolla yellow, salverform, tube 2.5-3cm long, limb 1.5-2cm long, lobes 5, equal, dextrorsely reflexed and strongly auriculate, with 5 linear interior appendiculate folds, opposite and slightly above stamen-attachment; calyx yellowish, nearly equalling corolla-tube in length, 2-2.5cm long, lobes 5, unequal, ovate, imbricate, 1.5-2cm broad, in 2 closely imbricated series (usually 3 larger interior and 2 smaller exterior lobes), bearing several cycles of small fusiform glands within, and near disc-attachment; stamens 5, included, attached to corolla at summit of tube, alternate with corolla lobes; filaments short, thick, unguiculate at anther-attachment; anthers of 2 elongate, unappendaged sporangia near-

ly parallel to base. Carpels 2, sessile, unilocular, with many ovules on lateral binate ventral placenta; style long, filiform; stigma terminal, borne on fleshy truncate clavuncle; disc shallow, immersed, entire; nectaries fleshy, coalescing into +- irregular, nearly smooth rim, around and slightly adnate to carpels. Fruit a pair of divaricate, leathery, glandular-punctate follicles c.3.5cm long, 3cm broad, rounded at apex; seeds many, striate, albuminous, ecomose, immersed in oily arilar pulp.

Tropical forest; s. Mexico, through Central America (Woodson 1928).

STENOCEREUS

(Cactaceae)



Stenocereus beneckei *(Ehrenb.) Backeb.* **(Hertrichocereus beneckei** *Backeb.***; Lemaireocereus beneckei** *(Ehrenb.) Br. et R.***)**

Stenocereus eruca *(Brandegee) A. Gibs. et Horak* **(Lemaireocereus eruca** *Br. et R.***; Machaerocereus eruca** *(Brand.) Br. et R.***)** – creeping devil, dagger cactus

Stenocereus stellatus *(Pfeiff.) Riccob.* **(Lemaireocereus stellatus** *(Pfeiff.) Br. et R.***)** – pitayo, xoconochtle

Stenocereus treleasii *(Br. et R.) Backeb.* **(Lemaireocereus treleasii** *(Vaupel) Br. et R.***)** – tunillo

The fruits of Stenocereus spp. are known as 'pitaya' in Mexico, and have served there as an edible fruit crop since ancient times (Pimienta-Barrios & Nobel 1994). Pitaya, however, is a name generally applied to all edible fruits from columnar cacti (Trout pers. comm.). The Seri of Sonora use heated slices of despined S. thurberi ['pitahaya dulce', 'organ-pipe cactus'] stem, wrapped in a cloth, to apply to rheumatic pains (Felger & Moser 1974).

S. beneckei was shown to contain <0.01% *mescaline*, c.0.01% *DMPEA* and 0.01% 3,5-dimethoxy-4-OH-*phenethylamine* (Ma et al. 1986); the surface wax contains the triterpenes lupeone [0.12%], lupeol [0.04%] and β-amyrin, in a ratio of 3:1:1; oleanolic acid and queretaroic acid were also isolated, but may have been artefacts of the extraction process (Kinoshita et al. 1992; Wollenweber & Dörr 1995).

S. eruca was shown to contain <0.01% *mescaline*, <0.01% *DMPEA* and 0.01% or less of 3,5-dimethoxy-4-OH-*phenethylamine*.

S. stellatus was shown to contain c.0.01% of each of these alkaloids (Ma et al. 1986), as well as 0.35% triterpenes, including oleanolic acid, betulinic acid, stellatogenin and thurberogenin (Trout ed. 1999).

S. treleasii was shown to contain c.0.01% of each of the alkaloids found in S. eruca (Ma et al. 1986), as well as 0.1% oleanolic acid, 0.64% stellatogenin, 0.02% thurberogenin and treleasegenic acid (Trout ed. 1999).

Stenocereus stellatus is an erect, columnar cactus up to 4m tall, branching from the base; branches ascending, 6-7(-9)cm thick, light green when young, later matt dark green, often reddish, pale bluish-green in general; ribs (7-)8-12(-15), sharply furrowed, blunt, low, somewhat crenate; areoles 1-2cm apart, somewhat indented, with V-shaped furrows above, white-felted, with 8-10(-12) straight, spreading, white or brown radial spines up to 12(-25)mm long, and 4-5 erect, brown central spines up to 2(-6)cm long and bulbous at the base, in general spines dark brown to black at first, later grey. Flowers near apex, bell-shaped, narrowly campanulate, 4-6cm long, white or red, pale pink outside, usually nocturnal; externally scaly and felty; ovary bearing small scales subtending wool and bristly spines. Fruit globular, 3-4cm across, red, edible, very spiny when young; seeds large, mostly flattened, ovoid or cap-shaped, seedcoat glossy to dull black, smooth or verrucose.

Puebla, Oaxaca; Mexico (Britton & Rose 1963; Cullmann et al. 1986; Haustein 1991).

Slow growing; cuttings may be slow to root [as with S. beneckei]. Likes moderately poor soil, very good drainage, moderate sun. S. beneckei needs warmth in winter and is quite frost-sensitive; S. eruca likes sand added to the soil, plenty of sun, and careful watering, as well as a prostrate habit. All species like being planted in the ground, for full root development (Trout & Friends 1999; pers. obs.).

STENOSOLEN

(Apocynaceae)

Stenosolen heterophyllus *(Vahl) Markgr.* **(S. eggersii** *Markgr.***; S. grandifolius** *Markgr.***; S. holothuria** *Markgr.***; S. stenolobus** *(Müll. Arg.) Markgr.***; Peschiera cuspidata** *Miers***; P. diversifolia** *Miq.***; P. heterophylla** *(Vahl) Miers***; P. laevifructa** *Allorge***; P. puberiflora** *Miers***; P. stenoloba** *(Müll. Arg.) Miers***; P. tenuiflora** *Poepp.***; Tabernaemontana heterophylla** *Vahl***; T. stenoloba** *Müll. Arg.***; T. tenuiflora** *(Poepp.) Müll. Arg.***; T. unguiculata** *Rusby***)** – sanango, tsecat

S. heterophyllus is used in both Brazil and Peru. The Mayna Jivaro chew bark scrapings for toothache, and Brazilian natives give a leaf tea to elderly people who are "slow and forgetful" (Schultes & Raffauf 1990).

S. heterophyllus trunk bark has yielded 5.1% alkaloids, consisting of 8% olivacine, 0.15% *ibogaine*, 0.9% *ibogamine*, 0.2% *coronaridine*, 0.8% affinisine [CNS depressant, analgesic], 1% *voacamine*, 0.7% descarbomethoxy-*voacamine*, 1.4% tabernamine, 0.4% 7-OH-*voacangine*-indolenine, 0.01% pericalline, 1.3% *vobasine*, 0.08% vallesamine and 0.03% tetrahydro-3,14,4,19-olivacine. Leaves yielded 0.4% alkaloids, consisting of 3% ervafoline, 0.6-3% ervafolidine, 1.5-3% 19'-OH-ervafolene, 1.1-3% 19'-OH-ervafoline, 0.1-3% 19'-OH-ervafolidine, 2.4-3% 19'-OH-epi-3-ervafolidine, 0.1-3% ervafolene, 1.2% 7-OH-*voacangine*-indolenine, 2.8% pandine, 1.3% voaphylline, 1.25% *voacangine* and 1.1% pandoline (Kan et al. 1984).

Stenosolen heterophyllus is a tree or erect shrub to c.2m tall; youngest twigs hairy; dichasially-branched immediately above leaf-nodes, out of axils of small scales alternating with leaves. Leaves opposite, unequal, papery, almost sessile, the two of each node +- unequal in size, obliquely elliptic, abruptly acuminate at apex, at base rounded on one flank, narrowed on the other, glabrous, 7-15 x 2.5-5cm, secondary nerves strongly bent, 10-12 on each side; intrapetiolar glands present. Inflorescence cymose, terminal or pseudo-axillary, few-flowered, bracteate, 2-3cm long; peduncles and pedicels very slender; calyx teeth glabrous, lanceolate, acute, 1mm long, slightly diverging, pluriglandular internally; corolla white, salverform, tube 1cm long, 1mm wide, gradually widening somewhat at base, otherwise constricted from base to throat, glabrous externally, with long straight hairs internally, lobes 5mm long, glabrous, oblong, acuminate, slightly oblique; stamens inserted near base of tube; anthers basal, sagittate, 4mm long, with spreading tails, bearing pollen only in middle portion. Ovary apocarpous, without disc; style split; stigma head globose with 2 short apical tips, and somewhat remote horizontal basal skin-ring. Fruit distinctly apocarpous, mericarps spreading, crescent-shaped or almost obovate, c.3.5cm long, 1cm diam., orangeish, densely covered with numerous pyramidal 2mm-high protuberances; seeds many, dark-brown, ellipsoid, longitudinally ribbed, ring-shaped aril around hilum.

At forest edges; n. Brazil, Guyana (Pulle 1966), Peru.

STEPHANOMERIA

(Compositae/Asteraceae)

Stephanomeria pauciflora var. pauciflora *(Torr.) A. Nelson* **(Lygodesmia pauciflora** *(Torr.) Shinners***; Ptiloria pauciflora** *(Torr.) Raf.***; P. runcinata** *(Nutt.) Davidson et Moxley***; S. cinerea** *(Blake) Blake***; S. neomexicana** *(Greene) Cory***)** – desert straw, desert skeletonweed, wire-lettuce, brownplume wire-lettuce, hehe imixáa, posapátx camoz

The roots of this herb are used by the Kayenta Navajo of N. America

as a narcotic (Ott 1993). I have been able to find no other ethnobotanical or chemical information regarding this plant.

Stephanomeria pauciflora var. pauciflora is a perennial, rounded herb with intricately much-branched stems, mostly divaricate and stiffish, 30-60cm tall from a woody rootstock, base of stems sometimes slightly woody. Leaves glabrous, pale green, basal leaves narrowly oblong, lanceolate or oblanceolate, 3-7cm long, remotely runcinate-pinnatifid, rarely over 1.5cm wide, including lobes, upper leaves reduced, linear to subfiliform, entire, often +- revolute, upper-most mere scales so branchlets form an open, nearly leafless system. Inflorescence of few-flowered heads, solitary on axillary or terminal short peduncles; involucres 8-10mm long at anthesis; bracts linear to lanceolate, acute or slightly callus-tipped; flowers mostly 3-5, ligules equal, flesh-coloured, 5-6mm long, opening early in morning and usually closing before noon; receptacle flat, naked or alveolate. Achenes linear, oblong or slightly turbinate, 3-4mm long, strongly 5-angled, striate between angles, minutely roughened but rarely rugose, truncate; pappus bristles 12-25, sordid to tawny or faintly rufous, 6-7mm long, plumose above basal ¼, lateral capillary hairs 1.5-2.5mm long, bases slightly dilated. Fl. almost all year.

Along washes, gravelly bajadas, plains and arid mesas; Colorado to Mojave Deserts, California, to Kansas, Texas, northern Sonora and central Baja California (Shreve & Wiggins 1964).

STETSONIA

(Cactaceae)

Stetsonia coryne *(Salm-Dyck.) Br. et R.* **(Cereus coryne** *Salm-Dyck.***; C. coryne** *Otto***)** – argentine toothpick

S. coryne was shown to contain 0.001-0.05% alkaloids [w/w], of which c.1-10% was *mescaline*, more than 50% 3-MeO-*tyramine* [homovanillylamine], c.10-50% *tyramine*, c.1-10% N-methyl-*tyramine* and traces of *DMPEA*, *anhalonidine* and anhalidine [6,7-dimethoxy-8-OH-2-methyl-THIQ] (Agurell et al. 1971); an earlier study found 1% [d/w] coryneine [N,N,N-trimethyl-*dopamine*; oxo-candicine] (Trout ed. 1999, citing Reti et al. 1935 [full paper]). The Chemical Abstracts entry for Reti et al. (1935) states only that a new, impure alkaloid was obtained, with physiological effects resembling those of candicine and *nicotine* (Reti et al. 1935).

Stetsonia coryne is a massive tree-like cactus 5-8m tall, with a short trunk up to 40cm thick, branching out into up to 100 and more branches, up to 60cm long and 9-10cm thick; ribs 8-9, 1-1.5cm deep, obtuse, more or less crenate; areoles felted, with 7-9 subulate, spreading, unequal radial spines 3cm long, and 1 subulate central spine c.5cm [or more] long. Flowers solitary at upper areoles, 12-15cm long, funnel-shaped, wide-opening, white; inner perianth segments white, oblong-lanceolate, acute, spreading; outer perianth segments broad, green, obtuse; pericarpel densely covered with broad, ciliate scales, receptacle tube with broader, more widely spaced scales; ovary oblong-globose, densely covered by ciliate, abruptly subulate-tipped membranous scales; stamens numerous, not exserted; anthers large, oblong; style stout; stigma lobes many, linear. Fruit stout, ovoid, lime light-green, similarly covered with scales, floral remains deciduous leaving brown scar; seeds obliquely elongate-ovoid, with broad, lateral hilum, seedcoat black, coarsely verrucose.

N.w. Argentina, Bolivia (Britton & Rose 1963; Haustein 1991).

Prefers rich, well-drained soil, little watering, and full sun; slow-growing. Can be frost sensitive, depending on the length of exposure and the hardiness of the individual; frosts and over-watering can cause orange colouration at the base, which usually leads to fatal rot (Trout & Friends 1999).

STICTOCARDIA

(Convolvulaceae)

Stictocardia tiliaefolia *Hallier* **(S. tiliifolia** *(Desreuz) Hallier fil.***; S. campanulata** *(L.) Merr.***; Argyreia campanulata** *(L.) Alston***; A. tiliifolia** *(Desr.) Wight***; Convolvulus campanulatus** *(L.) Spreng.***; C. gangetinus** *Roxb.***; C. grandiflorus** *L. f.***; C. melanostictus** *Schlecht***; C. tiliifolius** *Desr.***; Ipomoea benghalensis** *Roem. et Schult.***; I. campanulata** *L.***; I. gangetica** *Sweet***; I. grandiflora** *(L. f.) Lam.***; I. pulchra** *Blume***; I. tiliifolia** *(Desr.) Roem. et Schult.***; Rivea campanulata** *(Spreng.) House***; R. tiliifolia** *(Desr.) Choisy***)** – tugelmi, goili, kuginiballi, karihuginniyahambu, wa damudamu

The generic name for this plant comes from the Greek 'stiktos' ['punctured' or 'spotted'] and 'kardia' ['heart'], referring to the appearance of the leaf (Wagner et al. 1990). In India, the plant is said to be used as an antidote to snake poison, though neither roots or leaves have proven active in this regard (Kirtikar & Basu 1980). In Fiji, the plant is decocted and drunk after childbirth (Cambie & Ash 1994).

Recent human bioassays have revealed the seeds to have psychoactivity and potency similar to **Argyreia** nervosa, with 8 seeds of some material being an active dose (Torsten pers. comm. 1999).

S. tiliaefolia seed has yielded 0.14-0.15% alkaloids, consisting of [as % of total alkaloids] 48-49% *lysergol*, 24-26% *elymoclavine*, 3.2-3.6% *ergonovine*, 2-2.2% *penniclavine*, 1.8-2% iso-*penniclavine*, 1.5-1.8% ergometrinine, 1.5-1.7% isolysergol, 1.4% *ergine*, 1.5% *chanoclavine*-I, 1.2% *chanoclavine*-II, 1.1% α-dihydrolysergol, 1% iso-*ergine*, *festuclavine* and 7.5-18% unidentified alkaloids (Chao & Der Marderosian 1973a; Der Marderosian 1967); as well as sterolin and β-sitosterol glucoside (Rastogi & Mehrotra ed. 1990-1993). Leaves and roots have yielded calystegines [see **Convolvulus**] (Schimming et al. 1998).

Stictocardia tiliaefolia is a herbaceous liana; stems herbaceous at tips, becoming woody with age, up to 5m or more long. Leaves cordate to cordate-ovate, 8-25cm long, both surfaces glabrate, lower surface with numerous scattered pellucid-glandular dots, margins entire, apex acute to short-acuminate, base cordate. Flowers usually solitary, axillary, occasionally 1-3 in cymes, peduncles usually shorter than leaves; sepals subequal, suborbicular, 1-2cm long, puberulent, becoming glabrate; corolla reddish-purple with a darker centre, funnelform, 8-10cm long. Fruit indehiscent, globose, 2.5-3cm long, surrounded by calyx that eventually disintegrates, leaving the vascular framework; seeds 1-4, greyish-brown, obovoid, 8-9mm long, pubescent with minute hairs.

Dry disturbed areas, 3-220m; pantropical (Wagner et al. 1990), including Northern Australia [Northern Territory, Queensland] (Hnatiuk 1990), India east to Polynesia (Cambie & Ash 1994).

STIPA

(Gramineae/Poaceae)

Stipa inebrians *Hance* **(Achnatherum inebrians** *(Hance) Keng***)** – needle grass

Stipa robusta *(Vasey) Scribn.* **(S. vaseyi** *Scribn.***; S. viridula var. robusta** *Vasey***; Achnatherum robustum** *(Vasey) Barkworth***)** – needle grass, green needle grass, robust needle grass, popoton sacaton ['sleepy grass']

Stipa sibirica *(L.) Lam.* **(S. brandisii** *Mez***; S. confusa** *Litv.***; Achnatherum extremiorientale** *(Hara) Keng***; A. sibiricum** *(L.) Keng***; Avena sibirica** *L.***)**

Stipa viridula *Trin.* **(S. nuttalliana** *Steud.***; S. robusta** *Nutt. ex Trin. et Rupr.***; S. spartea** *Trin. ex Hook.***; Nassella viridula** *(Trin.) Barkworth***)** – needle grass

These grasses are known to cause intoxications in stock animals, which are generally due to endemic infestation of the seeds and other parts of the plants with an **Acremonium** sp. or related fungus [see **Festuca**, **Lolium**].

S. inebrians has been responsible for intoxicating cattle in Mongolia (Bruehl et al. 1994; Hance 1876), as has S. sibirica in northern Asia. In N. America, S. robusta caused some travelling problems with early Western settlers, as in areas where it was abundant their horses would graze on it and fall into a "profound, nearly stuporous sleep". Only grass from the Sacramento-White Mountain area [near Cloudcroft, New Mexico] is said to have this effect, though in Guatemala, the grass is taken by humans to induce sleep. S. viridula, which occurs in both Europe and N. America, has only been reported to be intoxicating in Europe (Cheeke 1995; Emboden 1979a; Kaiser et al. 1996; Pammel 1911; White et al. 1992; White & Morgan-Jones 1987).

A sterile, unidentified **Acremonium** sp. has been isolated from S. inebrians. A similar endophytic fungus has been isolated from S. robusta collected from the area mentioned above [also unidentified – intermediate between A. coeniphialum and A. starrii], as well as what appears to be A. chisosum. S. eminens has also been shown to support A. chisosum in the leaf sheaths, stems, and seeds. Of 13 North American Stipa spp. examined, only S. eminens, S. lobata [some specimens endophyte-free], S. robusta and S. viridula contained endophytes, which were macroscopically similar. S. viridula only contained an endophyte in specimens from central Colorado, where it grows with S. robusta (Bruehl et al. 1994; Kaiser et al. 1996; White & Morgan-Jones 1987).

One human subject experimented with eating 9 seeds of S. robusta; mild psychedelic and stimulant effects began after 1-1.5hrs. The subject then lay down in the dark and tripped calmly for another 30mins before drifting off to sleep. No negative side-effects were said to have occurred (DeKorne 1994). Another individual found 1tsp of seed, free of chaff and seed-hairs, to be psychoactive. Seeds that have been thawed after freezing are apparently inactive (Torsten pers. comm. 2001). Most people who have experimented with the seeds experience predominantly sedative or tranquillising effects, and little true psychedelic activity. One person has also reported on their experiments with eating fresh S. robusta leaves, chewing the foliage and occasionally spitting it out to take another mouthful; similar effects to those from consuming the seeds were experienced. It is claimed that the dried grass is inactive (Anon. 1999; Green 1999b; pers.

comm.), though in animal feeding tests, this was not the case (Epstein et al. 1964). However, samples stored for long periods would be expected to lose potency rapidly. Oddly, most human bioassays have focused on the seeds, with the false belief that the grass itself does not contain the endophyte or the psychotropic alkaloids.

S. inebrians has yielded a psychoactive alkaloid, stipatoxin (Bruehl et al. 1994).

S. robusta infected with an **Acremonium** sp. has yielded 0.002% *ergine*, 0.0008% isoergine, 0.00003% 8-OH-*ergine*, 0.0015% *chanoclavine-I*, 0.0007% *ergonovine* and 0.0018% N-formylloline (Petroski et al. 1992). Before the presence of alkaloids was noted, grass from near Ruidoso, New Mexico, was found to contain 1.2% diacetone alcohol [4-OH-4-methyl-2-pentanone], which was shown to have hypnotic and CNS-depressant activity in animals (Epstein et al. 1964).

Stipa robusta is a large, tufted perennial grass, 1-2m tall, growing in dense clumps. Leaves involute, setaceous, large, flattened, margins rolled inwards on upper surface, covered with bristly hair, flat to U-shaped, 4-8mm x 20-50cm; sheath glabrous, villous at throat, covered with long, soft hairs; ligule 2-4mm long. Panicle narrow, compact, often +- interrupted below, up to 30(-45) x 2cm, lower nodes of the panicle villous, the branches appressed; spikelets 1-flowered, c.1cm long, on short pedicels, attenuate into fine, soft point, disarticulating obliquely above glumes, leaving a bearded, sharp-pointed callus attached to base of floret; glumes firm, narrow, gradually acuminate, usually hyaline, the first usually 3-nerved, nerves inconspicuous, empty glume nearly equal in length to spikelets; lemma 6-8mm long, narrow, terete, strongly convolute, terminating in prominent awn; awn 2-3cm long, twisted below, obscurely twice bent, geniculate; palea enclosed in lemma.

Dry plains and hills, dry open woods; Colorado to w. Texas, Arizona and n. Mexico, 1670-2740m (Barnard & Potter 1984; Hitchcock 1951; Pammel 1911).

Of the **Acremonium sp.** – hyphae in the lower 2-3cm of seedlings grown aseptically from infected seed were intercellular, c.2µm diam., mostly straight, unbranched, some moderately convoluted [some convoluted segments up to 3.5-4.4µm diam.]. Considerable variation in conidial shapes occurred, and the average spore lengths did not conform to other described species (Kaiser et al. 1996).

STREPTOPUS

(Liliaceae)

Streptopus amplexifolius *(L.) DC.* **(Uvularia amplexifolia** *L.***)** – dead person's berry, twisted stalk, white mandarin

The Tlingit of Alaska process the roots of this lily into a decoction, which is drunk as an intoxicant (Lipp 1995). The Cherokee cook the foliage of S. amplexifolius and S. roseus to eat as a vegetable (Hamel & Chiltoskey 1975).

Chemistry of this plant is obscure.

Streptopus amplexifolius is a perennial herb springing from a rhizome, often branched, 40-100cm tall with a glabrous stem. Leaves alternate, ovate-oblong, varying to ovate or ovate-lanceolate, acuminate, cordate and clasping at base, entire or very minutely toothed, the principal leaves 6-12 x 2-5.5cm. Free portion of the peduncle and pedicel together 3-5cm long, jointed at about 2/3 of its length, above the joint 1(-2)-flowered, abruptly deflexed or twisted; perianth campanulate to rotate, segments separate to the base, essentially alike, greenish-white, c.1cm long, spreading from near the middle, the outer whorl usually slightly wider, 6-toothed at margin; stamens 6, adnate to base of perianth; filaments widened at base; anthers oblong to linear, 1-pointed. Ovary 3-celled with several ovules; style slender, 3-cleft, 3-lobed or entire; stigma entire or barely 3-lobed. Fruit a red, many-seeded berry, usually ellipsoid. Fl. Jun.-Jul.

In rich, moist woods; Greenland to Alaska, s. to Massachusetts, New York, Michigan, Wisconsin and Minnesota, in the mountains to N. Carolina, in the west to Arizona and New Mexico (Gleason 1952).

STRYCHNOS

(Loganiaceae)

Strychnos brachiata *Ruiz. et Pav.* – cabalonga negra

Strychnos cabalonga *Hort. Lind.* – cabalonga negra

Strychnos icaja *Baill.* **(S. alnifolia** *Baker***; S. dewevrei** *Gilg***; S. dundusanensis** *De Wild.***; S. inocua** *Delile***; S. kipapa** *Gilg***; S. mildbraedii** *Gilg***; S. pusilliflora** *S. Moore***; S. triclisioides** *Baker***; S. unguacha** *A. Rich***; S. venulosa** *Hutchinson et M.B. Moss***)** – icaja, benge, bondo, mbondo, mbundu

Strychnos nux-vomica *L.* **(S. colubrina** *Wight***; S. lucida** *R. Br.***; S. spiraena** *Dop***; S. vomica** *St. Lag.***)** – strychnine tree, nux-vomica, poison nut, crow tree, Quaker button, ma qian zi, fan mu pieh, ma ts'ien tse, kachita, krishnabana, kulaka, vishamushti, jahar, kuchla

Strychnos tessmannii *Perk.*

Strychnos spp.

These plants, particularly S. nux-vomica, are best known today as sources for *strychnine* and related indole alkaloids. Contrary to popular belief, there has been no *strychnine* found in mushrooms, cacti, or any other living things that I am aware of, unless purposely introduced as an adulterant. Strychnos spp. seeds are rarely employed today except in homoeopathic doses, due to the danger associated with their use. They have generally served as a nerve tonic or aphrodisiac, though they have also been used as a poison for both rodents and stray dogs in India. In some parts of India, seeds of S. nux-vomica are eaten habitually as an aphrodisiac. Some distillers of bootleg 'arrack' liquor add the seeds to the drink to make it more potent. The seeds have also been given to horses as a tonic (Chopra et al. 1965; Nadkarni 1976). Ayurvedists consider S. nux-vomica to be bitter, acrid, pungent and heating in energetics; the seeds are used as an appetiser and astringent to the bowels, as well as to treat fever, leucoderma, itching, blood diseases, piles, ulcers, urinary discharges, jaundice and anaemia. The seeds are generally used in Indian folk medicine to treat paralysis, weakness and ulcers with maggots; they act as a nervine, spinal stimulant, diuretic and emetic (Kirtikar & Basu 1980; Nadkarni 1976). In Nepal, the seeds are used to treat paralysis, rabies, menstrual problems, and as a digestive tonic. The seeds of the Indian S. potatorum ['clearing nut'] are put in water jars to cause impurities to sink to the bottom (Bremness 1994). The Cambodian 'shlain' tree remains unidentified to my knowledge, but is suspected of being S. nux-vomica; its wood is grated to shavings which are mixed with **Cannabis** and smoked, resulting in stronger and more psychedelic effects (Rätsch 1998).

According to a Tikuna shaman of s. Colombia, the rasped bark of S. tessmannii, if added to the fermented 'chicha' beverage [see *Methods of Ingestion*], can cause permanent insanity (Altschul 1967). S. cabalonga and/or S. brachiata are thought to represent 'cabalonga negra', a magical and potently psychoactive seed valued and used in Colombia. In n. Peru, S. ignatii is used as 'cabalonga' [see also **Jatropha** and *Endnotes*]. In w. Africa, the bark of S. icaja is sometimes taken with **Tabernanthe** iboga (Rätsch 1998). The people of Sette Cama have been reported to use a bark decoction of S. icaja in their initiation ceremonies; the brew is said to render the initiate unconscious for up to 3 days (Laydevant 1932). The root bark and/or trunk bark have also been used an an ordeal poison in central Africa. S. spinosa bark has been used for this purpose in e. Africa, as has the root bark from S. densiflora [Cameroon] and S. samba [c. Africa]. S. samba fruits have also been used to poison fish (De Smet 1998). In Papua New Guinea, S. minor is sometimes used as a hunting stimulant for dogs, as well as to make them fierce (Thomas 2001a).

Strychnos spp. have been used as major ingredients in dart poisons for hunting in Java, Borneo, Malaya, and other parts of Indo-China (Bisset 1966; Bisset & Woods 1966). Barks from more than 12 species of Strychnos are used in making 'curare' dart poisons in S. America (Schultes & Raffauf 1990), including S. solimoesana ['ira'], the stem-bark of which is used by the Jamamadi of Brazil, along with stem-barks from Curarea toxicofera, Guatteria cf. megalophylla, and a Fagara sp. [see *Endnotes*]. "S. solimoesana-based poison is said to be one of the most powerful and effective paralyzing curares" (Prance 1972). Strychnos spp. root bark is also used to make arrow poison in c. Africa, such as S. usambarensis [S. micans], which is used by the Nyambo of Rwanda and Tanzania (De Smet 1998). In n. Australia, the Ngarinyman use S. lucida ['naalij'] to stun fish

(Smith et al. 1993).

In very small amounts, S. nux-vomica seed acts as a CNS-excitant, nerve stimulant, aphrodisiac and respiratory stimulant, and has been suggested to even be a powerful psychedelic in moderate doses; at higher doses, overstimulation of the nervous system results in tetanic convulsions and respiratory depression; coma and death may occur. Seeds may be taken with great caution 0.1g at a time, or 0.2g a day. A fatal dose of seeds may be 0.7-2.7g. To treat poisoning, emetics and large doses of charcoal in water should be given, as well as inhalation of chloroform or amyl nitrite between convulsions (Chopra et al. 1965; Huang 1993; Nadkarni 1976; Rätsch 1990, 1992). Oddly, there has even been a popular song ['Strychnine', by The Sonics] seemingly espousing *strychnine* as a psychotrope! Lyrics to the song include "You may think it's funny that I like this stuff, but once you've tried it you can't get enough"; "if you listen to what I say you'll try *strychnine* some day"; and "makes you tough, it'll make you shout, it'll even knock you out"!

S. icaja bark has yielded 6.6% *strychnine*; this species is the richest known source of *strychnine* (Buckingham et al. ed. 1994).

S. nux-vomica seed has yielded 1.5-5% alkaloids [following figures from one analysis given as % in pericarp; % in pulp], predominantly *strychnine* [0.169; 0.04], with a smaller amount of *brucine* [0.065; 0.03], as well as 4-OH-*strychnine* [0.0007; 0.002], pseudostrychnine [0.002; 0.003], pseudobrucine [0.008; 0.003], *strychnine* N-oxide [0.005; 0.002], *brucine* N-oxide [0.016; 0.009], N-methyl-sec-pseudobrucine, icajine [0.006; 0.002], vomicine [0.091; 0.013], novacine [0.02; 0.018], N-methyl-sec-pseudo-β-colubrine [0.0007; -], α- and β-colubrine [between *strychnine* and *brucine* in potency][0.004; -] and struxine; also found are the glycoside loganin, and *chlorogenic acid*. The pericarps also contained another 0.092% alkaloids, a mix of *strychnine*, *brucine*, and their N-oxides; pulp yielded another 0.105% alkaloids, a mix of the same compounds. Leaves have yielded *strychnine*, *brucine* and strychnicine; bark yielded mostly *brucine*, with traces of *strychnine* [young bark 3.1% *brucine*, old bark 1.68% *brucine*]; wood has yielded *brucine* and *strychnine*; old roots have yielded 0.99% alkaloids, consisting of 0.2% *brucine* and 0.71% *strychnine* (Bisset & Phillipson 1976; Chopra et al. 1965; Henry 1939; Huang 1993; Morton 1977).

S. usambarensis root bark is unusual due to its lack of *strychnine* and related alkaloids, unlike most other Strychnos spp. used for arrow poisons in Africa; alkaloids found to be present include usambarensine [some *atropine*-like effects, spasmolytic], 3,4-dihydrousambarensine, 6,7-dihydroflavopereirine, calebassine, C-curarine, afrocurarine, dihydrotoxiferine, *harman* (De Smet 1998), melinonine F and 2-methyl-β-carbolinium quaternary salt (Shulgin & Shulgin 1997).

Other Strychnos spp. have yielded, besides *strychnine*-like indole alkaloids, some β-carbolines. S. elaeocarpa bark has yielded strychnocarpine [2-methyl-3,4-dihydro-β-carbolone-1]; S. floribunda has yielded strychnocarpine; S. johnsonii rootbark has yielded noreleagnine [1,2,3,4-tetrahydro-β-carboline], *norharman* and *harman*; S. melinoniana has yielded melinonine F [1,2-dimethyl-β-carbolinium salt]; and S. potatorum rootbark has yielded *norharman* (Allen & Holmstedt 1980; Shulgin & Shulgin 1997).

Strychnos nux-vomica is a deciduous tree to 30m tall, often with short, sharp, strong axillary spines; bark thin, grey, smooth or rough with lenticels. Leaves opposite, 7.5-15 x 4.5-7.5cm, broadly elliptic, acute, obtuse, or shortly acuminate, glabrous and shining, 5-nerved, the lateral pair often faint, base usually rounded; petioles 6-13mm long. Flowers numerous, greenish-white, in terminal pedunculate pubescent compound cymes; bracts small; peduncles and pedicels short, pubescent; calyx 2.5mm long, pubescent outside, segments 5, lanceolate, acute, 1.5mm long; corolla campanulate or hypocrateriform, a little less than 1.3cm long, 5-lobed, glabrous or nearly so outside, tube cylindric, hairy inside below, throat glabrous, lobes 4mm long, narrowly oblong, acute, valvate; stamens 4-5, inserted in throat of corolla; filaments short, filiform; anthers ovate, with distinct parallel cells. Ovary glabrous, 2-celled throughout, or 1-celled in the upper part; ovules many in each cell; style glabrous, long or short; stigma capitate or obscurely 2-lobed. Fruit a globose berry, 2.5-7.5cm diam., slightly rough but shining, orange-red when ripe, with hard rind; seeds usually many, discoid, c.2cm diam., much-compressed, concave on one side and convex on the other, clothed on both sides with very fine appressed grey silky hairs radiating from the centre.

In deciduous forests, sandy soil in dry forests, hilly areas; India, Sri Lanka, Indo-China, Laos, Burma (Kirtikar & Basu 1980).

SWAINSONIA

(Leguminosae/Fabaceae)

Swainsonia galegifolia *(Andr.) R. Br.* **(S. coronillaefolia** *Salisb.***)** – Darling pea, smooth Darling pea, red Darling pea, indigo plant

Swainsonia spp. – desert pea

This genus of Australian herbs has often been implicated in poisoning sheep, cattle and horses, the affected animals being referred to as 'pea-struck'. Effects have been compared to those of some Astragalus spp. and **Oxytropis** spp. ['locoweeds' from N. America – see also *Endnotes*], without the abortive and deformative symptoms. Poisonings generally occur in the dry season, following rains in early spring or autumn, or when fruit of the plant is mature, and may last 5-6 months. Intoxications in stock manifest gradually over days or weeks, and symptoms include staring eyes, or an agonised expression, stiffness, slight staggering, trembling of head and limbs, followed by motor incoordination and apparent distortion of perception of physical dimensions. Some animals become hyperexcitable, and may fall over if startled. Several species have caused illness and death from prolonged feeding [S. canescens, S. luteola, and S. procumbens] and these plants probably all contain similar compounds [see below]. Deaths are generally not reported from the species causing more noticeable CNS intoxication [which still does not manifest until after prolonged feeding]. It is probable these species do not contain the toxic compounds in appreciable amounts, or that they are located primarily in the mature fruits. Species causing predominantly CNS symptoms include S. galegifolia, S. oroboides and S. swainsonioides [which is very similar to S. procumbens]. Some animals even develop a craving for S. galegifolia and seek it out above other foods. Interestingly, S. cadelli has been credited with killing bees in Coonabarabran, NSW (Everist 1974; Hurst 1942; Schultes & Hofmann 1980). In inland n.e. Australia, indigenous people have used S. galegifolia [whole plant] as a poultice for bruises and swellings (Lassak & McCarthy 1990).

S. canescens contains swainsonine, which is a toxic α-mannosidase inhibitor (Buckingham et al. ed. 1994). Poisoning from plants containing it results in toxic symptoms including coarse faeces, upper respiratory congestion and infections, cataracts, profound mental retardation and other nasty effects (Everist 1974). S. canescens also contains (S)-canavanine – see **Canavalia**, as do some other Swainsonia spp. [S. greyana, S. maccullochiana, S. phacoides] (Bell et al. 1978).

S. galegifolia contains (S)-canavanine (Bell et al. 1978), as well as the alkaloid spherophysine; the hydrolysed flower yields a flavonoid, delphinidin (International... 1994). In independent testing, leaves picked in August [from a sample growing in the northern hemisphere] tested positive for the presence of what was tentatively identified as *N-methyltryptamine*, with lesser amounts of *DMT*; *N-methyltryptamine* was also tentatively detected in stems. A sample taken in November appeared to contain only *DMT* (Heffter 1996). In plants from Brisbane, Queensland [harv. Nov.], mature fruits, leaf and stem tested positive for alkaloids; immature fruits and roots tested negative. Leaf and stem from Clifton, Queensland, harvested in the same month, also tested alkaloid-positive, with negative assays for the roots (Webb 1949). In another alkaloid screening, leaves gave negative results (CSIRO 1990).

S. luteola from Queensland, harvested November [whole plant], tested positive for alkaloids (Webb 1949).

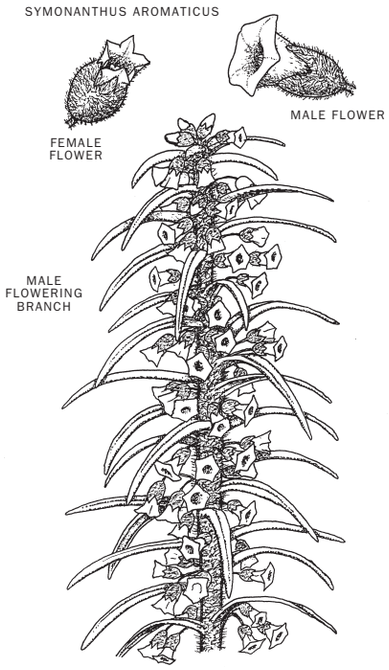
Swainsonia galegifolia is a perennial herb to c.1m tall; stems glabrous. Leaves usually imparipinnate, mostly 5-10cm long; pedicels glabrous, usually more than 5mm long, sometimes shorter; 21-29 leaflets, narrow-obovate to elliptic, the lower 8-15mm long, 3-5mm wide, apex obtuse to emarginate, both surfaces glabrous; stipe mostly 1-2mm long; stipules 2-5mm long, mostly triangular to triangular-acuminate. Inflorescences axillary 15-20 flowered racemes; flowers mostly 12-15mm long; bracts to 10mm long, bracteoles small; calyx +- campanulate, glabrous, teeth often much shorter than tube; corolla white, pink, purple, yellow, orange or dark red; keel apex obtuse and obscurely lipped, tip horizontal or at most a little raised; standard usually longer than wings, sometimes longer than keel; wings shorter than keel; stamens diadelphous, of alternating lengths; anthers uniform. Ovary usually +- stipitate; style tip straight or +- incurved, usually bearded lengthwise along the upper part, sometimes with a few hairs behind the stigma; stigma terminal or subterminal. Pod elliptic, mostly 20-40mm long, glabrous, usually dehiscent, sometimes inflated, 1-locular or longitudinally 2-locular; stipe often more than 10mm long; seeds few to numerous, aril not present.

Similar to S. greyana, but with smaller leaves and flowers; S. greyana also has a white-wooly calyx rather than a glabrous one.

Widespread in a variety of habitats; Australia [e. NSW drier forests, also in Vic. and Qld] (Costermans 1992; Harden ed. 1990-1993)

SYMONANTHUS

(Solanaceae)



Symonanthus aromaticus *(C. Gardner) Haegi* **(Anthocercis aromatica** *C. Gardner***)**
Symonanthus bancroftii *(F. Muell.) Haegi* **(Isandra bancroftii** *F. Muell.***)**

This Australian genus of only two species is very closely related to **Anthocercis**, and its members contain small amounts of similar tropane alkaloids.

S. aromaticus [mature specimen, harv. Jul. from near Newdegate, New South Wales] aerial parts yielded 0.01% alkaloids, and roots yielded 0.03% alkaloids; both parts contained *hyoscine*, apo-*hyoscine* and tiglic acid or tigloyl esters [these latter compounds being dominant in roots] (Evans & Ramsey 1983).

S. bancroftii has not been chemically analysed, but probably contains similar tropane alkaloids.

Symonanthus aromaticus is an erect, dioecious shrub to 1.3m; branches, lower surface of leaves and outer surface of corolla moderately to densely villous with non-glandular, forked to much-branched hairs and smaller glandular hairs; upper surface of leaves, pedicels and calyx sparsely to moderately pubescent mainly with glandular hairs, with non-glandular hairs also present. Leaves alternate, crowded, narrowly triangular to linear, sessile, usually 20-45 x 1.5-5mm, entire, margins narrowly revolute. Flowers solitary or in 2-3-flowered cymes, terminal or on short lateral branches, subtended by pairs of opposite bracts. Male flowers – pedicels 3-7.5mm long; calyx campanulate to cupular, 5-lobed, 4-5mm long; corolla regular, 7-8mm long, narrowly tubular with erect or spreading limb, tube 6-7mm long, white with purple striations in tube, limb 5-lobed, the lobes short and volutive in bud; stamens (3-)4-5, 3-6mm long, equal, inserted at base of corolla-tube; staminode sometimes present; anthers bilocular, cohering, dorsifixed, dehiscing by longitudinal slits; ovary 0.7-0.9mm long, infertile. Female flowers – similar but smaller; pedicels 1-3.5mm long; calyx 4-5mm long; corolla c.6mm long, the tube 5mm long; stamens 4(-5), 2-3mm long, infertile; ovary bilocular, 1.5mm long; ovules 6-10; stigma capitate, very shortly bilobed. Fruit a smooth capsule, broadly ovoid-ellipsoid to subglobular, 3.5-4.5mm long, opening apically by 4 valves, +- enclosed by calyx; seeds c.2mm long, ellipsoid.

Scattered populations in sandy soil, usually in disturbed habitats in mallee or woodland; endemic to s.w. Western Australia, in the south-eastern wheat-belt region (Haegi et al. 1982).

SYZYGIUM

(Myrtaceae)

Syzygium aromaticum *(L.) Merr. et Perry* **(Caryophyllum aromaticum** *L.***; Eugenia aromatica** *(L.) Baill., non. Berg***; E. caryophyllata** *Thunb. nom. illeg.***; E. caryophyllus** *(Spreng.) Bullock et Harris***)** – clove tree, Zanzibar red head, devakusumum, laung, kirambu, mekhaka, karanaphul, li-shi

'Cloves', the dried flower buds of S. aromaticum, were known and used by the Chinese from at least 266BC as a spice and medicine; they are an ingredient of 'Chinese five spice'. The Romans came to use them as their empire spread, but in 1500AD, more frequent visits to the Indies by European traders made the spice better known. Cloves are also an ingredient of 'garam masala', and are often included in mulled wines. They are often used to relieve toothache due to their anaesthetic properties. Some Asian cigarettes contain cloves, which numb the throat and allow one to smoke more. Their use as an aphrodisiac spice is ancient, and in China they were chewed as a breath-freshener before making love. In Tibet, cloves are used in psychiatric medicine, and are said to act on the 'life-vein' ['srog rtsa'] from whence consciousness originates, which is connected to the heart. Clove essential oil is analgesic, aphrodisiac, stimulant, spasmolytic, antiseptic, antibiotic, anthelmintic, antiviral, stomachic, antiemetic, antirheumatic, antineuralgic, antihistaminergic, antioxidant, antimycotic, carminative, counter-irritant, expectorant, larvicidal, insecticidal and vermifugal; it is effective against infection by coli bacilli, streptococci, staphylococci and pneumococci (Bremness 1994; Clifford 1984; Lawless 1995; Mabey et al. ed. 1990; Nadkarni 1976; Rätsch 1990; Simonetti 1990).

In Angola, unspecified parts of S. guineense and S. huillense are used to poison fish (De Smet 1998). In Cape York, Australia, Syzygium spp. leaves were smoked as a substitute for tobacco [see **Nicotiana**] or pituri [see **Duboisia**]. In New South Wales, white settlers used fruits of S. australe to make wine [see *Methods of Ingestion*] (Low 1990). In Australia, some native Syzygium spp. are called 'lilly-pillys', and are known for their edible fruits.

Closely related, the fruits or flower buds of a Eugenia sp. called 'khraat' are consumed with types of ginger [see *Endnotes*], galangal [see **Kaempferia and Alpinia**] and other plants, in the first three stages of initiation by the Bimin-Kuskusmin of West Sepik, Papua New Guinea (Poole 1987).

S. aromaticum buds yield 15-19% essential oil, which is pale yellow with a sweet, spicy odour, becoming darker with age – it may contain 60-90% *eugenol*, 8-12% *eugenol* acetate, 6-10% caryophyllene, 0-2% isocaryophyllene, vanillin, furfurol, salicylic acid, methyl benzoate and other compounds; leaf oil [yield c.4-5%] is dark brown, and may consist of 72-90% *eugenol*, 0-10% *eugenol* acetate and 10-15% caryophyllene, and other constituents similar to the bud essential oil; stem oil is pale yellow with a strong spicy-woody odour, consisting of 87-96% *eugenol*, 3-3.5% *eugenol* acetate, 6-8% caryophyllene and traces of isoeugenol. Cloves have also yielded 12-13% tannins, 2-OH-4,6-dimethoxy-5-methyl-*acetophenone*, naphthalene, gallotannic acid, α-humulene and α-humulene epoxide I. Some of the sesquiterpenes in cloves may have anticancer activity (Battaglia 1995; Bruneton 1995; Erickson 1976; Ilyas 1978; Lawless 1995; Simonetti 1990; Zheng 1992).

Syzygium aromaticum is an evergreen tree to 9m or more tall. Leaves opposite, simple, elliptic-lanceolate to obovate-oblong, glossy, leathery, c.6-13.5(-15) x 2.5-5.25cm, base very acute, apex shortly obtuse-acuminate, pinnately veined, lateral nerves strongly approximated, thin, intramarginal nerve +- 1mm from margin, blade dotted with glands, strongly aromatic of cloves when crushed; petiole 1.25-2.5cm. Inflorescences terminal corymbose panicles, 3-20-flowered (usually few); calyx tube slightly produced beyond the ovary, 1-1.5cm high, subterete, subquadrangular, purple or yellowish-green with a red flush, lobes 4-5, ovate-triangular, +- 2mm long; petals 4-5, to 6.5mm across, separate or united into a cap, often falling early, yellow +- tinged with red; stamens many, white, emerging in a dense pompon after the corolla cap formed by the linked petals drops off, filaments 3-7mm; anther sacs opening by lateral valves. Ovary inferior, 2-4-celled, ovules many; style +- 3mm; stigma 2-lobed. Fruit a dark red berry, ellipsoid-obovoid, 2-2.5cm long, with 1-2 black seeds; seed-coat roughish, adhering loosely or closely to the pericarp; cotyledons appressed against each other with lobed inner surfaces.

Native to the Moluccas in the Indian Ocean; widely cultivated in warm, maritime tropical areas such as Indonesia, Sri Lanka, Java, Madagascar, Tanzania and Brazil (Backer & Bakhuizen van den Brink 1963; Bailey & Bailey 1976; Ilyas 1978; Simonetti 1990).

Prefers well-drained sandy loam, rich in humus, though will grow in a wide variety of soils. Prefers warm, humid climate, 20-30°C, average annual rainfall 150-200cm, alt. up to 900m. Propagate from fresh seed, within 7-10 days of fruit falling. Fruits are dehusked either by leaving in a heap for 2-3 days, or soaking in water for 24 hrs, softening the husk enough for it to be removed. Selected washed seeds [those that are light

green are best] should be planted in shaded, manured, raised beds 10-15cm apart and 2cm deep, covered with sand and soil; plant seeds laying flat with protruding radicle into the soil; water regularly. Most should germinate within 16-46 days. Unhusked fruits are sometimes planted instead, but germination rates are not as good. Transplant into pots or polythene bags with manured soil when 6 months old, still with shade and regular watering. When 1-2 years old, transplant to prepared beds in the ground during rainy season, 6-10m apart, with protection from wind, and some shading from surrounding trees. Fertilise with organic manure several times a year, raising the amount of fertiliser slightly each year until the 15th year. Trees bear flower buds [the 'cloves'] from 5-10 years of age, but only in good yield from the 15th year onwards; alternating wet and dry periods are thought to be beneficial in flower bud formation. The buds are harvested by hand when they are changing from green to crimson in colour. With the stalks separated, the buds are spread out for drying by any of a number of means; sun drying may take 4-7 days, and they lose 70-75% of their weight (Ilyas 1978). Some report that the buds are prepared by immersion in boiling water for a few seconds after picking, and then the stalk is removed and the buds are sun-dried. Clove essential oil is usually made by steam distillation of discards (Simonetti 1990).

TABERNAEMONTANA including ERVATAMIA

(Apocynaceae)

Tabernaemontana affinis *Müll. Arg.* **(Peschiera affinis** *(Müll. Arg.) Miers***)**

Tabernaemontana amblyocarpa *Urb.*

Tabernaemontana australis *Müll. Arg.* **(Peschiera australis** *(Müll. Arg.) Miers***)**

Tabernaemontana brachyantha *Stapf.* **(Conopharyngia brachyantha** *(Stapf.) Stapf.***)** – kema-atung, eton-gongon

Tabernaemontana citrifolia *L.* **(T. berteri** *A. DC.***; T. lanceolata** *Miers***; T. oppositifolia** *(Spreng.) Urb.***; Rauvolfia oppositifolia** *Spreng.***)** – cojon de gato, lecherillo

Tabernaemontana coffeoides *Bojer ex DC.* **(T. membranacea** *DC.***; T. modesta** *Baker***; Conopharyngia coffeoides** *(Bojer ex DC.) Summerh.***; Ervatamia membranacea** *(DC.) Markgr.***; E. methuenii** *Stapf. et Green***; E. modesta** *(Baker) Stapf.***; Hazunta angustifolia** *Pichon***; H. coffeoides** *(Bojer ex DC.) Pichon***; H. membranacea** *(DC.) Pichon***; H. modesta** *(Baker) Pichon***; H. silicicola** *Pichon***; H. velutina** *Pichon***)**

Tabernaemontana contorta *Stapf.* **(Conopharyngia contorta** *(Stapf.) Stapf.***)** – pete-pete

Tabernaemontana corymbosa *Roxb. ex Wall.* **(T. yunnanensis** *(Tsiang) P.Y. Li***; Ervatamia corymbosa** *(Roxb. ex Wall.) King et Gamble***; E. yunnanensis** *Tsiang***)**

Tabernaemontana crassa *Benth.* **(Conopharyngia crassa** *(Benth.) Stapf.***; C. durissima** *(Stapf.) Stapf.***; Gabunia odoratissima** *Stapf.***; Sarcopharyngia crassa** *(Benth.) Boiteau et Allorge***)** – pete-pete, ninge-wuri

Tabernaemontana crassifolia *Pichon*

Tabernaemontana dichotoma *Roxb. ex Wallich* **(Ervatamia dichotoma** *(Roxb.) Burkill***; Pagiantha dichotoma** *(Roxb.) Markgr.***; Rujuoa dichotoma** *(Roxb.) Gamble***)** – Eve's apple tree, kat-arali, pilikarbir, kat-aralie

Tabernaemontana divaricata *R. Br.* **(T. coronaria** *R. Br. ex Roem. et Schult.***; T. coronaria** *(Jacq.) Willd.***; T. discolor** *Sw.***; T. flabelliformis** *(Tsiang) Li***; Ervatamia coronaria** *(Jacq.) Stapf.***; E. divaricata** *(L.) Burkill***; E. flabelliformis** *Tsiang***; Nerium coronarium** *Jacq.***; N. divaricatum** *L.***)** wax flower, East Indian rosebay, East Indian jasmine, grape jasmine, fleur d'amour, chandni, tagara

Tabernaemontana echinata *Aubl. non Vell.* **(Anacampta echinata** *(Aubl.) Markgr.***; Peschiera echinata** *(Aubl.) DC.***)**

Tabernaemontana eglandulosa *Stapf.* **(Gabunia eglandulosa** *(Stapf.) Stapf.***)**

Tabernaemontana elegans *Stapf.*

Tabernaemontana eusepala *DC.* **(Pandaca eusepala** *(DC.) Markgr.***)**

Tabernaemontana eusepaloides *(Mgf.) Leeuwenberg* **(Pandaca eusepaloides** *Mgf.***)**

Tabernaemontana fuschiaefolia *A. DC.* **(Peschiera fuschiaefolia** *(A. DC.) Miers***)**

Tabernaemontana hainanensis *(Tsiang) P.T. Li* **(T. bufalina** *Lour.***; Ervatamia hainanensis** *Tsiang***)** – gou ya hua, du gen mu

Tabernaemontana heyneana *Wall.* **(Ervatamia heyneana** *(Wall.) T. Cooke***)** – naglkud

Tabernaemontana humblotii *(Baill.) Pichon* **(Ochrorerium humblotii** *Baill.***; Pandaca humblotii** *(Baill.) Markgr.***; P. ochrascens** *Markgr.***; P. speciosa** *Markgr.***)**

Tabernaemontana lundii *A. DC.* **(Peschiera lundii** *(DC.) Miers***)**

Tabernaemontana muricata *Link ex Roem. et Schultes* **(T. macrophylla** *Müll. Arg.***; T. ochracea** *Benth. ex Müll. Arg.***; T. rigida** *(Miers) Leeuwenb.***; Peschiera muricata** *(Link. ex Roem. et Schult.) DC.***)**

Tabernaemontana olivacea *Müll. Arg.* **(Anartia olivacea** *(Müll. Arg.) Markgr.***; Bonafousia olivacea** *(Müll. Arg.) Miers***)**

Tabernaemontana orientalis *R. Br.* **(T. ebracteata** *R. Br.***; T. pubescens** *R. Br.***; Ervatamia daemeliana** *Domin.***; E. orientalis** *(R. Br.) Domin.***; E. pubescens** *(R. Br.) Domin.***)** – pallabara, bitterbark, iodine plant, banana bush, windmill bush, eastern gondola bush

Tabernaemontana pachysiphon *Stapf.* **(Conopharyngia cumminsii** *Stapf.***; C. pachysiphon** *(Stapf.) Stapf.***; C. pachysiphon var. cumminsi** *(Stapf.) H. Huber***)** – obanawa, abododo ['female **Voacanga**']

Tabernaemontana pandacaqui *Lam.* **(T. guangdongensis** *Li***; T. mollis** *Hook. et Arn.***; T. mucronata** *Merr.***; T. orientalis var. angustifolia** *Benth.***; T. orientalis var. angustisepala** *Benth.***; T. subglobosa** *Merr.***; T. thailandensis** *Li***; Ervatamia angustisepala** *(Benth.) Domin.***; E. benthamiana** *Domin.***; E. mucronata** *(Merr.) Markgr.***; E. pandacaqui** *(Lam.) Pichon***; E. puberula** *Tsiang et Li***; Pagiantha pandacaqui** *(Lam.) Markgr.***)** – banana bush, windmill bush, native gardenia, lontupak

Tabernaemontana pauciflora *Blume* **(Ervatamia blumeana** *Markgr.***)** – lontupak

Tabernaemontana penduliflora *K. Schum.* **(Conopharyngia penduliflora** *(K. Schum.) Stapf***)**

Tabernaemontana psorocarpa *(Pierre ex Stapf.) Pichon* **(Gabunia psorocarpa** *Pierre ex Stapf.***)**

Tabernaemontana psychotriifolia *Kunth* **(Peschiera psychotriifolia** *(Kunth) Miers***)**

Tabernaemontana quadrangularis *auct.*

Tabernaemontana retusa *(Lam.) Palacky* **(T. noronhiana** *Bojer ex DC.***; Conopharyngia retusa** *(Lam.) G. Don***; Pandaca retusa** *(Lam.) Markgr.***; Plumeria retusa** *Lam.***)**

Tabernaemontana rimulosa *Woodson ex Schultes* **(Bonafousia rimulosa** *(Woods. ex Schult.) Boiteau et Allorge***)** – sanango, lobo sanango

Tabernaemontana sananho *Ruiz et Pavón* **(T. poeppigii** *Müll. Arg.***; Bonafousia sananho** *(Ruiz et Pav.) Markgr.***; Merizadenia sananho** *(Ruiz et Pav.) Miers***)** – lobo sanango, yacu sanango, sanango de altura, tsicta, tsiikat, bai-su-su

Tabernaemontana sp. 'sananho' – uchu sanango

Tabernaemontana siphilitica *(L. f.) Leeuwenberg* **(T. cuyabensis** *Malme***; T. guianensis** *Miq.***; T. longifolia** *Benth.***; Echites siphilitica** *L. f.***)**

Tabernaemontana solanifolia *DC.* **(Peschiera affinis var. campestris** *Rizzini***; P. campestris** *(Rizzini) Rizzini***)**

Tabernaemontana sralensis *Pierre ex Pitard.*

Tabernaemontana stapfiana *Britten* **(T. johnstonii** *(Stapf.) Pichon***; Conopharyngia bequaerti** *De Wild.***; C. johnstonii** *Stapf.***; C. stapfiana** *(Britten) Stapf***;)**

Tabernaemontana tetrastachya *Kunth* **(T. longifolia** *Benth.***; Bonafousia tetrastachya** *(Kunth) Markgr.***; Malouetia tetrastachya** *(Kunth) Miers***)** – uchu sanango, saticu, bee'-e-ge

Tabernaemontana vitiensis *Seeman nom. nud.* **(T. orientalis** *Seeman***; Ervatamia obtusiuscula** *Markgraf***; E. orientalis** *Turrill***)**

Ervatamia lifuana *Boiteau* **(E. orientalis** *Guillaumin***)**

This large genus is notable for its species containing the psychotropic stimulants *ibogaine*, *voacangine* and related indole alkaloids. They have many medicinal uses, and are only occasionally reported to be used for their psychoactive properties. For greater clarity in this complex entry, each species discussed will be listed together with its alkaloidal content, in contrast to the trend in other entries. This should not be seen as a comprehensive coverage. Excellent reviews of the chemistry of the genus have been published by Danieli & Palmisano (1986) and Van Beek et al. (1984).

T. affinis leaves are toxic to cattle. Roots from Brazilian plants yielded *yohimbine* and serpentine (Van Beek et al. 1984); in other studies of Brazilian plants, root bark yielded 20-epi-heyneanine as the major alkaloid, with lesser amounts of *coronaridine*, *coronaridine* pseudoindoxyl, affinisine and olivacine (Matos et al. 1976); others found *coronaridine*, *vobasine*, *voacangine*, *voacristine*, *iboxygaine*, 19-OH-*iboxygaine*, affinisine, olivacine and epiheyneanine in bark and roots (Filho et al. 1987).

T. amblyocarpa from Cuba has yielded *ibogamine*, *akuammidine*, iso-*voacangine* and iso-*voacristine* from leaves; leaf and stem combined yielded *coronaridine*; and stem yielded *voacangine*, *voacristine*, vallesamine and (+)-tubotaiwine (Van Beek et al. 1984).

T. australis stems have yielded 0.054% *voacangine* and 0.016% *voacamine* (Gorman et al. 1960); in Paraguay, the latex is used to heal warts (Van Beek et al. 1984).

T. brachyantha from s. Nigeria and w. Cameroon is used as a febrifuge, in the form of crushed twigs mixed with **Ocimum** spp. Its bark has yielded *ibogaine*, *voacangine*, *coronaridine*, conopharyngine [analgesic, smooth muscle relaxant, hypotensive, bradycardiac, appears to be psycho-

tropic in animals] and voacangarine; voacorine, anhydrovobasindiol and normacusine B have also been found in the stem bark (Burkill 1985-1997; Carroll & Starmer 1967; Danieli & Palmisano 1986; Patel et al. 1967; Van Beek et al. 1984).

T. citrifolia latex is applied topically to remove warts in Central America (Usher 1974), and in the Antilles the bark is used as a bitter tonic, anthelmintic and febrifuge (Van Beek et al. 1984).The root has yielded 0.025% *ibogamine*, 0.006% *voacangine*, 0.006% *coronaridine* (Gorman et al. 1960) and *voacamine*; leaves have yielded apparicine, *coronaridine*, *voacangine* (Van Beek et al. 1984), voacangarine, pandoline, pandine, conoflorine, akuammicine, pleiocarpamine, sitsirikine, rhazinaline, vallesiamine, fluorocarpamine, tabersonine [see **Voacanga**], *ibogaine*, *iboxygaine* and *ibogamine*. *Voacristine*, 3-oxovoacristine, *akuammidine* and lochnericine have also been found in the plant, amongst other alkaloids (Abaul et al. 1989; Danieli & Palmisano 1986).

T. coffeoides leaves and bark are used in Madagascar to relieve fatigue, hunger and stomach cramps; a stem bark decoction is also given as a strengthening medicine to nursing mothers (Van Beek et al. 1984). The root has yielded *coronaridine*, *ibogamine*, *voacangine*, *vobasine*, dregamine, tabernaemontanine, methuenine, silicine, apparicine, tabernaelegantine A, 3,14-dihydroellipticine and other alkaloids; leaves have yielded *akuammidine*, methuenine, pericyclivine, polyneuridine, dregamine, hazuntine, hazuntinine, silicine, (+)-stemmadenine, tabernaemontanine, vallesamine, vincanidine, voacarpine, *vobasine*, voaphylline, lochnericine, tabersonine, (-)-heyneanine and other alkaloids; stem bark has yielded apparicine, reserpinine, dregamine, methuenine, normacusine B, tabernaemontanine, voacarpine, *vobasine*, silicine, tetraphyllicine, isovoacangine, 3,14-dihydroellipticine and other alkaloids (Danieli & Palmisano 1986; Van Beek et al. 1984).

T. contorta bark has yielded *ibogaine*, *voacangine*, *voacristine*, *coronaridine* and conopharyngine (Danieli & Palmisano 1986; Patel et al. 1967).

T. corymbosa is used in Malaysia to treat syphilitic and orchitis ulcerations, and in Thailand the bark and roots make an arrow poison (Van Beek et al. 1984; Zeches et al. 1995); root barks of other unidentified Tabernaemontana spp. are also used to make dart-poisons in Malaya (Bisset & Woods 1966). As T. yunnanensis, T. corymbosa is used in China to treat hypertension (Gui et al. 1988). Leaves have yielded 4.2% alkaloids, of which 1.5% was *yohimbine*, 45% β-*yohimbine*, 0.75% β-*yohimbine* pseudoindoxyl, 0.3% β-*yohimbine* oxindole, 2% modestanine and 1% vandrikine; stem bark yielded 2% alkaloids, of which 46% was β-*yohimbine*, 1% each of the above *yohimbine*-derivatives, less than 0.1% modestanine and 4.3% normacusine B (Zeches et al. 1995); roots have yielded *ibogaine*, *ibogamine*, *coronaridine*, *voacangine*, *voacangine* OH-indolenine, voachalotine, (+)-minovincinine and ervayunine (Gui et al. 1988).

T. crassa from w. Africa has many uses. The caustic sap is used as an arrow poison, sedative for insanity, disinfectant, haemostatic, anthelmintic, and as a dressing for sores and nose-drops for headache. One drop of the latex may cause blindness if brought into contact with the eyes. In Ivory Coast, the bark is given as an enema for constipation, kidney troubles and rheumatism; the leaf is rubbed into the body to strengthen and relieve fatigue. The Ebrié decoct the leaves as a tonic, given to "mentally retarded children and tired adults" (Burkill 1985-1997; Van Beek et al. 1984). Stem bark has yielded 0.268% crude alkaloids, including isovoacangine, conopharyngine, and an unidentified alkaloid; root bark yielded 0.763% crude alkaloids, including isovoacangine, conopharyngine, conodurine, conoduramine, and the same unidentified alkaloid (Renner et al. 1960). *Ibogaine* is the main bark alkaloid, with lesser amounts of conopharyngine (Van Beek et al. 1985), *voacristine*, (-)-heyneanine, *coronaridine*, akuammiline, anhydrovobasindiol, O-acetylpolyneuridine, 19-OH-conopharyngine and other alkaloids also found. Seeds have yielded tabersonine, *coronaridine* and *coronaridine* hydroxyindolenine. *Ibogamine* has been reported from unspecified parts, as well as perivine, pericyclivine, *vobasine* and gabunine (Carroll & Starmer 1967; Danieli & Palmisano 1986; Van Beek et al. 1984).

T. crassifolia from Madagascar yielded *ibogamine* and *tabernanthine* from stem bark (Van Beek et al. 1984).

T. dichotoma seeds are known in India to be a powerful deliriant 'narcotic' compared to **Datura**; they also have purgative properties. The fruit ['Eve's apple, 'forbidden fruit'] is variously said to be edible or a deadly poison. The leaf and bark are purgative, and the sap is laxative. The roots are sometimes chewed in Sri Lanka to relieve toothache (Chopra et al. 1965; Nadkarni 1976; Van Beek et al. 1984). The fruit has yielded *coronaridine*, tabersonine, perivine, *vobasine*, apparicine, vallesamine, dichomine and other alkaloids; seeds yielded *ibogamine*, *voacangine*, voaphylline, voaphylline hydroxyindolenine, *tabersonine*, *coronaridine* and stemmadenine; root bark has yielded *coronaridine*, 19R-heyneanine and *voacristine* hydroxyindolenine; stem bark yielded *ibogamine*, *voacamine*, *vobasine*, *coronaridine* and many other alkaloids; leaves yielded 0.19% alkaloids – apparicine, 19-epiiboxygaine, 19-epivoacristine, 12-MeO-voaphylline, *vobasine* and isomethuenine (Danieli & Palmisano 1986; Perera et al. 1983, 1985).

T. divaricata wood is used in incenses and perfumes. In India, the root bark is chewed to relieve toothache; it is reputed to be an aphrodisiac, brain tonic, antirheumatic and antiepileptic, amongst other properties. The plant is generally reputed to destroy poisons, give longevity, and promote conception and hair growth; it is often applied in oil, or clarified butter and water, with other ingredients. In Indonesia, the root is decocted for diarrhoea. In Pakistan, Yunani doctors use the flowers as an analgesic. In Burma, unspecified parts are used in preparing yeast cakes for the manufacture of rice beer [see 'chhang' in *Methods of Ingestion*]. In the Mentawei Islands, Indonesia, aerial parts are used as the main ingredient of an arrow poison (Nadkarni 1976; Usher 1974; Van Beek et al. 1984). In Malaysia, the flowers of the single-flowered variety are used in religious rites. The plant is much cultivated in s.e. Asia, and is used as a cancer remedy in Taiwan. Stems yielded 0.016% tabernaemontanine, 0.007% *voacamine*, 0.0035% descarbomethoxy-*voacamine*, 0.013% 19,20-dihydroervahanine A [a new alkaloid], 0.0029-0.006% *coronaridine*, 0.004% heyneanine, 0.022% *voacristine* and 0.001% dregamine; as well as the phenolic acids vanillic acid, gentisic acid, syringic acid, salicylic acid and 4-OH-benzoic acid. Stem extracts had analgesic, sedative and antiinflammatory effects. Flowers have yielded tabersonine, voaphylline, apparicine and hecubine (González, C.G. et al. 1982; Gorman et al. 1960; Henriques et al. 1996; Kam et al. 1993; Sharma & Cordell 1988). Leaves of the variety with a single whorl of petals [diploid] yielded [w/w] 0.00003% *coronaridine*, 0.015% *voacangine*, 0.000025% voaphylline and 0.0001% tabernaemontanine; leaves of the variety with a double whorl of petals [triploid] yielded [w/w] 0.0014% voaphylline and 0.000086% lochnericine (Raj et al. 1974). The plant has also yielded *ibogamine* and other alkaloids from the stem bark and root bark (Danieli & Palmisano 1986; Van Beek et al. 1984). One psychonaut found 40-50g of commercially-obtained root to "induce a 12 hour plus mellow walking dreaminess", with "a mild, pleasant sedation lingering afterward for a few days". However, he stressed that this may not be indicative of the potency of other T. divaricata specimens (Hoodoo pers. comm. 2002).

T. echinata leaves yielded 2.04% alkaloids, consisting of *voacangine*, *voacristine*, *vobasine*, *coronaridine*, pleiocarpamine, tubotaiwine, angustine and others; stem bark 1% alkaloids, of which 25% was 10-MeO-eglandine, as well as *ibogaine*, *ibogaine* 7-OH-indolenine, *voacamine*, *coronaridine*, pleiocarpamine and others; root bark 0.14% alkaloids, consisting of *ibogaine*, *voacamine*, voacamidine, *vobasine*, olivacine, N-dimethylvoacamine and decarbomethoxyvoacamine (Ghorbel et al. 1981).

T. eglandulosa root bark has yielded *coronaridine*, isovoacangine, perivine, *voacamine*, *vobasine* and other alkaloids; stem bark has yielded *voacangine*, *coronaridine*, conopharyngine, tacamine and other alkaloids (Van Beek et al. 1984); *ibogamine*, voaphylline, tacamonine, tubotaiwine, dichomine and norfluorocurarine have also been found in the plant. The root is abundant in alkaloids, the stem bark less so. Its sap is sometimes used to adulterate rubber in w. Africa (Burkill 1985-1997; Danieli & Palmisano 1986; Patel et al. 1967).

T. elegans seeds are used in S. Africa as an additive to chewing- or smoking-tobacco [see **Nicotiana**]; for this purpose, they are burnt and ground before being mixed with the tobacco. Root bark of specimens from Mozambique yielded conoduramine, dregamine, tabernaemontanine, tabernaelegantines A-D and tabernaelegantinines A-D (Van Beek et al. 1984).

T. eusepala stem bark has yielded 1.9% alkaloids; root bark 2.85%; and leaves 0.85%. These consisted of [as % of total alkaloids] *ibogaine* [15-50%], *ibogaine* hydroxyindolenine [4%], *vobasine* [2%], 19-epi-voacangarine [9%], apparicine [4%], 19,20-dihydrocondylocarpine [8.5%][may be identical to tubotaiwine or epi-20-tubotaiwine], (20S)-1,2-dehydropseudoaspidospermidine [11%], and the (20R)- and (20S)- isomers of 15,20-dihydro-cleavamine [17.5% and 4%, respectively] (Quirin et al. 1975).

T. eusepaloides from Madagascar yielded *ibogaine* from the root bark (Van Beek et al. 1984).

T. fuschiaefolia stem bark has yielded conopharyngine, *coronaridine*, affinisine, 16-epi-affinine, *voacangine*, 12-MeO-N-methylvoachalotine, voachalotine, *ibogaine* and/or *tabernanthine*, *voacamine*, voacamidine, N-demethylvoacamine, 16-decarbomethoxyvoacamine, *vobasine*, perivine and unidentified alkaloids, in varying concentrations (Lépine et al. 2002).

T. hainanensis roots and leaves are used in China to treat hypertension, stomach ache, dysentery, rheumatoid arthritis, hepatitis and snakebites. Roots have yielded 0.3% alkaloids, consisting of monomeric indoles [mostly *coronaridine*, with lesser amounts of *vobasine*, *ibogamine*, heyneanine, perivine, geissoschizol, *coronaridine* OH-indolenine, 3-oxo-*coronaridine*, 3-(β-hydroxyethyl)-*coronaridine*, 10-OH-heyneanine, and 10-OH-geissoschizol] and dimeric indoles [ervahanines A-C] (Feng et al. 1982); a later study also found the *voacamine*-type alkaloids ervahaimine A, ervahaimine B, ervahainamidine A and ervahainamidine B (Feng et al. 1989).

T. heyneana fruit flesh has yielded *coronaridine*, heyneanine and an unidentified alkaloid (Saradamma et al. 1971); *ibogamine* has been found in the root; stems have yielded alkaloids such as *voacangine*, *voacristine*, *coronaridine*, (+)-tubotaiwine and apparicine (Van Beek et al. 1984).

T. humblotii stem bark has yielded 1.3-2.1% alkaloids [20% *ibo-*

gaine, 6% *voacangine*, 12% voacangarine, and <1% each of *iboxygaine*, iboluteine and descarbomethoxy-*voacamine*]; root bark 2.7-3.1% [30% *ibogaine*, 8% *voacangine*, <1% each of iboluteine, descarbomethoxy-*voacamine*, akuammicine, *akuammidine* and dihydrocondylocarpine]; and leaves 0.9-1.6% [10-29% *ibogaine*, 5% *ibogaline*, 8% epi-19-*iboxygaine*, 5% epi-19-iboxygaline, 0-17% akuammicine, 13% voacangarine, 3% epi-16-dehydro-14,15-*vincamine*, <1% apparicine] (Lévy et al. 1975; Panas et al. 1974). *Voacristine* and tubotaiwine have also been found (Danieli & Palmisano 1986).

T. lundii leaves, stems and bark yielded 0.85% crude alkaloids; unfortunately, due to the way in which the analysis is reported it is difficult to calculate real yields. Alkaloids found were *ibogaine*, *iboxygaine*, *iboxygaine* OH-indolenine, *voacangine*, *voacristine*, 20-epivoacristine, *voacristine* pseudoindoxyl, *vobasine* and *coronaridine* (Hwang et al. 1969).

T. muricata is employed in the lower Rio Vaupes [Colombia], where natives sometimes use the sun-dried leaves and flowers to add stimulant activity to their fermented 'chicha' brew [made in this case from Manihot spp.; see *Methods of Ingestion*] (Schultes & Raffauf 1990). Its chemistry appears to be still unknown, though it has given positive results in alkaloid screening (Van Beek et al. 1984).

T. olivacea stems have yielded 0.489% crude alkaloids, in which was found 3.6% *coronaridine*, 0.2% *coronaridine*-OH-indolenine, 0.2% *coronaridine*-pseudoindoxyl, 2% *voacristine*, 1.1% *voacangine*, 0.15% *voacangine*-OH-indolenine, 0.1% *voacangine*-pseudoindoxyl, 0.2% *ibogaine*, 0.8% *ibogamine*, 0.2% *akuammidine*, 0.3% heyneanine and condylocarpine N-oxide (Achenbach & Raffelsberger 1980b).

T. orientalis is used by some indigenous inhabitants of Queensland [Australia] to disinfect ulcers and sores, and promote the healing process; the milky latex from the stem or fruit is used for this purpose. Early white settlers sometimes used the bark as a bitters (Cribb & Cribb 1981; Lassak & McCarthy 1990). In Fiji, the leaves are decocted to treat stomach ache, and the bark for headache; in Tonga, the grated root may be infused and used as a mouthwash to relieve toothache. In Samoa, the leaves have been used as an ingredient of arrow poisons. The plant has been suspected of killing cattle and horses (Van Beek et al. 1984). An extract of T. orientalis acted as a pleasant stimulant in small doses [quantity unspecified], though larger doses caused an unpleasant psychedelic experience accompanied by temporary blindness in one psychonaut (Torsten pers. comm.). T. orientalis bark [harv. Jun.-Jul.] has yielded 1.3-2% alkaloids, consisting of the indoles tabernaemontanine, ervatamine, dregamine, *vobasine*, *voacamine*, *voacristine*, 19-dehydroervatamine, de-MeO-carbonyl-voacamine, 16-de-MeO-carbonyldihydrovoacamine, 16-de-MeO-carbonyl-20'-epidihydrovoacamine and 20-epiervatamine; leaves [harv. Jul] yielded 0.13% alkaloids, consisting of *ibogaine*, apparicine, *iboxygaine*, ervatamine and 19-dehydroervatamine (Knox & Slobbe 1975). Another leaf sample [harv. time unspecified] yielded 0.84% alkaloids, of similar constituency (CSIRO 1990); leaves from New Guinea plants yielded 0.4-0.5% alkaloids, consisting of *voacangine*, conopharyngine, pandine and pandoline; no ervatamine- or *vobasine*-type alkaloids were found (Allorge et al. 1980). Other samples of unspecified harvest time yielded 0.53% alkaloids from leaf and fruit, and 0.61% alkaloids from the bark (Hartley et al. 1973). Plants from Mossman [Qld, Australia] harvested in August tested strongly positive for alkaloids in mature fruits, but weaker in leaves (Webb 1949). 2000mg/kg [oral] of the leaf alkaloids were lethal in mice; stem bark and leaf extracts are also active against Lewis lung carcinoma (CSIRO 1990). As Ervatamia daemeliana, specimens growing in Queensland [Australia] yielded 0.4-0.5% alkaloids from the leaves, including conopharyngine, *voacangine*, *iboxygaine* and *akuammidine* (Allorge et al. 1980). As Ervatamia pubescens, plants from Papua New Guinea yielded 0.48% alkaloids from the leaf (Hartley et al. 1973).

T. pachysiphon is used in w. Africa to trap birds, by means of its latex; this may also be applied to ulcers, and for mending broken pots. A decoction of the root bark treats insanity or mania in Nigeria and Ghana; it also acts as a hypnotic, and treats headache, flatulence, constipation and stomach ache. Leaves have yielded conopharyngine as the major alkaloid. Bark and seeds have yielded *voacangine*, conopharyngine and other alkaloids; root has yielded *vobasine*, perivine, pericyclivine, gabunine, *coronaridine*, conodurine, conoduramine and other alkaloids. The plant has also yielded *ibogaline*, *voacamine* and many others (Burkill 1985-1997; Carroll & Starmer 1967; Danieli & Palmisano 1986; Patel et al. 1967; Van Beek et al. 1984; Watt 1967).

T. pandacaqui is used in Thai folk medicine as a sedative analgesic, and the leaves for bleaching in the Philippines (Ott 1993; Van Beek et al. 1984). In Australia, as Ervatamia angustisepala, the root bark has reportedly been used to treat tropical fevers (Cribb & Cribb 1981; Lassak & McCarthy 1990). Bark from Jamaican plants yielded *ibogamine*, *iboxygaine*, *coronaridine*, *tabernanthine*, isovoacangine and *voacristine*. Leaves from Philippines plants yielded ervafoline, ervafolidine, isoervafolidine, pericyclivine, (+)-20-epi-lochneridine and tabernaemontanine (Van Beek et al. 1984). Stems from a Philippines collection [Feb.] yielded only *voacangine*, *voacristine*, voaluteine, tabernaemontanine, ervatamine and pandine, whilst leaves yielded *voacangine*, *voacristine*, pandine, akuammicine, vallesamine and vallesamine 17-O-acetate (Abe et al. 1993). Roots from Borneo [harv. Nov.] yielded 0.052% *voacangine* (Okuyama et al. 1992). As E. angustisepala, bark of Australian plants yielded 0.46% alkaloids, the identity of which was not investigated. The alkaloid extract caused decreased activity, ledge unsteadiness, dyspnoea, piloerection and an anticonvulsive effect in mice at 200mg/kg [oral]; hypotensive in anaesthetized cats at 39-79mg/kg [i.v.]; active against cell culture tumours (CSIRO 1990). Bark, leaf and stem of Australian plants all tested strongly positive for alkaloids (Webb 1949).

T. pauciflora is used for its analgesic effects to treat toothache in Sabah State, Borneo. Roots [harv. Oct.] yielded [w/w] 0.033% *coronaridine*, 0.01% 3-(2-oxopropyl)-*coronaridine*, and traces of 5R- and 5S-(2-oxopropyl)-*coronaridine*, 3,3'-(oxopropyl)-dicoronaridine, and 3-(2-oxopropyl)-*voacangine* (Okuyama et al. 1992).

T. penduliflora bark has yielded *voacangine*, *coronaridine* and conopharyngine, from Nigerian plants (Patel et al. 1967; Van Beek et al. 1984).

T. psorocarpa stem bark yielded 0.05% alkaloids – mostly 16-epiisositsirikine, as well as *voacangine*, 12-MeO-14,15-dehydrovincamine, *coronaridine*, tetrahydroalstonine, vallesiachotamine and isovallesiachotamine (Van Beek et al. 1983).

T. psychotriifolia roots yielded 0.99-1.17% alkaloids, including 0.026% *coronaridine*, 0.021% *voacangine*, 0.01% *voacamine* and 0.034% olivacine (Gorman et al. 1960); specimens from Guyana also contained *ibogaine* and other alkaloids in the root bark and stem bark (Van Beek et al. 1984).

T. quadrangularis roots yielded 1% crude alkaloids, in which was found 10.7% *coronaridine*, 0.7% *coronaridine*-lactam, 0.5% *coronaridine*-OH-indolenine, 0.1% *coronaridine*-pseudoindoxyl, 4% *voacangine*, 0.03% *voacangine*-lactam, 0.1% *voacangine*-OH-indolenine, 0.03% *ibogaine*, 2.3% *ibogamine*, 0.15% *ibogamine*-pseudoindoxyl, 0.07% (20R)-20-OH-*ibogamine*-pseudoindoxyl, 1.7% (20R)-20-OH-*ibogamine*, 0.3% (20S)-heyneanine, and 0.07% (20R)-epiheyneanine (Achenbach & Raffelsberger 1980a). The identity of the plants analysed is uncertain, as the species name does not seem to appear in any botanical literature (pers. obs.; Van Beek et al. 1984).

T. retusa root bark has yielded 0.91% alkaloids; trunk bark 0.46%; and leaves 0.37%, in one analysis of Madagascan plants. Trunk bark alkaloids consisted of 18% heyneanine, <1% *voacangine* and <1% *coronaridine*; leaf alkaloids consisted of 18% *voacangine*, 7% oxo-3-*voacangine*, 3% *coronaridine*, 3% heyneanine and 1.5% *voacristine* (Picot et al. 1973). In another analysis of Madagascan plants, root bark yielded *ibogamine*, heyneanine, *coronaridine* and *coronaridine* hydroxyindolenine; seeds yielded tabersonine, *voacangine*, voaphylline, *coronaridine* and pachysiphine (Van Beek et al. 1984).

T. rimulosa is considered a panacea in w. Amazonia, and is used to treat fever and rheumatism, as well as being emetic, diuretic and calmative. Venezuelan settlers in San Filipe, Rio Negro, use a decoction of several leaves in milk to treat insomnia (Schultes & Raffauf 1990).

T. sananho is used by the Quijos Quecha as a psychotrope, taken along with the sap of **Osteophloeum** platyspermum and **Brugmansia** spp. (Ott 1994). Made into a tea alone, the bark causes initial unpleasant side-effects, but later leads to greater awareness of one's surroundings and increased sensory sensitivity, and is thus used as a hunting aid. The Shushifindi Secoya put the fruit juice in their dog's noses to help them 'smell further'. The bark juice treats toothache, and the bark has also been used as a contraceptive and antirheumatic; the pulp may be gargled for sore throats and colds; and the dilute latex cures eye wounds (Ott 1993; Schultes & Raffauf 1990; Van Beek et al. 1984). One psychonaut found 8g of commercially-obtained roots to be similar in quality and strength to 40-50g of T. divaricata root [see above], though more stimulating; higher doses had sedative rather than stimulant effects (Hoodoo pers. comm. 2002). Bark from Peruvian plants has yielded *ibogamine*, *voacangine*, *coronaridine*, 3-OH-*coronaridine* and heyneanine (Van Beek et al. 1984).

T. sp. 'sananho' may or may not be the same as the above species. It is used as an ayahuasca additive [see **Banisteriopsis**] and dart poison ingredient. It is said that "only the strongest vegetalistas can prepare it", being very dangerous, even deadly. It is considered a powerful plant teacher, and is also taken by itself under a 1 month diet, to learn from the plant. It has yielded *coronaridine*, other bis-indole alkaloids, and triterpenes (Bear & Vasquez 2000; Luna 1984; Luna & Amaringo 1991; McKenna et al. 1995; Ott 1993; Schultes 1972).

T. siphilitica latex is dropped into the eyes by the Makuna of Colombia to stay awake. Leaves from Guyanan plants yielded *coronaridine*, vincadifformine, *voacangine*, isovoacangine, tetrahydroalstonine, apparicine, pleiocarpamine, geissoschizine, tetrastachyne, tetrastachynine, (+)-tubotaiwine and other alkaloids (Van Beek et al. 1984).

T. solanifolia leaves yielded isovoacangine and isovoacristine; roots yielded 0.25% 12-MeO-N-methylvoachalotine [major constituent], *coronaridine*, *voacangine*, *voacangine*-OH-indolenine, *voacamine*, heyneanine and voachalotine; bark yielded *voacamine*, heyneanine, *vobasine*, voachalotine and 12-MeO-N-methylvoachalotine (Gower et al. 1986).

T. sphaerocarpa fruit is used to relieve toothache in e. Malaysia; in Indonesia, the root is added to some arrow poisons, and the plant as a whole is considered 'very poisonous' (Van Beek et al. 1984). Specimens

from India yielded dregamine and tabernaemontanine from leaves, stems and bark; young leaves contained the lowest levels of alkaloids, and root bark contained the highest. Maximum yields were obtained in Nov., decreasing until Apr. (Biswas 1973).

T. sralensis root is chewed with betel nut [see **Areca**] in Kampuchea; one piece is added to the quid (Van Beek et al. 1984).

T. stapfiana bark and stems from Kenyan plants yielded *ibogamine*, isovoacangine, conodurine, conoduramine, 19',20'-epoxyconoduramine, gabunine, gabunamine, perivine and pericyclivine; stem bark yielded tabernamine. Root bark of plants from Zaire yielded (+)-tubotaiwine and tubotaiwine N-oxide (Van Beek et al. 1984).

T. tetrastachya latex is put in the eyes by the Makuna to prevent sleep; the root and leaves have also been applied externally or infused for rheumatism in other areas of the Amazon (Schultes & Raffauf 1990). Chemical studies are lacking.

T. vitiensis from New Hebrides yielded 0.4-0.5% alkaloids from the leaves, including *coronaridine*, iso-*voacangine*, tabernaemontanine, and dregamine, with smaller amounts of *vobasine* and epi-pandoline (Allorge et al. 1980).

Ervatamia lifuana from New Caledonia yielded 0.35% alkaloids from the leaves, of which 2% was *voacangine*, 1% *coronaridine*, 10% conopharyngine, 4% pandoline, 5% epipandoline, 10% pandine, 0.3% epiervatamine, 0.05% ervatamine, 15% dregamine, 15% tabernaemontanine and 1% *vobasine* (Allorge et al. 1980; Bruneton et al. 1980). This species is considered by some to be synonymous with T. orientalis (Van Beek et al. 1984).

Tabernaemontana dichotoma is a small, dichotomously-branched tree with milky latex; young parts glabrous, covered with a shiny resinous coat. Leaves opposite, 10.1-17.8cm long, lanceolate-oblong, tapering to base, suddenly and shortly acuminate, obtuse, stiff and coriaceous, dark green above; main nerves 10-22 pairs at right-angles to the midrib and meeting in loops, impressed above; petiole 1.3-3.2cm, stout; axillary stipules usually distinct; axillary glands small, usually numerous. Flowers white, in few-flowered and terminal and leaf-opposed cymes; peduncles 5-15cm long, stout; pedicels stout; calyx small, 5-lobed, glandular inside; corolla salver-shaped, 3.8-7.6cm across, tube cylindric, 2-2.54cm long, fleshy, slightly dilated towards the naked mouth, lobes overlapping usually to the left, falcately twisted, often crisped at margin; stamens included and enclosed in corolla tube; filaments very short; anthers free from stigma; disc 0. Ovary of 2 free, sometimes slightly coherent carpels; ovules numerous, many-seriate; style usually long, filiform; stigma clavate or oblong with a bifid apiculus; ripe carpels broadly ovoid, blunt, smooth, orange-yellow; follicles 2, coriaceous when mature, obliquely ovoid to lanceolate, usually curved and beaked. Seeds surrounded by a coat of crimson pulp.

India, at low altitudes; occasionally cultivated as an ornamental (Chopra et al. 1965).

Tabernaemontana orientalis is a small shrub 1-4.6m tall, with milky sap in stems; branchlets glabrous; young shoots smooth. Leaves opposite, smooth, large, glabrous, elongated-oval, tapering to base, blade 8-22.5 x 3.5-7cm, light green, elongated acuminate at apex, not punctate below; distinct venation, lateral nerves diminishing until inconspicuous near margin, sometimes slightly archingly joined, nervation irregularly transverse; petioles to 1cm long, base with or without axillary glands. Inflorescence paniculate, terminal or in upper leaf axils, partial inflorescences dichasial; flowers white, tubular with twisted petals, sweet-scented, 1-2.5 x c.1-1.5cm, in few-flowered groups; calyx deeply 5-lobed, lobes acute; corolla with long tube, often slightly twisted below stamens, lobes glabrous, clockwise, rarely anticlockwise covered in bud; stamens inserted above the middle of the tube; anthers mucronulate at apex; disc indistinctly developed. Ovary apocarpous, the 2 carpels free or connate at base only, at apex connate by style, with 2-many ovules in 2-6 series; style filiform or clavate towards apex; stigma conoid or ellipsoid in basal part, apical part subulate. Fruit pairs of smooth dehiscent drupes with thin pericarps, curved, 3-sided banana-shaped segments, each 1.5-2 x 0.7-0.8cm, orange when ripe, containing several seeds. Fl. (Sep.-)Oct.-May; fr. Feb.-Aug. (Brock 1988; Van Royen et al. 1971).

In vine thickets; Melanesia, New Guinea, Australia [WA (Kimberley region), NT (monsoonal region), Qld (e. coast)] (Forster & Williams 1996).

T. divaricata should be grown in a high-light situation; prefers 15-29°C, and 25% or more relative humidity. Propagate from seed, or from tip-cuttings 10-15cm long, with 3 or more leaves. Keep soil moist on surface; if leaf loss occurs, water more frequently. Pinch back tips to stimulate branching. May benefit from feeding every 2 months, from spring to autumn. Sometimes suffers from infestations of spider mites under the leaves (pers. comms.).

TABERNANTHE

(Apocynaceae)

Tabernanthe iboga *Baill.* **(T. bocca** *Stapf.***; T. mannii** *Stapf.***; T. pubescens** *Pichon***; T. subsessilis** *Stapf.***; T. tenuiflora** *Stapf.***)** – iboga, eboga, eboka, boga, libuga, bocca, lebogo, lebuga, dibuga, diboga, dibuyi, dibugi, mbasoka, kuta mbasoke, mebange, moabi, gifuma, nyoke [ñoke], dinyoke, oabe, minkolongo, mungondu, sese

The root-bark shavings from the iboga shrub [T. iboga] are used in western central Africa in small quantities as a CNS-stimulant and aphrodisiac. It helps warriors and hunters stay awake in long night-watches or hunts, and has been shown to increase endurance and stamina. However, its primary importance is as an initiatory entheogen, as utilised in Gabon by adherents of Bwiti, a native spirituality based on direct contact with the 'ancestors' [the 'Bwiti']. Bwiti has spread to other surrounding areas due to the genuine experience that it offers [despite Christian missionary attempts to stamp it out]. Bwiti is thought to have been introduced to the Fang by the Mitsogho [Metsogo], along with the custom of eating iboga roots. Previous to this, the Fang ate the leaves of the iboga shrub for shamanic 'dreaming'. Iboga root is now used mainly by peoples of the Fang and Mitsogho in elaborate initiation rituals, where a fully active dose of the plant is consumed for what will probably be the only time in one's life. For regular use, however, small quantities of the root bark are chewed for all-night drumming and dancing ceremonies. Sometimes, it is taken by shamans or others for divination on a pressing issue. The plant used is T. iboga, but sometimes varieties are used which were once recognised as separate species [such as T. mannii, T. pubescens and T. subsessilis, the former said to be 8-10 times stronger than 'typical' T. iboga]. Sometimes **Cannabis** is smoked as well, or its resin eaten. Sometimes **Alchornea** floribunda is taken with iboga in large amounts, and **Elaeophorbia** drupifera is also used when the iboga is slow to take effect (Fernandez 1982; Goutarel et al. 1997; Khuong-Huu et al. 1976; Pope 1969; Samorini 1993, 1995a, 1997a, pers. comm.; Schultes 1969c; Schultes & Hofmann 1980; Tyler 1966). The finer details of iboga ceremonies differ from group to group, but below we will look at one example.

Sex and food are abstained from the day before the iboga ceremony. Beginning at around 9am, iboga root bark is given orally in a powdered form, from a basket [usually about 20cm diameter] placed on a wildcat skin. It is eaten with the mouth, not the hands. Occasionally, an infusion is made, though this is less effective in extracting the alkaloids [which are not very water-soluble]. The initiate is given a 'mother' and 'father' of iboga, who oversee the consumption of the root and the successful journey of the initiate. Around 16 teaspoonfuls may have been consumed by midday, when an antelope horn is blown to "alert the ancestors that a descendant is coming among them." By 3pm, and another 16 tsp later, the initiate is led to a nearby stream, followed by several other people with important roles in the ceremony. Stripped to the waist, the initiate stands in the water and confesses past sins. Back on land, the aromatic leaves and flowers of Costus lucanusianus ['myan', 'okosakosa'] and leaves of **Piper** umbellatum ['abomenzan'; see **Piper 1**] are used to purify the initiate. 'Myan' is chewed and spat out by the father, who rubs it on the initiate before washing with stream water, to 'open the eyes'. 'Abomenzan' is then rubbed on by the mother, to win the sympathy of the spirits. Next, now naked, the initiate is rubbed down with the powdered bark of 12 trees [which are all used medicinally]. These are Bridelia grandis ['asas'], Distmananthus benthamianus ['eyen'], Enantia chlorantha ['mfol'], Guibourtia tessmannii ['ovung'], Kapaca guineensis ['asam'], Mimusops djave ['azap'], Musanga cecropioides ['aseng'; see *Endnotes*], **Ocimum** americanum ['adzam ntoma', 'elegalenga'], Polyalthia suaveolens ['otunga'], Psilanthemus manii ['azem'], Pterocarpus soyauxii ['mbel'] and Pycnanthus angolensis ['eteng']. The initiate then dons a white initiation smock, and after the other participants perform a symbolic reenactment of birth, s/he is hit over the head with large flowers from a 'parasol tree' ['zoseng aseng'] to symbolise 'cracking open the head' so that the soul may escape. Finally at the stream, the director of the ceremony lights a piece of pitch on a manioc leaf [the 'soul boat'] and drifts it downstream, between the initiate's legs, off to sea.

Back on land again, another 11 tsp are eaten and the initiate is helped back to the forest chapel, circling it, and coming to rest in front of it, where a sapling is planted that was pulled up the night before to determine if the ceremony should go ahead [its ease in being uprooted being a good sign]. All present help in planting the tree, which is the ladder by which the initiate climbs to the ancestors. At around 9pm, the initiate is taken to a chamber where more iboga is eaten for another hour or so, and the visionary phase of the experience begins fully. Administration of the drug stops when pin pricks in the spine fail to bring a response. It is said that no one will enter the full experience with less than 30tsp, and often as many as 60 may be given. This may translate to 1-3 baskets, or 200-1,000g, over an 8-24 hour period. Such high doses are only used once or twice in a lifetime to evoke full contact with the ancestors, to 'break open

the head', as it is often referred to. Some groups take it more regularly in smaller [non-visionary] amounts as part of their religious ceremonies, as mentioned above. For such use, 2-3 tsp [for women] or 3-5 tsp [for men] are taken early in the ceremony, with several more grams eaten halfway through after midnight, adding up to 4-20g of iboga. Such doses only elicit calm CNS-stimulation, a 'lightening' of the body and mild dissociation, as well as giving endurance for night-long dances. [However, some people have reported full-strength experiences from as little as 8g of root bark (Hoodoo pers. comm.).] It is not unknown for the seeds to sometimes be chewed, with a dose constituting 25-30 seeds.

The fully-active dose of iboga elicits a complex effect, with several distinct phases. Nausea and vomiting frequently occur earlier on, but amongst some groups it is not particularly desired, unless the initiate is in need of purging, as it means less of the iboga will be absorbed, and that the initiate may not be able to keep down the full dose. Others regard vomiting as essential to prevent death of the initiate, and the vomit is inspected carefully for signs of blood, which if found, will halt the ceremony. Initial effects are felt after about 20 minutes from beginning consumption, with agitation, loss of motor coordination, drowsiness, tremors, mood shifts, partial anaesthesia, alterations in blood pressure, and some degree of respiratory depression. After about 10 hours, vague coloured line hallucinations appear as though projected onto space; these commonly take the form of archetypal imagery. Objects are seen to shimmer with energy. These effects later give way to a lucid dream-like state, where the initiate is led through relevant events from their life and taken to a point where they may 'see' the course they must take. This period may last 5-10 hours, after which a relatively 'normal' consciousness returns, as does bodily sensation. At this stage, flashes of light are commonly seen around oneself. Energy levels are high during this period. The visionary phase is experienced much sooner when *ibogaine*, the major active iboga alkaloid, is taken as a single or dual dose. Over the next 20 hours or so, these events are re-integrated from a higher view-point during a phase of introspection. Residual stimulation may keep the person awake for many more hours, but only a few hours sleep is needed afterwards before the initiate can awaken feeling as good as new. In the last stages of the ceremony, it is considered important to relate to the group the visions and teachings that were received.

Sometimes deaths occur, usually with particularly high doses [above 1,000g] in frail or young people. Sometimes the dose reaches a toxic level [up to 6 or more times the fully-active dose of *ibogaine* (which is about 1g)]. Sometimes it is believed that in the visionary stage a person can be offered the chance to enter death and not return – if the initiate takes this path, then real physical death may be likely. Often, the ancestor-spirits are contacted beforehand by the elders to ask whether the ceremony should be performed. Some give a small dose of iboga the day before to test for any possible adverse reaction. The mother and father also monitor the physical and psychic state of the initiate to halt proceedings if any potential dangers or adverse physical reactions should arise. People with cardiac difficulties or high-blood pressure should probably not use iboga (De Rienzo et al. 1997; Fernandez 1982; Goutarel et al. 1997; Pope 1969; Samorini 1993, 1995a, 1997a, pers. comm. 1999; Schultes 1969c; Schultes & Hofmann 1980, 1992).

Iboga and *ibogaine* have been successfully used to interrupt drug addictions, notably those associated with opiates, *amphetamine*s, *cocaine*, *nicotine* and alcohol. This appears to arise from a complex biochemical reaction with the iboga alkaloids in areas of the brain directly related to addictive/compulsive behaviour – in a sense remodelling neurochemistry so that withdrawal symptoms or cravings do not persist after the experience, remaining effective in most subjects for up to 6 months. Reformed addicts after iboga usually adopt a more positive and constructive approach towards their own lives, revitalised and inspired by the revelations and trials of the iboga experience [which involves "release of repressed memories, intellectual re-evaluation of these memories, and integration of new insights"] (Popik et al. 1995).

Up to the time of printing, *ibogaine* has still not gained widespread official use as an addiction treatment, due mainly to resistance from a variety of US Government department officials who have the power to legalise the treatment and allow it to proceed. Many in this standing have financial interests in synthetic opiate-substitutes [which merely prolong withdrawal, have a low success rate, and substitute one addictive drug for another], currently widely used to 'treat' heroin addicts. Studies have been sponsored which found some degree of *ibogaine* neurotoxicity in animals at high doses [disputed in part by some other studies], and such results have been used as the main public evidence for the suppression of *ibogaine*, even though they may have little relevance to the real-life therapeutic use of iboga or *ibogaine* by humans in addiction treatment. Also, because *ibogaine*, being an indole alkaloid psychedelic [although qualitatively and quantitatively very different from the classic indole psychedelics], was blanket-banned with all of the other psychedelics, many have found it hard to see the chemical in an acceptable light (De Rienzo et al. 1997). Whatever the case, *ibogaine* is clearly not a recreational substance with abuse potential – the experience that it offers, though of high personal and spiritual value, is a long and arduous one, that at times may be quite unpleasant [although a somewhat detached, non-emotive mental state is exhibited – the experience may be neither delightful or horrifying – it just IS...] (pers. comms.). However, small [sub-psychedelic] doses of iboga root can act as a pleasantly euphoric stimulant. Some people still experience nausea at these low doses (theobromus pers. comm.). See the *Chemical Index* entries under *ibogaine* and related chemicals for more information.

T. iboga root bark has yielded 5-6% alkaloids [1-2.6% in whole root] – mostly *ibogaine* [c.1% of root bark, may be up to 80% of total alkaloids], as well as *ibogaline* [c.15% of total alkaloids], *ibogamine* [c.5% of total alkaloids], *tabernanthine* (Bruneton 1995; Delourme-Houdé 1947; Dybowski & Landrin 1901; Jenks 2002), *ibogaine*-OH-indolenine, *ibogamine*-OH-indolenine, iboluteine, desmethoxyiboluteine, *iboxygaine*, iboxyphylline, ibophyllidine, *voacangine*, *coronaridine*, eglandine, gabonine, iboquine, kimvuline and kisantine (Buckingham et al. ed. 1994; Dickel et al. 1958). Root wood, stem bark and leaves did not contain appreciable levels of *ibogaine* (Jenks 2002). Leaves of T. iboga var. 'sese' [see below] yielded 0.44% total alkaloids, including 0.0074% *ibogamine*, 0.013% a mixture of ibophyllidine and *ibogamine*, and traces of iboxyphylline; leaves of T. iboga var. 'minkolongo' [see below] yielded 0.32% alkaloids, including 0.015% a mixture of *ibogamine* and ibophyllidine, and 0.002% iboxyphylline (Khuong-Huu et al. 1976). The dried crude alkaloid extract was found to be stable "even after months of exposure to indirect sunlight and air" (Jenks 2002). See *Producing Plant Drugs* for discussion of the simple alkaloid-extraction procedure used by Jenks.

As T. pubescens, the root bark yielded 5.6% alkaloids – 2.6% *ibogaine*, 0.29% *voacangine*, 0.11% *voacangine*-OH-indolenine, 0.057% *voacristine* and 0.059% 3,6-oxido-*ibogaine*. Trunk bark yielded 2.1% alkaloids – 0.75% *ibogaine*, 0.21% *iboxygaine*, 0.21% 3,6-oxido-*iboxygaine*, 0.026% *ibogamine* and 0.02% *ibogaline*. Leaves yielded 0.8% alkaloids – 0.28% voaphylline, 0.04% voaphylline-OH-indolenine, 0.007% tetrahydroalstonine, 0.006% 11-OH-tabersonine, 10-OH-*coronaridine* and 10-OH-heyneanine. Fruits yielded 0.8% alkaloids, mostly *coronaridine* (Mulamba et al. 1981). When this major fruit/seed alkaloid was still uncharacterised, animal experiments showed it to potentiate the hypertensive activity of *epinephrine* (Delourme-Houdé 1947).

As T. subsessilis var. 'mebange' [see below], leaves have yielded 0.4% alkaloids, including 0.016% ibophyllidine, 0.0084% iboxyphylline and 0.0014% *ibogamine* (Khuong-Huu et al. 1976).

Tabernanthe iboga is an arborescent shrub to about 2m high; sometimes a small tree to 3m or more, bare to the top of the slender trunk of 150-180cm, then patently branched; branches and branchlets dichotomous, compressed at the nodes. Root robust, much branched; central bulbous mass 2-10cm thick, branching out 50-80cm; brown when fresh, grey when dried. Leaves opposite, petiolate, petioles 2-3mm long; elliptic-ovate or obovate-lanceolate, acuminate, base acute or long-cuneate, mostly 7.5-13 x 2.5-4.5cm, thinly coriaceous or membranous, a little fleshy, dark green, soft and rather glossy above, pale yellowish-green and rather shining beneath; nerves 9-11, oblique, arcuate; stipules interpetiolar, inside with dense rows of whitish cilia. Inflorescence loosely umbelliform or subcorymbose, from few to c.12-flowered, nutant, shorter than leaves; peduncle 1-4cm; pedicels about 8mm; flowers yellow or white, sometimes with pink spots; calyx 5-cleft, 1-1.5cm long, the lobes keeled, imbricate, carolline-yellowish, closely clasping the corolla-base; sepals broadly ovate or subtriangular, ciliolate, the inner with 1-2 basal glands within; corolla somewhat salver-shaped, sulphur-coloured, tube dilated below, about 5mm long, fleshy, gradually constricted towards throat, limb 5-cleft, segments rotundate, 2.5mm long, patented during flowering, soon revolute, contorted dextrorsely (as seen from above), unequal-sided, the outer side undulate; stamens inserted at the dilation of the corolla tube, filaments scarcely any; anthers 2mm long, subsessile, sagittate, shortly aristate at apex, surrounding stigma pyramidally. Ovary ovoid, entire, obsoletely bisulcate, unilocular; placenta central, multi-ovulate; style 2mm long, firm, cylindrical, bearing ovoid-acuminate stigma at apex, on a broad membranous disc. Ripe fruit ellipsoid, lemon-shaped and coloured, about 50 x 2-20mm, apex pointed or slightly curved, with a smooth, crustaceous pericarp, sometimes crowned with the persistent base of the style – contains a large amount of stinky latex; mesocarp white, pulpy; bearing 20-30 seeds. Seeds brown, globose or somewhat ellipsoidal, 3-6mm long, with a corky, lamellate-rugose testa. Fl. Nov.-Dec., fr. Dec.-Apr.

In small woods or damp forests, occupying deepest cracks of the rocks of the praesidium. Often cultivated. Gabon, s.e. Congo (Hiern 1898; Pope 1969; Schultes & Hofmann 1980).

The typical T. iboga is a shrub form of the species, with round fruit; the variety earlier known as T. mannii is a tree form, with elongated fruit (Samorini pers. comm.). However, Khuong-Huu et al. (1976) claimed that T. subsessilis [which they reported as synonymous with T. mannii], known as 'mebange' to the Fang, is distinguished by its globular fruits. Its roots were also reported to be useful in the same manner as other iboga roots. These authors also reported a further distinction within T. iboga, analysing two varieties [as well as their 'T. subsessilis' specimens – see above]. One, known by the Fang as 'sese' and by the Mitsogho as 'ñoke', was reported to be distinguished by its long, narrow fruit pods.

The other, known by the Fang as 'minkolongo' and by the Mitsogho as 'mbasoka', was reported to be distinguished by its wide leaves and ovoid fruit, and was widely cultivated in coastal Fang villages (Khuong-Huu et al. 1976). Giorgio Samorini, in a later overview, reported that the Fang and Mitsogho of Gabon differentiate between T. iboga ['iboga of the forest'] and T. subsessilis ['iboga of the village']. Samorini mentioned T. subsessilis as differentiated by its verrucose fruits (Samorini 1997a).

Prepare seeds for germination by soaking in hydrogen peroxide [2% solution] for 1 hour, and remove all traces of pulp from seeds. Sow between moist paper towels [sealed in a zip-lock bag or wrapped in plastic if in a cold, dry environment] or in sterilised river sand in a humidity chamber, and keep in a warm, bright place. Check for mouldy seeds, and change paper towels if discoloured. Seed may take from 10 days to two months to germinate; at first sign of such, sow 2.5cm deep in sterilised seed compost, and water with 25% fungicide solution. When established, transfer to a pot or ground plot in compost; benefits from occasional fertilisation. Keep soil wet, but not waterlogged. Outside of its natural habitat, the plant will grow under 25% shadecloth in a greenhouse that gets good sun exposure, with high [c.70%] humidity inside the greenhouse. Leaf propagation [see **Psychotria**] might possibly be a viable option for cultivating this plant without seed (pers. comms.).

TACHIGALIA

(Leguminosae/Caesalpiniaceae)

Tachigalia paniculata *Aubl.* **(T. angustifolia** *Miq.***; T. eriocalyx** *Tul.***; T. sericea** *Tul.***)** – kö'-ma-na, ma-ka-pê-tê, mo-ka-pê-tê, barbasco

Tachigalia ptychophysca *Spruce*

In the Colombian Amazon, the Taiwano boil and eat the unripe seedpods of these two plants as an aphrodisiac. An infusion may also be vigorously rubbed over the chest to treat chest-pains, or to apply to ant-stings. The Makuna of Rio Apaporis rub a leaf decoction of T. paniculata on aching limbs as an analgesic. The Kubeo use the ashes of the burnt leaves for chewing with their coca powder [see **Erythroxylum**]. The Tikuna use a tea of T. paniculata as a powerful stimulant, and a decoction of the seedpod is used as a strong emetic (Schultes & Raffauf 1990).

T. paniculata has given negative results in alkaloid screening (Schultes & Raffauf 1990), though others found an 80% ethanol extract of the inflorescences to contain 0.009% *tryptamine* and 0.005% *N-methyltryptamine* (Svoboda et al. 1979).

Leaves of the related T. myrmecophila have yielded skatole [3-methylindole] and tannins (Svoboda et al. 1979).

Tachigalia paniculata is a tree c.6-15m tall, with an outspread leafy crown; young branchlets and petioles minutely tomentose, greyish or pale tawny, becoming glabrate. Leaves 4-6(-8)-jugate; leaflets ovate-oblong to elliptic, rarely almost narrowly oblong, acuminate, base unequal, rotundate or acute, c.7.5-15cm long, glabrous, or sometimes when young minutely puberulous or sericeous and shiny-white beneath, when mature often glabrous on both sides, shiny above, coriaceous, pinnately-veined, reticulate-venulose; petiolules short, thick; petioles c.7.5-15cm long, thick, acutely 3-angled or sometimes almost 2-winged, terminating in a bristle; stipules caducous, foliaceous, lanceolate or ovate, c.1.2cm long, laterally narrow, often very small. Racemes in upper axils, simple, terminally branched, shortly pedunculate, first short and densely-flowered, becoming c.30cm long, panicle base foliate, rhachi angulate or above subterete, tomentose canescent, rusty-red or pale-yellowish vestite; bracts from base broadly subulate, caducous; pedicels short, thick, c.2-4mm long; calyx tube strongly oblique, turbinate, costate, c.5-6mm long, lacinia subequal in length; limb 5-segmented, suborbiculate, obtuse, c.6mm long, at bottom otherwise small; petals 5, yellow, base dark-pilose, broadly obovate or suborbicular, calyx somewhat longer, at top equal, concave, otherwise not very oblique; stamens 10, declinate, incurved-ascending; filament bases dark-bearded, 7 less than half as long as petals, 3 larger, shortly oblong. Ovary above disc subsessile, reddish-hirsute or tomentose; style filiform; stigma terminal, very small. Legume shortly stipitate, oblong, plane, becoming glabrate; seeds ovate, compressed, slenderly albuminate.

In forest along Amazon & Solimoës rivers, and around Rio Negro near Manáos, Brazil; also in Surinam, French Guiana & Guyana (Fridericus & De Martius ed. 1965-1975).

TAGETES

(Compositae/Asteraceae)

Tagetes erecta *L.* **(T. major** *Gaertn.***; T. patula** *L.***)** – kobac piH, African marigold, Aztec marigold, French marigold, big marigold, flor de muerto

Tagetes lucida *Cav.* **(T. anethina** *Sessé et Moc.***; T. florida** *Sweet***; T. gilletii** *De Wild.***; T. pineda** *La Llave***; T. schiedeana** *Less.***; T. seleri** *Rydb.***)** – yauhtli ['the dark one'], pericon, anisillo, curucumin, flor de Santa Maria, hierba de Santa Maria, hierba anis, hierba de nube ['cloud herb'], tzitziqui, tumutsali, sweet mace, sweet-scented marigold, Mexican tarragon

Tagetes minuta *L.* **(T. bonariensis** *Pers;* **T. glandulifera** *Schrank***; T. glandulosa** *Link***; T. porophyllum** *Vell.***)** – Inca marigold, stinking roger, muster-John Henry

As 'yauhtli', T. lucida was used in sacrifice by the Aztecs – the powdered herb being thrown or blown into the faces of sacrificial victims [pre-sacrifice] to 'dull their senses' during the festivals of Huehueteotl. Sometimes today, it is used in cleansing ceremonies by shamans in the Mexican state of Morelos, and is sometimes burned as incense. It is also important in modern-day Mexican celebrations of the feast of St Michael, which replace the festivals of Huehueteotl – on the afternoon of Sep. 28, the flowers are collected and bunched together to form crosses, which are nailed over doorways to protect against devils during that night. The herb was also smoked to 'aid clairvoyancy'. It has also been said that the herb "alleviates crazy people and those astonished and frightened by the thunder" (Diaz 1979; Nicholson & Arzeni 1993; Siegel et al. 1977). A tea of the herb is sweet and anise-flavoured [see **Pimpinella**, **Illicium**]; several cups can have strong stimulating effects (Neher 1968).

T. lucida is also smoked by the Huichol for either recreation or ceremony, either alone or mixed 1:1 with tobacco [**Nicotiana** rustica, itself a potent intoxicant] – it is usually smoked alone, however, as it is more abundant than tobacco. It is usually smoked either in long, thin, cornhusk cigarettes, or in clay pipes. However taken, it is acknowledged to cause an 'intoxication', and also synergises with the tobacco – the intoxication is "marked by quiescence, lying down, a fixed gaze, and frequent periods of closed eyes...the smoker would often turn away from the fire and face the darkness". Sometimes, visual images are reported from behind closed eyes, accompanied with nausea and vomiting. Often, the herb is smoked to accompany ingestion of peyote [see **Lophophora**], fermented maize drinks ['quino' or 'nawa'], cactus distillate ['cai' or 'sotol'] or other alcohol ['tepe'], all of which help produce a stronger psychotropic effect than the herb produces alone. T. lucida also has its more everyday uses – it is crushed and held against the face as an aromatic inhalant, used in offerings, baptisms, and relaxing baths for rheumatism, and made into a tea to promote relaxation and sleep. The plant juice relieves insect bites, and the plant itself also acts as an aphrodisiac, antipyretic, emmenagogue, galactagogue, ecbolic, diuretic, fumigant and insect repellant (Diaz 1979; Jiu 1966; Nicholson & Arzeni 1993; Siegel et al. 1977). The dried, powdered leaves are used as a cooking spice; in Australia, T. lucida is commonly found as a culinary herb for sale in nurseries (pers. obs.). With T. lucida and T. minuta foliage, up to 2g dried, powdered herb taken orally with fruit juice was found to bring about a 'lucid' state with effects including "clarity, alertness, closed-eye visuals, body warmth, body tingles, feeling of well-being, and some time-distortion", as well as dream enhancement; effects lasted 2-3hrs. An alcohol tincture also worked, but lost activity after a week; a simple tea was not found to have any psychoactivity. When taken orally it was observed that eating something minimal [such as a cracker] appears to aid intestinal absorption (Lazar 2002).

T. erecta flowers are used by the Mixe of Oaxaca, Mexico, in divination. For this purpose, 9 flowers are macerated in hot water, and then strained out with a cloth; the juice is poured into a gourd of spiced maize gruel, and consumed at night to "uncover pending misfortune and all that is hidden". The seeds have sometimes been placed in another's food to harm them (Lipp 1990).

Flowers of T. erecta are sacred to Shiva in India and Nepal, and are used in offerings and worn by saddhus at festivals. Its flowers are also the source of a yellow dye (Hartsuiker 1993; Neher 1968; Rätsch 1992). T. erecta leaves are boiled by the Tikuna of the Amazon, and the cooled liquid is dropped into the eyes to relieve pain; it may also be bathed in to treat fever (Schultes & Raffauf 1990). The leaves and juice are said to be drunk as an aphrodisiac, stimulant and muscle-relaxant in Mexico, ground with water or wine, or decocted. T. erecta ia also extracted into liquid and drunk as a calmative in Argentina (Neher 1968). The leaf of T. minuta is said to be used in S. America as a stimulant, hysteria remedy, diaphoretic, anthelmintic, diuretic and emmenagogue; the plant juice is irritant to the skin and eyes. It is also decocted and drunk as a stimulant in Argentina. In Basutoland, Africa, the leaf is burned to ash and mixed with tobacco [see **Nicotiana**] for snuffing (Neher 1968; Watt & Breyer-Brandwijk 1962).

T. erecta contains pyrethrins (Cashyap et al. 1978), tagetiin, patuletin, allopatuletin, isoeuparin, quercetagitrin, galetin, rubichrome, 5-(3,4-diacetoxy-1-butyryl)-2,2'-bithiophene, 5-ethynyl-5'-(1-propynyl)-2,2'bithiophene and 5-(1-propynyl)-5'-vinyl-2,2'-bithiophene (Buckingham et al. ed. 1994).

T. lucida contains thiophene-derived terpenoids (Diaz 1979); a leaf extract acted as a CNS-depressant in rats (Jiu 1966).

T. minuta may yield 0.5-2% volatile oil [which is dark, sticky and strong-smelling], containing linalool, carvone, tagetone and either myrcene or ocimene (Watt & Breyer-Brandwijk 1962); it has also yielded pyrethrins (Cashyap et al. 1978), fumaric acid, phenyl-acetaldehyde, 4-

(2,2'-bithiophen-5-yl)-3-butyn-1-ol, 5-(4-chloro-3-OH-1-butynyl)-2,2'-bithiophene (Buckingham et al. ed. 1994) and α-terthienyl. The essential oil has shown tranquillising, spasmolytic, hypotensive, bronchodilatory and antiinflammatory activities (Rastogi & Mehrotra ed. 1990-1993); anxiogenic and antidepressant activity was also reported in rats, appearing to be due to negative modulation of *GABA* receptor systems (Martijena et al. 1998).

Tagetes lucida is a strongly-scented (reminiscent of anise and/or liquorice) perennial herb, to c.45cm high or more, freely branching, or simple and unbranched; stem terete, turning reddish, c.30cm, branches opposite, glabrous. Leaves opposite, sessile, simple, ovate-lanceolate, connate, margins serrulate, punctate with oil glands, tips of serrulations reddish, ciliate. Inflorescence consists of heads in dense terminal corymb- or cyme-like clusters, +- 10-12mm diam., 2-3-rayed, usually yellow to yellow-orange; peduncles short, without bracts, often biflorous; common calyx simple, monophyllous, tubulose, apex 9-dentate; corolla composite, deep yellow; hermaphrodites many in disc, tubulose, limb 5-fid, lacinia acutely villose; females 3(-4) radially, rotundate, subcrenate; stamens in female none, in hermaphrodites 5, short; anthers yellowish, cylindric. Ovary oblong, fertile; style filiform; stigma reflexed. Involucre c.1cm long, uniseriate, glandular-punctate, narrowly cylindrical with acute teeth. Achenes with aristate pappus of 2-3 short, obtuse scales and 2 longer awn-like bristles; seeds linear, compressed.

Mexico [esp. abundant in states of Nayarit and Jalisco], Guatemala. Cultivated horticulturally as an ornamental condiment/medicinal herb (Bailey & Bailey 1976; Cavanilles 1794; Schultes & Hofmann 1980). T. minuta occurs as an introduced weed in many areas, such as Australia [WA, SA, Qld, NSW, Vic].

To harvest, the Huichol cut off the top 15cm or so of branch, holding flowers and upper leaves, and hang it in bunches to dry in the shade of their homes (Siegel et al. 1977).

Root secretions of some Tagetes spp. repel rose, tulip and potato eelworms; T. minuta root secretions also deter some herbs or weeds, such as **Convolvulus**, couch-grass and ground ivy (Bremness 1994).

TANACETUM

(Compositae/Asteraceae)

Tanacetum boreale *Fisch. ex DC.* **(T. vulgare ssp. boreale** *(Fisch. ex DC.) Löve et Löve***; Chrysanthemum asiaticum** *Vorosch.***)**

Tanacetum cinerariifolium *(Trevir.) Sch. Bip.* **(Chrysanthemum cinerariifolium** *(Trevir.) Vis.***; Pyrethrum cinerariifolium** *Trevir.***)** – pyrethrum, Dalmatian daisy, Dalmatian pellitory

Tanacetum vulgare *L.* **(T. audibertii** *(Req.) DC.***; Chrysanthemum tanacetum** *Vis.***; C. vulgare** *(L.) Bernh.***)** – tansy, golden buttons, batchelor's buttons, solucanotu

The name of this genus and of 'tansy' derives from the Greek 'athanasia' ['immortality', or its elixir]. A classical legend tells of the beautiful young shepherd Ganymede, who was made immortal by an 'athanasia' brew, so that he would serve forever as Zeus' cup-bearer and lover. However, Zeus' wife, Hera, became jealous, and Ganymede was changed into the constellation of Aquarius (Bremness 1988; theobromus pers. comm.). T. vulgare was often used to preserve corpses; similarly, in times before refrigeration, meat was sometimes wrapped in 'tansy' leaves to preserve and flavour it, as well as repelling flies; it is also known to repel aphids, ants, fleas, mice and intestinal worms (Bremness 1988, 1994; Simonetti 1990). It is used by the Cherokee as a tonic and to treat back ache (Hamel & Chiltoskey 1975). The root is reputed to be an excellent remedy for gout. Tansy-flavoured cakes called 'tansies' were a traditional Easter food in Britain, though they are rarely made today (Grieve 1931).

T. vulgare acts as a nerve tonic, stimulant, anthelmintic, diaphoretic and emmenagogue; it may be toxic in large doses, causing vomiting, convulsions, respiratory and circulatory depression and coma, sometimes death. It should not be used by pregnant women (Foster & Caras 1994; Hutchens 1992; Mabey et al. ed. 1990). Tansy has also been used as a bitter and strongly-stimulating tea by some **Cannabis**-smokers in England (theobromus pers. comm.). Otherwise, the herb may be smoked for psychoactive effects (pers. comms.). The related T. cinerariifolium is dried, powdered, extracted in alcohol and diluted with water for use as an insecticide (Bremness 1994); in humans, this extract can cause CNS and PNS excitation, sometimes with convulsions (Katzung & Trevor 1995).

T. boreale essential oil contains *thujone* and isothujone, as well as 2,6,6-trimethyl-2-vinyl-5-OH-tetrahydropyran [major component], 2,6,6-trimethyl-2-vinyl-5-acetoxytetrahydropyran, and 2,6,6-trimethyl-2-vinyl-5-ketoxyhydropyran (Dembitskii et al. 1985).

T. cinerariifolium contains pyrethrins in aerial parts, mainly in flower heads; these consist of pyrethrin I & II, cinerin I & II, jasmolin I and jasmalin II (Cashyap et al. 1978).

T. vulgare has yielded 0.15% essential oil, consisting of 66-95% *thujone* [some chemical races contain none], 29.6% *camphor*, 24.7% umbellulone, 6% sabinene, 2.5% camphene, 5.1% 1,8-cineole, 1.5% terpinen-4-ol, 0.8% *borneol*, 1% p-cymene, 6.8% thymol, 0.7% carvone, 0.4% valeranone, 0.2% sabinol acetate, carvomentone, carvotanacetone, isopinocamphone and camphone; the herb has also yielded artemisone, piperitone, acacetin, armexifolin, crispolide, eupatillin, tanacetin and many other minor compounds (Battaglia 1995; Buckingham et al. ed. 1994; Chiej 1984; Hall 1973; Lawless 1995; Schearer 1984; Turner & Szczawinski 1991).

Interestingly, the related 'feverfew' [T. parthenium] has yielded 0.00014-0.00025% *melatonin* (Murch et al. 1997).

Tanacetum vulgare is an aromatic perennial herb; stems 30-150cm, branched above. Leaves alternate, pinnatipartite to pinnatisect, glabrous to sparsely hairy, glandular-punctate, lower cauline leaves more than 5cm, petiolate, oblong to oblong-ovate, the segments pinnatisect to pinnatilobed, linear-lanceolate to oblong-elliptical, upper cauline leaves similar but sessile. Capitula (5-)10-70(-100) in a dense, terminal compound corymb, rarely solitary, with or without ligulate florets; involucral bracts in 3 rows; involucre 5-8mm diam.; receptacle convex to subglobose, usually punctate-tuberculate; outer row of florets tubular, female, zygomorphic, 3-toothed, rarely shortly ligulate, or actinomorphic, 5-toothed, hermaphrodite, yellow, inner florets hermaphrodite, tubular, 5-toothed; stamens 5, epipetalous; anthers usually connate into a tube around the style. Ovary inferior, 1-locular; ovule solitary, basal, anatropous; style solitary, with 2 stigmatic branches. Achenes 1.2-1.8mm, 5-ribbed, with scattered epicarpic, sessile, transparent, non-mucilaginous glands; pappus 0.2-0.4mm.

Roadsides, river-gravels and waste places, in dry soil, in sun or part shade; extensively cultivated, and in some regions naturalised; almost throughout Europe (Tutin et al. ed. 1964-1980); in Australia naturalised in South Australia, Queensland, New South Wales, Victoria and Tasmania (Hnatiuk 1990).

TANAECIUM

(Bignoniaceae)

Tanaecium nocturnum *Bur. et K. Sch.* **(Osmhydrophora nocturnum** *Barb. Rodr.***)** – koribo, sape-mandur, erchu-chuá

The Paumari of the Brazilian Amazon use the leaves of this plant to make a shamanic snuff, known as 'koribo-nafuni'. It is prepared by roasting, pulverising and sifting the leaves, and mixing them with tobacco [see **Nicotiana**] prepared in the same way. This is taken by male shamans prior to diagnosing patients, and during ritual occasions. It makes a person dizzy, and feel like throwing themselves in the nearest body of water, as well as causing headache. A tea of the root bark [c.2 tab.] is used by women, producing "drowsiness, an inability to concentrate, and reduced awareness". The Choco of southern Colombia use it as an aphrodisiac. The Tikuna regard the plant as being poisonous. Some field researchers have experienced psychoactive effects simply from inhaling the plant's aroma. One felt so dizzy in a room in which the plants were hanging that he had to crawl out on all fours (Prance et al. 1977; Schultes & Raffauf 1990)! On a more benign note, the Yanomamo cook the leaves and rub the juice on the skin to relieve itching (Milliken & Albert 1996).

The leaves have a scent reminiscent of almond oil [see **Prunus**], and contain hydrocyanic acids in high concentrations, as well as saponins (Prance et al. 1977; Schultes & Raffauf 1990). However, it is unlikely that much HCN would survive the preparation of the snuff.

Tanaecium nocturnum is a lofty climbing shrub. Leaves large, conjugate, tendrilled terminally, simple, generally strongly persistent (rarely weakly caducous), fairly long petiolate, blade broadly elliptic, shortly acuminate, base acutely cordate, subtrinerved, c.14cm long, 10cm wide, besides basal nerves, 3-4 approximate lateral veins, transversely connecting lengthwise. Inflorescence decussate, few-flowered racemes; bracts and bracteoles caducous, 1.5-2mm long; rachide robust, alternate, complanate; raceme rachis 7cm long, 5-8 flowered; peduncles 12-20mm long; calyx tubular, irregular above, lobulate, with glands near base, 2.2-2.5cm long, coriaceous, trilobed; corolla white, 16cm long, lips obtuse, c.3cm long, recurved, tube narrowly cylindric, upper part of throat gradually widening, puberulous within beyond base; stamens 8-9cm, basally affixed in corolla tube, theca divaricate, arranged vertically, smaller ones 5.5cm, larger ones 6cm long. Disc moderately long, excavate above, 2.5-3mm high; ovary oviform, 5-6mm long, covered with small scales, base sessile, +- angustate; ovules many, as locules affixed in 4 rows, compressed, anatropous, erect; style exserted, c.15cm long; stigma rhomboid. Capsule scandent, often glabrous, thickly subcylindric or broadly elliptic in transverse section, woody; valves smooth externally; seeds many, compressed or saddle-shaped, nucleus and margin thick or ulterior membranaceous.

In young forest, upper Amazon, near Rio Purus and Mandos; Brazil (Fridericus & De Martius ed. 1965-1975).

TARCHONANTHUS

(Compositae/Asteraceae)

Tarchonanthus camphoratus *L.* **(T. abyssinicus** *Sch. Bip.***; T. camphoratus var. litakunensis** *(DC.) Harv.***; T. minor** *Less.***)** – Hottentot tobacco, wild cotton, sage wood, guitar wood, wilde-salie, kamferhout, kamferbos, sieriehout, vaalbos, veld-vaalbos

The leaves of this African shrub were once smoked by the Hottentot and Bushmen, and chewed by Mohammedans, for their 'narcotic' effect. Modernly, T. camphoratus is more commonly used as an analgesic. The Suto inhale smoke from the burning green branches to relieve headache. The Rolong do the same with the green root, and also smoulder green twigs to smoke rheumatic joints. They also infuse the leaf for stomach complaints. Early Cape settlers used a leaf infusion or decoction as a diaphoretic and asthma remedy, as well as an analgesic for toothache. The heavy wood from this plant is also used for fancy woodworking, and to construct musical instruments (Usher 1974; Watt 1967; Watt & Breyer-Brandwijk 1932).

The leaves have yielded 0.107% essential oil by steam distillation (Stefanis 1925), said to contain *camphor* [of which the plant smells strongly] and tarchonyl alcohol (Watt 1967); the plant has also yielded pinocembrin (Buckingham et al. ed. 1994).

Tarchonanthus camphoratus is a large shrub with a strong balsamic odour. Leaves alternate, petioled, coriaceous, 7.6-12.7 x 1.3-3.8cm, lanceolate-oblong or obovate, acute at base, subacute or obtuse at apex, entire or denticulate, young leaves densely velvety above, adult glabrous, finely reticulated above, reticulations either flat or hollow in the middle, as if pitted, tomentose and penninerved below. Inflorescence of terminal panicles, many-headed; heads dioecious, few or several-flowered; involucre of male flower of 5 scales, connate to their middle; of the female, of many separate scales, in a double row; receptacle hairy; corolla tubular-campanulate, 5-toothed, externally hairy and viscid, glabrous within. Male: anthers exserted, connate, with long setose tails and glabrous filaments; ovary abortive; nectary large, callous, hollow at top, simulating an ovary; style filiform, scarcely 2-lobed at point. Female: stamen abortive; nectary none; style exserted, bifid, lobes revolute. Achene very wooly, without pappus.

Common throughout S. Africa (Harvey & Sonder 1984).

TASMANNIA

(Winteraceae)

Tasmannia glaucifolia *J. Williams* – fragrant pepper bush

Tasmannia lanceolata *(Poiret) A.C. Smith* **(Drimys lanceolata** *(Poir.) Baill.***; Winterana lanceolata** *Poir.***)** – mountain pepper bush

Tasmannia pupurascens *(Vickery) A.C. Smith* **(Drimys purpurascens** *Vickery***)** – broadleaved pepper bush

Tasmannia xerophila *(Parm.) M. Gray* – alpine pepper bush

Leaves and fruits of these eastern Australian shrubs have a distinct acrid, peppery taste (pers. obs.). The seeds and bark of T. lanceolata have been used as a 'native pepper' (Hurst 1942), or substitute for **Piper** nigrum [see **Piper 1**]. T. lanceolata has also been used as a stomachic and scurvy remedy, like the closely-related **Drimys** winteri [see **Canella, Drimys**] (Lassak & McCarthy 1990).

The essential oils found in some members of this genus contain phenylpropenes and terpenoids which may be of interest.

T. glaucifolia essential oil yielded 5.8-16.9% *safrole*, 0-1.4% *eugenol*, 0.3-3.3% *croweacin*, 0.5-5.3% *myristicin*, α-thujene, α-*pinene*, β-*pinene*, sabinene, myrcene, phellandrene, limonene, p-cymene, 1,8-cineole, γ-terpinene, linalool and others.

T. lanceolata essential oil yielded mainly *pinene* and 1,8-cineole, as well as 0-5.1% *eugenol* and many other minor constituents.

T. purpurascens essential oil yielded mainly limonene and sabinene, as well as 1.5-4% *eugenol*.

T. xerophila essential oil yielded mainly α-*pinene*, α-phellandrene, and limonene, as well as 1-4.8% *eugenol* and 2.7-8.4% *myristicin* (Southwell & Brophy 1992).

Tasmannia glaucifolia is a 2-3m tall bushy shrub, with glossy maroon branchlets. Leaves alternate, sessile, aromatic when crushed, usually 4-6cm x 4-15mm, oblanceolate, with fine oil dots, lower surface glaucous and densely papillose. Inflorescence at first apparently a terminal umbel with single flowers in axils of closely spaced bud scales, becoming pseudowhorled by further growth of the shoot; apical buds scaly, glabrous; flowers usually white, sometimes yellow, c.5mm diam., usually unisexual; sepals fused, completely enclosing the bud, splitting into 2-3 lobes, often falling early; petals absent; stamens numerous, hypogynous, free, with slender filaments. Ovules 1-several, usually marginal; carpels 2-3, sessile, folded longitudinally, free, with stigmatic surface extended along suture; sterile carpels often present in male flowers. Fruit a cluster of berries, globose to ovoid, c.5mm diam., glossy, deep purple-black, 1-3 sessile on peduncle usually 5-10mm long. Fl. Nov.-Dec.

Along small creeks or drainage lines, near or along edge of Nothofagus moorei rainforest, 1200-1550m; Australia [New South Wales, recorded from Barrington Tops, Ben Hall's Gap and Point Lookout] (Harden ed. 1990-1993).

TAXUS

(Taxaceae)

Taxus baccata *L.* – English yew, Himalayan yew, manduparni

Taxus brevifolia *Nutt.* **(T. baccata ssp. brevifolia** *(Nutt.) Pilg.***; T. baccata var. brevifolia** *(Nutt.) Koehne***; T. baccata var. canadensis** *Benth.***; T. bourcieri** *Carriere***; T. lindleyana** *A. Murray***)** – Pacific yew, western yew

Taxus spp. – yew, ground hemlock, tree of death

Yews are very long-lived trees, being able to survive for 1,000 years or more. Bows and axe handles made from their wood have been found with a 5,000 year-old human corpse in the European Alps (Bremness 1994; Chiej 1984). Magic wands were also often made from yew wood, and the yew was sacred to the Druids, who associated it with immortality, and planted it at holy sites (Chevallier 1996). The Gauls reputedly used the juice of yew leaves to poison their arrows. It has also been reported that "the exhalation emanating from the tree may occasion vertigo, lethargy, and a kind of drunkenness". It was believed that one who slept for too long beneath a yew tree would never awaken (Felter & Lloyd 1898), though it has also been used in magical spells to attempt to raise the dead. The trees are a symbol of sadness, and have narcotic properties, as well as being very toxic (Cunningham 1994; Ott 1993; Turner & Szczawinski 1991). Slips of yew were an ingredient of the witch's potion in Shakespeare's 'MacBeth'. Native Americans of the Pacific n.w. sometimes smoke T. brevifolia leaves alone or mixed with 'bearberry' [see **Arctostaphylos**]; they are said to make one dizzy. The Klallam also use it as an analgesic (Ott 1993). In Nepal, T. baccata ssp. wallichiana ['barma salla'] is used as a shamanic incense (Müller-Ebeling et al. 2002).

A cooled leaf decoction of T. baccata is sometimes given to nervous, twitchy stock animals for its mild paralysing effect. The foliage may also be smouldered to repel mosquitos. In n. India, leaves and fruits of T. baccata are used as a sedative, antispasmodic and emmenagogue; the leaves alone are used to treat "hysteria, epilepsy and nervousness". Yew is also said to be able to procure abortion and restore menstrual flow (Bremness 1994; Chiej 1984; Nadkarni 1976). Some pagans in modern Britain have claimed that yew is 'hallucinogenic'. However, one person who suffered an accidental intoxication from inner bark powder through cuts in the hands, described "uncomfortable vomiting, aching joints and everything for a few days, and a mildly visual delirium". He further reported, "I have had more pleasant flu and would recommend avoiding this one" (theobromus pers. comm.)!

Yew leaves are considered to be the most toxic part, but the aril [minus the seed] is actually edible and sweet [though some don't like the texture]. Several seeds may kill a child. Symptoms of yew poisoning include drowsiness, dizziness, stiffness, trembling, abdominal pain, fever, nausea, vomiting, dry throat, diarrhoea, rash and pallor; severe poisoning also gives rise to irregular heartbeat, dilated pupils, convulsions, collapse and coma, followed by slow pulse and weak breathing, and sometimes death (Felter & Lloyd 1898; Turner & Szczawinski 1991). Today, yews [particularly T. brevifolia] are a source of taxol, a potential anticancer treatment, due to its ability to prevent cell division in humans (Bremness 1994; Chevallier 1996).

T. baccata leaves and twigs have yielded 0.93% taxine [a complex mixture of alkaloids, absorbed rapidly by human digestive system; may cause death due to cardiac and respiratory failure] and 0.0017% *ephedrine* (Callow et al. 1931; Gulland et al. 1931; Henry 1939; Turner & Szczawinski 1991), as well as taxicotine, milossin, tannins, resin, and an essential oil (Chiej 1984); some varieties also contain taxol (Chevallier 1996). Taxus spp. may contain the cyanogenic glucoside taxiphyllin (Conn 1973).

Taxus brevifolia is a tree 10-25m tall, with a straight, often fluted trunk, 20-120cm diam., with slender, spreading or drooping branches; bark c.6mm thick, covered with small dark reddish-brown scales; wood durable, elastic. Leaves 2-ranked, forming flat sprays, linear, flat, 12-16 x 1-2mm, acute, keeled above, deep yellow-green and shining above, much paler and stomatiferous beneath, margins revolute; persisting 4-5 years. Inflorescence dioecious, males and females usually on separate trees. Male flowers small globose catkins with bracts, of 4-8 stamens; pollensacs several, pendent in a circle around the filament. Female flowers solitary on rudimentary axillary branches, minute and green, fleshy apical discs with a few scales at base, maturing in autumn. Seed with a bony integument, ovate-oblong, c.8mm long, surrounded but free from the thickened, gelatinous, sweet, scarlet, cup-shaped aril.

In deep, coniferous woods in moist situations, widely distributed,

but rarely forming groves; Pacific n.w. region of North America (Abrams 1940-1944).

TELIOSTACHYA

(Acanthaceae)

Teliostachya lanceolata var. crispa *Nees* **(Asteracantha longifolia** *(L.) Nees***)** – toé negro

This plant is commonly used to treat stomach ache by the Siona and Secoya of Ecuador (Ott 1993), yet the Kokama of Amazonian Peru have some more interesting purposes for its use. As 'toé negro' ['toé' normally being a name for **Brugmansia** suaveolens], it is either used as an additive to their ayahuasca potions [for which 2 branches of it are boiled with 'yajé' vine (see **Banisteriopsis**) for 11 hours], or it is taken alone as an intoxicant [for which 10 leaves are boiled gently for 7 hours]. The effects of the plant are very strong, and are said to last for 3 days, during which time the shaman converses with the spirit of the plant. People also sometimes go blind for the duration of the effect (Schultes 1972; Schultes & Raffauf 1990).

Apparently the plant contains no alkaloids (McKenna et al. 1984a), yet some of the effects described allude to tropane-alkaloids or chemicals of similar pharmacology being present.

Teliostachya lanceolata var. crispa is a low-growing perennial shrub, multi-stemmed, stems repent, simply branched, branches erect. Leaves subentire, lanceolate, recurved, margin undulate-subcrenate, repand, decurrent to petiole, beneath (especially in midrib) greyish-white pubescent-hirsute, decurrent to petiole. Inflorescence a dense, terminal spike, cylindrical, verticillate, regular, interrupted at base, entirely fertile; bracts equal, many, subsessile, acute-setaceous; flowers small; calyx 5-fid, acute-setaceous, lobes oblong, subequal; corolla bilabiate, upper labia obtuse, bidentate, lower labia trilobed, lobes similar shape; stamens 4, didynamous, subincluded, united; anther bilocular, locules parallel, ovate. Capsule bilocular, bivalvate, at base 4-seeded, dissepiment rigid; seeds compressed.

Maynas [Peru] and around Amazon River (Fridericus & De Martius ed. 1965-1975).

TERMINALIA

(Combretaceae)

Terminalia bellerica *(Gaertn.) Roxb.* **(T. belerica** *Roxb.***; Myrobalanus bellirica** *Gaertn.***)** – belleric Terminalia, bahera, bahera nut, bastard myrobalan, belleric myrobalan, bedda nut, aksha, vipitaka, vibhitaka, rale-daru, baleela, ba ru ra, pili lè, mao-he-zi [fruit in TCM]

The fruits of this tree, which are acid-sweet and plum-like, are called 'belleric myrobalans', or simply 'myrobalans' [different types of myrobalan come from different Terminalia spp.], and are exported from India in large quantities. They are eaten raw or in preserves, and are also used for dyeing and tanning; the fresh fruits are eaten by monkeys, deer, sheep and cattle. In Ayurvedic medicine, the purgative dried fruits are used for stomach disorders; the dried pulp of one fruit is a sufficient dose. The fruit improves lung function and eyesight, also acting as an antipyretic and rejuvenative tonic. A fruit decoction is used as an eye lotion, and in some countries the plant is used to poison fish. The dried kernels are eaten by the Lodha of w. Bengal for 'hallucination', and this property is apparently known throughout s.e. Asia. In IndoChina, the fruit is regarded as purgative when green, and narcotic in large doses. Some people eat them without effect, perhaps due to an insufficient quantity being consumed. It is said that drinking water after eating the kernels helps the intoxication to 'kick in'. Symptoms first include nausea and vomiting, followed by narcosis, or giddiness and inebriation. Some yogis say that eating one kernel a day "increases the appetite for sexual indulgence". In India, fruits of the related T. chebula ['common myrobalan'] are used as a brain and eye tonic (Chopra et al. 1965; Frawley & Lad 1986; Nadkarni 1976; Pal & Jain 1989; Perry & Metzger 1980; Usher 1974), and in Nepal [as 'harro'] they are used in ritual incense (Müller-Ebeling et al. 2002).

In Africa, T. sericea is used to treat dysentery, diabetes and stomach disorders, and as an antipurgative. Deaths have occurred from drinking decoctions of the plant. In some areas, at times of planting and harvesting crops, and before hunting, a stick from the tree is put in the floor of the village shrine to pay homage to ancestral spirits. If the tree is cut when crops are growing, it is believed to bring hailstorms. In Zululand, a root decoction is used symbolically by sorcerers to kill an adversary from far away (Watt & Breyer-Brandwijk 1962).

In Australia's north, inner bark of T. carpenteriae is made into a paste with cold water and spread over the body. This is left on for 1 day, and is said to 'indirectly increase sense of well-being', and strengthen the tone of skin and muscle. The inner bark has shown astringent and antiseptic properties (Aboriginal Communities 1988). T. arjuna has been used traditionally in India as a cardiotonic, and to treat cancer. Modern testing has shown the bark, stem and leaves to inhibit cancer cell growth (Nadkarni 1976; Pettit et al. 1996). T. ferdinandiana ['billygoat plum'] has attracted attention due to the high levels of vitamin C found in the fruit pulp [0.4-3.15%] (Low 1990).

T. bellerica fruit has yielded phyllemblin [potentiates the activity of *epinephrine*], glycosides, polyphenols, tannins and a fixed oil (Mehra & Qadry 1963); the pericarp [fruit rind] also yielded gallic acid and egallic acid (Row et al. 1962), and the seed-coat yielded egallic acid and β-sitosterol. Both fresh and dry fruits also yielded chebulagic acid, mannitol, galloyl-glucose, glucose, galactose, fructose and rhamnose (Row & Murty 1970). Seeds have yielded a cardenolide, cannogenol-3-O-β-D-galactopyranosyl-(1→4)-O-α-L-rhamnopyranoside (Yadava & Rathore 2001). Stem bark has yielded triterpene acids [bellericagenins A & B, arjungenin, belleric acid], and their glycosides [bellericasides A & B, arjunglucoside I, bellericoside] (Mahato et al. 1992).

Terminalia bellerica is a large tree 18-25m tall, deciduous in the cold season. Leaves alternate, clustered towards the ends of branches, 7.6-15.2cm long, broadly elliptic, narrowed equally at both ends, entire or slightly crenulate, exstipulate, glabrous when mature, generally punctate on upper surface, the punctations much more permanent than in other species; petiole 2.5-3.8cm long, often with glands on petiole or near base of midrib beneath. Flowers small, in simple solitary axillary spikes, lower flowers hermaphroditic, the upper flowers males; narrow bract at base of each flower, soon deciduous; bracteoles minute; calyx tube produced above the ovary with a campanulate mouth, limb of 5 short valvate triangular lobes, deciduous, pubescent; petals 0; stamens 10, inserted on calyx tube. Disc epigynous, densely hairy; young ovary always tomentose, 1-celled, inferior; style long, simple; ovules 2-3, pendulous from summit of cell. Fruit 30-35mm long, 13-19(-27)mm diam., globular, suddenly narrowed into a short stalk, smooth, covered with silky appressed hairs, giving a velvety texture, greenish-brown, when dried obscurely 5-angled; seeds solitary, exalbuminous.

Throughout India, common in the plains and lower hills [not in the desert region of w. India], extending to Sri Lanka and Malaysia [Malacca] (Hooker 1875-1897; Mehra & Qadry 1963).

TESTULEA

(Ochnaceae)

Testulea gabonensis *Pellegr.* – izombe, ake, akewe, n'gwaki, n'komi, ngron

This tree from west tropical Africa [the only member of its genus] is occasionally used for its wood, which is valued in cabinet making. It has no recorded medicinal uses that I am aware of, yet contains some chemicals of interest.

T. gabonensis stem bark yielded 2.5% alkaloids, and root bark yielded 5% alkaloids – *N-methyltryptamine* [NMT] comprised c.90% of the total alkaloids, the remaining portion consisting of *DMT*, N-formyl-*NMT* and 2-methyl-THβC. The triterpenes friedeline and friedelinol were also isolated; epi-friedelinol was identified but not isolated (Leboeuf et al. 1977).

Testulea gabonensis is an upright tree 15-18m tall; trunk cylindrical, 70-90cm diam.; wood yellow-rosy. Leaves simple, grouped at ends of branches, oblong-lanceolate, entire, slightly undulate, to 35cm long, 8cm wide; stipules fused in a triangular, acute ligule on the inner face of the petiole; petiole very short. Inflorescence simple, terminal, clustered, longer than leaves; flowers hermaphroditic, actinomorphic, white-yellowish or rosy; sepals 4, unequal, free; petals 4, 2 broad and 2 narrow, free, subsessile; stamen 1, free, of many staminodes fused into a column enclosed by the 2 large petals, filaments persistent; anther linear, basifixed, opening by terminal pores. Ovary stipitate, eccentric; ovules many; style long and curved. Fruit a bivalved capsule, opening at maturity to release seeds; seeds winged.

In primary forest; Gabon, s. Cameroon (Hutchinson & Dalziel 1954-1972 [for some family details only]; Leboeuf et al. 1977).

A description of this species is also found in Bull. Soc. Bot. France, 1924 [Vol. lxxi:76], which I have been unable to locate. Due to this difficulty, I must thank M. Leboeuf et al. for my liberal use of their 1977 article.

TETRAPTERYS

(Malpighiaceae)

Tetrapterys methystica *Schultes* **(T. squarrosa** *(Griseb.) Griseb.***; T. styloptera** *A. Juss.***; Bunchosia squarrosa** *Griseb.***)** – caapi, weé-po-awk, bee-ra-ree'-a-ma, no-ree-a-mee-see, nö-ña'-mee-koo-ma

Tetrapterys mucronata *Cav.* **(T. crebriflora** *A. Juss.***; T. glaberrima** *Benth.***; T. silvatica** *Cuatrec.***; Triopterys acuminata** *Willd.***; Tr. mucronata** *(Cav.) Räusch.***)** – kai-ee'-ree-gê, dö-yet' ['fire vine']

The Makú of the Rio Tikie of Amazonian Brazil make a cold-water infusion of T. methystica bark to prepare a 'strongly hallucinogenic' beverage. Alternately, they use the stem bark as a basis for ayahuasca [see **Banisteriopsis**]. It is decocted by the Makuna and drunk as a febrifuge. Also, the Karapana of the Rio Vaupes use T. mucronata to prepare ayahuasca. Natives of the Rio Piraparana boil the bark with **Strychnos** erichsonii bark for 4-5 hours to make a weak curare dart poison. Other species are used to treat various infections (Davis 1996; Schultes 1950, 1957; Schultes & Raffauf 1990; Uscategui 1959).

Chemistry of these plants is unknown.

Tetrapterys methystica is a scandent bush; trunk with black bark; branches ashy-yellowish, internodes 4-10cm long; branchlets terete, lightly canaliculate, grey-sericeous when young, 0.8-3.3mm diam. Leaves chartaceous, ovate, rather long acuminate, basally mostly rounded, margin entire but slightly revolute, 6-8.5cm x 2.5-5cm, strongly discolourous, upper surface bright green, minutely and remotely sericeous, under surface ashy green, rather densely sericeous and waxy; stipules small, soon caducous. Inflorescences pseudocorymbose, 4-5 flowered, much shorter than leaves, 2.5-3cm long; pedicels rather densely sericeous; bracts subulate, 1.5mm long; bracteoles ovate-triangular or suborbicular, 1.5mm long; sepals thick, pilose throughout, ovate-lanceolate, subacute, 3mm long, with 8 black oval-shaped glands 0.5mm long; petals spreading, membranaceous, mostly yellow but red or brownish in centre, elongate-orbicular or oval, apically rounded, basally obtuse, marginally subcrenulate, 4mm long, mostly 2.5mm wide, claw fleshy, 0.5mm long; stamens not included, equal; anthers allantoid, 1.3mm x 0.4mm, arcuate, filaments flattened, 1.3mm long. Ovary densely albopilose; styles equal, recurved. Samara nut sericeous, glabrescent, complanate-ovoid, 5mm x 6mm x 2mm, ventral areole ovate, c.3mm tall; wings chartaceous, brownish, lower ones obcuneiform, apically truncate-rotundate, 12mm x 2.5mm, upper ones similar but often subovate or semi-orbicular and slightly larger; dorsal wing 2.5-5mm long.

Rio Vaupes Basin, near Colombian/Brazilian border (Schultes & Hofmann 1980).

THALICTRUM

(Ranunculaceae)

Thalictrum foetidum *L.* – meadow rue

This small European herb has been found to contain an important indole alkaloid [see below], as well as a great array of isoquinoline alkaloids. While it appears to have no indigenous use, several of its relatives do.

'Columbine meadow rue' [T. aquifolium] roots are eaten raw or cooked by the Ainu of n. Asia. Roots and leaves of T. angustifolium are decocted in the Ukraine as a diuretic, and the plant is fed to cows to stimulate milk production. T. collinum, from the same broad locale, is prepared as a flower and root decoction to treat stomach aches, scrofula, urine retention and to clean wounds. Also, the Central American T. hernandezii [T. lasiostylum], known as 'alboquillo de campo', is used for its root, which is decocted as a diuretic, purgative and rheumatism treatment (Usher 1974). T. foliolosum root is used in India as a bitter tonic. It relieves fever and toothaches, and when snuffed it "clears the brain" (Nadkarni 1976).

T. dasycarpum, also known as 'meadow rue', has been administered to horses as a stimulant snuff by the Omaha [see also **Clematis**]. It is applied with white clay to the nostrils of their horses by the Pawnee, for the same reason (Morgan 1981). The Chinese T. faberi is used in folk medicine as an antiphlogistic, and is given rectally to treat stomach cancer (Wagner et al. 1984). T. minus, T. revolutum, T. rochebrunianum and T. rugosum have shown hypotensive activity in animals (Patil & Beal 1987). T. foetidum itself has been shown to possess CNS-depressant, hypotensive, antispasmodic and antiinflammatory properties (Baser & Ertan 1990).

T. foetidum root has yielded *harmine* (Shulgin & Shulgin 1997). Of specimens collected in June at Keltepe [Turkey, 1950m], aerial parts yielded thalmelatine, thalictrogamine, thalipine and argemonine [see **Argemone**]; roots yielded thalidasine, thalrugosaminine, thaligosinine, berberine and magnoflorine [see **Magnolia**] (Baser & Ertan 1990). Specimens from Mongolia yielded thalactamine, glaucine, corunine, argemonine N-oxide, berberine, *protopine*, O-methylthalicberine, thaligosine, hernandezine, thalidezine and *foetidine* (Velcheva et al. 1990). The plant has also yielded berbamine, oxoglaucine, isoboldine [blocks *dopamine*-sensitive adenylate cyclase activity], isotetrandrine, reticuline [inhibits *dopamine*-binding], ocobotrine, bisocobotrine, sinacutine, thalidasine, thalrugosidine, thalibrine, thalflavine, thalfiline, thalfinine, thalicmidine, thalicarpine [causes pressor effects and tachycardia, hypotensive in larger doses], thalfoetidine, rhamnetin and cyclofoetigens A & B (Buckingham et al. ed. 1994; Patil & Beal 1987).

Similar tetrahydroisoquinoline alkaloids are found in the many other Thalictrum spp.; some exhibit cholinergic and/or dopaminergic interactions (Patil & Beal 1987). It may be likely that some species would contain irritating compounds such as those found in the related **Clematis** and **Ranunculus**.

Thalictrum foetidum is a glandular, foetid-smelling, shortly rhizomatous perennial 10-40cm tall, with some long eglandular hairs. Leaves 2- to 3-pinnate or -ternate, about as wide as long, sometimes stipulate; basal leaves 3- to 4-ternate, without stipels; leaflets 2-4mm long, suborbicular or broadly ovate, irregularly dentate in upper half. Inflorescence a panicle with long branches; flowers small, yellow, pendent; perianth segments 4-5, usually caducous, c.3mm; honey-leaves absent; filaments slightly thickened, filiform; stigma fimbriate; stamens numerous, conspicuous. Fruit erect; achenes c.10, sessile, compressed, ovate in outline, strongly ribbed longitudinally, less than 5mm long, beak nearly as long as achene.

Mountains of east, central and southwest Europe, westwards to e. Spain. Plants from the Pyrenees and Spain do not have the eglandular hairs and may be a different species, T. minus ssp. pubescens (Tutin et al. ed. 1964-1980).

THAMNOSMA

(Rutaceae)

Thamnosma montanum *Torr. et Frém.* **(T. montana** *Torr. et Frém.***)** – turpentine broom, Mojave desert rue, cordoncillo

Kawaiisu shamans of North America have been reported to drink an infusion of this obscure plant "to go crazy like coyotes" (Ott 1993). The plant has also been used in the Mojave Desert as a tonic, and to treat gonorrhoea (Kearney et al. 1951). In Africa, T. africana is smoked by the Ndebele to treat chest complaints, and to repel fleas and ants (theobromus pers. comm.).

T. montanum roots have yielded quinoline alkaloids – 0.1% γ-fagarine, 0.075% N-methylacridone and 0.005% *skimmianine*; and coumarins – 0.05% thamnosin, 0.0275% bergapten, 0.025% isoimperatorin, alloimperatorin methyl ether, 0.025% phellopterin, 0.016% thamnosmin, 0.01% xanthotoxin and 0.0075% psoralen; 0.005% β-sitosterol was also isolated (Kutney et al. 1972). In later studies, roots and rhizomes yielded quinoline alkaloids – 0.02% robustine [potentiates effects of barbiturates], 0.094% *skimmianine*, 0.0008% acridone, 0.014% N-methylacridone and 9(10H)-acridinone; and coumarins – 0.003% thamnosmonin, 0.0012% thamontanin and 0.042% 5-(3'-methyl-2',3'-dihydroxybutanyl)-8-MeO-psoralen. Aerial parts have yielded N-methylacridone (Baumert et al. 1994; Chang et al. 1976; Harborne & Baxter ed. 1993). Shoots, leaves and seed pods [combined] yielded 0.04% umbelliprenin, isoimperatorin, 0.152% alloimperatorin methyl ether, thamnosmin, phellopterin, 0.18% isopimpinellin, 0.14% 5(2',3'-epoxy-3-methylbutyl)-8-MeO-psoralen, and possibly psoralen, bergapten and xanthotoxin. Byakangelicin has also been reported from the plant (Kutney et al. 1972).

Thamnosma montanum is an erect, rigid, glandular-dotted shrub with a strong disagreeable odour, to 80cm tall with stoutish, yellow-green, often spine-tipped branches. Leaves simple, alternate, distant, soon deciduous, linear to narrowly-oblong, 5-15mm long, sessile, subfleshy and conspicuously pellucid-dotted. Flowers perfect, racemose; sepals 4, deltoid to broadly ovate, 2.5-3.5mm long, rounded or infrequently acute at apex; petals 4, almost erect, purplish, oval to oblong, 8-14 x 4-5mm, glandular-pellucid; stamens 8, +- equalling petals, with subulate or filiform filaments and inserted on an entire or crenate cup-shaped disc; anthers apiculate. Ovary stipitate, 2(-3)-celled, bilobed; ovules 5-6 in each cell; style filiform, slender, exserted 3-6mm; stigma capitate. Capsule 10-13mm wide along greatest diameter, 6-9mm high, on a stout stipe to 10mm long, opening apically; seeds 1-3 in each cell, cochleate-reniform, 4-6mm long, smooth or finely wrinkled, brown to black, dull. Fl. Feb.-Apr.

Grows on desert slopes and rocky mesas (Shreve & Wiggins 1964), generally in warm desert shrub communities and in Yucca brevifolia, Pinus spp. and **Juniperus** spp. woodlands (pers. comm.); mainly Lower Sonoran Zone, w. margins of the Colorado Desert, Mojave Desert, and to s. Utah, s.w. Arizona and n. Baja California (Shreve & Wiggins 1964).

THEOBROMA

(Sterculiaceae)

Theobroma angustifolium *Sessé et Moc. ex DC.* **(T. quinquenervia** *Bernoulli***; T. speciosum** *Willd. ex Spreng.***)** – cacao mico, cacao de sonusco, cacao silvestre, cushta

Theobroma bicolor *Humboldt et Bonpland* – Nicaraguan cacao, cacao blanco, cacahoapatlachtli, pataxte, pataste, ninichh cacao

Theobroma cacao *L.* **(T. leiocarpum** *Bernoulli***; T. sphaerocarpum** *A. Chev.***)** – cacao, cacao tree, cocoa tree, chocolate nut tree, 'food of the gods', cacahuatl, cacaoaquauitl, cacvaqualhitl, cacao dulce, cacao-cacao criollo, cumala, hach kakaw

Theobroma subincanum *Martius* **(T. ferruginea** *Bern.***; T. tessmannii** *Mildbr.***; Cacao sylvestris** *Aubl.***)** – cupuí, cumala, mee-ñé-ro, cacao, sacha cacao, cacahuillo

'Cacao' [generally bastardised as 'cocoa'] is a popular product all over the world – even more so its major commercial byproduct, chocolate [another bastardised term – see below]. The generic name Theobroma means 'food of the gods'. Believed to be native to the northern Amazon basin, T. cacao is also naturalised as far north as Chiapas, Mexico. Two main forms of this species are distinct – the Central American, known as 'criollo', which is of finer quality, and the South American, known as 'forastero'. 'Trinitario' varieties are intermediate forms between criollo and forastero types. True wild stands of criollo are considered rare or unknown, due to its long history of human cultivation. Cacao was the basis of a sacred beverage to the Aztecs. It was cultivated for them by the Maya and other groups then subject to Aztec rule. The harvested fruits were called 'cacvacentli', and the beans 'cachoatl'. The classic form of the beverage [often bastardised as 'chocolatl' from the Aztec 'cacahuatl'] was made from roasted, ground cacao beans, corn meal, vanilla beans [from Vanilla planifolia], 'achiote' seeds [from Bixa orellana], **Capsicum**, and a small amount of water. This was mixed and shaped into cakes, which were dried and stored until needed. To prepare the drink, a piece of the cake was mixed with water, and whisked to make it thick and frothy. This was known to be consumed by the court of Moctezuma II. It was not exactly palatable to the unrefined tongues of the newly-arrived Europeans, who had to add sugar and cinnamon [see **Cinnamomum**] to give it an acceptable taste. Cacao is still used in this latter form in Mexico today [though the 'cinnamon' used may actually be from a **Canella** or similar plant]. In South America, however, the fruits of the tree are usually used for their edible pulp, and the seeds are discarded (Wood & Lass 1985; Young, A.M. 1994).

The Aztecs are known to have used cacao beverages as delivery drinks for **Psilocybe** mushrooms, and other sacred plants (Ott 1993, 1994). In Central America, the beans were also used as currency, and as a form of tribute or tax to the Aztec rulers. It is said that in Nicaragua during the 1500's, one could hire the services of a prostitute for 10 cacao beans. Once Cortes the Spaniard noted the use of cacao in Mexico, he was impressed by its alleged aphrodisiac properties and ordered its cultivation. It was later introduced to Europe, and its cultivation and consumption grew rapidly. 'Eating chocolate', a European invention, was not developed until 1848, and in 1879 the Swiss developed the first milk chocolate. Currently, most commercial cacao comes from S. America and Africa. T. angustifolium and T. bicolor have also been used as types of cacao, but their use is not prevalent today; however they are still sometimes used as shade trees in cacao plantations (Emboden 1979a; Wood & Lass 1985; Young, A.M. 1994).

The leaf of T. cacao is infused and drunk as a heart tonic and diuretic in Colombia; also, the Ingano use the bark, and the Karijonas use the toasted seeds, to treat some skin conditions (Schultes & Raffauf 1990). A national beverage of Nicaragua, 'piñolillo', is made from the pulp of T. bicolor fruits. A beverage made from T. cacao pulp is also enjoyed in much of S. America (Young, A.M. 1994). In the Amazon, ashes of T. subincanum bark are added to the **Nicotiana** snuff used by the Jamamadi, Deni (Prance 1972) and Tikuna (Ott 1993). The ashes derived from the leaves, twigs, bark, or dried fruit husks of this same species [and sometimes others, such as T. bicolor] are also sometimes used to coat psychotropic **Virola**-paste pellets (Schultes 1969b; Schultes & Swain 1976), or are mixed with **Virola**-paste snuff (Prance 1972; Schultes 1955a; Schultes & Raffauf 1990). See **Virola** for more details.

The major constituents of T. cacao are mild CNS stimulants. Chemical content of the beans varies depending on the stage in production. In general, the main constituents are *theobromine* [up to 2% or more] and *caffeine* [up to 0.35%] (Lindner 1956). Beans may contain c.0.03% *caffeine*; cocoa powder 0.08-0.35% *caffeine* and 1.46-2.66% *theobromine*; dark chocolate 0.017-0.125% *caffeine* and 0.359-0.628% *theobromine*; milk chocolate 0.005-0.054% *caffeine* and 0.135-0.186% *theobromine*; dark sweet chocolate 0.033-0.047% *caffeine*; white chocolate 0.014-0.028% *caffeine*; and hot chocolate 2-10mg *caffeine* and 54-94mg *theobromine* per cup (De Camargo & Toledo 1999; Gilbert 1986; Gilbert et al. 1976; Lindner 1956; Zoumas et al. 1980). Also present are *phenethylamine* and *tryptamine* derivatives, as expressed in µg/g in each of 3 stages [fermented unroasted beans; fermented roasted beans; blended cocoa] – *tyramine* [3.4; 3.6-11.6; 8.3], synephrine [4.6; 4.7; 7.5], octopamine [1.2; 29.7; 35.8], metanephrine [1.1; 1.5; 1.7], normetanephrine [1.4; 3.2; 3.5], *tryptamine* [6.2; 1.1; 2.4] and *5-methoxytryptamine* [5.0; 0.9; 0.8] (Kenyhercz & Kissinger 1977, 1978), as well as behenoyl-*tryptamine* (Ehmann 1974) and c.0.0012% *phenethylamine*. Other constituents include 0.0025-0.0044% *salsolinol*, *choline*, cacaonin, procyanidin B, leucocyanidin, phloroglucinol, caffeic acid, ferulic acid, vanillic acid, lauric acid, 2-OH-phenylacetic acid, p-coumaric acid, catechin, 1-epicatechol, protocatechuic acid, tannins, carbohydrates and fats (Buckingham et al. ed. 1994; Kenyhercz & Kissinger 1978; Melziga et al. 2000; Riggin & Kissinger 1976; Schermerhorn et al. ed. 1957-1974). Recently, *anandamide* [a cannabinoid receptor ligand], as well as N-oleoylethanolamine and N-lineoylethanolamine [these latter two chemicals inhibit the hydrolysis of *anandamide* by the enzyme *anandamide* amidohydrolase, increasing *anandamide* levels; see also *Neurochemistry*] were detected in trace amounts [0.00005-0.009%] in cocoa powder and dark chocolate (Tomaso et al. 1996). Even more recently, β-carbolines [along with the previously-found *serotonin* and *tryptamine*] were found in cacao-products, prompting several friends to comment that "if you wait long enough, everything turns up in chocolate"! As µg/g, the following compounds were found in dark chocolate, milk chocolate, cocoa powder, and chocolate cereals – 1-methyl-THβC [0.05-0.21; 0-0.1; 0.05-0.11; 0-0.03], (1R,3S)-1-methyl-THβC-3-carboxylic acid [0.53-0.88; 0.18-0.25; 0.3-0.66; 0.14-0.27], (1S,3S)-1-methyl-THβC-3-carboxylic acid [1.37-2.0; 0.47-0.59; 0.76-1.55; 0.35-0.65], THβC-3-carboxylic acid [0.23-0.68; 0.07-0.13; 0.012-0.38; 0.06-0.85], 6-OH-1-methyl-THβC [1.46-3.92; 0.43-0.68; 0.72-2.3; 0.16-0.39], *tryptamine* [0.2-1.16; 0.05-0.23; 0.068-1.33; 0-0.07] and *serotonin* [1.37-5.08; 0.13-0.87; 0.4-3.3; 0-0.18] (Herraiz 2000a).

Theobroma cacao is a wide-branching evergreen tree, 5-8m tall; twigs pubescent. Leaves alternate, oblong-oval or elliptic-oblong, entire, thick, 15cm long or less, base rounded, apex abruptly acuminate, midrib strong, side veins paired or somewhat alternate and arching; petiole short. Flowers small, in fascicles directly on bark of trunk and main branches, c.2cm across when expanded; pedicels slender, 12mm or more long; calyx rose-coloured, deeply 5-parted, segments acuminate; corolla yellowish, petals 5, with a stalk-like claw and expanded blade; fertile stamens 5, opposite sepals. Ovary sessile, 5-celled, many-ovuled; style filiform. Fruit 30cm long or shorter, mostly 10cm or less diam., c.10-ribbed, red to yellow, purplish or brown, elliptic-ovoid; rind thick, hard and leathery; cells 5, each with 5-12 seeds ('beans') in a row embedded in a white or pinkish acidic pulp (Kirtikar & Basu 1980).

The main agricultural 'races' of T. cacao may be divided into three major types, each with various subvarieties.

'Criollo' – derived from T. cacao ssp. cacao. Varieties include Mexican, Nicaraguan ['cacao real'], Colombian, 'lagarto' ['pentagona'], 'angoleta' [a rarer Nicaraguan form, with small green pods] and 'cundeamor' [another rare Nicaraguan form, with long, bright red pods more constricted at the 'neck' and with a curved apex]. Criollos are more susceptible to pests and diseases than other types.

'Forastero' – derived from T. cacao ssp. sphaerocarpum. Varieties are divided into Upper Amazonian and Lower Amazonian ['amelonado'], and include regional varieties of 'amelonado', 'cacao nacional', 'común' and 'Matina' ['Ceylan']. Amelonado is the most widely cultivated type of cacao.

'Trinitario' – intermediates between criollo and forastero; have not been found in the wild (Young, A.M. 1994).

Cacao trees may be grown in tropical areas with adequate rainfall [1250-2800mm ann.], temperature [min. 18-21°C, max. 30-32°C], high humidity, moderate wind protection and shading. They tolerate a wide range of soils, but prefer deep, well-drained soils with organic matter. Soil should be dug at least 1.5m; a mix of 50% sand, 10-20% silt, 30-40% clay is best, with good layer of organic matter on top; pH [6-]6.5[-7.5]. Plants grow best with nitrogen-fixing legumes, such as **Erythrina** spp., Inga spp. and Gliricidia spp. Cultivate from cuttings or seed. Seeds may be kept in their pods up to 7-10 days before losing viability; if coated with talcum powder they may last up to 4 weeks. The seed is planted flat 1cm deep, after removal of the mucilage; germination beds should be under heavy shade, and germination occurs in 7-15 days. Water every 1-3 days, and plant out when 4 months old. Trees bear fruit after the 2nd year; yields increase with time, reaching a maximum 8-10 years after planting. A mature tree produces, on average, 30-40 pods per year, though under good conditions hundred of pods can be obtained. Pods are ready for harvest 5-6 months after flowers have been fertilised, and remain harvestable for up to 1 month. Pods are cut from the tree without wounding the plant, which can allow mould fungi to enter; they are opened with a knife or a rock, and the beans are removed and separated from their placentas.

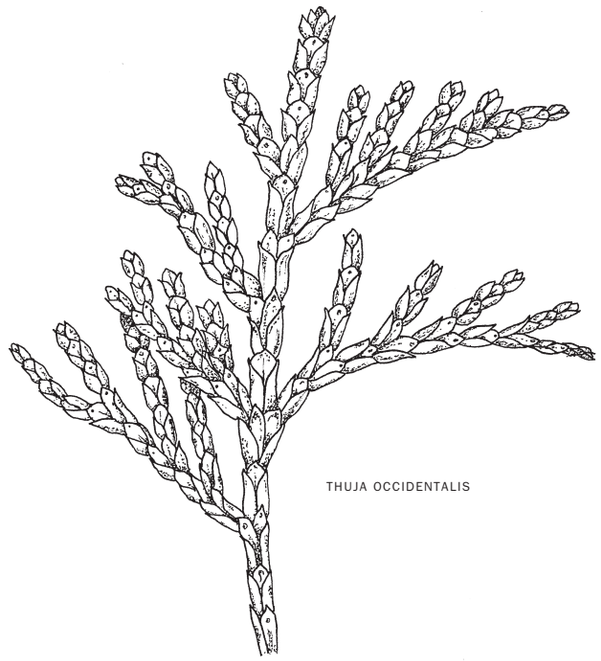
Cacao beans are fermented in boxes, baskets, or heaps for 6-8 days, with turning every 1-2 days. Drainage is allowed for, which removes most of the mucilaginous pulp in the sweat. The fermentation serves several purposes – to liquefy the pulp, kill the seed embryos, decrease astringency and bitterness, and develop the characteristic flavour and aroma. At the end of fermentation, the beans are dark and smell slightly of ammonia; they are then sun-dried, bringing moisture content down to 6-7%. The dryness can be tested by breaking half a bean – it should snap into 2 parts, and should not bend or shatter.

For chocolate making, the beans [after cleaning] are roasted at 100-120°C for 45-70min. [which helps develop the final taste and aroma], and the skins removed. The beans [more accurately now the cotyledons] are ground into 'cocoa mass' [cocoa liquor], which contains 55-58% fatty 'cocoa butter', which is mostly removed by hydraulic press [apparently much so-called cocoa butter available to the public, such as in health-stores, is

derived from coconut (Cocos nucifera)]. The remaining mass is 'cocoa powder', which still may contain 22-23% fats, and is used commercially in chocolate drinks. If the powder is re-pressed, a lower-fat [10-13%] product results, which is used for flavouring foods. Incidentally, although this cocoa butter consists of highly saturated fats, it is poorly absorbed, and scarcely affects serum cholesterol in the consumer. Chocolate is made from a mix of cocoa mass, cocoa butter and sugar, along with other ingredients specific to different types and brands. Milk is now a very common additive to chocolate, in the form of milk powder or sweetened condensed milk (Wood & Lass 1985; Young, A.M. 1994). The variety of possible additives might be limited only to the imagination, as chocolate has been used as a vehicle for psychotropic drugs including **Cannabis**, 'kava' [see **Piper 2**], Celastrus paniculatus seed oil [see *Endnotes*] and rose oil (theobromus pers. comm.).

THUJA

(Cupressaceae/Pinaceae)



THUJA OCCIDENTALIS

Thuja occidentalis *L.* **(T. obtusa** *Moench***; T. theophrasti** *C. Bauhin ex Nieuwl.***)** – arbor vitae, eastern white cedar, eastern arbor vitae, white cedar, false white cedar, yellow cedar, American cedar, feather-leaf cedar

Thuja orientalis *L.* **(Biota orientalis** *(L.) Endl.***; Platycladus orientalis** *(L.) Franco***)** – Chinese arbor-vitae, bo dze ren, bo zi ren, dhupi, mayur pankhi

Thuja plicata *Donn ex D. Don.* **(T. gigantea** *Nutt.***)** – western red cedar

Thuja standishii *(Gordon) Carrière* **(T. gigantea var. japonica** *(Maxim.) French. et Sav.***; T. japonica** *Maxim.***; Thujopsis standishii** *Gordon***)** – Thuja 'japonica'

In Europe, known as 'arbor vitae' ['tree of life'], Thuja spp. are often planted near graves and cemeteries. In Germany and England, they have had a place in folk medicine since at least the 1900's, to treat fever, menstrual disorders, and to procure abortion. Native North Americans used T. occidentalis both medicinally and mystically. Branches and inner bark were used for the same purposes as in Europe, as well as for coughs and headaches; twigs and foliage were burned as a ritual incense, and are said to protect against harmful magic. Modernly, Thuja is used in medicine for several ailments. Foliage treats bronchial, urinary and vaginal infections; twigs treat rheumatism, and their antiviral and antifungal properties are applied to treat warts and skin infections (Bremness 1994; Chevallier 1996; Rätsch 1992).

In TCM, T. orientalis seeds are taken in a 5-10g decoction as a sedative nutrient tonic, promoting semen production and tonifying the heart. Prolonged use is said to improve complexion, sharpen hearing and brighten the eyes. Leaves are also used as an astringent antipyretic, or infused in 60% alcohol for 1 week and applied as a hair tonic (Reid 1995). In Nepal, the plant is used as a shamanic incense (Müller-Ebeling et al. 2002).

Thuja spp. are fairly toxic if taken internally, leading to local irritation, long-lasting convulsions, liver and kidney damage, and bleeding from stomach mucosa (Frohne & Pfänder 1983). A more sensible route to intoxication is via smoke or vapour inhalation, but care should still be taken to avoid immoderate exposure to the fumes. These plants should be avoided by pregnant women, due to their high content of *thujone*, which is also probably one of the main inebriating principles.

T. occidentalis essential oil has yielded 60-65% *thujone*, 8-9.5% iso-*thujone*, 1% *camphor*, 1.2% camphene, 2% camphone, 14% fenchone [counterirritant], *borneol*, limonene [sedative, skin irritant, expectorant], 1.3% *pinene*, 1.8% d-sabinene, 1.2% terpinen-4-ol, 2.3% bornyl acetate and myrcene. The plant has also yielded diterpenes [including dehydroabietane, neothujic acids III & IV, (+)-7-oxo-13-epi-pimara-14,15-dien-18-oic acid, (+)-7-oxo-13-epi-pimara-8,15-dien-18-oic acid and isopimaric acid (these last 3 compounds have shown some potential anti-cancer activity)], the sesquiterpene alcohol (+)-occidentalol, lignans [including (-)-matairesinol, epi-pinoresinol, (-)-thujaplicatin methyl ether, (-)-wikstromol, (-)-deoxy-podophyllotoxin, (1S,2S,3R)-(+)-iso-picrodeoxy-podophyllotoxin and (-)-deoxy-podorhizone (these last 4 compounds have also shown potential anti-cancer activity)], a flavonoid glycoside, mucilage and tannins (Banthorpe et al. 1973; Battaglia 1995; Chang et al. 2000; Harborne & Baxter ed. 1993; Mabey et al. ed. 1990).

T. orientalis essential oil has yielded 53% *thujone*, 20% iso-*thujone* and 2% *camphor*. Leaf extracts have also yielded *apigenin*, quercitrin, cupressuflavone, kaempferol-7-O-glucoside, quercetin-7-O-rhamnoside and myricetin-3-O-α-L-rhamnoside (Banthorpe et al. 1973; Khabir et al. 1986).

T. plicata has yielded 0.8-2.3% essential oil, comprised of 76-88% *thujone*, 7-12% iso-*thujone*, 1-8% d-sabinene, and small quantities of d-α-*pinene*, d-limonene, camphene, p-cymene, 1,8-cineole, γ-terpinene, terpinolene, d-terpinen-4-ol and car-4-ene (Banthorpe et al. 1973; Rudloff 1962).

T. standishii essential oil has yielded 1% *thujone* and 27% *camphor* (Banthorpe et al. 1973).

Thuja occidentalis is a coniferous, conical tree with widely spreading branches, to 20m tall; bark orange-brown, peeling in vertical strips; ultimate branches very soft and flat, 1-2mm wide; foliage aromatic. Leaves opposite, scale-like, dark silver-green, appressed, closely imbricate, broadly ovate to rotund, 2-4mm long, obtuse, glandular, persisting on older branches for many years, becoming large and pointed. Flowers in separate clusters at the ends of shoots; perianth none. Male flowers globose, red; stamens several together, subtended by a scale; filaments +- united; anthers opposite, 2-4-celled, sacs globose, 2-valved. Female flowers ovoid or oblong, yellow-brown, small, scales opposite, with 2(-5) ovules; ovules with 2 integuments, borne on the surface of a scale. Cones oblong-ovoid, upright, yellow-green ripening to brown, coriaceous, opposite, 8-10 scales, outer scales nearly as long as inner, spreading when mature; seeds oblong. Fl. May-Jun.

In moist or wet soil in swamps, forming dense forests excluding other vegetation, and rocky mountain slopes, often on limestone; New Brunswick to James' Bay and Manitoba, s. to New Jersey, N. Carolina, Tennessee, Illinois, Minnesota (Gleason 1952).

TILIA

(Tiliaceae)

Tilia cordata *Mill.* **(T. parvifolia** *(Ehrh.) Ehrh. ex Hoffm.***)** – small-leaved lime, linden

Tilia mexicana *Schlecht.* – tilio, sirimo, jonote

Tilia tomentosa *Moench* **(T. argentea** *Desf. ex DC.***)** – linden

Tilia spp. – linden, lime tree, limeflower, tilleul

Leaves of T. cordata have been used as a tobacco additive [see **Nicotiana**] in the past (Lewis & Elvin-Lewis 1977), and in some parts of Asia imported T. tomentosa flowers [minus their bracts] are used as a tea substitute [see **Camellia**] (Landerer 1883). In Lithuanian religious rites, women make sacrifices to 'linden' trees, which in Europe may symbolise protection, luck and longevity, as well as being associated with love and Venus (Cunningham 1994). In Mexico, flowers of the endangered T. mexicana are used as a nerve tranquilliser, as well as to treat gastroenteritis, cardiac disorders, haemorrhoids and other ailments. The fresh flowers are considered more effective than dried flowers (Pavón 2000). The Winnebago of N. America use the root of T. americana ['basswood'] to treat 'female weakness' (Kindscher & Hurlburt 1998).

Very old, stale flowers of linden, particularly T. cordata, are said to be mildly intoxicating (Bremness 1994), and I have received an unsubstantiated [and most likely exaggerated] report that the fermented flowers are "hallucinogenic" (pers. comm.). A chloroform extract of commercial linden flowers [dry and old] had very potent sedative effects when smoked (theobromus pers. comm.).

Medicinally, linden flowers are infused and used as a nervine sedative relaxant; they lower blood pressure, reduce muscle tension, induce sweating, and treat colds, flu, arteriosclerosis and nervous indigestion. Water from infused flowers may also be used to bathe the skin to treat wrinkles and rheumatism. The inner bark treats kidney stones and gout, and is an antispasmodic, diuretic coronary vasodilator (Bremness 1994; Chevallier 1996; Chiej 1984; Mabey et al. ed. 1990; Polunin & Robbins

1992; Simonetti 1990).

The active agents in linden appear to reside in the flavonoid mixtures contained within, fractions of which bind to BZ-receptors (Medina et al. 1989; Viola et al. 1994). Tilia spp. flowers may yield largely the flavonoids kaempferol [MAOI (Sloley et al. 2000)] and quercetin, as well as aromadendrin [weak MAOI (Han et al. 2007)], fustin and pinobanksin; as well as tiliroside, vincetoxicoside A, c.3% mucilage, 0.02-0.1% volatile oil [including the phenylpropanoid caffeic acid (3,4-dihydroxycinnamic acid)] and tannins (Buckingham et al. ed. 1994; Chevallier 1996).

T. cordata flowers contain the flavonoids quercetin, quercitrin, hesperidin and astragalin; essential oil with farnesol and linden ether; and tannins, mucilage, saponins, sugars, acids [including ascorbic acid], carotene and manganese salts (Chiej 1984; Mabey et al. ed. 1990; Polunin & Robbins 1992).

T. mexicana leaves and flowers contain alkaloids, saponins, glucosides and an essential oil with hypotensive effects in animals (Pavón 2000).

T. tomentosa flavonoid extract had anxiolytic effects in animals; although the constituent kaempferol expressed low-level BZ-receptor binding, no chemical was isolated which shared the effects of the whole flavonoid extract (Viola et al. 1994).

Tilia cordata is a deciduous tree to 30m tall, with a large, spreading crown; young twigs glabrous or subglabrous. Leaves alternate, palmately veined, 3-9cm long, suborbicular, abruptly acuminate, acutely and finely serrate or denticulate, distichous, petiolate, cordate at base, glabrous except for some tufts of reddish-brown hairs in the vein-like axils beneath, tertiary veins not prominent; stipules caducous. Inflorescence axillary cyme-like clusters, obliquely erect, with 4-15 fragrant, white or cream coloured flowers; long peduncle adnate in basal half to the middle of a large, narrow, elongate, short-petioled foliaceous membranaceous bract; flowers perfect, 5-merous; sepals separate to the base, valvate in bud; petals usually present and conspicuous; stamens up to 80, free or in 5 antepetalous fascicles, one in front of each petal; epipetalous staminodes sometimes present. Ovary tomentose, 5-locular; stigma 5-lobed; style 1, dilated into a shallowly-lobed stigma; anthers 2-celled, opening longitudinally or by terminal pores. Fruit a unilocular nut, c.6mm, globose, tomentose, indehiscent, 1-3-seeded; pericarp of seed membranous, smooth or slightly ribbed. Fl. May-Jun.

Rich temperate woodland, throughout Europe except extreme north, extreme south, and some islands (Gleason 1952; Tutin et al. ed. 1964-1980); frequently cultivated in temperate zones worldwide, often lining streets.

TILLANDSIA

(Bromeliaceae)

Tillandsia mooreana *L.B. Smith* **(T. inflata** *Mez***)** – waráruwi, hichikoni, mescalito

Tillandsia purpurea *Ruiz et Pav.* **(T. azurea** *Presl***; T. longebracteata** *Meyen***; T. straminea** *Humb., Bonpl. et Kunth.***; Anoplophytum longebracteatum** *Beer***; Platystachys purpurea** *(Ruiz et Pav.) Beer***)**

Tillandsia usneoides *(L.) L.* **(Dendropogon usneoides** *(L.) Raf.***; Renealmia usneoides** *L.***)** – Florida Spanish moss, long moss, hanging moss, black moss, long-beard, tree-beard, vegetable hair

Tillandsia spp. – living air plants, tencho, soluchil

T. mooreana is regarded by the Tarahumara of Mexico as a companion to peyote [see **Lophophora**], and it is considered dangerous to damage the plant. Native informants have refused to divulge the importance of this bromeliad (Bye 1979b). It should be noted that to the Tarahumara, as with many other shamanic cultures, it is considered dangerous to harvest any sacred plant without the proper attending songs and ritual dedications for that plant, lest the plant spirit seek to harm the perpetrator of the desecration. The Tarahumara use a tea of T. benthamiana ['dowáka'] as an emetic purgative, and T. karwinskyana ['rereshiwasa'] to treat constipation. Tillandsia spp. are also applied as a body wash to treat rheumatism (Salmón 1995).

Interestingly, T. mooreana and T. recurvata are sometimes known in Sonora [Mexico] as 'mescalito', as is another bromeliad, a Hechtia sp. (Gentry 1942), though it was not made clear by Gentry where this naming originated from. This name has been associated with peyote by western drug-users (Trout & Friends 1999), yet is not known as properly being an indigenous term for peyote [outside of the fiction of Carlos Castaneda]. This reference, however, predates known use of the word in this context. Here it might simply mean 'little mescal', in reference to the superficial resemblance to Agave spp. [see *Methods of Ingestion*] (Trout pers. comm.).

T. purpurea and other Tillandsia spp. are depicted on pre-Incan Mochica pottery from northern Peru, in a context suggestive of possible psychoactivity. In Brazil, T. usneoides is used as an analgesic (Arslanian et al. 1986; Ott 1993). In other parts of South America, an unidentified Tillandsia sp. known as 'siempreviva' ['ever-living'] is sometimes added to San Pedro preparations [see **Trichocereus**] (Rätsch 1998).

T. purpurea has yielded many flavonoids, including retusin [5-OH-3,7,3',4'-tetramethoxyflavone; see **Ariocarpus**], artemetin [5-OH-3,6,7,3',4'-pentamethoxyflavone], possibly penduletin 4'-O-methyl ether [5-OH-3,6,7,4'-tetramethoxyflavone] and several other unisolated methoxylated 5-OH-flavones (Arslanian et al. 1986).

T. recurvata has yielded the unusual cycloartane triterpenes 25-hydroperoxycycloart-23-en-3β-ol and 24-hydroperoxycycloart-25-en-3β-ol [which decompose when the plant is dried], as well as cycloartanone, 24-methylenecycloartanone, cycloartenone, cycloartanol, 24-methylenecycloartanol, cycloartenol, lanostenol, lanosterol and 24-ethylcholest-4-en-3-one. All were found only in trace amounts (Cabrera & Seldes 1995).

T. usneoides has yielded the flavonoid 3,6,3',5'-tetramethoxy-5,7,4'-trihydroxyflavone; sterols such as β-sitosterol, cycloartenone, cycloartenol, cycloart-23-ene-3-β,25-diol, cycloart-25-ene-3-β,24-diol, 25-MeO-cycloart-23-ene-3-β-ol, 3-β-OH-cycloart-25-ene-24-one, cycloeucalenol and 24-methylenecycloartenol; and triterpenes [friedelin and 2 unidentified cycloartane triterpenes] (Atallah & Nicholas 1971; Lewis & Mabry 1977).

Raphides [bundles of tiny needle-like crystals of calcium oxalate] and proteolytic enzymes are present in the genus; raphides act as irritants, and their action is thought to be strengthened by the enzymes [see also **Spathiphyllum**] (Benzing 1980; Frohne & Pfänder 1983).

Tillandsia mooreana is an erect epiphyte, to c.1m tall when flowering. Leaves green, very numerous, simple, basal, spirally arranged forming a large cluster, blades flat, narrowly triangular, caudate-attenuate, 4cm wide, to 55cm long, densely and minutely pale-appressed-lepidote, sheathing below; sheaths elliptic, large, indistinct. Scape robust, erect or ascending, to 20cm long, glabrous; scape bracts foliaceous, spreading or reflexed-spreading, linear-lanceolate, filiform caudate, to 20cm long, many times as long as internodes, 25mm wide, coarsely pale-pruinose-lepidote towards apex. Inflorescence a terminal, bipinnate, paniculate spike 40-100cm long, 25cm diam.; primary bracts like the scape-bracts, the lower ones exceeding the axillary spikes, the upper shorter; spikes erect or divergent, oblong, 10-20cm long, 35-45mm wide, 14-20[or more]-flowered, rhachis straight, glabrous; floral bracts recurved-spreading and exposing the sepals and rhachis, 3-4 times as long as internodes, suborbicular, mucronulate, 3cm long, equalling or exceeding sepals, inflated, ecarinate, glaucous outside, lepidote inside, bright pink, finely nerved, fleshy-coriaceous, finely verrucose; flowers subsessile, divergent; sepals broadly elliptic, acute, 25-30mm long, ecarinate, subcoriaceous, even or nerved, glabrous, evenly connate for 3mm, dorsal side glabrous, smooth; calyx purple, tubular, exserted from bracts, petals purple, 4cm long, the claw linear, the blade elliptic, obtuse, narrowly white-margined; stamens and pistil exserted, stamens 6 in 2 series. Ovary superior, glabrous, 3-celled, placentation axillary; ovules numerous, caudate; style 3-parted. Fruit a septi-

cidal capsule; seeds erect, narrowly cylindric or fusiform, the plumose appendage basal, straight, white. Fl. Oct.

Shady side of cliffs in oak and 'short-tree' forest, epiphytic on Quercus albocincta or in rock of cliff-faces, from 600-1800m; w. slopes of Sierra Charuco and Sierra Saguaribo, Rio Mayo, Sonora, Jalisco, Guerrero, Oaxaca [Mexico] (Gentry 1942; Mez 1935; Shreve & Wiggins 1964; Smith & Downs 1977).

Two other, different, species have been known as T. inflata – T. inflata *(Wawra) Baker* [now known as Vriesea inflata *(Wawra) Wawra*], and T. inflata *Baker* [now known as V. heterostachys *(Baker) L.B. Smith*] (Smith & Downs 1977).

Many Tillandsia spp. absorb moisture through their highly-developed trichomes, or peltate scales, which cover the leaves; others collect water in the leaf-axils. After flowering, the mother-plant often gradually dies off, and produces offshoots which can be further propagated when larger, or left to form clumps over time. Some species do not produce offshoots, but instead produce copious seed. Tillandsia spp. require ample light, air circulation, and humidity to flower; to develop larger plants, flowering should be avoided if possible. In any case, the plants require fairly good access to light, especially indoors. Many species simply need a good anchor for their roots, and do not need to be planted in soil; large paddings of sphagnum moss should be avoided as a base, as it will encourage rot if kept damp. Drought-hardy. If natural humidity can not be simulated, submerge plants in water with a small amount of fertiliser, for several hours every couple of weeks. Additional misting can also be advantageous. Fertiliser should contain ammoniacal or nitrate nitrogen, phosphorous and potassium [2:1:3]; prefers water pH of 6 (Isley 1987).

TRACHELOSPERMUM

(Apocynaceae)

Trachelospermum asiaticum *(Sieb. et Zucc.) Nakai* **(T. asiaticum var. brevisepalum** *(C.K. Schneid.) Tsiang***; T. divaricatum var. brevisepalum** *C.K. Schneid.***; T. foetidum** *(Matsum. et Nakai) Nakai***; T. gracilipes** *Hook. f.***; T. jasminoides ssp. foetidum** *Matsum. et Nakai***; T. lanyuense** *C.E. Chang***; T. siamense** *Craib***; Malouetia asiatica** *Sieb. et Zucc.***; Melodinus cavaleriei** *H. Lév.***)** – luo shi teng, teikakazura

Trachelospermum jasminoides *(Lindl.) Lem.* **(T. adnascens** *Hance***; T. divaricatum** *Thunb.***; Rhynchospermum jasminoides** *Lindl.***)** – Chinese star jasmine, star jasmine, confederate jasmine, luo shi teng

The dried, leafy stem of 'luo shi teng' [usually T. jasminoides, or T. asiaticum] is used in TCM in a dose of 5-10g, to relax rigid muscles, stop bleeding, and restore the normal flow of vital energy. It also acts as a tonic, analgesic and emmenagogue (Huang 1993; Keys 1976). The plant is used in Indian and Pakistani folk medicine to treat rheumatism, wounds, gonorrhoea, sciatica, carcinomas and viper bites; the seeds have haemostatic and cardiotonic properties (Rahman et al. 1987). In India, T. fragrans ['dudhi'] is used as a substitute for 'dita', **Alstonia** scholaris (Nadkarni 1976).

Bioassays of a crude T. asiaticum [leaves and stems] extract, which was obtained in low yield, showed mild empathogenic or stimulant activity. At the dose that filled one 'vegicap', the extract showed empathogenic activity similar to low-dose *ibogaine*. Variation existed between different batches, with some appearing inactive, and others becoming so after a few days, possibly due to the auto-oxidation that is common in iboga alkaloids (theobromus pers. comm.). An extract of T. jasminoides [dose not stated] produced effects which were described as "quite psychedelic", but also "awful" – disturbing fluctuations in blood pressure were noted, as well as disturbed vision and moments of unconsciousness. Several days were required before the psychonaut felt normal again. Smaller doses of the same extract had a mild and pleasant effect (Torsten pers. comm.).

T. asiaticum leaves and stems have yielded pregnane glycosides, including teikaside A [0.002%] as a major component, as well as lignans (Abe & Yamauchi 1981). T. asiaticum var. intermedium stems have yielded *scopoletin*, vanillic acid, and the lignans arctigenin, matairesinol, trachelogenin, nortrachelogenin and (2R,3R)2-4"-OH-3"-MeO-benzyl-3-3',4',5'-trimethoxybenzyl-butyrolactone (Nishibe et al. 1981). Neither of these plants seems to have been analysed for alkaloids, though they potentially contain alkaloids similar to those found in T. jasminoides.

T. jasminoides has been found to yield several indole alkaloids [0.09% from leaves and stems], consisting of *ibogaine*, tabernaemontanine, *vobasine* and *voacangine*-7-OH-indolenine (Rahman et al. 1988); another study found instead *coronaridine*, *voacangine*, apparicine, conoflorine and 19-epi-voacangarine [see also **Tabernaemontana**, **Voacanga**] (Rahman et al. 1987). The herb has also yielded glycosides and other compounds – arctiin, dambonitol, tracheloside, nortracheloside, matairesinoside, matairesinol-4,4'-di-O-β-D-glucopyranoside, nortrachelogenin-4,4'-di-O-β-D-glucopyranoside and arctigenin-4'-β-gentiobioside (Buckingham et al. ed. 1994; Huang 1993; Nishibe et al. 1971b).

Trachelospermum jasminoides is an evergreen climber to 7m, with milky sap; shoots slender, hairy when young, becoming glabrous. Leaves opposite, entire, margin +- recurved, leathery, markedly veined, 4-7.5 x 1.25-2.5cm, oval-lanceolate, tapered at both ends, dark shiny green, lighter beneath and downy at first, apex acute mucronate, to +- acute, occasionally indented; petiole 3mm long. Flowers fragrant, white, in glabrous axillary and terminal cymes; calyx 5-lobed, lobes lanceolate, reflexed; corolla with cylindrical tube 0.75-1cm, and 5 spreading twisted lobes overlapping to the right, c.2.5cm across limb, lobes narrow, wavy; stamens short, included; anthers united and attached to stigma; ovary of 2 carpels. Fruit a pair of terete follicles to 15cm; seeds comose. Fl. summer.

Native to China; used in horticulture as an ornamental climber, of which there are several varieties -

var. japonicum – leaves veined white, turning bronze in autumn

var. minimum – dwarf plant, leaves mottled

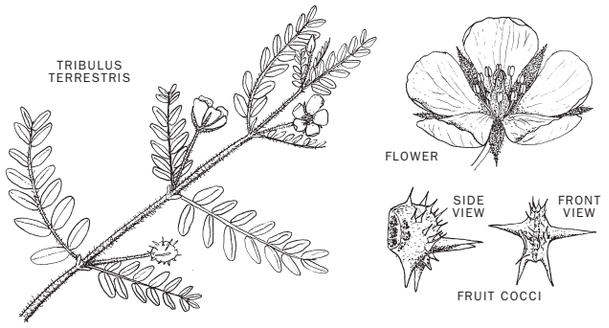
var. variegatum – leaves ovate to almost linear-lanceolate, with white and milk-green stripes, often tinged pink to red-bronze

var. wilsonii – leaves ovate to linear-lanceolate, veins distinct, flushed red-bronze to maroon in winter.

Propagate by seed, layering or semi-ripe cuttings in summer; grow in well-drained, moderately retentive soil in sun or with dry part shade; water moderately, maintain good ventilation. Tolerates winter min. of 5-7°C; should be grown in a conservatory in cold climates (Burras ed. 1994). Personally, I have found T. jasminoides [what is probably var. wilsonii] to tolerate winter temperatures at or below 0°C overnight for numerous nights in a row, though it may not fare as well with harsher extended frosts (pers. obs.).

TRIBULUS

(Zygophyllaceae)



Tribulus terrestris *L.* – caltrop, cathead, goat's head, yellow vine, California puncture vine, bear medicine, bear tobacco, ji li zi, ji li dze, ci ji li, gokshura, trikantah, shvadamstra, zama, chota gokhru, hommos el-harib, hasak, sa'adan, tadjnouft

Tribulus spp. – caltrop

The dried fruits of T. terrestris are used medicinally in scattered areas of the world. The plant is known to cause poisoning in sheep and cattle when feeding on it for long periods [as well as causing mechanical injury from the spiky fruit], with symptoms including CNS-derangement, jaundice, weakness of hind-limbs, photosensitisation and liver damage. Sometimes sudden death occurs from nitrate poisoning when the young plant is grazed (Bourke 1984; Gardner & Bennetts 1956; Lamp & Collet 1989; McBarron 1983). The hind-limb weakness has also been observed in sheep poisonings resulting from ingestion of T. micrococcus (Bourke & MacFarlane 1985).

In TCM, the fruit of T. terrestris is considered to have bitter, acrid and slightly cold properties, with an affinity for the lungs, spleen, liver and kidneys. Decocted in doses of 5-12g, it is a tonic, nutrient, antispasmodic, diuretic, slight hypotensive, galactagogue, blood-purifier and uterotonic. It strengthens bone and sinew, promotes semen production and improves vision, as well as treating vertigo (Huang 1993; Keys 1976; Reid 1995; Tierra 1988). In Ayurvedic medicine, its CNS properties are more recognised. A milk decoction of the fruit or aerial parts is known to be aphrodisiac. The fruit is also regarded as nervine, rejuvenative, tonic and analgesic, and is used to treat urinary tract disorders, gout, rheumatism, cough and infertility (Chopra et al. 1958; Frawley & Lad 1986; Nadkarni 1976). In Iraq, T. longipetalus [T. alatus] is used for the same purposes as T. terrestris (Chakravarty 1976).

In Ladakh, India, T. terrestris fruits and young twigs are dried, powdered, then roasted and dissolved in milk. This infusion is aged for 3-4 days to form a preparation known as 'zimpating', which is drunk after meals, and causes 'delirious' conditions when taken in excess. In the same area, the fruits are used in the manufacture of the local barley-based beer [Hordeum vulgare], 'chhang' [see *Methods of Ingestion*], also containing Delphinium cashmerianum roots [see *Endnotes*] and **Artemisia** tournefortiana twigs, as well as wheat flour (Navchoo & Buth 1990).

In India, T. terrestris fruits have also been used mixed in equal parts

with **Mucuna** pruriens seeds as an aphrodisiac, taken as a dose of c.1.8g with sugar and tepid milk (Dutt 1989; Nadkarni 1976). Given in higher doses, this combination could possibly act as a kind of ayahuasca analogue [see *Methods of Ingestion*], due to the potential MAOI effects of T. terrestris. However, high levels of *L-DOPA* from **Mucuna** could perhaps prove dangerous with MAO-inhibition (pers. obs.).

The powdered, dried fruit or seed of T. terrestris [15-17g] and a commercial powdered extract [concentrations of 1:5 and 1:10] equivalent to that amount have been successfully used as an MAOI in ayahuasca analogues by some people (friendly pers. comm.; Raver pers. comm.; pers. comms.), although others have found no apparent MAOI activity with this herb (Trout pers. comm.; pers. comms.). One of these combinations [with **Evodia** rutaecarpa unripe fruit extract – see **Evodia** for further discussion] could not accurately be described as an ayahuasca analogue for its effects, although definitely psychoactive. Attempts at combining the same T. terrestris extract with other *tryptamine*-containing plants resulted in no apparent MAOI activity (friendly pers. comm.). Another bioassay with a low-alkaloid extract of a **Desmanthus** sp. found T. terrestris to be seemingly effective as an MAOI, though the total effects were mild and inconclusive (Raver pers. comm.). Following reports of synergy and potentiation between **Psilocybe** mushrooms and **Peganum** harmala seeds, I combined an extract of T. terrestris fruit [calculated to chemically approximate several grams of P. harmala] with a mild dose of mushrooms of known potency, yet no extra psychotropic contribution was noted from this addition of T. terrestris (pers. obs.). The extract of T. terrestris most commonly used [and that used by myself previously] is prepared from material of Indian origin, though Chinese material has been used more commonly as the whole dried fruit. In either form it has been observed to be psychoactive on its own, similar to the effects of **Peganum** harmala but milder, and without gastric upset. One person used 30g of Chinese material for these effects – a decoction drunk over the course of a day resulted in "a definite mood lifting similar to chewing caapi" [see **Banisteriopsis**]. Anecdotal reports suggest that T. terrestris root bark is also psychoactive (friendly pers. comm.; Raver pers. comm.; Reville pers. comm.). It seems that T. terrestris is highly variable in chemical content and individual responses to its consumption, and that it is not a reliable MAOI, unless at some point the potent strains are isolated and put into circulation. Any MAOI activity observed from some batches might possibly be due to non-alkaloidal components of the herb (pers. obs.). Some people suspect the herb may be toxic with any regular consumption (Trout pers. comm.), which remains to be seen. As always, however, caution is advised, despite the seeming innocuity of this herb.

In Afghanistan, T. terrestris is also used as a spasmolytic and diuretic (Ott 1993). The Navajo smoke T. terrestris [usually the roots], 'bear medicine', as part of their smoking mixtures for performing the Bear Chant ritual (Winter 1998). In n. Queensland, Australia, T. cistoides is used by some indigenous people of the Pennefather River area to treat toothache, by keeping a portion of the plant between the gums and cheek (Cribb & Cribb 1981; Lassak & McCarthy 1990); it has been reported to be toxic, presumably to livestock (Gardner & Bennetts 1956).

T. cistoides whole plant from the US tested alkaloid-positive (Fong et al. 1972). Aerial parts have yielded *GABA* (Durand et al. 1962), steroid saponins including the cardioactive cistocardin, as well as 5'-(hydroxysulphonyloxy)-jasmonic acid, D-(+)-pinitol, sucrose and N-acyl-*tyramine*s (Achenbach et al. 1994); leaves have also yielded cardioactive saponins, as have the roots, which also yielded tribulosin, cholestane glycosides, D-(+)-pinitol and sucrose (Achenbach et al. 1996).

T. terrestris has been analysed for alkaloids numerous times. Fruits from Israeli plants tested weakly to strongly positive for the presence of alkaloids in several tests (Fong et al. 1972). Whole plant material from Toowoomba [Qld, Australia; harv. Nov.] tested weakly positive for alkaloids (Webb 1949); aerial parts have yielded from 0.001-0.0044% alkaloids, which in one Australian sample [mature parts collected in midsummer] 91% consisted of a mixture of *harman* and *norharman* (Bourke et al. 1992a; Chopra et al. 1958). One analysis of seeds [probably whole fruits] detected *harman* and *harmine* (Lutomski et al. 1968a); another detected traces of *harmine*, and no *harman* (Lutomski & Nowicka 1969). One analysis detected *harmol* and *harman* in unspecified parts (Gill & Raszeja 1971); another found *harman*, *harmine*, *harmaline* and *harmalol* (Tosun et al. 1995), and *leptaflorine* has also reportedly been found (Shulgin & Shulgin 1997). The plant has tentatively tested positive for the presence of traces of *5-methoxy-DMT* (Trout ed. 1997d). Fruits have also yielded lignanamides derived from *tyramine* [all showed some cytoprotective activity] – N-trans-feruloyltyramine, N-trans-coumaroyltyramine, tribulusamides A & B, and terrestriamide; as well as β-sitosterol (Li et al. 1998). Aerial parts and fruits also yielded 2.8% steroid saponins, including terrestroside F, *diosgenin* glycosides, tigogenine glycosides, tribuloside, dioscine, graciline, protodioscone, tribulosine, desoxydiosgenin, ruscogenin, chlorogenin, gitogenin, tigogenin, neotigogenin, hecogenin, neohecogenin, spirosta-2,5-diene, hecogenone, 25R-spirostan-4-ene-3,12-dione, (5-α,25R)-spirostan-3,6,12-trione and 25R-spirostan-4-ene-3,6,12-trione; flavonoids, such as astragalin [kaempferol-3-glucoside] (Buckingham et al. ed. 1994; Festi & Samorini 1997; Huang 1993; Iskenderov 1971; Kintya et al. 1973; Rastogi & Mehrotra ed. 1990-1993; Tomowa et al. 1974; Wu, G. et al. 1996; Xu et al. 1998; Yan et al. 1996), kaempferol-3-rutinoside, kaempferol [MAOI (Sloley et al. 2000)], quercetin, isorhamnetin [MAOI (Sloley et al. 2000)] and rutin; as well as potassium nitrate, linoleic acid, behenic acid, ascorbic acid, phylloerythrin, peroxidase, phlobaphenes, 0.4% oxalates, essential oil and tannin. The whole plant tested positive for HCN (Buckingham et al. ed. 1994; Festi & Samorini 1997; Rastogi & Mehrotra ed. 1990-1993; Reid 1995; Tierra 1998; Watt & Breyer-Brandwijk 1962; Zafar & Nasa 1988).

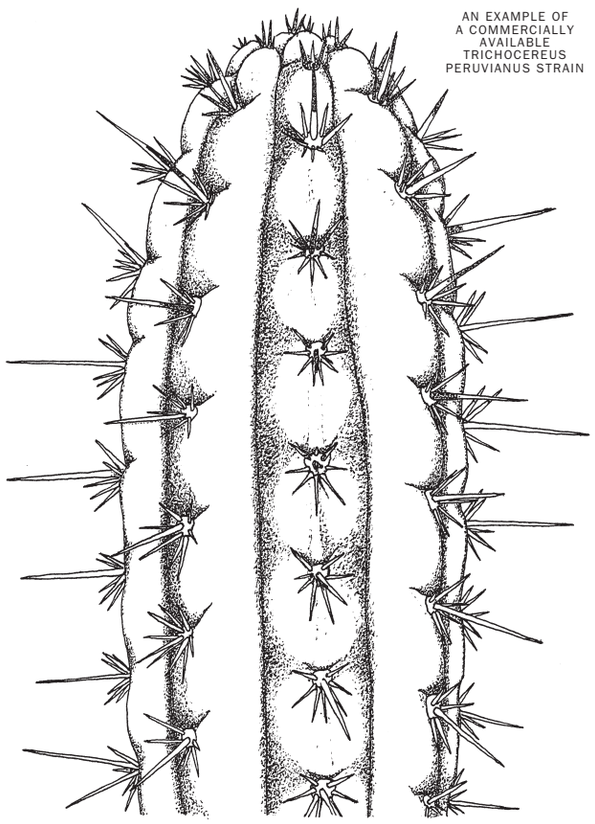
Tribulus terrestris is an annual herb, growing profusely after summer rains; extremely variable in habit, with spreading prostrate branches up to 2m long, +- pubescent, sometimes hairless, sometimes woody at the base. Leaves unequal, the larger up to 6cm long, usually much smaller, with up to 8 pairs of leaflets; the smaller up to 3.5cm long, usually much less, with up to 6 pairs of leaflets; leaflets 4-15 x 1.5-7mm, rather oblique, oblong to ovate-lanceolate, apex acute or subobtuse, hairy on both surfaces or nearly hairless; stipules up to 10mm long, linear or linear-lanceolate, acute. Peduncle usually shorter than, or as long as, subtending leaf; sepals c.3.6mm long, linear-lanceolate, usually hairy outside; petals 5, light-yellow, 3-8(-12)mm long, broadly cuneate, usually shorter than sepals; filaments c.3mm long; anthers 0.5-1(-2)mm long. Ovary with stiff, bulbous-based hairs; style very short; stigma 0.8-1.2mm long, hemispheric, mostly assymetrical and nearly sessile on ovary. Fruit breaking up into 5 cocci, each with 2 strong divergent spikes in the upper and 2 smaller ones in the lower part, usually crested on the back (Exell et al. ed. 1960-1993).

Widespread. Noxious weed in Australia [Vic., SA & NSW].

In Australia, T. terrestris occurs as a complex containing four different taxa, T. terrestris 'long-style' [style 0.6-1.3mm long, cocci not dorsally rounded, cocci spines long median], T. terrestris 'short style' [style 0-0.3mm, cocci not dorsally rounded, cocci spines long median], T. micrococcus [style 0.7-1.4mm, cocci dorsally rounded, cocci spines median, lacking or short] and T. minutus [style 0.2-0.7mm, cocci dorsally rounded, cocci spines median, lacking or short] (Barker 1998).

TRICHOCEREUS

(Cactaceae)



Trichocereus atacamensis *(Philippi) Marsh.* **(Cereus atacamensis** *Phil.***; Echinopsis atacamensis** *(Phil.) Friedrich et Rowley***; Helianthocereus atacamensis** *(Phil.) Backeberg***)**

Trichocereus bridgesii *(Salm-Dyck.) Britton et Rose* **(Cereus bridgesii** *Salm-Dyck.***; C. lagenaeformis** *Först.***; C. lasianthus** *Schumann***; Echinopsis lageniformis** *(Förster) Friedr. et Rowl.***)** – achuma, San Pedro

Trichocereus bridgesii forma monstrosa *Backbg.* – penis plant

'Trichocereus cordobensis' (not **Echinopsis cordobensis** *Speg.*)
Trichocereus cuzcoensis *Br. et R.* **(Echinopsis cuzcoensis** *(Br. et R.) Friedr. et Rowl.***)** – gigantón, jahuackollai, curi, avacollay, aguacolla quisca
Trichocereus fulvilanus *Ritter* **(Echinopsis fulvilana** *(Ritt.) Friedr. et Rowl.***;** may be a form of **T. deserticolus** *(Werdermann) Looser*, which is in turn very similar to **T. coquimbanus** *(Molina) Br. et R.***)**
Trichocereus grandiflorus *(Br. et R.) Backbg.* **(T. rowleyi** *Kiesling***; Helianthocereus grandiflorus** *(Br. et R.) Backbg.***; Lobivia grandiflora** *Br. et R.***) [**the synonymy of these species is still unclear**]**
Trichocereus huanucoensis *Hort. H. Johnson*
Trichocereus macrogonus *(Salm-Dyck.) Riccobono* **(Cereus macrogonus** *Salm-Dyck.***; Echinopsis macrogona** *(Salm-Dyck.) Friedr. et Rowl.***;** very similar to **T. peruvianus)**
Trichocereus pachanoi *Br. et R.* **(Echinopsis pachanoi** *(Br. et R.) Friedr. et Rowl.***)** – San Pedro, huachuma, achuma, agua-colla, gigantón
Trichocereus pallarensis *Ritter*
Trichocereus pasacana *(Weber) Br. et R.* **(T. eremophilus** *Ritter***; Cereus pasacana** *Weber***; Echinopsis atacamensis ssp. pasacana** *(Weber) G. Navarro***; E. pasacana** *(Weber ex Rümpler) Friedr. et Rowl.***; Helianthocereus pasacana** *(Web.) Backbg.***; Pilocereus pasacana** *Weber***)** – cardón
Trichocereus peruvianus *Br. et R.* **(T. pachanoi forma peruvianus** *Ritter***; Echinopsis peruviana** *(Br. et R.) Friedr. et Rowl.***)** – San Pedro, San Pedro macho, cuchuma, gigantón, aguacolla, huando
Trichocereus poco *Backbg.* **(T. cephalopasacana** *Backbg.***; T. pasacana var. albicephala** *Hort.***; T. tarijensis** *(Vaupel) Werd.* **var. poco** *(Backbg.) Ritter***; Echinopsis poco** *(Backbg.) Friedr. et Rowl.***; Helianthocereus poco** *(Backbg.) Backbg.***; H. tarijensis** *(Vaup.) Backbg. nom. illeg.***)**
Trichocereus puquiensis *Rauh et Backbg.* **(Echinopsis peruviana ssp. puquiensis** *(Rauh et Backbg.) Ostolaza***; E. puquiensis** *(Rauh et Backbg.) Friedr. et Rowl.***)**
Trichocereus santaensis *Rauh et Backbg.* **(Echinopsis santaensis** *(Rauh et Backbg.) Friedr. et Rowl.***)**
Trichocereus schoenii *Rauh et Backbg.* **(Echinopsis schoenii** *(Rauh et Backbg.) Friedr. et Rowl.***)**
Trichocereus scopulicola *Ritter sp. nov.* **(T. 'scoprina'** *Hort.* [incorrect name]**; T. scopularum** *Hort.* [incorrect name]**; T. scopulicolus** *Ritter***; Echinopsis scopulicola** *(Ritter) Mottram***)** – San Pedro [not a traditional name for this species], Easter lily cactus, scop
Trichocereus smrzianus *(Backbg.) Backbg.* **(Echinopsis smrziana** *Backbg.***; Soehrensia smrziana** *(Backbg.) Backbg.***)**
Trichocereus spachianus *(Lemaire) Riccob.* **(Cereus spachianus** *Lem.***; Echinocereus spachianus** *Rümpl.***; Echinopsis spachiana** *(Lem.) Friedr. et Rowl.***)**
Trichocereus strigosus *(Salm-Dyck.) Br. et R.* **(Cereus strigosus** *Salm-Dyck.***; Echinocereus strigosus** *Lem.***; Echinopsis strigosa** *(Salm-Dyck.) Friedr. et Rowl.***)**
Trichocereus taquimbalensis *Cardenas* **(Echinopsis taquimbalensis** *(Card.) Friedr. et Rowl.***; E. tacaquirensis ssp. taquimbalensis** *(Card.) G. Navarro***)**
Trichocereus terscheckii *(Parmentier ex Pfeiffer) Br. et R.* **(Cereus terscheckii** *Parm.***; Echinopsis terscheckii** *(Parm. ex Pfeiff.) Friedr. et Rowl.***)** – San Pedro, cardón santo ['holy cactus'], cardón grande, cardón del valle
Trichocereus thelegonoides *(Speg.) Br. & R.* **(Cereus thelegonoides** *Speg.***; Echinopsis thelegonoides** *(Speg.) Friedr. et Rowl.***)**
Trichocereus sp. 'Tom Juul's Giant' (Echinopsis sp. 'Juul's Giant') – Jewel's Giant [sic.], Jule's Giant [sic.], TJG
Trichocereus uyupampensis *Backbg.* **(Echinopsis uyupampensis** *(Backbg.) Friedr. et Rowl.***)**
Trichocereus validus *(Monville) Backbg.* **(Cereus validissimus** *Web.***; Echinopsis valida** *Monv.***?)**
Trichocereus vollianus *Backbg.* **(Echinopsis volliana** *(Backbg.) Friedr. et Rowl.***)**
Trichocereus werdermannianus *Backbg.* **(Echinopsis werdermanniana** *(Backbg.) Friedr. et Rowl.***)**
[Note: most, if not all Trichocereus spp. are now classified under Echinopsis spp. – see discussion below]

'San Pedro' [T. pachanoi] is widely used traditionally in areas of Peru [a practice dating back to at least c.1000BC], where it is consumed by 'maestros' [shamans]. Usually, it is consumed by both the shaman and the patient in all-night healing sessions, whereby the shaman divines the nature and cause of the illness or spiritual-affliction, and which herbs to prescribe. However, in these circumstances, often the dose administered is insufficient for notable visionary activity. Shamans also take the cactus as a solitary practice, in larger doses, to learn. Wild plants are considered more potent than cultivated ones; the strength of cultivated plants is considered to be increased by planting near sacred ruins. The cactus is harvested with a brand-new knife, at a time favourable according to moon phases; the person harvesting the plant must have kept a diet [no onion, garlic, chilli (**Capsicum** anuum), salt, pork fat or blood] and abstained from sex, as well as observing rituals with offerings for harvest. Rituals are usually held on Tuesday or Friday nights, sunset to midnight, as these are considered the most efficacious times for shamanic work. A piece of the cactus [dosage being adjusted to suit the patient's size and the characteristics of their illness] is sliced and boiled for several hours in a tin of water, and the concentrated liquid drunk. Some may also add **Brugmansia** arborea ['misha'] and other **Brugmansia** spp. in careful amounts [a practice considered dangerous], **Lycopodium** spp. ['condorillo', 'condor misha'], a **Tillandsia** sp. ['siempreviva'], **Valeriana** adscendens ['hornamo morado'] and many other potential 'magical' additives. Emetic herbs are usually also given after these additives are used. Some also consume a liquid tobacco preparation [see **Nicotiana**] by pouring it into the nostrils, before and during the ceremony. The shaman is usually consulted at his 'mesa' [table, or more specifically in this case, altar], which may consist of an array of ritually-powerful objects laid out in meaningful positions on a mat or small altar before the shaman. In northern highland areas, the tip of the cactus is often a central object on the mesa, acting as a "cosmic tree" and considered the most powerful part of the plant [though maybe not pharmacologically – see below]. Singing, whistling, prayer, and use of rattles and percussion may often accompany some stages of the ritual; it is often forbidden to see lights for several hours after consumption. More problematic cases are treated around certain high-altitude lakes, where the most efficient medicinal herbs may be gathered and where spirit forces are strongest; the long pilgrimage to the lakes also involves ritual bathing in the waters, for the purpose of spiritual rebirth or cleansing. The ritual is closed with the shaman blowing 'arranque' [see **Citrus**] over everyone, and giving each person some to drink to terminate the effects. The day after the ceremony, the same diet must be kept, and bathing, alcohol and seeing fire are prohibited (Davis 1983; De Feo 2003; De Rios 1968, 1977; Joralemon 1984; Ostolaza 1984; Polia & Baranchi 1991; Sharon 2001; Trout & Friends 1999).

T. pachanoi has been claimed to have been an ingredient of a drink called 'cimora' [thought to be once consumed around Huancabamba], which was also said to contain Neoraimondia macrostibas, a Pedilanthus sp. ['cimora misha'; see *Endnotes*], **Isotoma** longiflora, **Datura** stramonium and other plants. However, it is now thought that such a mixture may never have existed under that name, and that the term 'cimora' refers to a number of different plants [particularly **Brugmansia** spp.] which are sometimes considered to have malevolent properties. One native informant reported that cimora "is a conceptual term referring to 'algo malo' – something bad" (Davis 1983; Schultes 1967a). Nevertheless, these plants [with the exception of Neoraimondia macrostibas] and many others were reported by Rätsch (1998) to be used as additives to San Pedro brews in Peru [see also *Endnotes* for some of these].

T. peruvianus is believed to have been used as a visionary plant [as well as T. pachanoi] in Peru since ancient times, and is still used in the same manner as T. pachanoi. Both [though usually one or the other] have been depicted in motifs and figurines decorating ceramics from both Incan and pre-Incan cultures including the Cupisnique, Moche, Paracas, Wari, Chimú, Chavín and Nazca (De Feo 2003; Ostolaza 1995, 1996, 1997, 1998, 1999). In many areas of Peru, T. pachanoi is planted near the entrance to the house, as it is believed to act as a 'supernatural guardian', scaring away intruders with unearthly cries (Rosa 1999). T. bridgesii is also known in Peru to have psychoactive properties, and may have had a history of use in Bolivia (Davis 1996; Rätsch 1998), where it is known to cause 'drunkenness'. Although some modern-day Bolivians near La Paz do use this species as a shamanic ally, signs of traditional use have so far been elusive (Kavlin, in White 2000).

A bioassay of a very small amount of the outer skin from a single rib of Chilean T. atacamensis [c.15-20cm long section] produced strong stimulation (pers. comm.). Spines of this species have been found in prehistoric sites in the Atacama desert [n.e. Chile] in connection with psychoactive snuff-powders [**Anadenanthera** peregrina], possibly having been used to clean the snuffing tubes. In Peru, archaeological remains indicate that the Chavin culture there [1000-300BC] also used T. pachanoi as well as A. peregrina. T. pasacana has been found in Argentinian earth-layers dating back to 7670-6980 BC; later, these finds occur together with 'coca' leaf [see **Erythroxylum**], and in the same area today, the fruits [minus the seeds] and flowers are used to make alkaline ash for use with coca. The Mataco use the flesh of T. terscheckii and T. poco for this purpose, and they are said to improve the flavour and increase the strength of the coca. Taken alone, T. terscheckii is said to be equal in effect to T. pachanoi, though some strains are apparently inactive [see below]. Also, in n.w. Peru, the rare T. peruvianus var. truxilloensis is cultivated with 'trujillo coca' [**Erythroxylum** novogranatense var. truxillense] to shelter the latter plants (Rätsch 1998; Torres 1993, 1995). T. cuzcoensis has been depicted on some Mochica pottery, often in the context of hunting or battle. The Incas were reported to have eaten the cooked flowers. Its fruits are edible, and a substance obtained from them called 'nopal gum' is used in Cuzco as "a mucilaginous additive to whitewash". The Incas also used cacti, such as T. cuzcoensis, in strengthening the walls of dwell-

ings, due to the strong vascular bundles of the stems. T. peruvianus was also proposed to have been so used (Ostolaza 1995, 1998, 2000; Towle 1961). In Peru, the sap of T. cuzcoensis is used to treat 'cancerous lesions', and in Chile unspecified parts of T. chiloensis are used against tumours (Hartwell 1968).

In n. Argentina, fishermen and other folk sometimes consume a stew of [what was reported to be] T. pasacana as a recreational inebriant. Bioassays using young, seed-grown plants [a single plant several inches in diameter, for a dose] revealed definite psychoactivity, though insufficient material has prevented experiments with larger doses, or older plants. The effects were subjectively deemed to have some *mescaline*-like qualities, though another psychoactive component predominated. The inebriation was described as being on the threshold of a visionary or psychedelic experience (Thompson pers. comm.). Others have described stimulant activity from ingesting T. pasacana (Trout ed. 1999). To confuse the matter, Thompson regards T. terscheckii as a low-altitude variety of T. pasacana [a synonymy strongly disputed by others], and as such the plants reported by him to be consumed in Argentina may have been T. terscheckii. The bioassays mentioned above were conducted using plants that were more typical of T. pasacana. Most specimens of the two species are quite distinct from one another macroscopically, though they are known to interbreed, producing offspring which are less easily identified. Perpetuating the confusion, some specimens of T. terscheckii and T. pasacana in the Huntington Botanic Gardens [California] are clearly mislabelled (pers. obs.). It has been reported that "men and animals on the deserts of Argentina's Northwest in time of drought may find relief by drinking the juice of the crushed plant" of T. terscheckii, aparently without intoxication (Reti & Castrillon 1951), yet this might perhaps also be a confusion with another similar species.

In the last few decades, T. pachanoi [and rarely other Trichocereus spp., such as T. bridgesii, T. macrogonus and T. peruvianus; see below under the chemical listings for lesser-used species] have been used as psychoptics by western experimenters and others, usually unrelated to traditional use. In fact, T. scopulicola appears to have been used by many for quite some time, in the belief that it was T. pachanoi! These two species are so superficially similar [complicated by the near unavailability of published descriptions of T. scopulicola], and of similar potency and chemical content, that the differences were only noticed recently, at least amongst psychonauts who have been prepared to discuss their experiments. The general dosage for fresh T. pachanoi or T. scopulicola may be a piece of the branch c.30-40 x 7-10cm [or c.0.8-1kg w/w], though sometimes up to 60cm of length may be required.

The best time to harvest *mescaline*-containing species [for highest potency] is considered to be during summer and autumn. Some people prefer to deprive the plant of water for up to 2 months before harvest. These cacti become more potent with age. Older growth is more potent than growing tips, but very old, woody growth is usually not very potent at all (pers. comms.). It has recently been established through numerous bioassays that the flowers are psychoactive, and surprisingly, more potent than the branches of active Trichocereus spp. This is most likely due to a high alkaloid concentration in the green fleshy parts of the flower calyx (Trout pers. comm. 2004). Regarding traditional knowledge of potency and effects, in n.e. Peru a variegated form of San Pedro with white and red flowers, known as 'San Pedro misha', is said to be particularly strong. Plants growing on rocks are also regarded as more potent compared to those growing in soil, and specimens in arid zones are more potent than those in humid zones. A specimen growing near fire is thought to have no potency. Regarding the number of ribs, 12-ribbed plants are used for divination; 4-7-ribbed plants for curing; and 5-ribbed plants for 'protection rites' (De Feo 2003).

To harvest, the branch should be cut [with a very sharp, clean blade] in dry weather at a slight angle so that water will not accumulate in the wound, which will be cup-like in the centre when healed. The cutting should be cleaned of spider webs and other matter with a small brush. Some prefer to let it sit for a month or more to lose some water, to reduce the end volume to be consumed. The spines may be removed with a sharp knife, by cutting them away at the base with a small v-shaped notch of flesh. This is not necessary unless on stoutly-spined species, if intending to strain the brew by hand, or if your straining material will allow fragments to pass through. Freezing the cactus prior to preparation will break down cell walls and aid in efficient extraction once thawed. The cactus is chopped finely or sliced, and most people boil it gently in water [preferably acidified with lemon or lime juice] for several hours, with frequent stirring, and removal of surface scum. Often the pulp is then strained out, and the extract concentrated with gentle heating to minimise volume. Some prefer to only use the inner layer of flesh just under the skin, as this portion has the highest concentration of *mescaline* [the core and surrounding flesh contain much less, but can still be used]. This can be dried, powdered, and encapsulated for ingestion, though a large amount of material is still needed. Sometimes the liquid extract is reduced to a gummy concentrate to be rolled into small pills and swallowed – this method may cause greater gastric distress on an empty stomach than liquid consumption. Of course, people are ingenious and many methods of consumption have been devised and put into practice.

A simple modification offered by K. Trout (Trout & Friends 1999) stems from two important observations – that prolonged heating and volume-concentration seem to enhance the nausea produced by the resulting brew, and that minimising the amount of water added is also desirable to reduce nausea. The [once-frozen] thawed cactus is chopped or blended, then mixed with lime juice [2-3 limes per kg of cactus] and put in a non-aluminium pot. Slowly it is brought to the boil with stirring, and [still stirring] simmered gently for another 20-30 minutes. It is cooled and strained roughly through a sieve, then again through a fine filter [without squeezing pulp]. The pulp is returned to the pot and the process repeated; a little water may be added only if necessary. The second time, it is strained finely and the pulp squeezed dry. The resulting brew is best drunk cold, and as quickly as possible.

Liquid cactus preparations are very bitter, often with an unpleasant 'snotty' texture, and many say they should be drunk over a period of an hour or so to lessen sudden gastric disturbance. In practice, stretching it out does not help, and may actually make it more difficult to consume the full dose. Nausea and physical discomfort usually occur in the first hour or two after consumption, if at all [some people never get sick], and vomiting often occurs shortly afterwards. After this, or after the 3-hour mark if it is still down, the nausea and most of the discomfort disappear and the psychoactive effects begin to fully manifest. Often the effects come on in waves, and the full peak may not be felt until about 3-4hrs or more after onset; the whole experience may last up to 12hrs or more, depending on dose, and [in the case of most T. pachanoi] is characteristic of the *mescaline* experience, being a 'classic' psychedelic with a vivid colour aspect, and strong CNS stimulation (pers. comms.; pers. obs.).

It was observed by Agurell (1969a) that Trichocereus spp. with stems that branch or form candelabras produce *mescaline*, and that columnar, creeping, or low species produce N-methylated *tyramines* and/or disubstituted *phenethylamines*. There are, however, many exceptions to this.

It should also be noted that many of the plants analysed by Agurell and associates were of cultivated, European origin (Agurell 1969a), and that many of the extraction methods used would not have recovered all *mescaline* present. It has been observed that active species with less internal slime produce less nausea (Trout & Friends 1999). All yields given below are from fresh material unless otherwise specified.

T. bridgesii was found to contain more than 0.05% alkaloids, mostly *mescaline*, with smaller amounts of *tyramine*, 3-MeO-*tyramine* and *DMPEA* (Agurell 1969a); analysis of dry material yielded 0.56% *mescaline* (Cjuno et al. 2007). The triterpenes bridgesigenins A and B were isolated, but much of the yield was probably formed as an artefact of the extraction process, through hydrolysis of unidentified glycosides (Kinoshita et al. 1992; pers. comm.). Bioassays show it to have similar potency to T. pachanoi (Davis 1983; pers. comm.), or even more potent. Other strains of this species, such as the 'Eusaporus' clone and the monstrose strain, T. bridgesii forma monstrosa [see below], have been found to be particularly potent (Trout ed. 1999; Trout & Friends 1999; pers. comms.).

T. candicans was found to contain more than 0.05% alkaloids, including N-methyl-*tyramine* [0.004% d/w], *tyramine*, *hordenine* [major compound] and candicine [4-OH-N,N,N-trimethyl-PEA], as well as 2 unidentified alkaloids in trace amounts (Agurell 1969a; Mata et al. 1976). Extracts of the plant induced secretion of *epinephrine* from the adrenal glands in animals (Lewis & Luduena 1934); stimulation of respiration and cardiac activity, hypertension, protrusion of the eyes, mydriasis and incoordination were observed in dogs; in toads, *nicotine*-like toxicity was observed (Luduena 1934).

'T. cordobensis' has not been chemically analysed. Specimens believed to represent this species [cultivated in e. Australia] have been found to be psychoactive similarly to T. pachanoi or T. scopulicola, though less potent (pers. comms.). Myself and others have been unable to find a source or author for this species name (pers. obs.; Trout pers. comm.).

T. cuzcoensis was found to contain more than 0.05% alkaloids, mostly 3-MeO-*tyramine*, with 1-10% each of *mescaline* and *tyramine*, and traces of 3-OH-4,5-dimethoxy-*phenethylamine* (Agurell et al. 1971); later analysis of specimens from 4 locations found no *mescaline* (Serrano 2008). Most human bioassays of this species [wild-harvested from near Cuzco, Peru] have been negative, but there is one positive report using the same material. Proper identification of this species is in dispute (Trout & Friends 1999).

T. fulvilanus was found to contain more than 0.05% alkaloids, mostly *tyramine* and N-methyl-*tyramine*, with traces of *mescaline* (Agurell et al. 1971). There is one report of a positive bioassay, but identification of the material might have been in error (Trout & Friends 1999).

T. grandiflorus seems to exist in at least 3 varieties – a white, nocturnally flowering type, which was claimed to be '*mescaline*-active' in a human bioassay; a red, day flowering type [sometimes referred to as Helianthocereus grandiflorus, as a separate variety] which seemed to contain *DMT* in preliminary analysis by A.T. Shulgin; and a yellow flowered type which did not contain *DMT*. There is the possibility that contaminated equipment gave a false-positive indication for the presence of *DMT*, and Shulgin himself doubts the validity of the results obtained (Shulgin

pers. comm.; Smith 2000). The taxonomical status of what is referred to as T. grandiflorus greatly needs clarification.

T. huanucoensis has produced strong stimulation in a human bioassay, but remains chemically unanalysed (Trout pers. comm.).

T. huascha was found to contain 0.001-0.01% alkaloids, over 50% of which was *hordenine* (Agurell 1969a).

T. knuthianus was found to contain 0.01-0.05% alkaloids, consisting of 10-50% each of *tyramine* and N-methyl-*tyramine* (Agurell et al. 1971).

T. lamprochlorus was found to contain 0.01-0.05% alkaloids, over 50% of which was *hordenine* (Agurell 1969a); others have found traces of candicine (Trout ed. 1999, citing Reti & Arnolt 1935. Actas y Trabajo del V. Congr. Nac. de Medicina, Rosario 3:39).

T. macrogonus was found to contain 0.01-0.05% alkaloids, mostly *mescaline*, with lesser amounts of *tyramine*, 3-MeO-*tyramine* and *DMPEA* (Agurell 1969a). Human bioassays so far have given mixed results – some have claimed high potency [2-2.5 times as potent as 'average' T. pachanoi], whilst others have found it to be less potent, or even inactive. Proper identification of this species is still disputed [see below], and some believe much of the material sold as T. peruvianus is actually T. macrogonus; sometimes the reverse may be true (Trout ed. 1999; Trout & Friends 1999; pers. comms.).

T. manguinii was found to contain 0.01-0.05% alkaloids, consisting of 10-50% each of *tyramine*, N-methyl-*tyramine* and *hordenine*, and 1-10% 3-MeO-*tyramine* (Agurell et al. 1971).

T. pachanoi has yielded 0.05-0.23% alkaloids, mostly *mescaline*, with lesser amounts of 3-MeO-*tyramine*, *DMPEA* [c. 5% of the amine fraction], and traces of *tyramine*, 3,5-dimethoxy-4-OH-*phenethylamine*, 3,4-dimethoxy-5-OH-*phenethylamine* and *anhalonidine* (Agurell 1969a, 1969b; Agurell & Lundstrom 1968; Lundstrom 1970); dry samples have yielded 0.09-2.4% *mescaline* (Cjuno et al. 2007; Crosby & McLaughlin 1973; Gennaro et al. 1996; Helmlin & Brenneisen 1992; Poisson 1961); Brown et al. (1968) found several alkaloids which they did not identify. Also found [in a plant cultivated in Japan] were triterpenes – pachanols A & B, and bridgesigenins A & B. Enzymatic degradation of the extract resulted in the formation of pachanols A & C, and bridgesigenins A & C (Kinoshita et al. 1995). For mention of the possible artificial origin of the triterpenes [which may nonetheless occur naturally in much smaller amounts], see the T. bridgesii entry above.

T. pallarensis was psychoactive and indicated to contain *mescaline* from human bioassays; it was claimed to be superior to T. pachanoi in potency (Trout & Friends 1999).

T. pasacana yielded 0.08% candicine, *tyramine*, N-methyl-*tyramine* and *hordenine* (Agurell 1969a; Meyer & McLaughlin 1980). It is very similar to T. atacamensis [which is sometimes considered a variety of T. pasacana, and has not been chemically analysed].

T. peruvianus was found to contain 0.001-0.01% alkaloids, mostly *tyramine*, and traces of 3-MeO-*tyramine*, with no *mescaline* detected (Agurell 1969a); others have obtained much higher yields [from the KK242 strain], up to 0.82% *mescaline* [d/w], with traces of the *tyramine*-derivatives, as well as *DMPEA* and 3,5-dimethoxy-4-OH-*phenethylamine* (Pardanani et al. 1977). There have been mixed degrees of success, and some failures, with human bioassays of this species, most likely due in part to the unclear taxonomic status of the many varieties which change hands as T. peruvianus (Trout & Friends 1999; pers. comms.). It is important to note that Karel Knize, who made the KK242 collections, recognises "at least 9 different plants he considers to be KK242". Plants obtained directly from Knize, as KK242, differ considerably in comparison to material propagated from KK242 seed in the US, and it is this seed-grown material which is most commonly encountered commercially as KK242 (Trout pers. comm.).

T. poco was found to contain 0.001-0.01% alkaloids, over 50% of which was *hordenine* (Agurell 1969a).

T. puquiensis has a *mescaline*-positive bioassay report, from a c.50cm-long section of a monstrose variety; the diameter of the section was not reported (Trout pers. comm.). Analysis of specimens from 4 locations in Peru found 0.11-0.5% *mescaline* [d/w] (Serrano 2008).

T. purpureopilosus was found to contain 0.01-0.05% alkaloids, consisting of 10-50% each of *tyramine* and N-methyl-*tyramine*.

T. santaensis has been found to have *mescaline*-like activity in human bioassays, with around 455g reported to give perceptible effects (Trout pers. comm.).

T. santiaguensis was found to contain 0.001-0.01% alkaloids, consisting of 10-50% each of *tyramine* and *hordenine* (Agurell et al. 1971).

T. schickendantzii was found to contain 0.001-0.01% alkaloids, over 50% of which was *hordenine*, with traces of N-methyl-*tyramine* (Agurell 1969a).

T. schoenii was found to contain 0.14-0.24% *mescaline* [d/w] (Cjuno et al. 2007; Serrano 2008).

T. scopulicola has not been chemically analysed, yet bioassays indicate it contains similar levels of *mescaline* to T. pachanoi. It appears to be similarly variable in potency. Bioassays of 800-1000g [w/w] have resulted in experiences ranging from mild to intense full-blown psychedelic effects (pers. obs.).

T. skottsbergii has yielded 0.01-0.05% alkaloids, consisting of over 50% *hordenine* and 1-10% *tyramine* (Agurell et al. 1971).

T. smrzianus was psychoactive in a human bioassay, but may contain active compounds other than *mescaline*, as it was said to be "different than San Pedro [T. pachanoi]" (Trout ed. 1999).

T. spachianus has yielded 0.01% candicine, *hordenine* [major alkaloid], 0.004% *tyramine*, and 0.007% N-methyl-*tyramine* (Agurell 1969a; Mata et al. 1976); a specimen cultivated in Indiana apparently yielded *mescaline* (Rätsch 1998), though this requires verification and is likely to be an error. There is one report of a human bioassay claiming it was psychoactive but "different than San Pedro [T. pachanoi]"; other bioassays have been unanimously negative (Trout ed. 1999).

T. strigosus has yielded [d/w] 0.14% *hordenine*, 0.11% candicine, and traces of *mescaline* and *tyramine* (Nieto et al. 1982). Agurell et al. (1971) found 0.01-0.05% alkaloids, which was entirely *hordenine*.

T. taquimbalensis was found to contain 0.01-0.05% alkaloids, mostly *mescaline*, 1-10% *hordenine*, and traces of 3-MeO-*tyramine* and *DMPEA* (Agurell et al. 1971).

T. terscheckii dried branches yielded 0.25-1.2% alkaloids; epidermis yielded 29% of the total alkaloids; central parts yielded 45% of the total alkaloids. They consisted of trichocereine [N,N-dimethyl-*mescaline*] and *mescaline*, in a 5:1 ratio. Some samples contained no *mescaline* in the alkaloidal constituents (Reti & Castrillon 1951). Fresh samples in other tests yielded 0.01-0.05% alkaloids, over 50% of which was *mescaline*, with lesser amounts of trichocereine (Agurell 1969a). It has proven active in human bioassays, some specimens strongly so. Trichocereine was inactive at up to 550mg orally in human experiments (Trout & Friends 1999). However, compared with *mescaline*-dominant species such as T. pachanoi the psychedelic experience obtained from T. terscheckii was described as qualitatively "messier" (R.S. pers. comm. 2002). This species was once thought to contain *DMT* [N,N-dimethyltryptamine] (Schultes & Hofmann 1992), but this was probably a confusion derived from the reported presence of N,N-dimethyl-*mescaline*.

T. thelegonoides yielded 0.01-0.05% alkaloids in fresh material, which was entirely *hordenine* (Agurell et al. 1971); other tests revealed traces of *mescaline* (Siniscalco 1983).

T. thelegonus has yielded 0.01-0.05% alkaloids, consisting of over 50% *hordenine*, and traces of N-methyl-*tyramine* (Agurell et al. 1971).

T. sp. 'Tom Juul's Giant' has proven to be highly variable in potency, from human bioassays, ranging from inactive to "twice as potent as San Pedro". Reports indicate that active compounds besides *mescaline* may be present, though *mescaline* does occur. However, there appear to be at least two varieties of this unclassified species in circulation. The active variety, which has a slight yellowish mottling of the skin, was shown in preliminary analysis to contain *mescaline*, comprising less than 10% of the total [unidentified] alkaloids. The other variety, which lacks mottling, did not contain any *mescaline*, but did contain unidentified tetrahydroisoquinoline alkaloids (Trout & Friends 1999; Trout pers. comm.).

T. uyupampensis has been found to have *mescaline*-like activity in human bioassays (Trout pers. comm.).

T. validus has yielded over 0.05% alkaloids, mostly *mescaline* (Agurell et al. 1971). Apparently a different plant is available horticulturally under this same name; it is a clumping plant with red flowers (Smith 2000), as opposed to the large columnar plant with white flowers described by Curt Backeberg (Backeberg 1959). It is most likely Backeberg's species that was used in Agurell et al's analysis (Smith 2000).

T. vollianus has yielded traces of *mescaline* (Siniscalco 1983).

T. werdermannianus has yielded 0.01-0.05% alkaloids, mostly *mescaline*, with lesser amounts of 3-MeO-*tyramine* and *DMPEA*, and traces of *tyramine* and 3,5-dimethoxy-4-OH-*phenethylamine* [0.1% of total alkaloids] (Agurell 1969a, 1969b). It has ranged from weakly active to highly potent [2-3 times as potent as 'average' T. pachanoi] in human bioassays (Trout & Friends 1999).

An unidentified Trichocereus sp. has been claimed to contain *caffeine* in the seeds, a report which needs verification (Trout ed. 1999).

Trichocereus pachanoi is a cactus to 6m tall, with numerous strict branches, bluish-green, slightly glaucous when young and on new growth (sometimes glabrous), dark green in age, branches up to c.10cm thick, some starting from the base; ribs 4-7(-14), broad at base, obtuse, with slight horizontal or V-shaped depression above areole; areoles small, c.2cm apart; spines 1-4(-7), unequal, very small or completely absent, the longest 1-2cm long (usually much less), dark yellow to brown. Flower buds pointed; flowers very large, funnel-shaped, 19-25cm long, to 20cm diam., white, borne near top of branches, night-blooming, very fragrant; outer perianth segments brownish-red; inner perianth segments oblong, white; flower tube bearing numerous scales, their axils bearing long hairs; filaments long, weak, greenish; style greenish below, white above; throat stamens clearly separate, numerous, filiform, arranged in 2 groups; stigma lobes numerous, linear, yellowish; ovary covered with black curled hairs; axils of scales on flower tube and fruit bearing long black hairs. Fruit without bristles or spines, dull coloured.

Andean Ecuador & Peru (Britton & Rose 1963; Cullman et al. 1986; Ostolaza 1984; Trout & Friends 1999; pers. obs.).

There is a great deal of confusion over the taxonomy of the genus Trichocereus. Many of the original descriptions have proven insufficient in reliably separating species. This is largely due to botanists not examining a wide variety of material from different locations, and growing under different conditions. Even within one batch of seed for a given species, much variation will be noted in the resulting plants; large variations in morphology can also occur through different stages in the life of a plant. T. bridgesii, T. macrogonus, T. pachanoi and T. peruvianus all have inadequate descriptions which do not firmly distinguish these species from one another, as a group, or from other lesser-known species of similar appearance. All of them have been observed to intergrade to varying degrees, and hybrids are known, as they are also with T. scopulicola and T. sp. 'Tom Juul's Giant', two more similar species. T. pachanoi, and some of the variable forms of T. bridgesii, are usually easy to distinguish at species level from the others. However, long-spined forms of T. pachanoi and short-spined forms of T. peruvianus are also known, which further confuses matters (pers. obs.; Trout pers. comms.). Interestingly, in n.e. Peru the 'wild' San Pedro ['San Pedro cimarrón'] said to be more potent than 'true' or cultivated San Pedro ['San Pedro legitimo'] has long spines and may in fact be T. peruvianus (De Feo 2003). T. macrogonus and T. peruvianus are also difficult to separate in practice, due to the insufficient description of the former. There are also problems with both botanists and horticulturalists lumping many different, but similar species, into one designation, particularly with T. peruvianus, which was described by Ritter as a form of T. pachanoi. It seems very likely that there are as-yet undescribed species, which are morphologically similar to other known Trichocereus spp. It is also a strong likelihood that many of the intergrading plants found in this genus are natural hybrids that have become firmly established over hundreds or thousands of years. Many species are showing up in cultivation which have not been neatly fitted to any known and described species. This is a vague and highly confusing area even for the 'experts'. Clearly much work needs to be done to revise the classification of this genus (pers. obs.; Trout pers. comms).

Many cultivators of plants from this genus feel that the currently accepted reclassification of all species into Echinopsis (see Rowley 1974; and the highly confusing and seemingly irrational reclassifications listed in Hunt 1999) is too broad a generalisation, although the dividing lines between these genera are not firm. The best compromise may be to classify Trichocereus as a subgenus of Echinopsis. Coordinated work is needed between cultivators, collectors and botanists worldwide to clarify this taxonomic mess, as well as to classify the unidentified species or strains, and determine the extent of their relationships in the wild. The main problem with the classifications and synonyms given by Hunt (1999) and Rowley (1974) is that no new descriptions were written to clarify and justify the revisions, and it is even doubtful that any taxonomic study of living specimens was undertaken, with much relying solely on seed morphology analysis. Comparison of horticultural material with that from the wild, at all stages of growth and from many locations, as well as genetic and chemotaxonomic study, is well overdue. It would be a shame if the chemical content of some of these species were a factor in preventing such scientific work. See Trout & Friends (1999) for a more in-depth discussion of this grey area.

Cereus peruvianus is sometimes misrepresented as being T. peruvianus by unscrupulous cactus-dealers, due to the reputation of the latter as having a high alkaloid content. T. peruvianus [a very poorly defined species] appears broadly similar to T. pachanoi, but has larger spines and areoles, as well as sometimes having a partially prostrate habit with age. It is now sometimes considered a variety of T. pachanoi.

As mentioned earlier, the distinctions between T. macrogonus and T. peruvianus are unclear, and T. cuzcoensis is easily confused with much of what is circulated commercially as T. peruvianus (pers. obs.). T. cuzcoensis is usually distinguished by the yellowish spines [later darkening and turning amber] (Ressler 2000) with swelling at the base, and young growth that is green and not glaucous (Britton & Rose 1963). At least one person believes that active species can be distinguished from inactive species of similar appearance by the presence of glaucous new growth, and a pronounced bluish tinge to the skin. He believes such specimens to be T. macrogonus rather than T. peruvianus (pers. comm.). T. santaensis also lacks a really good description and may be confused with T. cuzcoensis and T. peruvianus.

T. scopulicola is similar in appearance to T. pachanoi, and in Australia, it is much more commonly available from nurseries. Mature plants differ from T. pachanoi in having a more club-shaped branch apex, usually thicker branches, usually only [4-]5[-6] ribs, frequently more depressed and smaller areoles, less prominent spines, and duller skin [not glaucous] with a slightly roughish texture. The quickest way to differentiate between these two species seems to be comparison of the rib profile, between areoles. T. pachanoi generally curves upwards, as though supporting the areole at the top of its curvature; T. scopulicola generally curves downwards, as though slightly over-hanging the areole at the bottom of its curvature, or simply indenting. When closely inspected, the areoles and spination of these two species are also markedly different (pers. obs.). To add to the confusion, the mysterious 'T. cordobensis' has also been confused with T. pachanoi and T. scopulicola, sharing similarities with both. It appears to have a skin texture more similar to T. scopulicola, but new growth appears more like that of T. pachanoi [though larger and more robust]. Spines become stout [though short] and angled, in large areoles [much smaller on some, but not all young growth]. Branches are typically stout. I suspect it might perhaps be a hybrid between T. pachanoi and T. scopulicola (M.S. Smith pers. comm.; pers. obs.).

Cereus colossus [Trout suggests it should be re-named Trichocereus colossus, due to its hairy flower buds] is a poorly defined species. A plant bearing this label at a Botanical Garden in California is superficially similar in appearance to T. scopulicola and T. sp. 'Tom Juul's Giant' [from a distance], and is clearly a Trichocereus sp. rather than a Cereus sp. This plant, whatever it its identity, is suspected of being active. However, the Cereus colossus sign in front of this specimen may represent a deceased plant, according to collection records, leaving the identity of the remaining plant even more unknown [if that is possible!]. The equally poorly-defined T. argentinensis is also suspected of being active (Trout & Friends 1999; Trout pers. comm.).

T. bridgesii is recognised by some taxonomists as three forms [not including monstrose varieties]. T. bridgesii var. brevispinus has 7-8 ribs, and very short spines. T. bridgesii var. lageniformis has clavate stems, 6-7 ribs, and numerous short spines. T. bridgesii var. longispinus has 4-5 ribs, with very long central spines (Marshall & Bock 1941). The monstrose varieties, all falling under the name T. bridgesii f. monstrosa, are very easy to recognise, though they can still be variable in form. The most commonly encountered form is a low, clumping plant, completely or mostly spineless and cylindrical, with a linear indentation at the apex. It vigorously produces offsets all over the plant, with branches remaining short. In later growth, irregular monstrose and spined portions occur, with usually longer and stronger spines than 'normal' T. bridgesii varieties. Often these plants form a mass of short branches or joints, with new shoots emerging from older branches [which still may be only 6cm long or less at the time], and sometimes from relatively young shoots. The other main variety produces mostly only longer branches, exceeding 30cm in length and mostly spineless. All such monstrose varieties share the fact that their ribs are absent, or indistinct at best. T. bridgesii f. monstrosa is often quite slow-growing, though I have seen it put out bursts of rapid growth that were surprising in their vigour (Backeberg 1959; pers. obs.)! T. bridgesii is highly variable in spination, even on the same plant over time, and firm distinctions between the proposed varieties can sometimes be difficult or impossible to make, as Backeberg (1959) noted.

Trichocereus spp. are easy to grow from seed [treat like other cacti seed, though artificial heat is often not needed], and very easy to grow from cuttings [for most species]. These plants constantly amaze me with their vitality and persistence! I have seen new growth emerge from a small piece of branch-cutting which had been left inside sitting on a piece of glass for months, and had been assumed to be dead. It had only been kept to that point because I couldn't bring myself to dispose of it. They like to be planted in well-drained ground when older, and once established will show much more growth than if kept potted. Regular feeding with dilute [1/5-1/10 of recommended concentration] organic fertiliser will improve growth and [reputedly] alkaloid content – the latter especially if using fertiliser high in ammoniacal nitrogen. Many species can handle daily watering when hot and sunny, though water should not splash on the plant itself. This may cause sunburning. Full sun is appreciated for some of the day, but young plants and those bought from indoor nurseries need to be adjusted to it gradually. Most species prefer strong light, but not full sun. T. bridgesii should be watered less than many other Trichocereus spp. – the monstrose form needs even less water. Avoid calcareous soils for this species. Patience will be required for many of the larger species, which can be very slow-growing. Most of the 'pachanoid' or 'peruvianoid' species are fast-growing when happy and healthy (Trout & Friends 1999; pers. obs.).

TRICHOCLINE

(Compositae/Asteraceae)

Trichocline dealbata *(Hook. et Arnot) Benth. et Hook. f. ex Griseb.* **(Chaetanthera dealbata** *Hook. et Arn.***; C. parviflora** *Phil.***)** – coro, contrayerba

Trichocline exscapa *Grisebach* – coro, contrayerba

Trichocline reptans *(Wedd.) Rob.* **(Bichenia reptans** *Wedd.***; Gerbera incana ssp. reptans** *(Wedd.) Kuntze***)** – coro, contrayerba

The roots of these Argentinian herbs were once added to the alcoholic 'chicha' brew [see *Methods of Ingestion*] of the Calchaqui. More recently, they have been reported to be powdered and smoked, alone or with tobacco [see **Nicotiana**], as a narcotic by the Mocovie, Toba and Mataco. T. reptans is the species most often used, as it is most common. The roots are also used as a fumitory and stomach-ache treatment (Zardini 1977).

Chemical studies are lacking for the above species (Zardini 1977).

T. incana leaf and stem [harv. Jan., Salta Prov., Argentina] yielded

furocoumarins, including 0.88% trichoclin, 0.23% phellopterin and 0.1% isopimpinellin (Miyakado et al. 1978).

Trichocline dealbata is a rhizomatous perennial herb, rhizomes dense, vertical or oblique, much-branched. Leaves in basal rosettes, leaves obovate or spatulate, obtuse, attenuate at base to a large petiole, margin irregularly crenate, wooly or glabrescent on upper side, densely tomentose on underside, 5-12 x 3-6mm; petiole 6-20mm long. Inflorescence a scape, 15-50mm long, arising from base, wooly or downy; flowers yellow or orange, capitula solitary, involucre hemispherical, 10mm high x 10-15mm diam., receptacle flat; involucral bracts overlapping, in 4-5 series, lanceolate, acute, tomentulose on dorsal side, herbaceous or membranaceous; marginal flowers female, c.20, corolla long and bilabiate, outer lip liguliform and tridentate at apex, inner lip bifid, tomentose within, 8-9mm; disc flowers hermaphrodite, corolla bilabiate with lips +- the same length, outer lip tridentate and inner lip bifid; anthers sagittate, connective lanceolate, acute, lateral half ending below in long, linear tails; style short, bilobed, lobulate, redundant in apex. Achenes short, turbinate, densely papillose; pappus white, formed by numerous simple hairs, denticulate.

Endemic to the mountain range of Mendoza, and north of Neuquen, to 2000m; Argentina (Correa 1971).

TURBINA

(Convolvulaceae)

Turbina corymbosa *(L.) Rafinesque* **(Convolvulus corymbosus** *L.***; C. multiflorus** *Kunth***; C. sidaefolius** *Kunth***; Ipomoea burmannii** *Choisy***; I. corymbosa** *(L.) Roth ex Roem. et Schult.***; I. sidaefolia** *Choisy***; Legendrea corymbosa** *(L.) Ooststr.***; Rivea corymbosa** *(L.) Hallier f.***)** – ololiuqui, coaxihuitl, coatlxoxouhwui, piule, xtabentum, amukia, nosolena, yucayaha, bado, bado shnaash, quahn shnaash, ma'zhun paHK ['bones of the children'], snake plant, Christmas vine

The seeds ['ololiuqui' – roughly translated as 'round thing'] of this plant ['coaxihuitl' or 'coatlxoxouhwui' – 'snake plant'] were used by the ancient Aztecs and probably the Mayans, primarily as a sacred shamanic plant for divination. The flowers are believed to be depicted on the statue of the Aztec deity Xochipilli, 'Prince of flowers', which shows him permanently enthroned in a state of shamanic voyage. The seeds are still used by the Zapotec, Yucatan Maya, Chinantec, Mazatec and Mixtec in Mexico, consumed at night in dark and silence for divination. The seeds were once ground and drunk with milk and pepper [see **Piper 1**] as a kind of panacaea, specifically treating pain and inflammation. Often, however, the leaves are the part used for medicinal purposes, except for in aiding childbirth, when c.33 seeds may be taken. The Aztecs used it, mixed with peyote [see **Lophophora**], **Psilocybe** mushrooms and **Datura** to treat 'aquatic fever', which was probably malaria. It was also given topically mixed with **Psilocybe** mushrooms and **Datura** to treat gout. The seeds may also have been mixed with tobacco [see **Nicotiana**] and the burnt remains of venomous insects, and rubbed over the body by shamans as a topical inebriant.

Today, the seeds are used by traditional healers in Mexico as an aphrodisiac which treats menstrual disorders, infertility and fever. For divination, Mixe shamans are known to ingest them ['ma'zhun paHK'] in a dosage of 26 seeds, which are ground in a metate by a 10-15 year-old virgin, and infused in cold water before being strained out and the water drunk [see **Ipomoea**]. In San Baltazar Guelavila, the remaining seed paste is also spread over the top of the head and the veins of the arms, for topical absorption. Zapotec shamans end their curing ritual with the seeds by 'sucking' ['se chupa'] parts of the patient's body [often done with mezcal or water in the mouth], to remove the effects of the sacrament. It is said that insanity can result if this final procedure is not carried out. The shaman begins with the tip of one of the little fingers, proceeding to the other fingertips, up one side of an arm to the shoulder, then on the inside arm from wrist to shoulder, with the same on the other arm, then the middle of the forehead, sides of the forehead, and each side of the head from behind the ear to the shoulder; this may need to be repeated several times, at intervals of a few hours (Diaz 1979; Emboden 1979a; Fields 1969; Lipp 1990; Ott 1993; Rätsch 1992; Schultes & Hofmann 1980, 1992; Wasson 1961, 1963, 1973).

The traditional dosage of the seeds is often stated as the amount it takes to fill a bottle cap; this may be up to 100 seeds or more. They are finely ground and infused in cold water for several hours or up to 1 day, before being strained finely and drunk. Effects are sometimes similar to low doses of LSD, yet with more sedation and physical side-effects [abdominal cramps, nausea, vertigo etc.]. See **Ipomoea** for further discussion. The seeds contain ergot-type indole alkaloids [see **Claviceps**] which are uterotonic, and should not be taken by pregnant women (Osmond 1955; Ott 1993; Wasson 1963).

T. corymbosa seed has yielded [w/w] 0.012-0.06% indole alkaloids – of this, 16.2% may be *tryptophan*, 6.9% *chanoclavine*, 33.7% a mixture of *penniclavine* and isoergine [or up to 34.88% isoergine alone], 18.3-47.33% *ergine*, 2.7% *elymoclavine*, 3.7% *ergonovine* and 3.3% ergometrinine, as well as *agroclavine*, *lysergol*, lysergene, molliclavine, isosetoclavine, lysergic acid α-OH-ethylamide and its iso-derivative, and 9 other unidentified indole alkaloids; the levels of total clavine alkaloids may be as low as 16.2% of the total alkaloids. Seeds also contain the diterpene glycosides ent-16-α-17,19-kauranetriol-17-O,19-O-di-O-β-D-glucopyranoside and turbicoryn, as well as purgative resins and galactomannan; lipids may account for up to 8% of the seed, and one new diterpene glycoside was found at 0.2%. Alkaloids appear to be concentrated entirely in the embryo of the seed; none were found in the seed coat (Chao & Der Marderosian 1973a; Der Marderosian & Youngken 1966; Federico et al. 1993; Franco et al. 1990; Genest 1965; Genest & Sahasrabudhe 1966; Hofmann 1961, 1963; Nair et al. 1987; Ott 1993; Taber et al. 1963a). Leaves and stems, but not the roots, also contain indoles. The content increases with age; 9 month old plants yielded 0.027% alkaloids from leaf, and 0.012% from stem. These consisted of *ergine* and isoergine, as well as at least 2 other unidentified ergot-type alkaloids (Taber et al. 1963b). It should also be noted that the samples in this test were not exhaustively extracted, and the true alkaloid levels are probably higher.

The related T. abutiloides contains calystegines [see **Convolvulus**] in its roots (Schimming et al. 1998).

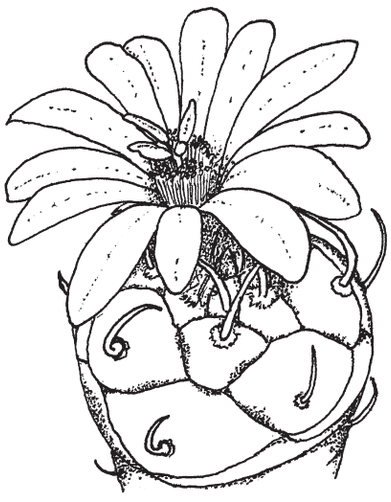
Turbina corymbosa is a large herbaceous or nearly woody climber. Leaves alternate, heart-shaped, ovate, to 10.2cm long, 4.5cm wide, base cordate, margins entire. Inflorescences many-flowered cymes; calyx lobes ovate to oblong, obtuse, enlarging in fruit; corolla white with greenish stripes, campanulate, 2-4cm long, to 3.8cm wide, centre yellowish, glabrous or sparsely hairy outside along stripes. Fruit dry, indehiscent, woody or leathery, enclosed in enlarged calyx, ovoid-oblong to ellipsoidal with persistent enlarged sepals; bears a single seed, hard, roundish, irregularly ovoid, greyish to light brown, 3-5.5mm long, 3-3.5mm wide, ventral surface with a very slight central shallow longitudinal groove near the proximal end of which is a circular hilar depression with numerous trichomes on its periphery.

Native to tropical America; introduced and naturalised in the old world (Bailey & Bailey 1976; Der Marderosian et al. 1964; Schultes & Hofmann 1980).

To cultivate from seed, nick the coat or soak in just-boiled water for several hours before planting; plant 1cm deep, at least 15cm apart, in a strong, well-drained soil with plenty of sun and water. In colder climates they may need to be started indoors in a greenhouse. Frost sensitive (Grubber 1973; pers. obs.).

TURBINICARPUS

(Cactaceae)



TURBINICARPUS SCHMIEDICKIANUS VAR. SCHWARZII

Turbinicarpus alonsoi *Glass et Arias*

Turbinicarpus lophophoroides *(Werd.) Buxb. et Backeberg* **(Strombocactus lophophoroides** *F. Knuth et Backeb.***; Thelocactus lophophoroides** *Werd.***; Toumeya lophophoroides** *Bravo et Marshall***)**

Turbinicarpus pseudomacrochele *(Backeb.) F. Buxb. et Backeb.* **(Strombocactus pseudomacrochele** *Backeb.***; Toumeya pseudomacrochele** *Bravo et Marshall***)**

Turbinicarpus pseudomacrochele var. krainzianus *(Frank) Glass et Foster* **(T. krainzianus** *(Frank) Backeb.***; Toumeya krainziana** *Frank***; To. pseudomacrochele var. krainziana** *Kladiwa***)**

Turbinicarpus pseudopectinatus *(Backeb.) Gl. et F.* **(Pelecyphora pseudopectinata** *Backeb.***)**

Turbinicarpus schmiedickianus *(Bödeker) Buxb. et Backeb.* **(Echinocactus schmiedickianus** *Bödeker***; Strombocactus schmiedickianus** *Berger***; Toumeya schmiedickianus** *Bravo et Marsh.***)**

Turbinicarpus schmiedickianus var. flaviflorus *(Frank et Lau) Gl. et F.*

Turbinicarpus schmiedickianus var. schwarzii *(Shurly) Gl. et F.* **(Strombocactus schwarzii** *Shurly***; T. polaskii** *Backeb*. is apparently a brown-stemmed form**; T. schwarzii** *Backeb.***; Toumeya schwarzii** *Bravo et Marsh.***)**

T. pseudomacrochele first attracted attention as it was believed to possibly be a 'peyotillo', or peyote substitute [see **Lophophora**]. This was due to finding the plant in an area where the researchers were told they could find peyotillos (Bruhn & Bruhn 1973), certainly a dubious basis from which to make such a claim. However, some species have recently been shown to contain low levels of *mescaline* and related alkaloids, warranting a return of interest for the phytochemically-minded.

All yields given below are w/w. Plants analysed by Štarha were cultivated in greenhouses in the Czech Republic.

T. alonsoi yielded 0.0066-0.0084% 6,7-dimethoxy-1,2-dimethyl-1,2,3,4-tetrahydroisoquinoline [6,7-dimethoxy-1,2-dimethyl-THIQ; methyl-*salsolinol*], 0.0044% N-methyl-*tyramine*, 0.004-0.0056% *hordenine* and 0.0015-0.0025% N-methyl-*DMPEA* (Štarha et al. 1999b).

T. lophophoroides yielded more than 0.5% alkaloids, comprising traces of *mescaline*, 0.4-0.62% N-methyl-*mescaline*, traces of N,N-dimethyl-*mescaline* [trichocereine], 0.77-1.31% *phenethylamine*, 1.65-1.99% *tyramine*, 0.02-0.24% N-methyl-*tyramine*, 91.15-92.23% *hordenine*, 0.52-0.57% O-methylanhalidine, 0.07-0.23% anhalinine, 2.25-2.49% *anhalonidine* and 0.38-0.54% *pellotine* (Štarha et al. 1999a).

T. pseudomacrochele has yielded 0.001-0.01% *hordenine* (Bruhn & Bruhn 1973).

T. pseudomacrochele var. krainzianus yielded 0.25-0.5% alkaloids, comprising 2.29-2.67% *mescaline*, 3.18-3.36% N-methyl-*mescaline*, 2.74-3.04% trichocereine, 0.99-1.25% *phenethylamine*, 0.8-1.16% *tyramine*, traces of N-methyl-*tyramine*, 49.05-50.15% *hordenine*, 0.73-0.81% O-methylanhalidine, 29.2-29.28% anhalinine, 2.31-2.57% *anhalonidine* and 0.28-0.44% *pellotine*.

T. pseudopectinata yielded more than 0.5% alkaloids, comprising 0.98-1.24% N-methyl-*mescaline*, traces of trichocereine, 0.86-1.1% *phenethylamine*, 2.99-3.37% *tyramine*, 23.94-26.36% N-methyl-*tyramine*, 59.69-64.53% *hordenine*, 1.77-2.07% O-methylanhalidine and 2.73-3.03% anhalinine (Štarha et al. 1999a); an earlier analysis found more than 0.05% alkaloids, over half of which was *hordenine* (Bruhn & Bruhn 1973).

T. schmiedickianus yielded 0.1-0.25% alkaloids, comprising 0.81-1.23% N-methyl-*mescaline*, traces of trichocereine, 0.89-1.13% *phenethylamine*, 5.32-5.6% *tyramine*, traces of N-methyl-*tyramine*, 41.16-44.88% *hordenine*, 2.34-3.18% O-methylanhalidine, 16.19-18.19% anhalinine, 18.45-21.27% *anhalonidine* and 8.96-9.08% *pellotine*.

T. schmiedickianus var. flaviflorus yielded 0.1-0.25% alkaloids, comprising traces of *mescaline* and N-methyl-*mescaline*, 0.8-1.32% *phenethylamine*, 3.0-3.16% *tyramine*, traces of N-methyl-*tyramine*, 91.34-92.76% *hordenine*, 2.43-3.35% O-methylanhalidine, traces of anhalinine, 0.76-1.0% *anhalonidine* and 0.08-0.22% *pellotine*.

T. schmiedickianus var. schwarzii yielded 0.25-0.5% alkaloids, comprising 2.29-2.67% *mescaline*, 3.18-3.36% N-methyl-*mescaline*, 2.74-3.04% trichocereine, 0.99-1.25% *phenethylamine*, 0.8-1.16% *tyramine*, traces of N-methyl-*tyramine*, 49.05-50.15% *hordenine*, 0.73-0.81% O-methylanhalidine, 29.2-29.28% anhalinine, 2.31-2.57% *anhalonidine* and 0.28-0.44% *pellotine*.

T. schmiedickianus var. dickisoniae was also analysed, but was devoid of *mescaline*, N-methyl-*mescaline*, or trichocereine (Štarha et al. 1999a).

Turbinicarpus schmiedickianus var. schwarzii is a solitary cactus c.4-5cm wide, to 5cm tall, body like **Lophophora** spp., pale green to bluish- or brownish-green; tubercles arranged in 5-8 spirals, 4-angled and completely flat, with fine spots; spines 1-5, usually only 1, to 2cm long, strong, long, curving upward, some projecting above the crown, pale to dark, soon falling off. Flowers white to lavender coloured, 3cm long, 2.5-4cm wide; fruit a laterally bursting berry.

Mexico [San Luis Potosi] (Cullmann et al. 1986; Innes & Glass 1991); usually under shrubs in heavy, black earth.

May be prone to rot, but can withstand low temperatures for brief periods (Trout & Friends 1999).

TURNERA

(Turneraceae)

Turnera diffusa *Willd. ex Schult.* **(T. aphrodisiaca** *Ward***; T. diffusa var. aphrodisiaca** *(Ward) Urb.***; T. humifusa** *Endl.***; T. microphylla** *Desv.***)** – damiana, Mexican damiana, mis kok ['asthma broom'], x misib kok, granizo, hierba de la pastora ['herb of the shepherdess'], hierba del venado ['herb of the deer'], oreganillo, mejorana, cumana, salvia amarilla ['yellow sage']

Turnera opifera *Cambess*

Turnera ulmifolia *L.* **(T. alba** *Liebm.***; T. angustifolia** *Mill.***; T. caerulea** *DC.***; T. mollis** *Kunth***; T. peruviana** *Willd. ex Roem. et Schult.***; T. trioniflora** *Sims***; T. velutina** *C. Presl***)** – la coquette ['the pretty one']

'Damiana' [T. diffusa] is a popular female aphrodisiac herb which has long been used by Mexican women, who may consume a cup of the infused herb several hours before sexual intercourse. It has sometimes been added to 'pulqué', the fermented drink made from Agave spp. [see *Methods of Ingestion*]. The Mayans used it to treat asthma, and as an aphrodisiac. The herb acts as a stimulating nerve tonic, diuretic, mild laxative, and antiperiodic, increases blood flow to the lower abdominal area, and is mildly irritating to the genito-urinary tract when excreted. A usual dose for infusion [or brief light decoction] is 2 tablespoons; the herb may be extracted more efficiently into alcohol. The herb may also be smoked for its mild euphoriant effects; good results may also be obtained by smoking the herb at the same time as drinking the tea, and smoking it mixed with other psychotropic herbs. Some find the smoke quite harsh, and prefer to smoke it through a water-pipe (Heffern 1974; Hutchens 1973, 1992; Jiu 1966; Miller 1985; Rätsch 1990; Siegel 1976). In general, women seem to find the effects of damiana stronger than do men (pers. comms.). Rat experiments have shown that the herb has little aphrodisiac effect in 'sexually potent' rodents, but produced improvements in impotent or sluggish animals (Arletti et al. 1999).

In Australia and other countries, the herb has been a common major ingredient of commercial 'mull-mix' herbal smoking mixtures intended for use with **Cannabis**, as an alternative to tobacco [see **Nicotiana**] (pers. obs.). However, few vendors seem to admit to the identity of any ingredients, and commonly claim the mixtures consist of 'horse chaff' [probably to discourage people from making their own]. Of course, given the number of rip-off merchants lurking around these days, it would not be unlikely that some people are being sold 'horse chaff'.

In Brazil, T. opifera and T. ulmifolia are made into a tea and drunk daily as a tonic. In the Republic of Seychelles, the latter is used to treat eye ailments (Rätsch 1990). In Mexico, Chrysactinia mexicana ['false damiana'] is sometimes used as a substitute for true damiana (Dominguez & Hinojosa 1976).

T. diffusa leaves have yielded 0.2-0.9% essential oil, containing 2% α-*pinene*, β-*pinene*, 11% 1,8-cineol [sometimes not present], p-cymene [sometimes not present], thymol, α-copaene, β-cadinene, calamenene and β-sitosterol; as well as arbutin, triocosanone, triacontane, hexacosanol-1, 14% resin, 3.5% tannin, 6% starch, the flavone gonzalitosin I [5-OH-7,3',4'-trimethoxyflavone], a cyanogenic glycoside and a bitter amorphous substance called damianin. *Caffeine* has also been reported, though this has not been followed up for verification (Dominguez & Hinojosa 1976; Hutchens 1973; Mabey et al. ed. 1990).

T. ulmifolia contains cyanogenic glycosides, including deidaclin; it is sometimes fed on by a **Heliconius** sp. (Spencer 1988).

Turnera diffusa is a shrub 30-200cm tall, with slender brownish branches. Leaves estipulate, alternate, oblong to rhombic-ovate, 1-2cm long, cuneate at base, acute to obtuse at apex, pilose to tomentose beneath, dark green and often glabrous or essentially so above, margin crenate-serrate to dentate, often with 2 glands at base; petioles short. Flowers axillary and usually solitary, perfect; calyx tubular or campanulate, 5-toothed, 4-5mm long, yellowish, the narrowly-lance-triangular teeth nearly as long as the tube; petals 5, bright yellow or orange-yellow, 8-12mm long, inserted on calyx tube, distinct, contorted in bud; stamens 5, inserted at base of corolla tube; anthers 2-celled, splitting lengthwise. Ovary superior, 1-celled, with 3 parietal placentae; style branches 3; stigmas fringed apically. Fruit a capsule 2.5-5mm long, loculicidally 3-valved, valves widely spreading at dehiscence, a placenta in the middle of each valve; seeds pitted, arillate. Fl. Jan.-Jul.

Dry ridges and hillsides; Lower Sonoran Zone to Tropical Zone, s. Baja California, central Sonora and Texas south through Mexico, the West Indies, and C. America to S. America (Shreve & Wiggins 1964).

Propagation from seed is very difficult due to naturally low seed viability. Export of live plants or seeds from Mexico is prohibited (Torsten pers. comm. 2001). Grow in good quality soil with full sun; water freely from spring to autumn, sparingly in winter. Grow outdoors in hot climates, in a greenhouse in colder climates. Harvest leaves when plant is flowering, and dry them in a cool, shady spot (Grubber 1973).

UNCARIA

(Rubiaceae)

Uncaria acida *(Hunt.) Roxb.*

Uncaria attenuata *Korth.*

Uncaria barbata *Merr.*

Uncaria borneensis *Havil.*
Uncaria callophylla *Korth.*
Uncaria canescens *Korth.*
Uncaria elliptica *R. Br. ex D. Don.*
Uncaria gambir *(Hunt.) Roxb.* **(Nauclea gambir** *Hunter***)** – gambir, pale catechu, khadir, katha
Uncaria guianensis *(Aubl.) Gmel.* **(U. aculeata** *Willd.***; U. spinosa** *Räuschel***; Nauclea aculeata** *(Willd.) Willd.***; Ourouparia guianensis** *Aubl.***)** – garabata
Uncaria nervosa *Elmer*
Uncaria orientalis *Guill.* – tevi-cow
Uncaria quadrangularis *Geddes* **(U. homomalla** *Miq.***; Uruparia homomalla** *(Miq.) Kuntze***)**
Uncaria rhynchophylla *(Miq.) Miq. ex Havil.* **(Nauclea rhynchophylla** *Miq.***; Ourouparia rhynchophylla** *(Miq.) Matsum.***)** – pale catechu, cho-to-ko, gou teng
Uncaria sessilifructus *Roxb.* **(U. tonkinensis** *Havil.***; Nauclea sessilifructus** *(Roxb.) D. Dietr.***; Uruparia sessilifructus** *(Roxb.) Kuntze***)** – gou teng, day cau muc
Uncaria sinensis *(Oliv.) Havil.* **(U. membranifolia** *F.C. How***; Nauclea sinensis** *Oliv.***)** – gou teng
Uncaria tomentosa *(Willd. ex Roem. et Schult.) DC.* **(U. surinamensis** *Miq.***; U. tomentosa var. dioica** *Bremek.***; Nauclea aculeata** *Kunth***; N. tomentosa** *Willd. ex Roem. et Schult.***; Ourouparia tomentosa** *(Willd. ex Roem. et Schult.) K. Schum.***)** – una de gato, cat's claw
Uncaria spp.

U. guianensis is used as an ayahuasca additive in Amazonia [see **Banisteriopsis**] (McKenna et al. 1995), though it is unclear whether its presence is for therapeutic or psychotropic reasons. A leaf decoction of the plant is sometimes made to treat dysentery (Usher 1974). U. tomentosa is used traditionally in Peru in the form of a bark infusion, to treat arthritis, gastritis, asthma, weakness, wounds, inflammation, menstrual difficulties, cancer and some skin diseases. It is also used as a disease-preventative tonic (Aquino et al. 1989; Jones 1995; Laus et al. 1997). In animal experiments, a water-extract of the herb has been shown to stimulate immune function and DNA repair, as well as being non-toxic with extended use (Sheng et al. 2000). Anti-tumour activity has also been reported (Mohamed et al. 2000). U. tomentosa has become popular in the west as an all-round tonic medicine, and as a result of its mass-consumption, it is becoming threatened in its natural range (Jones 1995; pers. comms.; pers. obs.).

Several Uncaria spp. are used in TCM [as 'gou teng'] – U. hissata, U. macrophylla, U. rhynchophylla, U. sessilifructus and U. sinensis are all used interchangeably. The dried stem and hooked thorns of the plants are used as an antispasmodic sedative to treat dizziness, hypertension-related headache, cerebral arteriosclerosis, and childhood epilepsy. The herb is also sometimes given in the 8th month of pregnancy, to reduce foetal movement and post-partum spasms (Bremness 1994; Huang 1993; Kanatani et al. 1984; Keys 1976). U. sinensis has been shown to improve "the disruption of spatial cognition in rats" (Mohamed et al. 2000).

U. sessilifructus bark is chewed in Indochina as a betel nut substitute [see **Areca**], and the leaves of U. gambir are sometimes chewed with betel nut. U. acida has been similarly employed (Cooke 1860; Gowda 1951; Phillipson et al. 1978; Usher 1974). Also in this part of the world, leaves of U. quadrangularis are often chewed as a 'kratom' substitute [see **Mitragyna**] (Tantivatana et al. 1979). It is said that elephants will become docile after having Uncaria spp. rubbed on them (Phillipson et al. 1978). A dried water extract of U. gambir young leaves and shoots constitutes the astringent drug 'pale catechu' or 'catechu pallidum' [see also **Acacia**] (Felter & Lloyd 1898).

'Gou teng' antagonises *caffeine*-induced CNS-stimulation and reduces cortical excitation, as well as lowering blood pressure over time. The drug contains indole-type alkaloids including rhynchophylline [stimulates respiration and lowers blood pressure in small doses, paralyses respiration and causes ataxia in high doses; antipyretic, paralyses sympathetic nerve endings], isorhynchophylline [competitive 5-HT2a receptor antagonist], corynoxeine, corynantheine [partial 5-HT receptor agonist, inhibits *serotonin* binding], isocorynoxeine [competitive 5-HT2a receptor antagonist], hirsutine [depresses nerve response] and hirsuteine (Harborne & Baxter ed. 1993; Huang 1993; Kanatani et al. 1984; Kawazoe et al. 1991; Keys 1976; Matsumoto et al. 2005). Indoles found in the genus, consisting mostly of representatives from the oxindole, hetero-*yohimbine*, β-carboline, roxburghine, and pyridinoindoloquinolizidinone groups, have varied physiological activities, and their presence in different species may vary greatly.

U. acida leaf has yielded 0.03-2.03% alkaloids, including *harman*, rhynchophylline and isorhynchophylline (Phillipson et al. 1978); others did not find any alkaloids (Kam et al. 1992).

U. attenuata leaf has yielded 0.03-2.32% alkaloids, including *harman*, corynoxeine, isocorynoxeine, rhynchophylline, isorhynchophylline, hirsuteine, dihydrocorynantheine [same *serotonin* activity as corynantheine – see above], dihydrocorynantheine pseudoindoxyl, epiallocorynantheine, uncarines A & B [isomers of *mitraphylline*], *mitraphylline*, isomitraphylline, akkuamigine, 3-iso-*ajmalicine*, 19-epi-3-isoajmalicine, speciophylline [uncarine D], pseudoyohimbine, rotundifoline, isorotundifoline, 7-OH-3-oxo-3,7-secorhynchophylline, 14-α-OH-rauniticine, rauniticine and salacin (Buckingham et al. ed. 1994; Harborne & Baxter ed. 1993; Phillipson & Hemingway 1975a; Phillipson et al. 1978).

U. barbata leaf has yielded 0.07-0.42% alkaloids, including *harman* (Phillipson et al. 1978).

U. borneensis has yielded *harman*, rhynchophylline, isorhynchophylline, corynoxeine, isocorynoxeine, allo-*yohimbine*, pseudoyohimbine and 3-epi-β-*yohimbine* (Kam et al. 1992; Phillipson et al. 1978).

U. callophylla leaves yielded dihydrocorynantheine, callophylline and gambirine as major alkaloids, as well as *yohimbine*, α-*yohimbine*, β-*yohimbine*, pseudoyohimbine and other alkaloids (Kam et al. 1992).

U. canescens leaf has yielded 0.09-1.79% alkaloids, including *harman* and unidentified oxindole alkaloids; stem yielded 0.53% alkaloids of similar composition (Phillipson & Hemingway 1975a; Phillipson et al. 1978).

U. elliptica leaf has yielded 0.19-1.69% alkaloids, including *harman*, roxburghines, rhynchophylline, *ajmalicine* and other alkaloids; stem has yielded 3.87% alkaloids (Phillipson et al. 1978); no roxburghines were found in another test (Kam et al. 1992).

U. ferrea [from Queensland, Australia] yielded 0.39% alkaloids from leaves and stems, consisting of pteropodine [uncarine C], isopteropodine [uncarine E], speciophylline and uncarine F. In mice, the total alkaloids [oral] had no effect at 100mg/kg; 250-1,000mg/kg resulted in death. In cats, 35mg/kg [i.p.] "led to weak CNS depression, spastic locomotion and crying". Given p.o. [50-100mg/kg], some analgesic and antipyretic effect was observed (CSIRO 1990).

U. gambir leaf has yielded up to 1.1% alkaloids, including tetrahydroalstonine, dihydrocorynantheine, rhynchophylline and other alkaloids; stems also yielded *mitraphylline* (Phillipson et al. 1978); others found no alkaloids (Kam et al. 1992).

U. guianensis has yielded 0.14% alkaloids from leaves [rhynchophylline, isorhynchophylline] and 0.04% from stems [50% speciophylline, 40% pteropodine and 10% *mitraphylline*] (Lavault et al. 1983; Phillipson et al. 1978).

U. longiflora leaves have yielded 1.3% alkaloids, including *mitraphylline*, isomitraphylline, speciophylline, pteropodine, isopteropodine, and their N-oxides, as well as uncarine F (Phillipson & Hemingway 1973a).

U. macrophylla leaves yielded 0.14-0.42% alkaloids, including rhynchophylline, isorhynchophylline, corynoxine [not the same as corynoxeine] and corynoxine B (Phillipson & Hemingway 1973b).

U. nervosa has yielded *harman* and other alkaloids (Phillipson et al. 1978).

U. orientalis leaf has yielded 0.11-1.72% alkaloids, including *harman*, *mitraphylline*, *mitraphylline* N-oxide, isomitraphylline, isomitraphylline N-oxide, pteropodine, pteropodine N-oxide, isopteropodine, isopteropodine N-oxide, *ajmalicine* and speciophylline N-oxide (Phillipson & Hemingway 1975a; Phillipson et al. 1978).

U. quadrangularis leaves have yielded *mitraphylline* and isomitraphylline; bark has yielded pteropodine and isopteropodine (Tantivatana et al. 1979).

U. rhynchophylla – see 'gou teng' above; also, extracts of U. rhynchophylla have shown strong binding to α-2 adrenoreceptors, 5-HT1, 5-HT1A, *dopamine*-1, *GABA*a, *GABA*b and opiate receptors, as well as to the Ca+2 channel (Zhu et al. 1996a).

U. sinensis stems and hooks have been shown to contain rhynchophylline, isorhynchophylline, corynoxeine, isocorynoxeine, hirsutine, hirsuteine, corynantheine, dihydrocorynantheine and geissoschizine methyl ether [inhibits *serotonin* binding, partial 5-HT receptor agonist] (Kanatani et al. 1984).

U. tomentosa root bark has yielded *mitraphylline*, isomitraphylline, speciophylline, uncarine, pteropodine and isopteropodine; the plant has also yielded rhynchophylline, isorhynchophylline, isoajmalicine, akkuamigine, dihydrocorynantheine, corynoxeine, isocorynoxeine, tetrahydroalstonine, speciophylline, hirsutine and hirsuteine (Laus et al. 1997; Sturm & Stuppner 1992). Powdered commercial material [probably stem-bark] yielded 0.35% crude alkaloids, including 0.106% isopteropodine, 0.025% pteropodine, 0.005% *mitraphylline*, 0.027% isorhynchophylline and 0.003% rhynchophylline. An extract of the total alkaloids, as well as the individual constituents rhynchophylline, isorhynchophylline and isopteropodine [as well as pteropodine and *mitraphylline*, which were less potent], antagonised the memory-deficit induced by *hyoscine* (Mohamed et al. 2000).

Harmine and *harmaline* have been said to reside in the genus (Shulgin & Shulgin 1997), though this may be in error, as is the similar generic claim for *mitragynine* (Buckingham et al. ed. 1994), which refers to Phillipson & Hemingway (1975b), who refer to these alkaloids as reference compounds, but do not mention their extraction from, or detection in, any Uncaria spp. Chemical variation within species exists with this genus, and chemotypes probably exist (Laus et al. 1997).

In U. rhynchophylla, and probably other Uncaria spp., oxindole alkaloid content in stem and hooks is highest in the stem parts nearest to the

hooks (Kawazoe et al. 1991).

Uncaria quadrangularis is a climbing shrub, branches 4-angled, hooked, at first pubescent, later glabrous. Leaves ovate-elliptic, apex acuminate, base truncate, 7.5-11.5 x 2.5-4.5cm, upper side reddish-brown, especially near nerves puberulous, under side yellowish-brown, pubescent, lateral nerves on both sides 6, prominent on under side; petiole 6mm long, upper side canaliculate, pubescent, subtended with lanceolate stipules, bifid, 5mm long. Flowers in axillary, solitary heads 2.5cm diam., peduncle 3-4cm long, puberulous, soon subtended with hooks, bracteolate; calyx tube 2mm long, base pilose, bearing long hairs, lobes 5, linear, 1mm long, ciliate; corolla tube 6mm long, externally pubescent, lobes 5, obtuse, 2mm long, upper surface pubescent; stamens 5, filaments very short, attached near base of corolla tube; anthers 1.5mm long, apex obtuse, base sagittate. Ovary 2-loculate; style c.11mm long; stigma fusiform, 2.7mm long.

In scrub, 1300m, Nan, Pu Huat; Siam (Geddes 1928).

UROLOPHUS

(Urolophidae/Dasyatidae)

Urolophus jamaicensis *Cuvier* **(U. torpedinus** *M. et H.***; Urobatis sloani** *Garman***)** – yellow stingray, raya

The pre-Columbian Maya apparently used stingray spines [the stings], often by drawing strings of them through the tongue or other body parts, in the performance of ritual blood-letting. This was a practice of spiritual importance which is thought to have been intended to bring one into contact with the 'vision serpent' as part of the ordeal (Schele & Miller 1986). There is some suggestion that the venom of the species used [thought to have been U. jamaicensis] served as an aphrodisiac and intoxicant at the same time (Rätsch 1992).

Normally, these stingrays sting if stepped on, whipping their tails around from one side to lacerate the flesh with their sting apparatus. The sting possesses a sheath, which is easily damaged and is torn when it enters the skin, exposing the dentate sting itself, and the venom is then released. The main symptom of a sting is pain. Low doses of the venom may cause either peripheral vasodilation or vasoconstriction, while larger doses cause only vasoconstriction. The venom affects the CNS, and other symptoms include irregularities in breathing and heart-rate, vomiting, diarrhoea, sweating and hyperactivity, followed by ataxia and sometimes convulsions.

The venom consists of c.30% protein, 3% nitrogen, 3% carbohydrate, *serotonin*, 5-nucleotidase and phosphodiesterase. It loses its toxicity after 4-18 hours at room temperature, but is more stable at lower temperatures or in 20-40% glycerol (Halstead 1988).

Urolophus jamaicensis is a small stingray to 76cm long; disc (body) smoothly rounded, rhomboid, longer than wide, snout slightly pointed; tail shorter than the disc and with a distinct tail fin at its extremity; tail with a venomous spine near the end, a serrated dagger close to the tail fin. Densely spotted with yellow dots on a variable brownish dark background, with larger pale blotches around disc; ventrally yellowish-white.

Confined to shallow water, usually on sandy or muddy bottoms. It buries itself in the seabed by flapping its pectoral fins, and is said to feed on small fish, shrimps and worms it disturbs. They also raise the front of their disc to form a tunnel to attract prey seeking shelter. Gives birth to live young in litters of 3-4. Easily approached, very common in harbours and bays.

West tropical Atlantic from s. Caribbean to Florida, occasionally to N. Carolina (Halstead 1988; Lieske & Myers 1994).

URTICA

(Urticaceae)

Urtica dioica *L.* **(U. galeopsifolia** *Wierzb. ex Opiz***)** – common nettle, stinging nettle
Urtica parvifolia *Buch.-Ham.* – stinging nettle
Urtica pilulifera *L.* – Roman nettle, stinging nettle

Most people know of nettles only as the small weeds that cause a painful sting when touched [the sting loses its power when the herb is heated or dried], though the juice of the plant can treat the same sting! The cooked young greens make a nutritious vegetable, and the plant is also an excellent fertiliser. The whole plant is used to treat digestive problems, haemorrhoids, skin complaints, arthritis and gout, stimulate circulation, and act as an astringent diuretic. The rhizome may be used as a scalp tonic, and the seeds treat tuberculosis and bronchitis. It also has a reputation as a blood purifier, probably due to its nutritive and diuretic properties (Bremness 1994; Chevallier 1996; Chiej 1984). Magically, nettles have been used to ward off negative influences, or to induce lust (Cunningham 1994). One means of attaining these aphrodisiac effects is to whip your partner's naked genitals with the fresh plants (Rätsch 1990! A friend reported enjoying a satisfying stimulation from smoking commercially obtained dried nettle leaves [possibly U. dioica] (Baill pers. comm.), which might be explained by some of the known chemical constituents of these herbs.

U. dioica contains *serotonin*, *histamine* and *acetylcholine* in the stings, leaves, and stems (Collier & Chesher 1956; Smith 1977b); the herb also has yielded *acetophenone* (Harborne & Baxter ed. 1993) and glucoquinone, and is rich in minerals, such as iron, calcium, potassium and silicic acid (Chevallier 1996). Roots contain *scopoletin*, lignan glucosides, flavonol glycosides and phenylpropanoids (Chaurasia & Wichtl 1987).

U. parvifolia contains *serotonin*, *histamine* and *acetylcholine* in the leaves (Rastogi & Mehrotra ed. 1990-1993).

U. pilulifera leaf and stem contain *serotonin* (Smith 1977b) and *bufotenine* (Regula 1973a).

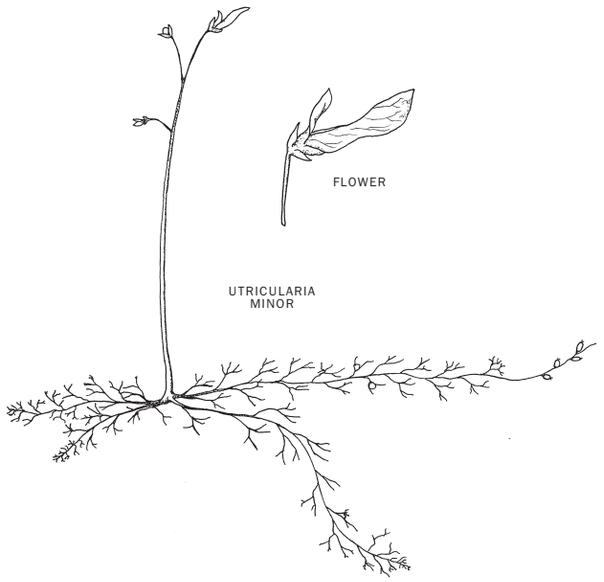
Leaves and stems of U. cubensis, U. ferox, U. membranacea and U. thunbergiana [but not U. urens] contained *serotonin* at levels of 0.000042-0.000126% [w/w]; *serotonin* was also found in the isolated stings of these first 4 species (Regula & Devide 1981).

Urtica pilulifera is an annual, monoecious herb 30-100cm tall, with stinging hairs. Leaves opposite, 2-6cm long, ovate, truncate to subcordate at base, serrate or entire, green below; petiole almost as long as leaf blade; 4 stipules at each node, free. Inflorescence an axillary unisexual raceme, with clustered cymes; females long-pedunculate spikes with flowers in globose heads; males spicate. Female flowers with inflated, deeply-lobed 4-merous perianth, perianth segments +- unequal, the 2 larger enclosing the achene; often with small staminodes; ovary superior, 1-locular, sometimes adnate to perianth; ovule 1, orthotropous; style simple. Male flowers with 4 stamens opposite the perianth segments, inflexed in bud, often with rudimentary ovary. Fruit an achene; seeds usually with endosperm, embryo straight.

S. Europe, often naturalised elsewhere (Tutin et al. ed. 1964-1980).

UTRICULARIA

(Lentibulariaceae)



Utricularia minor *L.* – lingna, bladderwort

In Ladakh, deep in Himalayan India, the dried, powdered leaves of this small aquatic plant are first roasted on a flat stone [which is being heated on a fire], before being mixed with water and kept underground in a tightly sealed bottle for 10-15 days. The resulting drink is usually consumed only in winter, and is highly intoxicating, occasionally causing death (Navchoo & Buth 1990).

The chemistry of this plant is relatively unknown. Perhaps the presence of a toxic and psychoactive mould [eg. see **Aspergillus**] in the preparation explains some of the above effects. Such a mould could feasibly enter the bottle through air or soil exposure prior to sealing, being prepared in [presumably] unsterile conditions. It is also possible that the plant collects its own active chemicals by leaching toxic algal metabolites from the water [see **Acanthurus et al.**]. The carniverous bladder-traps of some Utricularia spp. have been shown to contain thriving algal populations [especially Cyanophyta] (Botta 1976; Mosto 1979). However, some carniverous plants are known to produce their own toxic psychoactive alkaloids, such as *coniine* produced by Sarracenia flava (Mody et al. 1976).

U. minor from Sweden tested positive for the presence of c.0.003% al-

kaloids (Hultin & Torssell 1965).

The related U. australis has yielded iridoid glycosides, including 0.014% aucubin, 0.0003% gardoside, 0.005% mussaenosidic acid and 0.01% 6-deoxycatalpol (Damtoft et al. 1985).

Utricularia minor is an aquatic herb, with stems creeping on the bottom of shallow water; stems often 10-30cm long, leafy. Leaves alternate, once to several times finely to dichotomously branched, rarely up to 8mm long, often bearing 1-2 bladders; width of segments scarcely reduced after each successive dichotomy, the ultimate segments flat, entire, sharply acuminate; leaves at base of scape linear or spatulate, often evanescent before flowering; scales of scape and branches attached by their bases. Peduncles up to 15cm long, 2-8-flowered, usually minutely bracteate, bearing around the middle a cluster of oblong vesicles; pedicels bracteate and often 2-bracteolate, soon becoming curved and the capsules nodding; scapes simple or branched; racemes few- or many-flowered, rising above the surface of the water; flowers yellow; calyx 2-partite, lobes equal and entire or nearly so, often enlarged in fruit; corolla 8-9mm, 2-lipped, spurred, spur reduced to a mere sac, upper lip entire or emarginate, lower lip 3-6-lobed, 4-8mm long, c. twice as long as upper; palate hardly developed; filaments broad; anthers ovate, 2- or sub-1-celled. Style short; stigma unequally 2-lobed. Capsule globose, as long as calyx; seeds smooth, ellipsoid or ovoid, scrobiculate or glochidiate, testa reticulate. Fl. summer.

Sometimes washed ashore and blooming in wet soil – under these circumstances the dissected leaves may be scarcely apparent, and may be mistaken for other species; it is distinguished by its basally attached lateral bracts.

Alpine w. Himalaya, 3350m; Europe, w. & c. Asia, Greenland, Canada, south to Virginia, Indiana, California and S. Carolina (Gleason 1952; Hooker 1875-1897).

Utricularia spp. are interesting carniverous plants, mostly of aquatic habit. They are called 'bladderworts' because of the bladder-shaped traps which grow from the leaves of aquatic species, and from any part of terrestrial and epiphytic species. These traps are 'set' by expelling water from within themselves, producing a low internal pressure and sealing the door of the trap shut. The bladders have 'hairy' protrusions which funnel the prey [small creatures such as insects and baby fish] close to the door of the trap. Brushing past these hairs triggers the door of the trap to open, causing an influx of water, carrying the prey. The door then shuts and the prey is consumed by the activity of enzymes and bacteria living within the bladders, before the trap re-sets itself to await further food (Pietropaolo & Pietropaolo 1986).

VACCINIUM including some Sclerotinia parasites

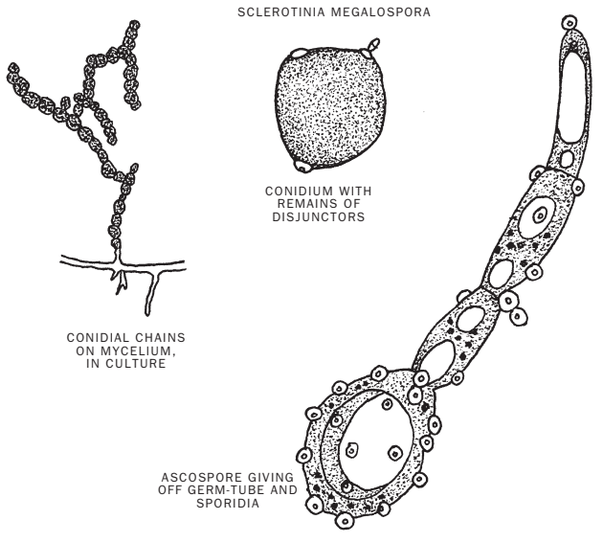
(Ericaceae)

Vaccinium floribundum *Kunth* **(V. crenulatum** *Dunal***; V. dasygynum** *Blake***; V. marginatum** *Dunal***; V. moritzianum var. ovatum** *Klotzsch***; V. mortinia** *Benth.***; V. polystachum** *Benth.***; V. ramosissimum** *Dunal***; V. tatei** *Rusby***; Metagonia marginata** *(Dunal) Nutt.***)** – Andean blueberry, Colombian blueberry, borrachero ['intoxicant'], agraz, chivaco, macha-macha, mortiño

Vaccinium uliginosum *L.* **(V. gaultherioides** *Bigalow***; V. pedris** *(Harshb.) Holub***; V. pubescens** *Wormsk ex Hornem.***; Myrtillus uliginosa** *(L.) Drejer***)** – bog bilberry, bog blueberry, bog whortleberry, northern bilberry, alpine blueberry, trunkelbeere ['drunken berry'], rauschbeere ['inebriating berry'], schwindelbeeren ['dizzy berries'], odon, juolukka

Vaccinium vitis-idaea *L.* **(V. jesoense** *Miq.***; V. vitis-idaea var. genuinum** *Herder***; Rhodococcum vitis-idaea** *(L.) Avror.***)** – cowberry, bog cranberry, rock cranberry, mountain cranberry, foxberry, partridge berry, lingonberry, whortleberry, whimberry, kokemomo

(Helotiae)



Sclerotinia megalospora *Wor.*
Sclerotinia minor *Jagger*

V. uliginosum, a small Eurasian bush, is closely related to the large cranberry [V. macrocarpon], small cranberry [V. oxycoccus], blueberry [or 'bilberry', 'wimberry'; V. myrtillus] and the dingleberry ['mountainberry'; V erythrocarpon]. It was once [and possibly still is] used in Siberia for its berries, which were mixed with **Amanita** muscaria preparations for consumption, and said to have an intoxicating and narcotic effect. Today in Germany and Austria, the berries are reputed to have toxic properties, and children are warned not to eat them lest they "lose their wits". However, despite sometimes causing mild intoxication, the berries are usually considered edible (Rätsch 1992; Von Bibra 1855). Some people have eaten huge quantities with no effect, while one subject reported dizziness, tiredness, visual troubles, bursts of heat and difficulty swallowing after eating 300g of the berries. The typical intoxication also includes psychomotor excitation, mydriasis and vomiting. It has been proposed that the effects may be due to the obscure ascomycete [Sclerotinia megalospora] which often grows parasitically on the leaves and berries, as well as on berries of Empetrum nigrum ['crowberry'] (Festi & Samorini 1996; Von Tubeuf 1897), which has been known as 'rauschbeere' ['inebriating berry'] (Rätsch 1992). Perhaps psychoactive compounds are produced by the plants in response to fungal infection (theobromus pers. comm.). Unfortunately, the chemistry and toxicology of Sclerotinia spp. has been poorly studied, with most research focusing on methods for their eradication from plant crops.

Shakers of N. America smoked V. vitis-idaea as a favoured replacement for **Arctostaphylos**, and it may have inebriating properties (Emboden 1979a). V. reticulatum, a Hawaiian endemic species often growing on new lava flows, is known as ''ôhelo' or ''ôhelo-'ai', and its fruiting branches are thrown into a fiery pit at Kilauea as an offering to Pele, the volcano goddess. The berries are edible, and the dried leaves are sometimes made into a tea (Palmer 2001; Pukui & Elbert 1971). V. floribundum is known as 'borrachero' ['intoxicant'] in Venezuela, and is thus suspected of being psychoactive (Festi & Samorini 1996). Blueberry [V. myrtillus] fruits are used to make a wine in central Europe called 'Heidelbeersejt', or 'Heidelbeerwein', which may be distilled to make a spirit known as 'Heidelbeergeist' (Usher 1974).

V. corymbosum fruits have been shown to contain a large number of compounds, including *eugenol*, iso-*eugenol*, *myristicin* and α-*pinene* (Hirvi & Honkanen 1983).

V. myrtillus leaves, stems, and fruits were shown to contain monotropein [see **Monotropa**] (Swiatek & Komorowski 1973) and arbutin (Trzaski 1954), though another study found no arbutin in the leaves (Walewska 1966); leaves have also yielded hydroquinone [in cats, hydroquinone was toxic orally either in repeated doses of 30-50mg/kg, or single doses of 60-100mg/kg, causing haemolysis and eventual death from respiratory paralysis] (Oettel 1937). The plant has given positive tests for the presence of alkaloids (Zolotnitskaya 1954). Fresh aerial parts yielded traces of the quinolizidine alkaloids myrtine and epimyrtine, via a mild extraction (Slosse & Hootelé 1978, 1981). Berries have been shown to contain a large number of compounds, including methyl-salicylate, *eugenol* and iso-*eugenol* (Hirvi & Honkanen 1983). The leaves of this species are often infected by Sclerotinia baccarum (Von Tubeuf 1897).

V. oxycoccus fruits have yielded β-carboline alkaloids called cannaguinines (Jankowski et al. 1972, 1974).

V. uliginosum leaves have yielded the triterpenes friedelin, ursolic acid and α-amyrin; the sterols β-sitosterol and β-sitosterol-β-D-glucoside;

and condensed tannins. They may also contain oleanolic acid (Nees et al. 1973). Arbutin has been found in the plant (Trzaski 1954). The berries have been found to contain quercetin-3-monogalactoside (Kawaguti et al. 1939), acetic acid, hexanoic acid, hexan-1-ol, cis-3-hexan-1-ol, trans-2-hexen-1-ol, hexanal, trans-2-hexenal, benzyl alcohol, benzaldehyde, α-terpineol, phenol, 4-vinylphenol, 2-MeO-5-vinylphenol, 2-phenylethanol, trans-cinnamylalcohol, and traces of limonene, linalool, myrcenol, nerol, pentan-1-ol, 3-methylbutan-1-ol, octan-1-ol, pentylfuran, vanillin, guaiacol and pyrocatechol (Hirvi & Honkanen 1983).

V. vitis-idaea leaves and stems have yielded monotropein (Swiatek & Komorowski 1973), and up to 10.4% arbutin (Fromard 1985; Trzaski 1954); highest arbutin levels were found in leaves, with highest yields obtained in late summer and autumn (Drathschmidt & Zechner 1939). Pyroside is present in fully-developed leathery leaves, and not in young leaves (Walewska 1966). Leaves have also yielded hydroquinone (Oettel 1937) and quercetin-3-monogalactoside (Kawaguti et al. 1939). V. vitis-idaea leaves and berries are often infected by Sclerotinia vaccinii [S. urnula]; S. oreophila has also been observed on the leaves (Von Tubeuf 1897).

Sclerotinia libertiana [S. sclerotiorum] growing on **Brassica** napus yielded an unidentified alkaloid with uterotonic properties. This species is also found on other vegetable plants, particularly of the Leguminosae (Gradnik 1951).

S. minor mycelium and sclerotia have shown anticholinergic properties, and have been found to contain an alkaloid that was tentatively identified as either *atropine* or *hyoscyamine* (Mutschler & Rochelmeyer 1960).

Vaccinium uliginosum is a deciduous shrub, with stems up to 75(-100)cm, erect, freely branched, arising from a creeping rhizome; twigs terete, usually glabrous, brownish. Leaves alternate, subsessile or very shortly petiolate, 6-25(-35) x 4-12(-20)mm, obovate, entire, obtuse to subacute, glabrous, glaucous, margin slightly revolute. Flowers 4-5-merous, in racemes of 1-3 which terminate short branches bearing only scale-leaves; bracteoles absent; sepals largely, often almost completely connate; calyx lobes rounded, scarious, reddish; corolla rotate to globose, 4-6mm, urceolate, white, usually tinged with pink; lobes short, revolute; stamens 8 or 10; filaments glabrous; anthers with small, subulate appendages, each lobe prolonged apically into a tube with a pore at apex. Ovary included; style inferior. Fruit a berry, 7-10mm, globose to ellipsoid, bluish-black, sweetish.

Widespread in moors, heaths, coniferous woods, subalpine pastures and tundras; n. & c. Europe, extending southwards in mountains to Sierra Nevada, n. Appennini, Albania and Bulgaria (Tutin et al. ed. 1964-1980).

Sclerotinia megalospora is noticeable on the leaf and fruit of the infected plant; observed as a white conidial cushion on midrib of leaf, causing it eventually to wither; sclerotia take over the berry by 'mummification', turning it white and deformed; sclerotia give rise to smooth stalked cup-like ascocarps, their stalks not producing rhizoids; asci containing 8 unicellular hyaline spores, elliptical or spindle-shaped, of varying size; conidia forming chains from mycelium; paraphyses thread-like; rhizoids absent; ascospores large, similar to each other, in a gelatinous envelope, later giving off a germ tube and sporidia; sporocarps consisting of a pseudoprosenchyma (Von Tubeuf 1897).

S. libertiana ['cottony softrot', 'watery softrot', 'white mould'] is a common fungal disease of many plants, particularly **Camellia** spp., Chrysanthemum spp., Dahlia spp., **Narcissus** spp. and **Nicotiana** spp. (Fox 1996).

VALERIANA and some close relatives

(Valerianaceae)

Valeriana adscendens *Trel.* – hornamo morado
Valeriana angustifolia *Turcz.* **(V. officinalis var. latifolia** *Miq.***)**
Valeriana alliariifolia *Vahl*
Valeriana capensis *Thunb.*
Valeriana celtica *L.*
Valeriana dioica *L.*
Valeriana edulis ssp. procera *(Kunth) F.G. Mey.* **(V. 'mexicana'** *DC.***)**
Valeriana excelsa *Poir.*
Valeriana glechomifolia *Meyer*
Valeriana kilimandscharica *Endl.*
Valeriana officinalis *L.* **(V. baltica** *Pleijel***; V. exaltata** *J.C. Mikan***; V. hortensis** *Lam. nom. illeg.***; V. palustris** *Kreyer, non Gars***; V. sylvestris** *S.F. Gray***)** – common valerian, all heal, setwall, garden heliotrope, bloody butcher, vandal root, Capon's trailer, phu, antamilla, tagara, sugandhwala
Valeriana palustris *Gars*
Valeriana phu *L.*
Valeriana sambucifolia *Mik.*
Valeriana simplicifolia *(Rchb.) Kabath*
Valeriana sitchensis ssp. scouleri *(Rydb.) Piper* **(V. scouleri** *Rydb.***)** – Pacific valerian
Valeriana thalictroides *Graebn.*
Valeriana tiliifolia *Troitzky*
Valeriana tripteris *L.*
Valeriana wallichii *DC.* **(V. harmsii** *Graebn.***; V. jatamamsi** *Jones***; V. mairei** *Briq.***; Nardostachys jatamamsi** *(D. Don) DC.***)** – jata mamsi, nakpo, somana, sungandhaval, Indian spikenard
Valerianella olitoria *(L.) Poll.* **(V. locusta** *(L.) Later.***)**
Centranthus angustifolius *(L.) DC.*
Centranthus calcitrapa *(L.) Dufr.*
Centranthus longiflorus *Steven*
Centranthus macrosiphon *Boiss.*
Centranthus ruber *(L.) DC.* – red valerian
Fedia cornucopiae *(L.) Gaertner*
Fedia sulcata *Pomel*
Patrinia scabiosifolia *Fisch. ex Trevir.*
Plectritis spp.

The generic name Valeriana derives from the Latin valere, 'to be in health'. Cats and rats are attracted by the smell of valerian, and it has even been said that the Pied Piper of Hamelyn carried valerian root to lure the rats away from the town, his music being a decoy. The powdered root is sometimes used as 'graveyard dust' in magical practices. The Greeks hung a sprig of it under windows to dispel evil; it was also said to attract lightning and bring a lover. The root used to enjoy huge popularity as a nervine sedative [since the late 16th century in Europe], particularly for symptoms of the so-called 'women's hysteria' or 'vapours'. It returned to popularity during the first two World Wars, for treatment of shell-shock and nervous stress. Valerian root has been used historically by Persian, Nordic, Indian and Chinese herbalists. In Ayurveda and TCM, V. wallichii is used as well as V. officinalis. V. wallichii is said to have similar properties to V. officinalis, yet is more desirable for 'strengthening the mind and promoting awareness'. Excessive use of V. officinalis, however, is said to dull the mind. The most notable property of valerian is its strong nervine action, excellent for promoting sleep. Some studies, and practical experience, have found it to act as a sedative for agitated people, and as a stimulant in the fatigued; old roots are more likely to produce stimulation. It may also be less effective for younger, more energetic people. It has been used to treat anxiety, nervous tension, depression, insomnia, headache, stomach cramps, irritable bowel, diarrhoea, bloating, muscle pain, bronchial spasms, cough, nervous heart conditions, bedwetting, Parkinson's disease and PMS (Bremness 1988; Cunningham 1994; Emboden 1979a; Hobbs 1993; Frawley & Lad 1986; Lawless 1995; Leathwood et al. 1982; Nadkarni 1976; Tucker & Tucker 1988).

The root of the related V. capensis from S. Africa is used for epilepsy and hysteria, and has antispasmodic actions (Watt 1967). In Peru, V. adscendens aerial parts are sometimes added to brews prepared from **Trichocereus** pachanoi to increase the effects; the whole plant has strong purgative properties (Davis 1983; De Feo 2003). In Nepal, V. wallichii rhizome is used in ritual incense (Müller-Ebeling et al. 2002).

Centranthus spp. are also well known sedatives, with chemistry similar to that of Valeriana spp., and C. longiflorus is used as such in Turkey (Demirezer et al. 1999). Though Fedia spp., Patrinia spp. and Plectritis spp. do not have any notable use to date, they also bear similar chemistry or effects to Centranthus spp. and Valeriana spp., and might potentially be used in the same way (Foerster et al. 1984; Funke & Friedrich 1975).

The active compounds in Valeriana and Centranthus are monoterpenoid iridoid esters called valepotriates [sedative, spasmolytic, anticonvulsant, increase *GABA* levels, reduce alcohol-induced concentration deficits; cytotoxic and mutagenic in large amounts], the most important being the valtrates [*valtrate*, isovaltrate, *dihydrovaltrate*, acevaltrate, homovaltrate and IVHD-*valtrate*]; essential oil components [sesquiterpenes]; and small amounts of alkaloids. The valepotriates are unstable, and decompose rapidly to baldrianal and homobaldrianal with the influence of heat, water or stomach acids. These latter two compounds are better absorbed than the valepotriates, and have stronger sedative qualities. Drying the root causes enzymatic formation of isovaleric acid, which creates the characteristic odour of dried valerian root [described by some as 'mousy', or like old socks]. Essential oil makeup is very variable. Excessive use can cause excitability, headaches, uneasiness, insomnia and cardiac irregularities; very high doses can cause CNS paralysis, and should be treated with gastric lavage, charcoal and sodium sulfate.

Fresh or freshly dried roots are more desirable than old roots; most potency may be lost after 1 year. A dose of 1 tsp ground root may be sufficient. The herb may be extracted into alcohol and water as a tincture, or may be steeped as a tea; although the valepotriates and essential oil are not water-soluble, water extracts still have activity (Foerster et al. 1984; Fugh-Berman 2000; Hendricks et al. 1981; Hobbs 1993; Wagner et al. 1980). The official drug consists of the rhizome, roots and stolons, dried below 40°C (Bruneton 1995).

Valeriana adscendens aqueous extract has CNS-depressant effects, and inhibits *GABA* uptake (De Feo 2003).

Valeriana angustifolia has yielded 0.5-6% essential oil [51% acetate, 16% camphene, 7% α-*pinene*, 6.5% β-*pinene*, 5.5% carveyl acetate, 2% limonene, 2% dihydrocarveyl acetate], valepotriates, kanokosides A, B, C

& D, and kessane derivatives. The essential oil is protective against pulmonary oedema in rats, contracts coronary vessels, and is antiarrhythmic (Hobbs 1993).

V. celtica essential oil contains 1.3% *nepetalactone* [see **Nepeta**] (Tucker & Tucker 1988), and mostly isovaleric acid, seychellene and patchouli alcohol [53.4% combined] (Hobbs 1993).

V. edulis ssp. procera root has yielded 7-8% valepotriates (Bruneton 1995; Dossaji & Becker 1981), including *valtrate*, isovaltrate and *dihydrovaltrate* (Hobbs 1993).

V. glechomifolia [harv. Apr., s. Brazil] yielded *valtrate*, acevaltrate, diavaltrate, *dihydrovaltrate*, AHD-*valtrate*, 1-β-aceacevaltrate and dihydrocornin; aerial parts and roots had similar chemical composition (Salles et al. 2000).

V. kilimandscharica has yielded valepotriates including isovaltrate and *valtrate* [major constituents], and traces of *dihydrovaltrate*, acevaltrate and IVHD-*valtrate*; leaves yielded up to 5.89% valepotriates, 5.15% in rhizomes, 3.84% in flowers and 3.17% in stems (Dossaji & Becker 1981).

V. officinalis root has yielded up to 1% essential oil, including valerenic acid, 3-16% valerenal, 0-18% valeranone, valerenol, OH-valerenic acid, acetoxyvalerenic acid, valerenyl esters, valerenone, valene, 0.7-8.6% pacifigorgiol, 2-12% elemol, 9-10% α-kessyl alcohol, maali alcohol, patchouli alcohol, 31% bornyl acetate, 8.2% carvone, 4.3% thymol, isovalerate, caryophyllene, camphene, *pinene*, *borneol*, myrtenol, myrcene, limonene, phellandrene, carvacrol, terpinene, terpinolene, p-cymene, α-fenchene, guaidol, eudesmol, bisabolol, cadinene, curcumene, ergonophylene, kessane, azulene, β-ionone, faurinone, bornyl formate, 1-myrtenyl acetate, 1-myrtenyl-isovalerianate, valenol, kanokonole, *valtrate* and valeridin. Root has also yielded 0.2-2% valepotriates, including *dihydrovaltrate* [breaks down to valtroxal, which is a more effective sedative], isovaltrate [0.25-0.75% of whole root], acevaltrate, isovaleroxy-OH-*dihydrovaltrate*, *dihydrovaltrate*-hydrin [valechlorine], *valtrate*-hydrine B1, *valtrate*-hydrine B2, acetoxyvaltrate-hydrine, and valepotriate glycosides valerisodatum, patrinoside, kanokosides A & B; carboxylic acids, including isovaleric, malic, stearic, palmitic and acetic acids; alkaloids *actinidine* [see **Actinidia**], 8-MeO-*actinidine*, isovaleramide, 0.01% chatinine, 0.01% valerianine, Δ-methylpyrrylketone and dipyridylmethylketone; as well as isoeugenyl-isovalerate, behenic acid [see **Calonyction**], hesperitinic acid, *chlorogenic acid*, caffeic acid, luteolin, diosmetin, kaempferol [MAOI (Sloley et al. 2000); in aerial parts], arachidonic acid, *choline*, *GABA*, *glutamine*, *tyramine* and tannins. Valepotriate content decreases in autumn (Bruneton 1995; Hobbs 1993; Johnson & Waller 1971; Nadkarni 1976; Pethes & Verzár-Petri 1977; Tucker & Tucker 1988).

V. sitchensis ssp. scouleri has yielded 1.12% valepotriates from roots, and 0.033% from leaves, as well as a large quantity of essential oil (Hobbs 1993).

V. thalictroides roots have yielded 14.5% valepotriates, consisting mainly of isovaltrate, as well as *valtrate*, IVHD-*valtrate*, *dihydrovaltrate*, homovaltrate and acevaltrate, in decreasing order of magnitude (Becker et al. 1983).

V. wallichii root has yielded 2.8-3.5% valepotriates, and the flavonoid linarin-isovalerianate, as well as alkaloids; leaf has yielded 1% valepotriates (Bruneton 1995; Dossaji & Becker 1981; Funke & Friedrich 1975; Hobbs 1993). The defatted extract has good sedative properties (Chatterjee et al. 1965).

V. alliariifolia, V. dioica, V. excelsa, V. palustris, V. phu, V. sambucifolia, V. simplicifolia, V. tiliifolia, V. tripteris, Valerianella olitoria, Centranthus angustifolius, C. calcitrapa and C. macrosiphon also contain valepotriates (Funke & Friedrich 1975).

C. longiflorus ssp. longiflorus aerial parts yielded the iridoid glycosides patrinoside and kanokoside A, the valepotriate *valtrate*-hydrine B8, the iridoid lactone longiflorone, quercetin 3-O-rutinoside, oleanolic acid and sitosterol (Demirezer et al. 1999).

C. ruber has yielded 5-7% valepotriates from roots, and up to 1% from leaves, including *valtrate*, acevaltrate, *dihydrovaltrate*, homoacevaltrate, acetoxy-OH-*dihydrovaltrate* [AHD-*valtrate*] and deiso-valeroxy-acetoxyvaltrate; as well as gentioside, gentioflavoside, gentioflavine, gentiopicroside, gentianine, gentianidine and swertiamarin; as well as a small quantity of essential oil (Funke & Friedrich 1975; Handjieva et al. 1978; Hobbs 1993; Marekov 1977).

Fedia cornucopiae and F. sulcata contain valepotriates (Funke & Friedrich 1975).

Patrinia scabiosifolia has yielded 0.1% essential oil [containing patrinine and isopatrinine], as well as isopentanoic acid and saponins [patrinosides]. The essential oil and saponins have sedative and hypnotic actions in humans (Hobbs 1993).

Plectritis brachystemon, P. ciliosa, P. congesta and P. macrocera all contain low levels of *valtrate*s [below 0.1%] in all parts (Foerster et al. 1984).

Valeriana officinalis is a perennial herb, bearing a short rhizome with many hollow rootlets, sometimes stoloniferous; stems (15-)30-150(-240)cm, usually solitary, simple, grooved, hollow, robust, sulcate, pubescent or glabrous. Leaves opposite, pinnate or pinnatisect with 3-25 leaflets, mostly sessile; basal leaves petiolate, in a rosette before stem forms; leaflets linear, lanceolate, elliptical or oblong, with entire or dentate margin. Flowers in compound umbellate cymose clusters, hermaphrodite; calyx teeth 5-15, linear, inrolled in flower, accrescent and plumose in fruit; corolla pink or white, tube 2.5-5mm long, infundibuliform, slightly gibbous near base, 5-lobed, lobes unequal; bracteoles +- equalling fruit; stamens 3. Ovary inferior, 3-locular, 1 loculus with 1 pendent ovule, other 2 sterile, sometimes very small; stigma 5-fid. Fruit 2-5mm, hairy or glabrous, indehiscent, 1-seeded, with feathery persistent calyx and very small sterile loculi; seed endospermic, with straight embryo.

In damp, fertile soil, especially by ditches and stream banks, as well as moist woodland; common wild in Europe [rare in deep south], Britain and n. Asia, frequently cultivated (Bremness 1994; Chiej 1984; Tutin et al. ed. 1964-1980).

Cultivate from seed or root cuttings; sow seed in mid-summer, spaced 40cm apart, keeping constantly moist. Slightly acid, sandy soil increases yields of active compounds. Likes lots of nitrogen. Gather roots and rhizomes in autumn or early spring, on a cool morning. Best dried at 40°C, with airflow; large roots should be cut to shorten drying time (Hobbs 1993). May require protection from cats, as they are so drawn to the smell of the roots [perhaps because of the 'mousy' odour?] that they have been known to dig them out of the ground (theobromus pers. comm.).

VANDA

(Orchidaceae)

Vanda roxburghii *R. Br.* **(V. tesselata** *(Roxb.) Hook.***; Cymbidium tesselloides** *Roxb.***)** – rasna, vandaka, rasna nai, darebanki, tesselated vanda

The flowers of this orchid are decocted and drunk, or tubers ingested, by Ayurvedic shamans and tantric magicians in India to aid entrance into a trance state for divination. This practice may stem from observing the stupefying effect the nectar has on bees (Emboden 1979a; Rätsch 1992). Medicinally, the fragrant, bitter roots are used in oils to be applied externally for nervous system disorders and rheumatism; medicinally, the roots are used interchangeably with those of Acampe papillosa, A. praemorsum or A. wrightiana, or leaves and flowers of V. spathulata. The leaf juice may be dropped into the ear for ear inflammations (Chopra et al. 1958; Dutt 1989; Lawler 1984; Nadkarni 1976). The orchid was also taken in an ancient Sanskrit preparation to "avert calamities"; in another preparation it was "eaten with food by women who wanted sons". It is also contained in some ayurvedic aphrodisiac preparations. Ghee containing V. roxburghii and Eria muscicola [another orchid] reputedly "powerfully excited the venereal appetite". V. spathulata [flowers or whole plant] has also been used in Malabar to treat madness (Lawler 1984).

V. cristata yielded [w/w] 0.02% laburnine acetate, a pyrrolizidine alkaloid [see **Laburnum**] (Lindström & Lüning 1969). In an alkaloid screening, it was found to contain over 0.1% alkaloids (Lüning 1967).

V. parishii [fresh whole plant] yielded 0.0026% of a new glucoside, parishin [tris[4-(β-D-glucopyranosyloxy)-benzyl]citrate], as well as 0.0018% of a glucoside which was probably an artefact of the extraction (Dahmén & Leander 1976).

V. roxburghii contains an unidentified alkaloid and a glycoside, as well as tannins, saponins, sterols, resins, fatty oils and colouring agents. The active component is thought to reside in the glycoside, and stimulates cholinergic nerves, producing an initial rise, and later fall in blood pressure (Chopra et al. 1958; Willaman & Li 1970).

V. lamellata, V. luzonica, V. merrillii, V. roeblingiana and V. sanderiana were found to contain c.0.01-0.1% alkaloids (Lüning 1967).

Vanda roxburghii is an epiphytic orchid with a leafy stem 30-60cm long, climbing. Leaves praemorse, 15.2-20.4cm, narrow, complicate, very coriaceous or fleshy, flat-keeled or terete. Flowers in a suberect raceme; peduncle 15-20cm, 6-10-flowered; flowers 3.8-5.1cm diam.; sepals 5, subequal, widely spreading, not incurved, clawed, obovate, waved, bases narrowed; petals 5, described as for sepals, yellowish-green or bluish except for the clathrate-brown nerves, margins white, lip ½ as long as sepals or more, with erect small-acute side-lobes, base usually saccate or spurred, midlobe panduriform, violet, tip dilated, truncate, 2-lobed, fleshy; disc of midlobe convex with fleshy ridges, white margins and mesial lines; spur conical; stamens and style united in a short, stout column; foot not or very shortly produced; anther 2-celled; rostellum obscure; pollinia 2, didymous, subglobose or obovoid, strap broad, short or long-geniculate, gland rather large. Ovary inferior, 1-celled, usually linear and twisted; stigma a viscid surface on the top or concave face of column, opposite the lip and below the anther. Seeds minute.

Common on mango trees; Bengal, Behar, west to Guzerat and the Concan, south to Travancore, Tenasserim and Ceylon (Hooker 1954-1961). Members of the genus in general are cultivated in pots or wooden baskets, with coarse pine bark; propagate from cuttings with 3 or more roots. Roots often grow outside of the pot to gain the air circulation they need. Most species like bright, humid conditions with winter min. 10-16°C (Banks & Perkins 2005).

VEPRIS

(Rutaceae)

Vepris ampody *H. Perr.*

Vepris lanceolata *(Lam.) G. Don.* **(V. undulata** *(Thunb.) Verdoorn et C.A. Sm.***; Toddalia lanceolata** *Lam.***)** – white ironwood, witysterhout, umZane, forest Vepris, African cubebs [the fruit]

Vepris madagascarica *(Baill.) H. Perrier* **(V. spathulata** *(Engl.) H. Perrier***; Humblotiodendron madagascaricum** *(Baill.) H. St. John***; H. spathulatum** *Engl.***; Pelea madagascarica** *Baill.***)**

V. ampody has no traditional uses that I am aware of. The trunk and root-bark of V. louisii are used in Cameroon to treat mycoses and dermatitis; it contains an antibacterial quaternary alkaloid called veprisinium salt (Ayafor et al. 1982). Another African species, V. heterophylla, is used in folk medicine as a diuretic and antipyretic; it contains furoquinoline alkaloids (Gomes et al. 1994). In Madagascar, V. madagascarica is used as a perfume due to its aniseed-scented parts [see **Pimpinella**]; the essential oil is used in preparations for teeth-cleaning in Japan and China (Billet & Favre-Bonvin 1973). V. lanceolata root is powdered and used by the Zulu to treat colic and influenza, and as an emetic. In Zanzibar, the fruits have been been used to cure spirit possession; the fruits are thrown on a fire and their fumes inhaled, in order "to throw out the devil" (Watt & Breyer-Brandwijk 1962).

V. ampody leaves and branches [combined] yielded 0.3% alkaloids, consisting of 80% *DMT*, 10% (n-nonadiene-3',6')-2-quinolone-4, 5% kokusaginine [see **Dutaillyea**], 0.5% 2,4-dimethoxy-10-methylacridan-9-one, 0.5% evoxanthine, 0.2% (n-nonanol-9')-2-quinolone-4, 0.1% (n-undecanone-10')-2-quinolone-4 and 0.001% phenylacetamide (Kan-Fan et al. 1970).

V. madagascarica leaves and twigs have yielded an essential oil containing *eugenol*, *methyleugenol*, *estragole*, p-cymene and *α-pinene* (Billet & Favre-Bonvin 1973).

Vepris ampody is from Madagascar; I have been unable to obtain a description, but see if you have any better luck – it is cited to be found in Mem. Acad. Sci. Paris, Ser. 2, lxvii. No. 3, 30 (1948).

VERATRUM

(Liliaceae)

Veratrum album *L.* – white false hellebore, European white hellebore, langwort

Veratrum viride *Aiton* **(V. eschscholtzii** *A. Gray***)** – American white hellebore, American false hellebore, green hellebore, swamp hellebore, Indian poke, puppet root, crow poison, devil's bite, tickle weed, bugbane, wolfsbane

These plants, as well as about a dozen other Veratrum spp., have been used in folk medicines in the past, but are now considered too dangerous for general use (Tamplon 1977). European shamans called V. album the 'seed of Hercules', and they used the dried root to treat madness caused by demons. The plant was also burned as a magical incense for its narcotic effect. Around 1900, mixtures of V. album and **Amanita** muscaria were popular with occult groups in Prague, Czechoslovakia, said to 'open doors to another world' (Rätsch 1992). V. album has also been used to poison knife-blades and arrows, or as a directly administered poison (Morton 1977).

V. viride was introduced to Europe from N. America in the late 19th century, and was taken into use for the same purposes as V. album – that is, as a cardiac sedative, analgesic, hypotensive, antispasmodic and mania treatment. It had also previously been in use in its native territory. The plants have also been used to treat neuralgia, pneumonia, respiratory afflictions, cholera, muscular dystrophy, rheumatism, arthritis and headache. They have been applied externally to skin disorders and intranasally to cause sneezing, and are also emetic, purgative and diaphoretic, though V. viride is less likely to cause gastric upset (Morton 1977). V. viride is used by the Cherokee as an ointment ingredient, to apply to painful areas and aching muscles (Hamel & Chiltoskey 1975).

When used externally, false hellebore should only be applied to unbroken skin (Chiej 1984). The plant can only be used safely in very small doses; as little as 1-2g powdered V. album rhizome may be fatal if ingested. The rhizome is the most potent plant part, though all parts are toxic. Overdose from internal administration can cause nausea, vomiting, burning sensation in throat and mouth, hallucinations, headache, numb extremities, breathing difficulties, salivation, dilated pupils, impaired vision, dizziness, abdominal pain, diarrhoea, cold sweats, weakness, tremors, sometimes convulsions, irregular and speeding pulse, brachycardia, hypotension, partial loss of consciousness and later paralysis and collapse. Symptoms usually disappear completely within 24 hours. In extreme cases death results from asphyxia. Some British Columbian natives say the only effective antidote for Veratrum poisoning is large amounts of salmon oil. Numbness of the mouth and nausea have even been reported from drinking water in which V. viride was growing (Bruneton 1995; Morton 1977; Tamplon 1977; Turner & Szczawinski 1991). V. californicum has long been known to induce teratogenic effects in sheep, largely due to the actions of the alkaloids cyclopamine and veratramine (Keeler 1968, 1975).

V. album rhizome has yielded 1.5% steroidal alkaloids, mainly protoveratrines A & B [the A form is more potent orally; the B form is also known as veratetrine or neoprotoveratrine], as well as veramanine, veratrosine, germerine, neogermitrine, germitetrine B, jervine, rubijervine, pseudojervine and neojerminalanine; and a glucoside, veratramarine.

V. viride contains protoveratrines A & B, veratridine, veratramine, veratrosine, germidine, germitrine, germine, cevadine, jervine, pseusojervine, rubijervine and isorubijervine (Bruneton 1995; Jacobs & Craig 1946; Kupchan & Deliwala 1953; Morton 1977; Rahman et al. 1996). Veratrine has been shown to inhibit plasma AChE (Orgell 1963a).

Veratrum viride is a leafy perennial 0.6-1.5m tall, polygamous, with a slender bulb, joining to a stem with a persistent elongated base; stems 0.5-1cm diam., pubescent. Leaves elliptic, from tubular sheathing bases (except higher up stem), 15-30 x 6-14cm, conspicuously plaited, acuminate (sometimes acute), sessile, or the lower short-petiolate. Inflorescence a paniculate raceme 0.3-1m long, the terminal raceme usually the longest, rachis pubescent, lowest branches of inflorescence subtended by leafy bracts; pedicels 1-4mm long; flowers actinomorphic; sepals and petals 3; perianth segments non-glandular, 1-1.5cm long, 3-5mm wide, acute to acuminate, base attenuate; stamens 6, attached to the very base of perianth segments. Carpels 3; ovary superior or partly inferior. Capsule 1.7-2cm long, 9-12mm diam., ovoid-lanceolate to ellipsoid, with persistent perianth; seeds yellowish to brown, lanceolate, winged, tapered to an acute apex, base oblique, 8-11mm long. Fl. Jun.-Aug.; fr. Jul.-Sep.

In bogs and wet woods, common; mountains of North Carolina, Tennessee, Virginia, West Virginia, Georgia (Radford et al. 1964).

Gather early autumn. Do not confuse with 'gentians' [Gentiana spp.; see *Endnotes*], which look similar and are not considered to be dangerously toxic (Chiej 1984). 'True' hellebores are Helleborus spp. [see *Methods of Ingestion*].

VERBENA

(Verbenaceae)

Verbena officinalis *L.* – verbena, verbenaca, vervain, veneris herba, herba sacra, holy wort, druid's weed, enchanter's plant, Juno's tears, Brittanica, pigeon's grass, pigeonwood, simpler's joy, ma bian cao

Verbena has been quite esteemed in European history. Priests of ancient Rome used bundles of the herb to sweep and purify their altars to Jupiter; they also used it in love rituals, and it was carried by the 'verbenarius' in peace negotiations. Pliny wrote that French Druids used verbena to prophesy, and that the Zoroastrian priests known as the Magi would rub the plant all over the body, to obtain all that they desired and enable them to 'cure all ills'. The Magi used elaborate rituals for the collection of the plant at the ascribed time, reminiscent of the ritual collection of mandrake root [see **Mandragora**]. The herb is said to give 'wondrous, prophetic dreams' and to act as an aphrodisiac and nerve tonic. It was also used as an ingredient in some witch's flying ointments. Ancient Germans, who also used the herb as an amulet for peace, used it to protect against the 'evil eye' and other evil influences. In magical practices, the herb is often used to effect love (Bremness 1994; Chiej 1984; Cunningham 1994; Mabey et al. ed. 1990; Pliny 1897; Rätsch 1990, 1992).

In TCM, the dried herb is used as an antibacterial, analgesic, antiinflammatory and blood coagulant (Huang 1993). It may have some antidepressant, cardiotonic and antitumour activity, and can be used to treat headache and gallstones, as well as acting as a liver tonic, emmenagogue and galactagogue. Flowering tops can be infused to treat insomnia, jaundice, urinary difficulty and cramps. A wash is good for mouth ulcers, hair and eyes; a poultice can be used for wounds and skin ulcers. Nausea and gastric upset is experienced by some people who take this herb internally. It should be avoided by pregnant women (Bremness 1994; Huang 1993; Mabey et al. ed. 1990).

On a related note, the Mojo Arawak of e. Bolivia have made use of an unidentified plant called 'marari', reported to be "similar to our verbena [Verbena officinalis]". A decoction of it was drunk by shamans when they were required to "interview the spirits". It was only used for difficult divinations, and caused excitation, insomnia and pain for up to 24 hours (Schultes 1966, 1967a).

V. officinalis contains glycosides, including verbenalin [0.244%; laxative, weak parasympathetic agent, causes uterine contractions; in frogs, acts as a CNS motor stimulant, causing stupor and convulsions, followed by paralysis, in large doses], verbenalol, verbenin, eukovoside and hastatoside; as well as *adenosine*, an unidentified alkaloid, mucilage, tannin and a small amount of essential oil (Buckingham et al. ed. 1994; Chiej 1984; Chopra et al. 1965; Harborne & Baxter ed. 1993; Huang 1993; Mabey et

al. ed. 1990; Watt & Breyer-Brandwijk 1932).

Verbena officinalis is a perennial herb; stems 30-60(-100)cm, erect, quadrangular, longitudinally ribbed, scabrid on the angles and diffusely branched. Leaves opposite or rarely on whorls of 3, +- rhombic, strigulose, the lower 4-6 x 2-4cm, petiolate, deeply incised, lyrate to 1-2-pinnatifid, the upper smaller, sessile and subentire or entire. Flowers in bracteate spikes, 10-25cm in fruit, terminal, long-pedunculate, solitary or in a very lax panicle; bracts ovate-acuminate, ciliate, up to ½ as long as calyx; calyx tubular, 5-ribbed and unequally 5-dentate; corolla hypocrateriform, weakly 2-lipped, pale pink, twice as long as calyx, with obtuse or emarginate lobes; stamens inserted at about middle of the corolla tube, included; stigma unequally 2-lobed. Ovary superior, initially 1-locular but becoming 2-4-locular by development of septa; style terminal. Ovules usually 1 in each loculus. Fruit separating at maturity into 4 nutlets; nutlets 1.5-2mm, reddish-brown, with 4-5 longitudinal ribs on the back (Tutin et al. ed. 1964-1980).

Fertile, well-drained loam, wasteground, roadsides, sunny positions (Bremness 1994); most of Europe, naturalised in Australia [all states except Western Australia] (Hnatiuk 1990); often cultivated. Gather in summer.

VINCA and CATHARANTHUS

(Apocynaceae)

Vinca major *L.* – greater periwinkle, blue periwinkle, sorcerer's violet

Vinca minor *L.* – lesser periwinkle, blue buttons, creeping myrtle, sorcerer's violet, fior di morto ['flower of death'], centòcchio ['hundred eyes'], devil's eye, flower of immortality, joy of the ground, priapisci, pervinca, vincapervinca

Catharanthus lanceus *(Boj. ex A. DC.) Pich* **(Lochnera lancea** *Boj. ex A. DC.***; Vinca lancea** *(Boj. ex A. DC.) K. Schum.***)**

Catharanthus roseus *(L.) G. Don* **(Lochnera rosea** *(L.) Reichb.***; Vinca rosea** *L.***)** – Madagascar periwinkle

In 2nd century Rome, V. minor was held to be effective against "the devil sickness and demoniacal possessions and against snakes and wild beasts". While these last few claims may be fabricated, the plant is effective against some forms of dementia due to its capacity to increase cerebral blood flow. It has been used also as an astringent and to staunch wounds (Chevallier 1996).

Vinca spp., when gathered under appropriate conditions, are used in love magic, though they have long been associated with death, and placed on children's coffins. In some areas, the trailing stems [for which the genus is named – from the Latin vincere ('to bind'), due to the tendency of the branches to wrap around supports and cover the ground] are used in basket-making. V. minor is antispasmodic, hypotensive, astringent and prevents haemorrhage, as well as improving cerebral blood flow; these properties are shared by V. major. The herbs should not be taken by pregnant women (Chiej 1984; Cunningham 1994; Polunin & Robbins 1992).

C. roseus is used medicinally in Brazil – the leaf is infused for haemorrhage and scurvy; this is also used as a mouthwash for toothache, and to heal and cleanse chronic wounds. In the West Indies, a flower infusion is used as a diabetes treatment, and a decoction is used as an eyewash. The leaves are bitter, emetic, astringent and diaphoretic. C. lanceus leaves are used in S. Africa as a bitter astringent emetic. In Madagascar, the plant is used to treat dysentery; aerial parts are galactagogue and emetic, and roots are used as a purgative vermifuge. Extracts of the plant are hypotensive, hypoglycaemic, antiviral and antitumour in effect (Morton 1977; Svoboda & Blake 1975; Tin-Wa & Farnsworth 1975).

This closely related genus, Catharanthus, enters our picture due to a possible error of sorts. In the late 1950s, scientists at Eli Lilly Co., pursuing a diabetes treatment, discovered that extracts of C. roseus showed antitumour activity. The chemicals focused on were vinblastine [vinkaleukoblastine; VLB] and vincristine [VCR], and in their sulfate forms they were marketed as Velban and Oncovin [Vincovin], respectively, and have been used in chemotherapy (Blackwell 1990). When using extracts of the plant on patients, physicians noted that some side effects of the treatment were a euphoria with pleasant hallucinations. When this news spread, there was an outbreak of periwinkle smoking in Florida, usually stated to involve C. roseus, which is common there. However, a national magazine article which brought some attention to this matter and helped spread the practice, referred to the use of a blue-flowered periwinkle ["...five teenagers disclosed that they were smoking the dried and shredded leaves of the periwinkle, a blue-blossomed plant common throughout the U.S. The smoke, the youngsters reported, made their skin tingle as though ants were crawling over it and they seem to see the world through the wrong end of a telescope."]. Flowers of C. roseus are usually pink, but never blue; V. major and V. minor flowers may be blue, purple, or white. Either the plant involved was a Vinca sp., or it was C. roseus and the error occurred in journalistic interpretation. Side effects of vinblastine and vincristine administration include an immediate reduction in white blood cell count. Exposure over time leads to itching and burning skin sensations, loss of coordination, muscle deterioration and hair loss (Emboden 1979a; Farnsworth 1969; Morton 1977). Due to this, it has been advised not to smoke C. roseus, although today some have overcome the fear and tried it with positive results (pers. comms.). Still, moderation should be advised to avoid such potential toxicity.

Leaves of V. major, and presumably of V. minor, can also be smoked, producing a hypnotic tranquillisation with anxiolysis, mild euphoria and mild perceptual distortions, lasting several hours. This was subjectively similar to a smoked sample of **Mitragyna** speciosa leaves (pers. obs.). One psychonaut ingested a tea made from 1g dry V. minor root, with fruit juice, and found it to act as a pleasant and effective euphoriant and nöotropic (theobromus pers. comm.).

As a note of interest, in the mid-1940's in Jamaica, one could be arrested for smoking periwinkle, which was called 'ram-goat rationale' (Chevannes 1994), suggesting that the psychoactive effects of the plant were known there and made use of. The actual species of periwinkle [ie. Vinca spp. or Catharanthus spp.] is not mentioned, though it was probably in reference to C. roseus.

Periwinkles contain a wide array of indole alkaloids in all parts, many with physiological and psychoactive effects; they often act as hypotensive tranquillisers, and may increase cerebral blood flow.

V. major aerial parts yielded c.0.79% alkaloids, including *vincamine*, vincine, 0.022% reserpinine, vincamajoreine, 0.0013% vincamajoridine [akuammine], 0.00065% vincamedine, 0.003% vincamajine, 0.0005% vincanovine, 0.026% majdine, 0.0028% majorine, 0.0029% majoridine, 0.0002% majvinine, 0.0004% majovine, perivincine, 10-MeO-vellosimine and lochvinerine (Banerji & Chakrabarty 1974, 1977; Kaul & Trojanek 1966).

V. minor aerial parts have yielded 0.3-1% alkaloids, 10% of which may be *vincamine*, as well as c.30 other indole alkaloids (Bruneton 1995), including quebrachamine, N-methylquebrachamine, vincadine, vincaminoreine, vincaminoridine, vincaminorine, N-methylaspidospermidine, 1,2-dehydroaspidospermidine, minovine, minovincine, 16-MeO-minovincine, 10-oxo-minovincine, minovincinine, 12-epi-minovincinine, 16-MeO-minovincinine, vincadifformine and 16-MeO-vincadifformine (Ganzinger & Hesse 1976). The plant inhibits human plasma AChE (Orgell 1963b). Total alkaloids from this plant have been reported to have a *reserpine*-like activity (Verzár-Petri 1972).

V. sardoa aerial parts yielded 0.018% N(1)-methyl-14,15-didehydro-12-MeO-aspidofractinine, 0.009% N(1)-formyl-14,15-didehydroaspidofractinine, 0.007% venalstonine, 0.006% conoflorine, 0.0036% N(1)-formyl-14,15-didehydro-12-OH-aspidofractinine and 0.002% N(1)-methyl-14,15-didehydro-aspidofractinine. Roots yielded norfluorocurarine, akuammigine, carapanaubine, majdine, isomajdine, rauvoxinine, ent-N(1)-methyl-14,15-didehydroaspidospermidine, N(1)-methyl-14,15-didehydrotuboxenine, and aspidofractinine derivatives (Nicoletti et al. 1998).

C. lanceus leaf yielded 1.36% crude bases, containing *yohimbine* as a major alkaloid [0.0029-0.0074%], as well as perivine [0.008-0.0092%; CNS depressant], *ajmalicine*, leurosine [0.00047%; adrenergic blocker], lochnerinine, vindolinine [CNS stimulant], vindoline [0.00004-0.00016%; CNS stimulant & depressant], catharanthine [CNS depressant] and 3,4-dimethoxy-phenylacetamide [CNS-depressant]. Roots have yielded 0.2-2.127% crude alkaloids, containing *yohimbine* [0.002%], *ajmalicine* [0.0196%], tetrahydroalstonine [weak muscle relaxant], pericalline [0.0028%], perimivine [0.0002%], lanceine and cathalanceine [0.0002%]. Stems have yielded 0.1-0.15% crude alkaloids. Also isolated from the plant have been pericalline [convulsant], ammocalline, vincoline, vinosidine, catharine, pericyclivine, periformyline, horhammericine, horhammerinine and cathanneine [cathovaline] (Blomster et al. 1964b; Maloney et al. 1968; Svoboda & Blake 1975; Tin-Wa & Farnsworth 1975).

C. roseus leaf has yielded catharanthine, catharosine, catharicine, catharine, cavincine, vincarodine, vincolidine, vincoline [CNS depressant], vindoline, vindolinine, vindolicine, vindolidine, desacetyl-vindoline, vindosidine, vinsedicine, vinsedine, vindorosine, vincristine, vincaleukoblastine [VLB], desacetyl-VLB [CNS depressant], vincathicine [CNS depressant], vincamicine, vinaphamine, vinaspine, vinaphamine, sitsirikine [CNS depressant, vasodilator], isositsirikine, dihydrositsirikine, perivine, perividine, perosine, perimivine, *mitraphylline*, lochnericine, lochneridine, lochnerinine, lochrovicine [CNS depressant, weak autonomic effects], lochrovidine [CNS depressant], lochrovine, carosine, carosidine, leurosine, isoleurosine, leurosidine [CNS depressant & stimulant], leurocristine [CNS depressant], neoleurocristine [CNS depressant], neoleurosidine, pleurosine, rovidine, *adenosine* and 0.00022% *norharman*. Roots yielded 1.18-1.22% alkaloids. The plant has also yielded *ajmalicine*, akkuamine, tetrahydroalstonine, *reserpine*, serpentine and lochnerine [CNS depressant & stimulant] (Chevallier 1996; Morton 1977; Rahman et al. 1985; Svoboda & Blake 1975). Leaf and stem of plants from Brisbane [Queensland, Australia], harvested in April, tested strongly-positive for alkaloids (Webb 1949).

Vinca major is a low, creeping dwarf shrub or herbaceous perennial, with usually trailing vegetative shoots, stems up to 100cm, ascending

in the lower part, then arching or procumbent, overwintering. Leaves opposite, 2.5-9 x 2-6cm, mostly ovate or broadly ovate, rarely lanceolate, evergreen, deep green, usually glabrous, margins ciliate with hairs 0.1-1mm long. Flowers solitary in leaf-axils, on ascending flowering stems up to 30cm; pedicels shorter than the subtending leaves; calyx lobes 7-17mm long, very narrowly triangular, margins densely ciliate with hairs 0.5-1mm; corolla hypocrateriform, usually bluish-purple, the tube gradually widened, 12-15mm long, with a zone of hairs above insertion of stamens, and a low ridge connecting lobes at mouth, lobes obliquely truncate, as long as tube, overlapping to the left in bud, limb 30-50mm diam.; stamens inserted ½ way up corolla tube; filaments bent abruptly at base; anthers introrse, closely surrounding the stigma, with connective expanded above into a flap-like appendage. Ovary superior; carpels 2, usually free, united by a single style above, with 4-8 ovules, alternating with 2 disc scales. Fruit of (1-)2 fusiform follicles, patent, usually opening by ventral suture; seeds glabrous.

In woods, scrub, hedges, or other shady places; west and central Mediterranean region, widely naturalised and cultivated elsewhere (Tutin et al. ed. 1964-1980).

Catharanthus roseus is a downy herb or small shrub; branches terete. Leaves opposite, evergreen, coriaceous, elliptic, obtuse, mucronate; petioles bidentate or bistipulate at base. Flowers axillary, solitary, or twin, sessile, bright crimson to peach- or rose-coloured (some varieties white, or white with a purple circle), paler on underside, with a dark purple eye; calyx 5-parted, segments subulate, ciliate; corolla salver-shaped, 5-lobed, segments nearly equal-sided, obovate, mucronate, throat bearded, tube long and slender, clavate at top with 5 tubercles; stamens enclosed, conniving over stigma; anthers mucronate, not membranous at top, sessile. Hypogynous glands 2, elongated like the ovaria; stigma capitate, marginate, bearded at top, furnished with a cup-shaped membrane below, which sheaths the upper part of the style. Follicles twin, small, terete, glabrous, 2-celled, dehiscing inside; dissepiment double, taking its rise from the suture, which is plaited inwards; seeds 16-20 in each follicle, attached longitudinally to each side of dissepiment, small, ovate-acuminate above, grooved and rugged from sharp tubercles on one side, smooth on other side.

In tropics; appears to be native to Madagascar (Stearn 1966).

VIROLA

(Myristicaceae)

Virola bicuhyba *(Schott) Warburg*

Virola calophylla *Warburg* **(Myristica calophylla** *Spruce***)** – paricà, yakee, ajua apumpo, ardilla paparahua, huapa, anya huapa, pucuna huapa, huapa jandia, sacha, shiquillo, suni panga huapa, a-re-dje, iheara, tegidewe, cumala blanca, yato, yea-ga-seii

Virola calophylloidea *Markgraf* – ya-kee, ya-to, ko-ga, rase-jiameti, cumala, bojorique

Virola duckei *A.C. Sm.* – angus caspi, huachig caspi, anya huapa, huapa, huapa blanca, ardilla paparahua, sacha paparahua, huapa urcu

Virola elongata *(Benth.) Warburg* **(V. cuspidata** *(Spruce ex Benth.) Warburg***; Myristica elongata** *Benth.***)** – huapa, anya huapa, pucuna huapa, calun-calun, ucufe-ey, ra-se-ne-mee, tsu-nem, ko-de-ko, oo-koó-na, yakoana, cumala blanca, cumala caspi

Virola loretensis *A.C. Smith* **(V. villosa** *Ducke***)**

Virola multinervia *Ducke*

Virola pavonis *(A. DC.) A.C. Smith* **(V. venosa var. pavonis** *Warb.***; Myristica pavonis** *A. DC.***)** – anya huapa, puliu huapa, pucuna huapa, cedro ajua, huachig caspi, ko-do

Virola peruviana *(A. DC.) Warburg* **(Myristica peruviana** *A. DC.***)** – nankitawe, tegidewe, cumala blanca, ya-kee

Virola rufula *(Mart. ex A. DC.) Warburg*

Virola sebifera *Aublet* **(V. mocoa** *Warb.***; V. peruviana var. tomentosa** *Warb.***; V. venezuelensis** *Warb.***; Myristica mocoa** *A. DC.***)** – wircaweiyek, orika-bai-yek, paissam, cuajo negro, camaticaro, cacao del monte

Virola surinamensis *(Rol.) Warburg* – oo-koó-na, kur-du-ko, ucuuba branca, cumala blanca, cumala colorada, caupuri

Virola theiodora *(Spruce ex Benth.) Warburg* – oo-koó-na, ko'-ke-ko, gua-roo'-ta-ta, ka-se-ree-mee'-hoog-nou, bicuhyba cheirosa

Trees of the genus Virola were only relatively recently discovered to be widely used for entheogenic purposes in the Amazon; many are used medicinally, to treat skin disorders, malaria and other complaints. Several species, especially V. elongata and V. theiodora are used either as a snuff [usually blown forcefully into the nasal cavities by another, through a long, slender tube], notably by the Yanomamo [who also snuff **Anadenanthera** sp.], or as an orally-ingested pill. In some tribes the snuffs are only used by shamans to enter a healing trance, or else used by everyone following a death in the tribe, in ceremonial festivals, or before going on a hunt. Others allow use by all males older than 13-14 years of age. Some use it only occasionally, while others [such as the Yanomamo] use it almost recreationally, snuffing all day, most days. Usually, it is snuffed in very large amounts to reach the full point of 'ekstasis' and communion with the world of the 'hekula' spirits – and in such large amounts that at least one death has been reported, that of a Puinave shaman who died whilst under the influence [which may have been due to suffocation, from the snuff entering the lungs] (Brewer-Carias & Steyermark 1976; Chagnon et al. 1971; Lizot 1985; Prance 1970, 1972; Prance et al. 1977; Schultes 1955a; Schultes & Hofmann 1980, 1992; Schultes & Holmstedt 1971; Seitz 1967; Uscategui 1959).

Bark sap of V. calophylla is made into a snuff ['yakee'] by natives of the Colombian Amazon, as is bark sap from V. calophylloidea in the Vaupes. More than 1 tsp may be snuffed at a time. V. elongata is used by the Maku and possibly the Barasana of Colombia, as well as the Paumari of Rio Purús, Brazil. The Waiká Yanomamo of n.w. Brazil and Venezuela prepare a snuff, called 'epéna' ['semen of the sun'], 'ebena' or 'nyakwana', from bark sap [and sometimes leaves] of V. theiodora; they also use it to make dart poisons. Apparently, when they run out of snuff, they may scrape resin from their darts and snuff that, for the same effect. The Barasana, Makuna, Taiwano, Kabuyari, Kuripako and others also make a snuff from this species. V. sebifera was once used in Venezuela as an entheogen, shamans smoking the bark when curing. V. bicuhyba seed is said to be 'narcotic', and acts as a 'brain stimulant', reviving memory and intelligence. V. peruviana is possibly used as an entheogen in Colombia, and has tested positive for alkaloids; V. rufula might also be so used (Davis 1996; Macrae & Towers 1984a; Prance 1970, 1972; Prance et al. 1977; Schultes 1955a; Schultes & Holmstedt 1971; Schultes & Raffauf 1990).

The Witoto of the Peruvian Amazon once consumed resin from V. theiodora in oral pill-form, to "see and converse with the little people". It appears this use is no longer practised, though its methods of preparation are still known. From 3-6 of the coffee bean-sized pellets were reportedly taken; effects are said to manifest within 5 mins, lasting about 2 hrs, with 'visual hallucinations' occurring. Sometimes more is taken after the effect wears off. It was used mostly by shamans, and occasionally by small groups of people for purposes of divination, or 'studying' from the spirits (Schultes 1969b). The Bora preferred to use V. elongata, but also used V. loretensis, V. pavonis or V. surinamensis to prepare the pills (Schultes & Holmstedt 1971; Schultes et al. 1977a).

As 'caupuri', V. surinamensis has been used as an ayahuasca additive [see **Banisteriopsis**], and may also be taken under diet, as a plant teacher (Luna 1984). Bear & Vasquez (2000) mention the use of a plant called 'cahuapuri' as a plant teacher; this might also represent V. surinamensis. When taken after dieting with Canavillesia spp. [see *Methods of Ingestion*], Vasquez reported that it "can give one mastery over the mind, and the power to heal". He prepared it by grinding the fresh bark, and infusing it in water overnight; the next day the liquid was strained and drunk (Bear & Vasquez 2000). Some bees are known to produce intoxicating honey after feeding on the nectar of V. surinamensis (Groark 1996).

The Quichua use Virola spp. sap to treat caries, thrush and skin infections. The Quijos Quichua recognise the entheogenic properties of V. duckei sap (Bennett & Alarcon 1994).

Orally-active pills are prepared from the bark as follows – best trees are selected by slashing and testing a small strip of bark. It should have an ample cambial layer, bitter taste and musty odour (Schultes et al. 1977a). Collections are made in the early morning, when alkaloid content is highest. Strips of the bark c.75cm long are cut from the lower portion of the trunk; sometimes, it is stripped from the entire circumference of the tree, then the tree is felled and the upper bark stripped. Inner bark exudes a clear resinous sap when freshly cut – this later congeals and turns a deep reddish-brown (Schultes & Raffauf 1990; Schultes & Swain 1976). The inner part of the freshly stripped bark is rasped; the tissue obtained is rolled into balls and squeezed into water, which is boiled for 5-6 hrs with careful stirring until it is a thick, sticky syrup; or, it is reduced to a simmer for 1 hour or so. Some steep the leaves of a fern [Anemia sp.] in the water used for this previous step, or add the juice of the crushed stems of Philodendron nervosum. Some also add bark of Rinorea racemosa [see also *Methods of Ingestion*], or an unidentified lichen to the resin. The Witoto reduce the bark of Gustavia poeppigiana to ashes, and rinse them with cool water until no more cloudiness leaches out; this water is boiled down to a greyish residue, or 'salt' ['le-sa']. The Virola resin is rolled into coffee bean-sized balls, and rubbed in the 'salt', ready for consumption (McKenna et al. 1984b; Schultes 1969b). This is similar to the alchemical preparation of some tobacco-pastes [see **Nicotiana**], and may contribute to activity. Other plants are also used in making the 'salt' – Eschweilera itayensis [bark with some adhering wood], **Spathiphyllum** cannaefolium [whole plant], Geonoma juruana [trunk & leaves], [tentatively identified] a Carludovica sp. [see *Endnotes*] or a Sphaeradenia sp., **Theobroma** subincanum [leaves and twigs] and a Bactris sp. [trunk & leaves]. Often, pellets are only coated with the 'salt' if they are to be kept for later – otherwise, they are used immediately. They are said to keep their potency for about 2 months (Schultes & Raffauf 1990; Schultes & Swain 1976).

Virola snuffs are prepared in a similar manner to oral pills, the main difference being that the paste, once boiled down, is sun-dried, finely pulverised and mixed 1:1 with the ashes of either Elizabetha princeps bark, or

Theobroma subincanum; powdered dried leaves of **Justicia** pectoralis var. stenophylla may also be added; also, no salts are added. Sometimes, the bark scrapings themselves are simply dried over a fire and powdered and sifted for use, alone or with the above admixtures. Some build a fire at the place of harvesting, and immediately heat the bark strips over the fire, collecting the resin that oozes out. This method is sometimes used to obtain resin with which to coat the tips of hunting arrows. The snuff is said to lose potency rapidly, even when stored in a tight container, and as such, it is prepared often, and only in small amounts. A shamanic dose of such snuff is said to be roughly 1 heaped tsp, taken in 2-3 inhalations at intervals of 15-20 minutes (Brewer-Carias & Steyermark 1976; Prance 1970, 1972; Prance et al. 1977; Schultes 1955a, 1967b; Schultes & Raffauf 1990; Seitz 1967).

It is not surprising to note [given the phytochemistry outlined below] that barks and the concentrated saps of some Virola spp. have been successfully used in ayahuasca analogues (pers. comms.).

Virola spp. seem to be very variable in their alkaloid content, and while one sample of a given species may yield large amounts of alkaloids, another may yield much less or none at all.

V. calophylla flowers and shoots yielded 0.193% alkaloids [96% *DMT*, 4% *N-methyltryptamine* (NMT)]; fruit and seeds 0.0185% *DMT* and traces of *NMT*; leaves 0.155% [same ratio as flowers and shoots]; bark 0.009-0.056% [91-100% *DMT*, 0-9% *5-MeO-DMT*], as well as *tryptamine*, 2-methyl-THβC (Holmstedt et al. 1980; McKenna et al. 1984b) and 2-methyl-6-MeO-THβC [2-methyl-*pinoline*]; and root 0.001% [87% *DMT*, 13% *5-MeO-DMT*] (Agurell et al. 1969a; Cassady et al. 1971; Shulgin & Shulgin 1997). Leaves have also yielded otobaene, hydroxyotobain, 2',4'-dihydroxy-4,6'-dimethoxydihydrochalcone, vanillin and sitosterol; bark has also yielded *safrole* and methylparaben (Constanza et al. 1999).

V. calophylloidea leaves have yielded 0.098% *DMT*; bark yielded 0.0075% alkaloids [50% *DMT*, 45% *5-MeO-DMT*] (Holmstedt et al. 1980); trunk wood contains neolignans, flavonoids and steroids (Martinez & Cuca 1987).

V. elongata bark phloem has yielded *tryptamine*, *DMT*, *NMT*, *5-MeO-DMT*, 5-MeO-*NMT* and 2-methyl-THβC; 2-methyl-*pinoline* has also been found in the resin. Whole bark yielded 0.023% *5-MeO-DMT* and traces of *NMT* in one sample; another contained 0.0102% *NMT* and 0.0063% *DMT*. Leaves have yielded 0.017-0.019% *DMT* and traces of *NMT* (Holmstedt et al. 1980; McKenna et al. 1984b); stem and leaf together [as V. cuspidata] yielded 6-MeO-1,2,3,4-*tetrahydroharman* [*adrenoglomerulotropin*] as the major alkaloid, with lesser amounts of *6-MeO-harmalan* and 6-MeO-*harman* [isoharmine], as well as otabaene and hydroxyotobain. Bark has also yielded the lignans [0.016% combined] virolongin, eusiderin, sesartemin, epi-sesartemin, dihydrosesartemin, yangambin, epi-yangambin and β-dihydroyangambin; the stilbenes 3,4',5-trimethoxy-trans-stilbene and 3,4',5-trimethoxy-cis-stilbene; β-sitosterol; and unidentified aromatic compounds (Cassady et al. 1971; Macrae & Towers 1984a; Shulgin & Shulgin 1997). Snuff made from the tree has yielded 0.15-2% alkaloids, consisting of 7-10% *DMT*, 90-93% *NMT*, and, in one sample, entirely *5-MeO-DMT* (Chagnon et al. 1971; McKenna et al. 1984b). Human bioassay of 1.5-2g of the oral-paste [which contained 1.57% *5-MeO-DMT*, and traces of *NMT*] resulted in effects being felt 10 minutes after swallowing, consisting of "a strong burning sensation in the mouth and throat, which quickly developed into a feeling of numbness in the lips, tongue and throat. Swallowing was difficult and breathing was impaired. The numbness gradually spread throughout the body, with a tingling sensation in the extremities...[body] felt chilled...heavy and inert...breathing was irregular and shallow...experienced enhanced acuity of hearing...but otherwise no perceptual changes." Symptoms subsided over 45 minutes, except for the chilling sensation, followed by drowsiness, and a light, brief sleep (McKenna et al. 1984b). Assays in mice [i.p.] showed the non-alkaloidal extract [20-320mg/kg] to have greater effects on motor activity [due to the bioactive lignans] than the alkaloid fraction [causing depression and stupor], relative to the weight of the source bark for each. In terms of actual potency, the alkaloid fraction [1-15mg/kg] was similarly potent, but instead caused slight hyperactivity at the higher doses tested (Macrae & Towers 1984a).

V. multinervia root yielded 0.001% alkaloids [59% *5-MeO-DMT*, 41% *DMT*], and bark yielded 0.001% *DMT* (Agurell et al. 1969a), though others have found no alkaloids in the bark (McKenna et al. 1984b); the wood has yielded sitosterol, stigmasterol, virolane and virolanol (Filho et al. 1973).

V. pavonis leaves and twigs from one sample tested positive for the presence of *DMT* and *NMT*, though this collection was based on sterile material, and identification was probably in error, as all other samples tested negative for alkaloids. An oral-paste sample made from V. pavonis was devoid of alkaloids, and showed no activity in a human bioassay of 10g (McKenna et al. 1984b).

V. peruviana bark [fresh] has yielded 0.0175% *5-MeO-DMT*, *5-MeO-tryptamine*, *DMT*, 2-methyl-*pinoline*, 1,2-dimethyl-*pinoline*, 0.0072% phytosterols [β-sitosterol, stigmasterol, campesterol], 0.0039% lirioresinol-A dimethyl ether, 0.0046% lirioresinol-B dimethyl ether, myoinositol, and n-alkanols [octacosanol, triacontanol, dotriacontanol]; paste prepared from the bark has yielded 0.028% alkaloids [99% *5-MeO-DMT*, traces of the THβC's] (Holmstedt et al 1980; Lai et al. 1973a, 1973b).

V. rufula has a high content of *5-MeO-DMT*, also containing 2-methyl-*pinoline*. Bark has yielded 0.2% alkaloids [95% *5-MeO-DMT*, 4% *DMT*]; root has yielded 0.144% alkaloids [94% *5-MeO-DMT*, 4% 5-MeO-*NMT*, 1% *DMT*]; leaves 0.098% [94% *DMT*, 6% *NMT*] (Agurell et al. 1968a, 1969a); the plant has also yielded 6-MeO-THβC (Shulgin & Shulgin 1997). The snuff made from the bark resin yielded c.8% alkaloids [*5-MeO-DMT*, *DMT* and trace other tryptamines] (Schultes 1969b).

V. sebifera bark has yielded 0.018% *5-MeO-DMT*, 0.0078-0.014% *DMT*, *DMT* N-oxide, *NMT*, N-methyl-N-formyltryptamine, N-methyl-N-acetyltryptamine and 2-methyl-THβC, as well as β-sitosterol, and complex mixtures of phenolic [0.014%] and acidic [0.008%] compounds. Leaves have yielded traces of *NMT*. A sample of an orally-active paste from the bark yielded 1.88% alkaloids [70% *5-MeO-DMT*, 20% *DMT* and 10% *NMT*]. A human ingestion of the bark resin nearly 150 years ago [dose and method of ingestion not noted] resulted in vivid dreams, confusion and insomnia lasting 5 days. A more recent human bioassay of 3-4g by Dennis McKenna resulted in "hypnagogic imagery behind closed eyelids...easily disrupted by external stimuli" (Corothie & Nakano 1969; Kawanishi et al. 1985; McKenna et al. 1984b; Schultes & Holmstedt 1971; Shulgin & Shulgin 1997).

V. surinamensis leaf has yielded the neolignans virolin and surinamensin (Macrae & Towers 1984a; Zacchino 1994). The plant has in one test been found to contain no alkaloids (Holmstedt et al. 1980), but considering its reported usage, it seems likely that some specimens will yield tryptamines.

V. theiodora bark has yielded 0.25% alkaloids [52% *DMT*, 43% *5-MeO-DMT*, 4% 2-methyl-*pinoline*, 1% *NMT*] – another study found 0.065% [95% *5-MeO-DMT*, 5% *DMT*]; flowers and shoots 0.47% [93% *DMT*, 7% *NMT*]; leaves 0.044% *DMT*, with traces of 2-methyl-THβC; root 0.017% [62% 6-MeO-*DMT*, 22% *DMT*, 15% 5-MeO-*NMT*] (Agurell et al. 1968a, 1969a; Holmstedt et al. 1980; Schultes & Hofmann 1980); the plant has also yielded *pinoline* and 2-methyl-*pinoline* (Shulgin & Shulgin 1997). Snuff prepared from it has yielded 0.715-11% tryptamines, mostly [72-88%] *5-MeO-DMT*, with 11-20% *DMT*, 0-2% *NMT*, 0-4% 2-methyl-THβC and 0-2% 2-methyl-*pinoline* (Agurell et al. 1969a).

V. venosa root yielded 0.001% *5-MeO-DMT*; leaves yielded 0.001% *DMT* (Agurell et al. 1969a).

V. carinata, V. divergens and V. melinonii also contain trace amounts of *5-MeO-DMT* (Holmstedt et al. 1980).

Snuffs made from unidentified Virola spp. have yielded 0.038-1.97% alkaloids, comprised of 83-100% *5-MeO-DMT* and 0-17% *DMT*. An oral paste sample, also from an unidentified source Virola sp., yielded 1.1% alkaloids, comprised of 86% *NMT*, 14% *DMT*, and traces of 2 β-carbolines; it showed no activity in human bioassays of 5-10g (McKenna et al. 1984b). Yanomamo dart poison made from bark sap of a Virola sp. yielded c.8% *5-MeO-DMT* in one analysis; each dart held about 12mg of the alkaloid (Galeffi et al. 1983). Needless to say, an intramuscular injection of large amounts of *5-MeO-DMT* would stun a small animal rather easily!

A bioassay of concentrated bark resin, obtained from a presumed Virola sp. known as 'cumala' [courtesy of Boris], resulted in mild psychoactivity. The sweetish but slightly bitter resin [several grams] was taken orally, held under the tongue and between lips and gums until dissolving, with the juice then swallowed. Subjectively, the effects consisted of relaxation and mild enhancement of the senses, lasting 2-3 hours (pers. obs.). Similar effects have been observed by others who bioassayed the same material (pers. comms.).

Though it is known that these tryptamines can be absorbed intranasally and produce an entheogenic effect, the mode of action of the oral pills has still not been adequately explained. However, the recent finding by Jonathan Ott that *5-MeO-DMT* is orally [and especially sublingually] active [see *Chemical Index*] casts some light on the matter. Of *5-MeO-DMT* and *DMT*, the major active principles, the latter is not active orally without an MAOI, although they have both been shown to have some low level in-vitro MAOI activity of their own. Any of the β-carbolines with MAOI activity are only present in very small amounts in these plants. The suggestion has been raised that lignans from the bark resin may contribute to the activity of the tryptamines, but they only show low level non-specific MAOI activity at high doses. The lignans, or other non-alkaloidal constituents, may also act as antioxidants, resulting in less molecular oxygen being available for metabolism of the tryptamines in peripheral tissues. Incidentally, MAOI screening [in-vitro rat liver] of oral pastes showed equivalent activity to 'analogues' consisting of the tryptamine constituents alone (McKenna et al. 1984b). Some experiments by western researchers (eg. McKenna 1993; McKenna et al. 1984b) have yielded no discernable activity. Perhaps the samples were from weak sources? Perhaps their informants misled them regarding proper dosage? Perhaps the other plants reported to be incorporated are vital to produce the full activity? Perhaps the indigenous users consumed other substances in their diet that exert an MAOI-effect, or even have naturally low MAO levels as a genetic trait [leading them to require a smaller dose]? Or perhaps, and more likely,

they took the pills sublingually rather than swallowing them, for greater absorption of *5-MeO-DMT*? Perhaps the tryptamines are not really the sole active constituents at all, and the lignans are major contributors to the activity of the pills? As stated above, the lignans of V. elongata bark have been shown to act as behavioural and motor depressants in mice, when administered i.p. (Macrae & Towers 1984a), though this would not seem to explain the reputed 'entheogenic' activity.

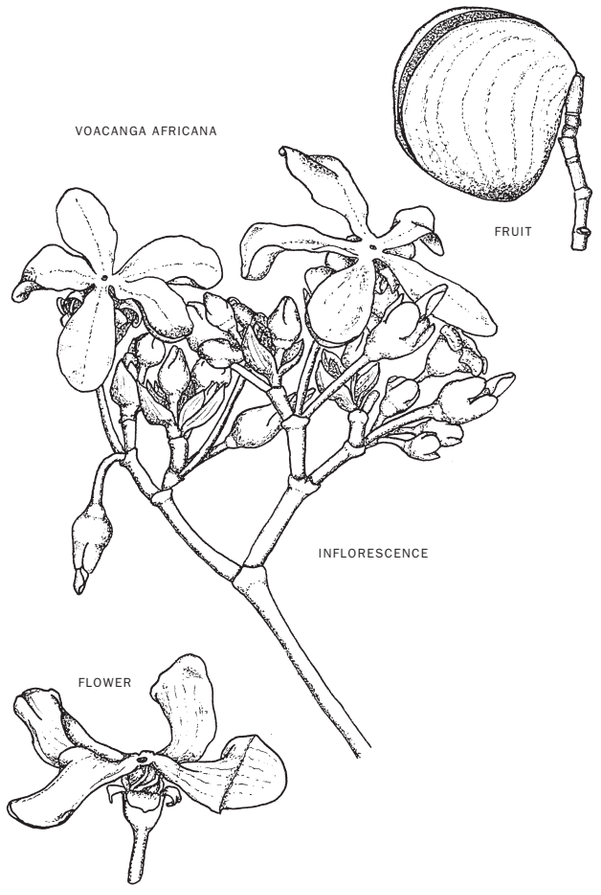
Ultimately, the most likely explanation [as stated above], in light of the sublingual activity of *5-MeO-DMT*, would appear to be that the 'oral pills' were intended to be taken sublingually, rather than swallowed, and that *5-MeO-DMT* is indeed the major psychoactive component of these preparations (pers. obs.). I later learnt that Ott had reached the same conclusion, discussed in Ott (2001c).

Virola theiodora is a slender tree, 7.6-23m; trunk cylindrical, up to 45cm diameter; bark smooth, mottled brown with grey patches; branchlets slightly red-brown tomentellous, becoming glabrous. Leaves firm-papyraceous, sometimes thick-chartaceous, often sparsely glandular-punctate, oblong to broadly ovate, basally obtuse to cordate, apex long-acuminate, margin usually sinuate, 9-35cm x 4-12cm, upper surface glabrous, dark green, nitid, underside sparsely stellate-puberulent, secondary veins 9-20, usually very prominent, ascending and arcuate; petiole subterete, most 4-15cm long, often brown-tomentellous. Staminate inflorescences many-flowered, paniculate, usually shorter than leaves, up to c.15cm, usually shorter, often brown- golden-brown-tomentellous, usually becoming glabrous; bracts 2.5cm long, deciduous. Pistillate inflorescences shorter. Staminate flowers strongly pungent, single or in clusters of 2-10; pedicel c.2mm long; perianth thin, puberulent, infundibuliform, 1.5-2.5mm long, subacutely lobed c.¼ of its length; androecium 2mm long; filament column thick, 0.5-0.8mm long; anthers 3(-5), 1-1.7mm long, usually connate, apiculate. Fruit c.5-8 per inflorescence or less, subglobose, 1-2cm long, 8-15mm diam., usually slightly apiculate, glabrescent when mature; pedicels 3-4.5mm long; aril membranaceous, laciniate c.½ of its length.

In well-drained forests. Mainly in Rio Negro Basin, w. Amazonian Brazil and Colombia; possibly also in adjacent Peru and Venezuela (Schultes & Hofmann 1980). Some botanists believe that this species is synonymous with V. elongata and V. calophylla, with V. elongata being the accepted name under this revision (McKenna et al. 1984b), and this should of course be borne in mind when considering their chemistry.

VOACANGA

(Apocynaceae)



Voacanga africana *Stapf* **(V. angolensis** *Stapf ex Hiern***; V. angustifolia** *K. Schum.***; V. bequaerti** *De Wild.***; V. boehmii** *K. Schum.***; V. eketensis** *Wernh.***; V. glaberrima** *Wernh.***; V. glabra** *K. Schum.***; V. klainei** *Pierre ex Stapf.***; V. lemosii** *Philipson***; V. lutescens** *Stapf.***; V. magnifolia** *Wernh.***; V. puberula** *K. Schum.***; V. schweinfurthii** *Stapf***; V. schweinfurthii var. parviflora** *K. Schum.***; V. schweinfurthii var. puberula** *(K. Schum.) Pichon***)** – o-bonawa, kongkong, pete pete, sulaberekilo ['monkey's testicles'], kombrocina, mokboto, mboke, boni, namanti, piegba, umdwedwe, epanda [many other regional names]

Voacanga bracteata *Stapf* **(V. bracteata var. lanceolata** *Stapf***; V. diplochlamys** *K. Schum***; V. micrantha** *Pichon***; V. talbotii** *Wernh.***)** – akbapoto, boni, bekapu, buanga, muinya, katongo, kalenge kamume, langure, kakapempe, ebangabanga lo lowe [many other regional names]

Voacanga grandifolia *(Miq.) Rolfe* **(V. papuana** *(F. von Mueller) K. Schum.***; V. papuana** *(F. von Mueller) Boerlage***; Orchipeda papuana** *F. von Mueller***; Pootia grandifolia** *Miq.***)**

Voacanga megacarpa *Merr.*

Voacanga thouarsii *Roem. et Schult.* **(V. dregei** *E. Mey.***; V. obtusa** *K. Schum.***; V. thouarsii var. dregei** *(E. Mey.) Pichon***; V. thouarsii var. obtusa** *(K. Schum.) Pichon***; Annularia natalensis** *Hochst.***; Cyclostigma natalense** *(Hochst.) Hochst.***; Orchipeda dregei** *(E. Mey.) Scott-Elliot***; O. thouarsii** *(Roem. et Schult.) Baron***; Piptolaena dregei** *(E. Mey.) DC.***; Tabernaemontana thouarsii** *(Roem. et Schult.) Palacky***)** – bu lukun, knubwobwoyi, kokiyar birii ['**Strychnos** of the monkey'], kakope, kompoure, gegbwema, papando, kivubavuba, lujiya, dumba, mabingu, muhanda, entoma, nkahlo wa tsovo [many other regional names]

These plants, and others of the genus, contain a milky latex used as glue, and indole alkaloids related to those found in **Tabernanthe** and **Tabernaemontana**. V. africana and V. thouarsii are similarly used in central Africa by hunters, drummers and shamans as a stimulant and heart tonic, to give extra endurance and alertness. Bark of V. bracteata is also reportedly used in Gabon to 'get high'. V. africana is used as a magical cleansing plant for the home in s. Nigeria. In Senegal, its latex is applied to wounds, as it is to tooth caries in Nigeria. In Senegal, a decoction of the leaf is considered a strengthening panacea, and relieves fatigue and shortness of breath. Senegalese women use a root decoction to avoid premature childbirth, or to treat painful hernias. In Tanganyika, root or bark decoctions are used to treat painful menstruation and heart troubles. In the Congo, the plant is used to relieve heart troubles and blennorrhoea, as well as being used externally on skin conditions and fungal infections. In the Ivory Coast, a lotion of the plant treats convulsions in infants; leaf sap is given as nose drops to treat insanity; and a leaf decoction is given externally for leprosy, or by enema for diarrhoea. V. thouarsii bark is used to make hunting nets in e. Africa, and its latex is applied to toothache in Sierra Leone. The latex is said to be very dangerous to bring into contact with the eyes or skin. In Mali, leaves and roots are also decocted and drunk, or bathed in, to combat fatigue and weakness, similarly to V. africana. In Liberia, the ripe seeds of V. thouarsii are scattered on the ground of rice crops to deter wild pigs. The Kru of the Ivory Coast regard an unidentified Voacanga sp. as a protective tree for children, who gain its protection by being bathed in a leaf-macerate every morning until old enough to walk (Bisset 1985b; Burkill 1985-1997; De Smet 1996; Ott 1993).

Seeds of Voacanga spp. [usually V. africana or V. thouarsii] have been used in Europe for their high tabersonine content; the extracted tabersonine is used as a precursor for *vincamine*, which is used commercially to treat various neural deficiencies in the elderly [see *Chemical Index*] (Bisset 1985a).

V. africana seeds have been used by western psychonauts as a mild **Tabernanthe**-like stimulant or mild entheogen, with c.50g ground seeds representing a dose for some people (pers. comms.). Others report that as little as c.7g of ground seeds may be sufficient, if taken in a dark, quiet room, lying down with no distractions and 'clear intent' (friendly pers. comm.). There appears to be a very variable response to these seeds in humans, and some find the experience quite unpleasant, with feelings of mild toxicity lasting up to several days afterwards (pers. comms.). It is suggested, as with **Corynanthe**, that blood-sugar levels be kept high to minimise unpleasant effects (Torsten pers. comm.). Antioxidants would probably also prove beneficial. One psychonaut ingested 20 crushed and encapsulated V. africana seeds 1 hour before eating dried **Psilocybe** mushrooms, on several occasions; the seeds were reported to greatly potentiate the mushrooms (Hoodoo pers. comm.). I have used an alcohol tincture of V. africana root bark in doses equivalent to c.3g root bark, and experienced mild and long-lasting stimulation with no negative side-effects (pers. obs.).

In animal studies, the total root bark alkaloids show CNS-depressant, hypotensive, cardiotonic and spasmolytic activities; they have been stated to be "only slightly toxic and on chronic administration they are well tolerated and there is no accumulation" (Bisset 1985a). The seeds are suspected of being neurotoxic, but no formal studies have been made. The minor alkaloids from V. africana seeds might be responsible for toxicity (pers.

comms.). Tabersonine [the major seed alkaloid] is a *reserpine*-like hypotensive, and has a spasmolytic action on intestinal smooth-muscle; it is said to be "only slightly toxic" (Bisset 1985a; Van Beek et al. 1984). It is probably responsible for most of the effects of V. africana seed consumption. See also *Chemical Index*, **Tabernaemontana** and **Tabernanthe** for more on pharmacology of this group of indole alkaloids.

V. africana root bark has yielded 3.7-10% alkaloids – *voacangine* [0.4%], voacimidine [0.8%], *voacamine* [1.4%], *voacamine* N-oxide [0.043%], vobtusine [papuanine; causes agitation followed by sedation in animals, hypotensive, cardiac depressant, causes convulsions in high doses], voacorine [CNS-depressant, hypertensive, cardiotonic], 3,6-oxido-*voacangine* [0.08%], *ibogaine* [0.02%], *coronaridine* [0.02%] and tabersonine [0.02%]; leaves yielded 0.3-2.03% alkaloids – *voacangine*, *voacamine*, vobtusine [0.0003%], voaphylline [conoflorine; 0.0265%], voaphylline OH-indolenine [0.0025%], voaphyllinediol [0.0003%], voafoline [0.0005%], isovoafoline [0.00005%], voafolidine [0.0001%], folicangine, 2-deoxy-18-oxovobtusine [0.001%], 18-oxovobtusine [0.0014%] and 2-deoxyvobtusine [0.0011%]; trunk/stem bark yielded 0.97-5% alkaloids – *voacangine* [0.14-0.17%], *voacangine* OH-indolenine [0.00625%], *voacangine* pseudoindoxyl, *voacamine* [0.04-0.6%], *voacamine* N-oxide, decarbomethoxy-*voacamine* [0.0025%], voacorine [0.093-0.38%], *vobasine* [0.04-0.7%], vobasinol [0.01%], vobtusine [0.01-0.12%], *voacristine* [0.1-0.25%], 20-OH-voacamidine, voacafrine [0.05%], voacafricine [0.01%], voacryptine, β-*yohimbine* [0.0025%], 3-epi-α-*yohimbine* [0.015%], pseudoyohimbine [0.00025%], *reserpine* [0.01%], *ibogaine* [0.01%], iboluteine [0.0025%], *ibogamine* [0.00125%], *iboxygaine* [0.0025%], *coronaridine* [0.00075%], perivine [0.01%] and perakine [0.00075%]; and seeds yielded 1.5-3.5% alkaloids – almost entirely tabersonine, as well as the ketone-derived alkaloids Δ14-vincanol [0.2%], O-methyl-16-epi-Δ14-vincanol [0.3%], and Δ14-vincamone. Leaves have also yielded 0.17% flavonoids. Leaves, bark and roots gave positive tests for saponins (Bisset 1985a; Ganzinger & Hesse 1976; Janot & Goutarel 1955; Pegnyemb et al. 1999; Richard et al. 1983; Thomas & Biemann 1968).

V. bracteata root bark has yielded 12.1% alkaloids – *voacangine*, *voacristine*, *voacamine* and 3 other bases; stem bark yielded 2.46% alkaloids – *voacangine* [0.094%], *voacamine* [0.22%], *voacamine* N-oxide, voacorine [0.038%], (-)-20-epi-voacorine [0.146%], *voacristine* [0.004%], (-)-19-epi-*voacristine* [0.058%], alkaloid G [0.007%] and alkaloid H [0.116%]; seeds yielded mostly tabersonine in unspecified amounts (Bisset 1985a).

V. grandifolia alkaloids reach a maximum in all parts in November, with the minimum yields in March [plant was 10-12 years old, cultivated in Calcutta]; maximum yields were 2.4% in root bark – including *voacangine* [0.14%], *voacamine* [0.02%] and vobtusine [0.44%]; 1.7% in trunk and branch barks – *voacangine* [0.035%], *voacamine* [0.0012-0.2%], vobtusine [0.006-0.02%] and 18-oxovobtusine [0.0015%]; 1.2% in leaves – vobtusine [0.03-0.65%], *voacamine* [0.0009%], 2-deoxyvobtusine [0.002%], 18-oxovobtusine [0.0002%] and amataine; and 1.2% from fruits – *voacangine*, vobtusine [0.01-0.52%], (-)-tabersonine [0.0015%], (+)-*akuammidine* [0.004%] and *voacamine* [traces] (Bisset 1985a; CSIRO 1990; Majumdar & Dinda 1974).

V. megacarpa bark yielded *voacamine* and vobtusine (Magno et al. 1965).

V. thouarsii root has yielded 1.2% alkaloids, mostly vobtusine [0.5%], the identity of the others not having been pursued; stem bark yielded 1.9-2.71% alkaloids – *voacangine* [0.15-0.28%; specifically not found in one analysis], *voacamine* [0.027%], vobtusine [0.019-0.1%; specifically not found in one analysis], (-)-dregamine [antifatigue agent, local anaesthetic, respiratory stimulant, convulsant], *ibogaine* [0.04%], iboluteine [0.0008%], (-)-*voacristine* [0.004%], (-)-voaluteine [0.0004%] and 18-decarbomethoxy-*voacamine* [0.0006%]; leaf yielded 1.08% alkaloids – vobtusine [main alkaloid], amataine, *ibogaine*, *voacangine*, *voacristine*, 18-oxovobtusine, (-)-18-oxoamataine, 3'-oxovobtusine [alkaloid A], 3'-oxovobtusine N-oxide [alkaloid B], 2-deoxy-3'-oxovobtusine [alkaloid D], 12-demethylvobtusine [alkaloid F] and alkaloids C, E & G; seeds contain tabersonine (Bisset 1985a; Ganzinger & Hesse 1976; Janot & Goutarel 1955; Rolland et al. 1973).

V. caudiflora and V. chalotiana also contain tabersonine as the predominant seed alkaloid (Bisset 1985a), and may have similar psychoactivity to V. africana seeds.

Voacanga africana is a shrub or tree up to 10(-25)m tall; trunk terete, 2-30(-40)cm diam.; bark pale grey-brown, smooth or shallowly fissured near base; branches lenticellate; branchlets glabrous, puberulous or pubescent, with more latex than in the bark. Leaves broadly ovate or subrhomboid, apex acute or bluntly subacuminate, base cuneate, up to 7-41.5 x 3-20cm, softly pubescent (sometimes only on midrib and secondary nerves) beneath, lateral nerves in c.10 pairs, raised beneath, tertiary venation reticulate, impressed. Inflorescence a 10-12-flowered terminal corymb; calyx green, usually shed with corolla, 5-lobed, lobes obtuse, +- 0.5cm long; calyx tube +- 0.5cm long, or longer when lobes erect; limb +- 3cm across; corolla lobes spreading, overlapping to the left, pure white, broadly deltoid, +- 1.8cm long or longer, contorted in bud; stamens 5, epipetalous, alternating with corolla lobes; anthers sessile, narrowly triangular, acuminate at sterile apex, sagittate at base, glabrous, introrse. Ovary mostly broadly ovoid; carpels free or connate at base, surrounded by a ring-shaped connate entire or lobed disc; disc adnate to abaxial sides of carpels; style 1, thickened at apex; clavuncula with thin ring at base, obovoid with 5 short lateral lobes, coherent with the connectives of the anthers; style and stigma shed with corolla; stigma short. Fruit of 2 separate mericarps of which often only one develops; mericarps single or in pairs, united only at base, fleshy when young, coriaceous and dehiscent when ripe, 3-8 x 3-8 x 2.5-7cm, obliquely subglobose, dark or pale brown, very pale green-spotted, with very large, conspicuous, buff lenticels, and with one deep groove to ½ the width on the hilar side, 2-valved, wall 5-15mm thick. Seeds many, dark brown, dull, obliquely ellipsoid, 7-10 x 3.5-5 x 3-4mm, 4-5 grooved laterally, rough, minutely tuberculate; aril orange; endosperm copious, starchy, creamy to white, ruminate, surrounded by spathulate embryo. Fl. Oct., fr. Aug.

Open woodland, bush or light forest, riverine forests, in savannas only in moist places or 'gallery forests', 0-1100m; widespread in tropical Africa and on islands in Gulf of Guinea, especially common near West African coast (Exell et al. ed. 1960-1993; Hutchinson & Dalziel 1954-1972; Leeuwenberg 1985; White 1962).

V. grandifolia occurs in Malesia, as well as Australia [Torres Strait and Cape York Peninsula] (Forster & Williams 1996).

WITHANIA

(Solanaceae)

Withania somnifera *(L.) Dunal* **(W. kansuensis** *Kuang et A.M. Lu***; Physalis somnifera** *L.***)** – ashwagandha, asgandh, jangida, kuthmithi, asundha, asana, Indian ginseng, winter cherry

Mentioned frequently in the Atharva Veda of the Hindus, 'ashwagandha' ['horse-root'] is considered second in importance only to 'soma' [see **Amanita**], and is much-used in Ayurvedic medicine. The plant is considered a magical aphrodisiac, elixir of life, remedy and charm. Roots taking on a human shape are said to be more powerful, an anthropocentric myth similar to those surrounding ginseng and mandrake [see **Panax** and **Mandragora**, respectively]. The dried root, called 'kuthmithi', is sold in Indian markets, and is generally used as a nerve tonic, aphrodisiac, rejuvenative and asthma treatment. It is infused as a safe sedative tonic by both adults and children with no observed toxicity. Roots and leaves are often interchanged, as they share similar properties; they are also both used as a hypnotic in treating alcoholics. The fruits, due to their high saponin content, are used to make soap; seeds are said to be poisonous (Bone 1996; Chopra et al. 1958, 1965; Emboden 1979a; Grandhi et al. 1994; Kirtikar & Basu 1980; Nadkarni 1976; Rätsch 1990, 1992). In Africa, a preparation of the whole plant is taken internally to tone the uterus after a miscarriage, and is macerated in oils and applied topically on boils and swellings. The herb is also known in Africa as a hypnotic, aphrodisiac and abortifacient (Watt 1967; Watt & Breyer-Brandwijk 1962).

The whole plant is a **Panax**-like tonic and adaptogen, also acting as an immune stimulant, hypnotic, tranquilliser, sedative, narcotic, analgesic, hypotensive, respiratory stimulant, vasomotor stimulant, appetite stimulant, astringent, brachycardiac, antirheumatic, antiinflammatory, antitumour [in high doses], antiparasitic and anti-stress agent (Bone 1996; Chopra et al. 1958, 1965; Davis & Kuttan 2000; Grandhi et al. 1994; Kirtikar & Basu 1980; Nadkarni 1976; Rastogi & Mehrotra ed. 1990-1993). An extract also inhibited *morphine* tolerance and dependence, and reduced withdrawal symptoms in mice (Kulkarni & Ninan 1997).

W. somnifera root has yielded alkaloids, such as somniferine, somnifernine, withasomnine, somnine, withanine, withananine, withananinine, *nicotine*, hygrine, anahygrine, cuscohygrine, tropine, pseudotropine, 3-α-tigloyloxytropane, dl-isopellieterine, anaferine and *choline*; c.2.84% steroidal lactones called withanolides [many with antitumour properties] and withaferins [withaferin A shows cytotoxic and antitumour properties]; sitoindosides; and iron. Leaves and fruits also contain withanolides and withaferins (Abraham et al. 1975; Bone 1996; Chopra et al. 1958, 1965; Farnsworth & Cordell 1976; Grandhi et al. 1994; Rastogi & Mehrotra ed. 1990-1993; Schwarting et al. 1963; Yu et al. 1974); leaves were also shown to contain calystegines B2 and C1 (Bekkouche et al. 2001). Shoots and flowers yielded *scopoletin* and aesculetin [0.00025% combined, w/w] (Kala 1958). The withanolides coagulin and withasomidienone have also been isolated from members of the genus (Rahman et al. 1993).

Withania somnifera is an erect, sprawling shrub 30-150cm tall, with nearly all parts +- stellately matted with hairs; branches terete. Leaves 5-10 x 2.5-5cm, ovate, entire, +- minutely stellately pubescent, sub-acute, base acute; main nerves in c.6 pairs, stout, conspicuous; petioles 6-13mm long, stellately tomentose. Flowers greenish or lurid-yellow, 8-13mm long, hermaphrodite, usually c.5 together in sessile or subsessile axillary umbellate cymes; pedicels 0-4mm long; calyx campanulate, 5mm long in flower, stellately tomentose, 5-6-toothed, teeth linear, acute, 2.5mm long, from a deltoid base; corolla campanulate, 8mm long, divided more than ½ way down, lobes 3-6, lanceolate, short, acute, pubescent outside; stamens 5, attached near base of corolla; filaments 3mm long, slender, glabrous; an-

thers broadly elliptic, almost orbicular, 1.25mm long, dehiscing longitudinally. Ovary glabrous, 2-celled; ovules numerous; style glabrous, linear; stigma shortly 2-fid. Berry 6-8mm diam., 13-20mm long, bright red or yellow when ripe, enclosed in translucent papery calyx, globose, slightly 5-angled, pointed with the connivent calyx-teeth, scurfy-pubescent outside; seeds 2.5mm diam., yellow, somewhat silvery and hairy.

India in drier areas, in open places and waste areas, up to 1680m in the Himalayas; also in south and tropical Africa (Chopra et al. 1965; Kirtikar & Basu 1980), as well as Balearic Islands, Spain, Greece, Crete, Sardinia and Sicily (Tutin et al. ed. 1964-1980).

Cold-hardy [though only moderately frost-tolerant], laying dormant in winter (pers. obs.).

ZANTHOXYLUM [Xanthoxylum]

(Rutaceae)

Zanthoxylum arborescens *Rose* **(Z. goldmanii** *Rose ex P. Wilson***; Z. peninsulare** *Brandegee***; Fagara arborescens** *(Rose) Engl.***; F. goldmanii** *(Rose ex P. Wilson) Engl.***)** – prickly ash

Zanthoxylum clava-herculis *L.* **(Z. americanum** *Mill.***; Z. carolinianum** *Lam.***; Z. catesbianum** *Raf.***; Z. clavatum** *St.-Lager***; Z. fraxineum** *Willd.***; Fagara caroliniana** *(Lam.) Engl.***; F. clava-herculis** *(L.) Small***; Thylax fraxineum** *(Willd.) Raf.***)** – Hercules' club prickly ash, southern prickly ash

Zanthoxylum hamiltonianum *Wall. ex Hook. f.* **(Z. nitidum** *(Roxb.) DC.***)** – tezmoi, tezmuri, changre, parpar timur, lian mian zhen

Zanthoxylum martinicense *(Lam.) DC.* **(Z. album** *Vahl***; Z. amoyense** *Tul.***; Z. juglandifolium** *Willd.***; Z. lanceolatum** *Poir.***; Fagara amoyensis** *(Tul.) Engl.***; F. martinicensis** *Lam.***)** – bwa pine

Zanthoxylum microcarpum *Griseb.* **(Z. rhoifolium** *Lam.***; F. microcarpa** *(Griseb.) Krug et Urb.***)** – rabo lagarto

Zanthoxylum procerum *Donn.-Sm.* **(Z. acuminatum** *(Sw.) Sw.***; Z. juniperinum** *Poepp.***; Fagara procera** *(Donn.-Sm.) Engl.***)** – toothache tree

Zanthoxylum schinifolium *Sieb. et Zucc. (***Z. mantschuricum** *Benn.***; Z. pteropodum** *Hayata***; Fagara pteropoda** *(Hayata) Y.C. Liu***; F. schinifolia** *(Sieb. et Zucc.) Engl.***)**

Several Zanthoxylum spp. are used in a variety of medicinal applications around the world. Z. alatum [Z. planispinum], 'wingleaf prickly ash', is used for its seeds to treat stomach ache in China. Z. piperitum fruit ['hua jiao'] is considered stimulant, carminative, diuretic and anthelmintic in China [dose – 3-5g], and is used as a cooking spice ['Szechuan pepper']. Dried root of Z. hamiltonianum ['lian mian zhen'] is used in TCM as an analgesic and circulatory stimulant. Z. hamiltonianum fruit is considered a stimulant in India, where along with Z. alatum its roots and bark are used to kill fish. In Nepal, Z. oxyphyllum fruit ['sil timbur'] might be an ingredient of an incense used to guard against witches. 'Senegal prickly ash', Z. senegalense, is used in tropical Africa – seeds treat rheumatism, and the bark is a sudorific. The Cherokee use Z. clava-herculis to bathe swollen joints, and it is used in southern US as a bark decoction to treat toothache and rheumatism, whilst the berries are considered a tonic stimulant (Chin & Keng 1990; Chopra et al. 1965; Hamel & Chiltoskey 1975; Huang 1993; Keys 1976; Müller-Ebeling et al. 2002; Usher 1974).

In Mexico, Z. microcarpum bark is used as a stimulant and analgesic (Jiu 1966). Z. martinicense, considered narcotic, is an ingredient of some Haitian zombi potions [see *Methods of Ingestion*]. A leaf and bark preparation is used in Cuba as a tonic, and to treat syphilis, rheumatism and alcoholism; the bark is chewed for toothache. The astringent root juice is used in Jamaica for gastrointestinal upsets, and the bark is considered to be antispasmodic (Davis 1988a). Also, an Amazonian Zanthoxylum sp. [Z. cf. tachuelo – 'mina-ko-ro'] is used by the Kofan, who apply a bark decoction as an external analgesic. It may also sometimes be drunk for unclear purposes [unclear to us, that is – presumably those using it in such a fashion would know what effects to expect] – this latter use apparently was given to them by a shaman who had communicated with 'demons' (Schultes & Raffauf 1990).

Z. alatum bark has yielded berberine (Chopra et al. 1965).

Z. arborescens is of more interest to us, as its leaves have yielded 0.09% *DMT*, as well as 0.002% *N-methyltryptamine*, 0.04% 1-methyl-3-(2'-phenylethyl)-1H,3H-quinazoline-2,4-dione, 0.01% 1-methyl-3-[2'-(4"-methoxyphenyl)ethyl]-1H,3H-quinazoline-2,4-dione, 0.01% *skimmianine*, and three new alkaloids – 0.05% 8-(2-isopentenyloxy)-4,7-dimethoxy-furo[2,3b]quinoline, 0.03% 8-OH-4,7-dimethoxyfuranoquinoline and 0.006% (+)-(2S,5S)-2,5-dibenzyl-1,4-dimethylpiperazine. Bark yielded 0.15% (+)-tembetarine, 0.007% of the first quinazoline-compound listed above, and 0.007% of the first new alkaloid. Wood yielded 0.02% *hordenine*, 0.01% (+)-tembetarine and 0.03% (-)-4-[2-(dimethylamino)ethyl]-phenyl-β-D-glucopyranoside (Grina et al. 1982).

Z. brachyacanthum from Ravenshoe and Yarraman, Queensland [Australia], harvested in August and October, gave strong positive tests for alkaloids in both leaf and bark (Webb 1949).

Z. clava-herculis root bark has yielded laurifoline, nitidine, chelerythrine, magnoflorine [see **Magnolia**], tembetarine, candicine [4-OH-N,N,N-trimethyl-*phenethylamine*], herclavine, xanthyletin and xanthoxyletin; stem bark yielded the same compounds in lesser concentration, except chelerythrine was absent (Fish et al. 1975; Lundstrom 1989). The plant has been shown to inhibit human plasma AChE (Orgell 1963b).

Z. conspersipunctatum has yielded the *phenethylamine*-conjugate tembamide (Lundstrom 1989).

Z. hamiltonianum has yielded nitidine, oxynitidine and vitexin (Huang 1993).

Z. oxyphyllum stem bark yielded the indole alkaloid rhetsinine [hydroxyevodiamine] (Chatterjee & Mukherjee 1964), which is also found in **Evodia** rutaecarpa.

Z. piperitum fruits have yielded 2-4% essential oil, containing limonene, phellandrene, geraniol, and sanshool; xanthoxylin is also found in the fruits and berberine in the roots (Keys 1976).

Z. procerum leaves have yielded mainly culantraramine and culantraraminol, as well as lesser amounts of alloculantraraminol, 5-epiculantraraminol, *DMT* and *hordenine* (Schroeder 1986); also found in the plant is 3-(3,4,5-trimethoxyphenyl)-2-propenal (Buckingham et al. ed. 1994).

Z. schinifolium stems yielded the coumarin lacinartin, which inhibited mouse brain MAO [MAO-A more than MAO-B] (Jo et al. 2002).

Z. thomense stem bark from Congo yielded 0.15% crude alkaloids, including 0.06% zanthomamide [N-methyl,N-cinnamyl-(3',4'-methylenedioxy)-*phenethylamine*], 0.03% angoline, 0.075% decarine and 0.016% norchelerythrine (Simeray et al. 1985).

Z. torvum bark from Cairns, Queensland [harv. Sep.] tested strongly positive for alkaloids.

Z. veneficum leaf and bark from Malanda, Queensland [harv. Aug.] tested strongly positive for alkaloids (Webb 1949).

Zanthoxylum arborescens is a shrub or tree with aromatic bark, to 6m tall, with unarmed branches, or armed with scattered, slightly curved, stout spines, often with heavier conical spines on trunk; twigs, petioles, rachis of leaves, and branches of inflorescence hispidulous. Leaves alternate, unifoliate, odd-pinnate, 10-20cm long, usually with stipular spines; leaflets (3-)5(-7), oblong-elliptic to obovate, 1.5-4cm wide, 3-7.5cm long, cuneate at base, acute to obtusely short-acuminate at apex, entire to crenulate, tomentulose beneath, hispidulous to glabrate above, with pellucid glands; petioles and rachis often winged. Inflorescence paniculate; calyx hypogynous or wanting; sepals (4-)5, triangular-ovate, 1.5-2mm long; petals 3-10, 2.5-3mm long, greenish-yellow; stamens 5, hypogynous, reduced or lacking in pistillate flowers; pistils 1-5; ovaries 1-celled, each 2-ovuled; styles somewhat united near summit. Fruits follicular, follicles ellipsoid to subglobose, subsessile, 4-6mm long; seeds ellipsoid, 3.5-4.5mm long, black and shiny. Fl. Sep.-Oct.

Rocky canyons, dry arroyos and valley floors; Lower Sonoran and Subtropical zones, s. Baja California and Sinaloa (Shreve & Wiggins 1964).

ZIERIA

(Rutaceae)

Zieria arborescens *Sims* **(Z. smithii var. macrophylla** *(Bonpl.) Benth.***)** – stinkwood, tree Zieria

Zieria cytisoides *Sm.*

Zieria laevigata *Sm.* – angular Zieria, native candytuft, twiggy midge bush

Zieria laevigata var. fraseri *(Hook.) Domin* **(Z. fraseri ssp. 'a'** *Armstrong***)**

Zieria smithii *Andr.* – sandfly Zieria, sandfly bush, native sassafras bush

Zieria spp.

This group of Australian shrubs is of modern interest due to the phenylpropene content of some of their essential oils [which, unfortunately, can be highly variable]. Although they do not seem to have any uses by humans, Z. smithii and Z. arborescens are known to cause a stock intoxication called 'panting disease', which often results in death weeks after consumption. However, the plants are not very palatable, and are rarely eaten by choice. Z. laxiflora is also suspected of causing intoxications in stock animals, though there is little evidence to support this. The toxic principles are undetermined (Hurst 1942).

Z. sp. aff. arborescens [Z. sp. nov. 'F'] yielded 0.4-2% essential oil, consisting of 7.6-23.4% *myristicin*, 0-6.4% *elemicin*, 1.7-5.1% *methyleugenol* and 0-1.2% *safrole*.

Z. arborescens sens. strict. [Z. arborescens ssp. 'a'] yielded 0.2-3.2% essential oil, containing 0-15.1% *safrole* and 0-7.2% *methyleugenol*.

Z. arborescens ssp. 'b' [ringed-stem form] yielded c.2% essential oil, containing 5.7% *safrole* and 2.5% *methyleugenol*.

Z. arborescens ssp. 'c' [broad-leaved form] yielded 0.6-3% essential oil, containing 2.4-94.1% *safrole*, 0-9.3% *methyleugenol*, 0-52.8% *elemicin* and 1-2.9% 1,3,5-trimethoxybenzene.

Z. arborescens ssp. 'e' [hairy-stem form] yielded 1.7-5% essential oil,

containing 12.7-26.3% *safrole* and 12.9-47.5% *elemicin*.

Z. cytisoides sens. strict. [Z. cytisoides ssp. 'a'] yielded 0.2-0.6% essential oil, containing 0-22% *safrole* and 0-12.3% *methyleugenol*.

Z. cytisoides ssp. 'b' [coastal form] yielded 0.2-0.6% essential oil, containing 1.2-11.3% *safrole* and 0-53.3% *methyleugenol*.

Z. laevigata sens. strict. [Z. laevigata ssp. 'a'] yielded 0.1-0.35% essential oil, containing 0-4.7% *myristicin* and 1.3% *methyleugenol*.

Z. laevigata var. fraseri [Z. fraseri ssp. 'a'] yielded 0.1-1.2% essential oil, containing 15.9-33.8% *methyleugenol* and 2.4-15.4% *safrole* (Flynn & Southwell 1987). Aerial parts yielded 0.16-0.49% hydrocyanic acid [HCN]; the plant does not contain this compound, but it contains a glucoside, zierin, which reacts with an enzyme when the plant is crushed to form HCN (Hurst 1942).

Z. smithii sens. strict. [Z. smithii ssp. 'a'] yielded 0.5-8% essential oil, containing 0-81.2% *safrole*, 0-93.6% *methyleugenol*, 0-83.6% *elemicin* and 0-1.3% *eugenol*.

Z. sp. aff. smithii [Z. sp. nov. 'J'] yielded 0.6-4.8% essential oil, containing 90-95.5% *safrole*.

Z. smithii ssp. 'b' [tomentose form] yielded 0.8-1.5% essential oil, containing 1-19% *safrole*.

Z. smithii ssp. 'c' [glabrous form] yielded 0.7-4.8% essential oil, containing 4.7-32.2% *safrole*, 57.9-61.4% *elemicin* and 0-6.3% *methyleugenol*.

Z. smithii 'd' form [Z. sp. nov. 'E' ssp. 'a'] [robust mountain form] yielded 0.4-2.8% essential oil, containing 5.5% *safrole*, 84.8% *elemicin* and 1.2-4.1% 1,3,5-trimethoxybenzene.

Z. smithii 'e' form [Z. sp. nov. 'E' ssp. 'b'] [glabrous mountain form] yielded 0.9-1.9% essential oil, containing 52.5-59.1% *safrole*.

Z. smithii 'f' form [Z. sp. nov. 'E' ssp. 'c'] [prostrate mountain form] yielded c.0.5% essential oil, containing 41.4% *safrole* and 27.7% *eugenol* (Flynn & Southwell 1987). Z. smithii leaves have yielded 0.046-0.057% HCN, which was also observed in the stems (Hurst 1942). Leaf, stem, and root from Brisbane, Queensland [harv. Mar.] tested strongly positive for alkaloids in some assays (Webb 1949).

Other species also yield minor quantities of the above phenylpropenes, and many others do not. Many of these oils are high in compounds such as naphthalene, chrysanthenone, cis-chrysanthenyl acetate, zierone, limonene and α-*pinene*. Z. arborescens, Z. furfuracea, Z. laevigata and Z. smithii have all been reported to be cyanogenic (Flynn & Southwell 1987), and as such it would seem unwise to ingest these plants directly.

Zieria arborescens is a tall shrub or small tree. Leaves and stems pubescent, or if glabrous, then with prominent tubercles, dotted with translucent oil glands; leaves opposite, trifoliate; leaflets elliptic to narrow-elliptic or lanceolate, 5-10cm long, glabrous or hairy beneath. Flowers regular, bisexual, in axillary cymes, rarely solitary; calyx 4-5-lobed, lobes shorter than petals; petals 4, spreading, free, white, 3-7mm long; stamens 4; anthers without a terminal point. Ovary superior, deeply lobed, surrounded by a perigynous disc, 4-5-locular; 1-2 ovules per loculus; style usually simple; carpels 4, nearly distinct. Fruit a dehiscent schizocarp capsule; 1 seed per carpel. Fl. spring-summer.

Widespread, in moister forests, mountain slopes, gullies; Australia [Victoria, New South Wales, Queensland] (Carolin & Tindale 1994; Costermans 1992).

ZIZIPHUS [Zizyphus]

(Rhamnaceae)

Ziziphus jujuba *Mill.* **(Z. sativa** *Gaertn.***; Z. vulgaris** *Lam.***; Z. zyzyphus** *(L.) Karsten***; Rhamnus ziziphus** *L.***)** – Chinese date, wild Chinese jujube, suan zao ren, shan dzao, da zao

Ziziphus mauritiana *Lam.* **(Z. jujuba** *(L.) Gaertn.***; Z. jujuba** *(L.) Lam.***; Z. mairei** *(H. Lév.) Browicz et Lauener***; Paliurus mairei** *H. Lév.***; Rhamnus jujuba** *L.***)** – Indian jujube, Indian cherry, Indian plum, ber, bush cherry, nabagaya

Ziziphus napeca *Willd.* – kakoli, kankla, kattivatigai, teumani-chettu

Ziziphus spina-christi *(L.) Desf.* **(Rhamnus spina-christi** *L.***)** – Christ's thorn, jujubier de Palestine, bauyer, batomono ['jujube of the river'], dabi furu, kurna, surgô tomono, seder

Ziziphus spinosa *Hu* – Chinese date, wild jujube, sour jujube, suan zao ren, suan zao

Chinese dates [Z. jujuba and Z. spinosa] are prized in TCM as a 'kingly tonic'. The dried seed is decocted in doses of 5-18g to treat insomnia, neuraesthenia, irritation, heart palpitations, hypertension, profuse sweating, chronic thirst and malnutrition. It is considered to have an affinity for the heart, liver, spleen and gallbladder. The fruit is also used, in a dose of 3-5 fruits, as a nutrient tonic and sedative for insomnia. The drug is considered incompatible with plants of the Menispermaceae. Chinese dates may stimulate the immune system, nourish the muscles and enrich bone marrow, whilst acting as a tranquillising hypnotic, sedative, analgesic and anticonvulsant. They may be used regularly with no harmful side-effects. In India, Ayurvedists use the fruit of Z. mauritiana as an aphrodisiac, tonic, laxative blood purifier that may also be used to treat burning sensations and vomiting. The bitter, cooling leaves are also used for diarrhoea, obesity and fever; the bark is used for boils and dysentery; and the root for delirium, headache, fever and to promote hair growth; all parts are used to treat biliousness (Bremness 1994; Huang 1993; Keys 1976; Kirtikar & Basu 1980; Nadkarni 1976; Reid 1995). In addition, the bark has emetic properties and is sometimes considered 'dangerous' (Perry & Metzger 1980).

In Katanga, Africa, the root of Z. jujuba is used as an epilepsy remedy (Watt 1967); in China it has also been used as an antagonist to the actions of Aconitum spp. and 'gentian' [Gentiana spp.] [see *Endnotes*]. In Korea, the seeds have been used as a hypnotic narcotic (Perry & Metzger 1980). The wood is of a fine quality, and is used to manufacture a wide range of things. An excellent honey may also be made from the flower nectar (Outlaw et al. 2002).

In Ethiopia, Z. mauritiana bark is used as a fish poison. In Senegal, the Nyominka observe a 'tabu' on the fruits, which are reserved for the use of Muslim priests. In Somalia, Muslims believe that if they die during the 14 days the fruit is considered to remain in the stomach, they will ascend directly to Paradise. In Botswana, it is believed that drought will come if someone cuts down a Z. mucronata tree after the first summer rain. It is believed to ward off lightning, and the Tenda consider it to be a charm for hunting antelope. The fruit pulp has analgesic activity, and has been used to relieve earache and toothache. Although often said to be toxic, the bitter, acrid pulp is still sometimes cooked into a kind of porridge for food; when dried and fermented, it is made into cakes called 'lotus bread'. The seeds are sometimes roasted to make a coffee substitute [see **Coffea**] (Burkill 1985-1997). The plant is used in Angola to poison fish. In Malawi, Z. abyssinica fruit is used to make alcoholic beverages [see *Methods of Ingestion*] (De Smet 1998). In India, Z. napica root is used as an aphrodisiac, nutrient and antipyretic (Nadkarni 1976). Z. joazeiro is considered a protective tree by the Kariri-Shoko, 'jurema-drinkers' [see **Mimosa**] of n.e. Brazil (Da Mota 1997).

Z. spina-christi is believed to have been the plant from which Christ's crown of thorns was fashioned, although today there are varieties of the plant which have been selectively bred to bear no spines. Others believe the plant used was the related 'Jerusalem thorn', Paliurus spina-christi. The fruit of Z. spina-christi is considered delicious to eat. Z. spina-christi is now thought to have been the 'lotus' of the Lotophagi ['lotus-eaters'] referred to in Homer's 'The Odyssey', the flowers and fruit of which overtook Odysseus' crew with narcosis when they visited the land of the Lotophagi [probably in modern Libya]. This plant was previously thought to have been the similar Z. lotus (Burkill 1985-1997), though others believe it to have probably been a **Nelumbo** or **Nymphaea** (Jones 2001). This latter option may be more likely, as the fruits of Z. spina-christi are a renowned food and do not have a reputation for psychotropic activity. However, perhaps it is the seeds of this species which are psychoactive. These diverse plants known as 'lotus' should not be confused with the leguminous herbs Lotus spp. [see *Endnotes*].

Z. jujuba and Z. spinosa fruits have yielded 12 phenanthrene isoquinoline-type alkaloids, including asimilobine, N-methylasimilobine, *nuciferine*, N-nornuciferine, oxonuciferine, zizyphusine, stepharine, norisocorydine, caaverine and (+)-coclauline, as well as vitamins, sugars and organic acids. Seeds have yielded 14 peptide alkaloids named samjoinines, as well as glucosides [jujubosides A & B; convert to jujubogenin on hydrolysis], betulin and betulic acid. The stems also contain peptide alkaloids, but these apparently do not share the sedative action of the seeds and fruit (Buckingham et al. ed. 1994; Huang 1993; Rastogi & Mehrotra ed. 1990-1993). Seeds also contain the flavonoid glycoside spinosin, which has sedative and hypnotic activity (Outlaw et al. 2002). In mice, the seeds showed sedative activity only with higher doses, and had anxiolytic effects at lower doses (Penga et al. 2000).

Z. mauritiana root bark has yielded peptide alkaloids including mauritines A-H, mauritine J, frangufoline, amphibine B and amphibines D-F (Jossang et al. 1996); flavonoids, glycosides, saponins and an essential oil were also detected (Dahiru et al. 2006).

Z. spina-christi bark [harv. Jan., Nigeria] yielded peptide alkaloids – mostly mauritine-A [0.025%], with smaller amounts of mauritine C, amphibine A, amphibine E and amphibine F (Tschesche et al. 1974).

Ziziphus jujuba is a small, subdeciduous tree with a dense, spreading crown, commonly 60cm girth and 6m tall; bark blackish to grey or brown, rough, regularly and deeply furrowed, the furrows c.1.2cm apart; blaze 9-13mm, short fibre, pink with or without paler streaks, the juice turning purplish-black on the blade of a knife; branches usually armed with spines, mostly in pairs, one straight, the other curved. Young shoots +- densely pubescent; leaves alternate, subdistichous, 3-6.3 x 2.5-5cm, oblong or ovate, usually minutely serrulate or apex distinctly toothed, obtuse, base oblique and 3-nerved, nerves depressed on the glabrous shining upper surface, densely clothed beneath with white or buff tomentum; petiole 2.5-10mm long. Flowers 3.8-5mm diam., greenish, in dense axillary tomentose cymes or fascicles 1.2-1.9cm long; calyx with broadly obconic tube and 5 triangular acute lobes keeled within, lobes valvate; petals 5 or rarely 0, cucullate, deflexed; stamens 5, opposite to and enclosed in the petals and usually longer than them. Disc 5-10 lobed, flat or pitted,

margin free; ovary sunk in or adnate at base to the disc, 2-4 celled; styles 2-3(-4), free or connate; stigmas small, papillose. Fruit a globose or oblong drupe, 1.2-2.5cm diam., first yellow then orange and finally reddish-brown, containing a single stone surrounded by fleshy pulp.

Indigenous and naturalised throughout India, Burma, Ceylon, outer Himalayas to 1370m, China, Australia, Afghanistan, Africa (Kirtikar & Basu 1980).

To obtain seed, the stones must be cracked open; keep moist and warm, should germinate in a few weeks. Raising strong plants past this point has proven difficult in Australia; propagating from transplanted root suckers may be a more viable option. Potential weed due to roots sending up new shoots. Frost tolerant to c. -10°C or more when dormant; heat tolerant. Better adapted to arid regions, but will grow in a wide range of climates. Grows in a wide variety of soils, but fruits poorly in humid or very moist conditions. The 'Indian jujube' [Z. mauritiana] is more cold-sensitive and does better in such humidity. Requires long hot summers and clear skies for fruit to ripen fully. Sometimes fruits split and spoil before maturity. Fruits may be harvested and eaten when mature [when the skin is bright green and shiny] for a crisp, apple-like taste; or, they may be left to ripen further on the tree, turning brown and finally a rich bronze-red, becoming wrinkled and partially dried. As birds may eat them before you do, it is sometimes considered best to harvest when they have developed a few brown patches, then allowed to ripen off the tree. Fruits may be eaten as they are, or slashed and boiled with sugar/honey syrup several times before drying, resulting in a fruit that will store for longer periods. Care should be taken with the two sharp, pointed ends of the seed kernel (Glowinski 1997; Outlaw et al. 2002).

These sources of 'dates' should not be confused with the source of common dates, the unrelated Phoenix dactylifera (Palmaceae). Z. jujuba *Mill.* should not be confused with Z. jujuba *(L.) Gaertn.* or Z. jujuba *(L.) Lam.*, which are synonymous with Z. mauritiana (Outlaw et al. 2002).

ZORNIA

(Leguminosae/Fabaceae)

Zornia diphylla *(L.) Pers.* **(Z. conjugata** *(Willd.) Sm.***; Z. reticulata** *Sm.***; Z. surinamensis** *Miq.***; Z. zeylonensis** *Pers.***; Hedysarum conjugatum** *Willd.***; H. diphyllum** *L.***)** – tandi-jhapni, nelammari, poor man's soap

Zornia gibbosa *Spanoghe* **(Z. angustifolia** *Sm.***; Z. cantoniensis** *Mohlenbr.***; Z. graminea** *Span.***)**

Zornia latifolia *DC.* **(Z. diphylla ssp. latifolia** *(DC.) Malme***; Z. diphylla var. latifolia** *(DC.) Benth.***; Z. ovata** *Vogel***; Z. sericea** *Moric.***)** – maconha brava

The leaves of Z. latifolia, as 'maconha brava' ['wild marijuana' – see **Cannabis**], are smoked in Brazil as a "hallucinogen". The plant is used to treat dysentery in San Salvador (Schultes & Hofmann 1980, 1992). Z. diphylla also treats dysentery, and acts as a febrifuge and diuretic. In southern India, the roots are given to children as a soporific. In Australia, horses feeding on it have suffered from impaired vision and mobility, suggesting psychotropic effects. This and other Zornia spp. are valued as good forage crops in parts of S. America and Africa (Allen & Allen 1981; Nadkarni 1976). In Papua New Guinea, Z. gibbosa has been used in sorcery (Schultes & Hofmann 1980).

Z. diphylla aerial parts have yielded 2H-1-benzopyran-2-one (International... 1994) and saponins (Allen & Allen 1981). The chemical compositions of Z. latifolia and Z. gibbosa are still unknown.

Zornia diphylla is a diffuse or erect herb, glabrous or pubescent-villose; root annual or persistent, forming thick, woody rhizomes; stems annual, short, much-branched, branches ascending or erect, c.60-90cm, terete or compressed. Leaves palmately 2-4-foliolate, stipellate; leaflets 2, ovate-lanceolate-linear; stipules ovate-lanceolate, acute, striate, affixed-peltate near base, below insertion in auricle short, obtuse or acute elongate, caducous. Flowers in terminal spikes, +- elongate, remote, sessile, yellow; bracts or bracteoles resembling stipules, flowers tightly appressed and almost entirely included; calyx hyaline or paleaceus, membranaceous, tubulose-campanulate, bilabiate, upper labia emarginate, lower labia 3-fid, lateral lobes short; corolla very short, labium ciliate, of equal length, lateral lobes very short, petals clawed, standard rotundate, bracts short or long, wing keel overtopping; stamens 10, in tube completely connate; anthers alternately oblong-linear, and ovate. Ovary subsessile, many-ovuled; style filiform; stigma small, subcapitate. Legume linear, compressed, 3-6-articulate, vexillary sutures straight, keel sinuate, joints compressed, immarginate, pubescent or glabrate, surface reticulate-venose, prickles arising from veins frequent, rare or absent, glabrous or apex glochidiate or on all sides reflexed-hairy.

South America (Fridericus & De Martius ed. 1965-1975), also widespread elsewhere as a forage crop (Allen & Allen 1981).

ZYGOPHYLLUM

(Zygophyllaceae)

Zygophyllum fabago *L.* – Syrian bean caper

In Italy, flower buds of this plant are pickled in vinegar and eaten in the same manner as 'capers' [Capparis spinosa (Capparaceae)]. The plant is also used there and in the Middle East as an anthelmintic (Festi & Samorini 1997). The related Z. album from n. Africa and the Canary Islands is used as a perfume, derived from a decoction of the flowers (Usher 1974). Also in Africa, Z. foetidum [when eaten in excess] is considered toxic to animals in early winter mornings, when grown in the shade, possibly due to highest alkaloid concentrations at this time [see **Phalaris**]. Z. herbaceum, Z. microcarpum, Z. microphyllum, Z. sessilifolium and Z. spinosum are also considered toxic to sheep. Z. morgsana powdered seed is used in the Cape area to treat convulsions, paralysis and stroke; it is also considered toxic, and is used with caution (Watt & Breyer-Brandwijk 1962).

Z. apiculatum leaf from Queensland [Australia], harvested February, tested strongly positive for alkaloids; assays of the whole plant harvested in June gave weaker results (Webb 1949). In later work, leaf [from Australia; harv. April] tested positive for alkaloids in preliminary screenings, but follow-ups found none (Fong et al. 1972).

Z. atriplicoides from Armenia contains unidentified alkaloids (Zolotnitskaya 1954).

Z. fabago contains β-carboline alkaloids. Roots have yielded 0.058% total alkaloids, consisting of *harmine* [0.007%], *harman* [0.014%] and *harmol* [seems to be major alkaloid], as well as 2 unidentified alkaloids; aerial parts have yielded 0.002% *harmine*, 0.008% *harman* and *harmol* (Borkowski 1960; Festi & Samorini 1997; Lutomski & Nowicka 1969; Lutomski et al. 1968a); stems alone yielded 0.00045% alkaloids calculated as *harman* [Table 1 in this paper actually lists 0.000045%, yet the former value is given in the summary of findings] (Lutomski & Malek 1975b). The plant has also yielded 3-β-OH-2-β,21-β-oleananolide (Buckingham et al. ed. 1994). The leaves have a very hot flavour, which has been compared to mustard [see **Brassica**] and capers; this strong taste may discourage use of the aerial parts in quantities sufficient for MAO-inhibition (theobromus pers. comm.).

Zygophyllum fabago is a much-branched perennial herb or subshrub, glabrous and bushy; stems terete, thick, smooth, branching from the base. Leaves opposite, 2-foliate, stipitate; leaflets elliptic-oval, oblique at base, rounded at apex, succulent, 10-35mm long. Flowers solitary, axillary; sepals 5, nearly distinct, 5-10mm long, margins whitish; petals 5, yellow or orange-yellow, 5-10mm long, clawed; stamens 8-10, exserted. Ovary sessile, 4- or 5-carpellate. Fruit angular, oblong, 1-4cm long; seed solitary in each cell. Fl. Jun.-Aug.

In waste ground, 1070-1520m; originally from Asia Minor, occurring also in s.e. Europe and w. Mediterranean region, also introduced to western US including s. New Mexico (Martin & Hutchins 1980).

PART THREE

Endnotes

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APPENDIX A: ENDNOTES

This appendix is a collection of various snippets of information that could not be fully included in the main text due to space and time restrictions, or due to weak or tentative evidence for their activity. Here, in a loosely organised format, are compiled some interesting facts and preliminary observations, as well as pointers for further research.

MISCELLANEOUS SMOKING HERBS, TOBACCO, BETEL, TEA and COFFEE SUBSTITUTES

There are a group of diverse herbs used as substitutes for tobacco or pituri [see **Nicotiana**, **Duboisia**] by indigenous Australians. Many of these plants are known to have mild narcotic, stimulating, or otherwise psychoactive properties when chewed or smoked. Those not discussed more fully in the main body of the book are mentioned here.

Adriana glabrata (Euphorbiaceae) ['bitterbush'] dried leaves were sometimes smoked as a tobacco substitute by some tribes near Gladstone, Queensland. There appear to be two varieties of this species, which may explain why it is considered a useful forage plant in some areas, and a suspected stock intoxicant in others (Cribb & Cribb 1981; Low 1990).

An Amorphophallus sp., probably either A. variabilis [Brachyspatha variabilis] or A. glabra [many sources list this as 'galbra', which I suspect is a perpetually-repeated spelling error] (Araceae) ['stinking Arum'] has been smoked in the Daly River area, Northern Territory. It is dangerously narcotic with a chloroform-like effect – it is said that "a short smoke makes one sleepy; if he smokes for too long he will not awaken" (Cribb & Cribb 1981; Plowman 1969).

Callicarpa longifolia (Verbenaceae) ['chukin'] has not been used as a narcotic by indigenous Australians, though in the early 1900's, Japanese immigrants living near the Johnstone River, Queensland, chewed the bark with betel nut [see **Areca**] and lime, as a substitute for betel leaves [see **Piper 1**]. The plant has also been used as a fish poison (Cribb & Cribb 1981).

Centipeda cunninghammii ['common sneezeweed'], C. minima ['spreading sneezeweed'] and C. thespidioides ['desert sneezeweed'] (Compositae) are highly aromatic [the aroma has been described as "an objectionable odour"], and have been used as tobacco substitutes. The powdered leaves and seeds have been used as a snuff, for their ability to induce sneezing [hence their common names]. They also relieve inflammation of the eye, and treat coughs, colds and sore throats. In inland Australia, C. cunninghammii was sometimes scattered around campsites to repel ants (Cribb & Cribb 1981; Latz 1995). C. minima contains triterpenes (Rai et al. 1999).

Codonocarpus cotinifolius [Gyrostemon cotinifolius] (Gyrostemonaceae) ['kandurangu', 'desert poplar', 'horseradish tree'] may not technically be a tobacco or pituri substitute, but the roots are chewed as a narcotic in some drier regions of Australia; the leaves are also chewed to ease toothache [sometimes with **Acacia** cuthbertsonii bark] (Lassak & McCarthy 1990). The root often contains grubs which must be removed before consumption, as they have toxic properties (Bindon 1996). The plant contains the alkaloids (E,E)-codonocarpine and N-methylcodonocarpine (Buckingham et al. ed. 1994), and leaf essential oil contains benzyl cyanide and cochlearin (Lassak & McCarthy 1990).

Dendrocnide spp. (Urticaceae), particularly D. excelsa ['giant stinging tree'], are well known in n.e. Australian rainforests for the intensely painful and lingering stings that result from even light contact with the plants (Cribb & Cribb 1981; pers. comms.). The stings [which in the case of D. excelsa, contain *serotonin*, *acetylcholine* and *histamine*] are reputedly relieved by sap of the wild banana **Musa** banksii. The bark and leaves have been used externally by indigenous healers to treat rheumatism, or as a counter-irritant for stings (Lassak & McCarthy 1990). D. moroides [Laportea moroides] leaves and stalks have yielded the bicyclic octapeptide moroidin, which causes extended duration of pain from stings (Oelrichs et al. 1992); the stinging hairs also contain *serotonin* (Schneider et al. 1972). Although not a substitute for tobacco or pituri, at least one Dendrocnide sp. has been used as an unusual masticatory drug. In the early 1900's, ethnographer Walter Roth observed that "At certain of the corroborees on the lower Tully River [Queensland] some of the blacks will chew, and spit out again, the leaves of the 'stinging tree'. The immediate effect is apparently a condition of frenzy, in which the individual may take violent action on his mates, or perhaps more commonly produce in himself a grossly disgusting perversion of the alimentary functions which enables him to eat human excreta" (Low 1990). Well, what can I say to that...

Derris trifoliata var. macrocarpa (Leguminosae), as 'keni' [a name also applied to a variety of medicines], may have been smoked in pipes by the Kawadji of e. Cape York Peninsula. The herb is also sometimes called 'dynamite plant' (Peterson 1979; Thomson 1939). It was not made clear by Thomson whether this species was actually used in place of tobacco, or if it simply shared the same name [the Kawadji also call tobacco 'keni'] (Thomson 1939). The powdered root of D. trifoliata is known as 'derris dust', and has weak insecticidal properties (Cribb & Cribb 1981). Roots of D. urucu and D. utilis [from Brazil] are known to be toxic to cold-blooded animals, and the former has been found to contain rotenone [see **Lonchocarpus**] (Pinto 1955).

Gastrolobium laytonii (Leguminosae) ['kite leaf poison bush'] has been used in unclear ways as a psychotropic drug by some elders in the desert regions north of Kalgoorlie, Western Australia. It is known to be toxic to stock animals, and contains sodium fluoroacetate. Also known as '10-80', sodium fluoroacetate is used to poison dingos (Low 1990), and is extremely toxic (pers. comms.)! G. callistachys has yielded 3-carbomethoxy-2-methyl-β-carboline (Shulgin & Shulgin 1997) and N-methyl-*tryptophan* methyl ester (Husson 1985).

Geijera parviflora [G. pendula] (Rutaceae) ['wilga'] is used in inland n.e. Australia; leaves are baked and powdered, to be smoked with other 'narcotic' plants for ceremonial purposes. It is said to induce drowsiness and drunkenness. The leaves are also infused and taken both internally and externally as an analgesic, or chewed and put in cavities to relieve toothache. Plants are highly variable in chemistry (Lassak & McCarthy 1990). Some varieties are eaten by sheep, whilst other varieties are not. Leaves of 'unpalatable varieties' from Goondiwindi [s.w. Qld] and Jondaryan [s. Qld] yielded the coumarin dehydrogeijerin [c.0.214%]; leaves of a 'palatable variety' from Jondaryan yielded instead the coumarin geiparvarin [c.0.22%] (Lahey & MacLeod 1967), which has shown antitumour activity (Bocca et al. 2001). Leaf essential oils are also variable; one variety [from Eidsvold, Qld] yielded an essential oil containing mainly linalool and geijerene (Sutherland 1964); another variety is rich in phlor-*acetophenone* dimethyl ether (Lassak & McCarthy 1990). Gently oven-dried leaves, collected near Peak Hill [NSW], next to the Newell Highway in mid-February, gave mild but definite narcotic-like effects when smoked through a water pipe (pers. obs.).

Goodenia lunata (Goodeniaceae) ['ingulba ndarinya'] leaves are dried, broken up or crushed between stones and mixed with ash for chewing by the Alyawarra and western Arrante; considered a poor substitute for 'real' pituri. It is sometimes used to poison waterholes in order to more easily catch game (Latz 1995; Low 1990; O'Connell et al. 1983). What was thought to have been a Goodenia sp. was reported to be administered to babies by native women, as a soporific for long journeys. Unfortunately further data is lacking on the identity of the plant or the region of use (Cribb & Cribb 1981). G. varia has been reported to be given to babies in the same way (Lassak & McCarthy 1990).

Heteropogon contortus (Gramineae) ['bunch spear-grass'] has been chewed as a narcotic amongst tribes around Broome, Western Australia. In India, the roots are considered stimulant and diuretic, and used to treat rheumatism (Cribb & Cribb 1981). In Bengal, the distilled oil from the awns is given with betel leaf [**Piper** betle] to treat asthma; a paste of the plant is applied to bites from scorpions, rabid dogs or jackals (Pal & Jain 1989). The plant may be burned to repel mosquitoes (Bindon 1996).

Lomandra spp. (Xanthorrhoeaceae) have no known traditional psychotropic use, yet one modern psychonaut reported that an unidentified ornamental species had similar stimulant effects to some **Cyperus** spp. when smoked (Gerbil pers. comm.).

Pterocaulon serrulatum [P. glandulosum] (Compositae) ['toothed ragweed'] has been chewed as a low-quality tobacco substitute in the Derby region of Western Australia. It has a strong and pleasant apple-scent when crushed, which is inhaled to treat colds. The new growth after rain is considered the most medicinally potent. The leaves have yielded 0.1% essential oil, with unidentified constituents. P. sphacelatum is used for the same purposes, but is less potent as a tobacco (Aboriginal Communities 1988; Cribb & Cribb 1981; Latz 1995). This latter species has yielded 0.08% essential oil, containing 1.7% *elemicin*, as well as many other compounds, most unidentified (Aboriginal Communities 1988).

Stemodia lythrifolia (Scrophulariaceae) ['bunu bunu'] has been chewed with ash as a stimulant 'bush tobacco' in n.w. Australia; an infusion of the plant is applied externally to treat headaches (Lassak & McCarthy 1990; Low 1990). S. viscosa has reputedly been used to relieve insomnia (Cribb & Cribb 1981).

Streptoglossa odora [Pterigeron odorus] (Compositae) ['applebush'] is used by the Northern Warlpiri as a pituri substitute; it also treats colds and internal pains (Aboriginal Communities 1988; Latz 1995). The plant has been described as smelling like mouse faeces (Low 1990).

Trichodesma zeylanicum (Boraginaceae) ['ngurnungurnung', 'camel bush', 'cattle bush'] was once used as a 'bush tobacco' in Arnhem Land; the Ngarinyman used to prepare it by sun-drying, and smoked it in long-stemmed pipes called 'larwa' (Smith et al. 1993). It is similarly used by the Gunwinggu of Arnhem Land, though elsewhere it is only used medicinally, or not at all (Low 1990). In n. Western Australia, the plant has been decocted and applied to sores to aid in healing. In Africa, the root has been

used as an analgesic, and one tribe uses the leaves in brewing beer, to aid in proper fermentation (Cribb & Cribb 1981).

Incidentally, whilst we are still in Australia, flower buds of a Banksia sp. (Proteaceae) have been claimed anecdotally to be psychoactive when smoked (pers. comm.). Flower heads of B. integrifolia are occasionally made into an alcoholic beverage by some indigenous people in s.w. Australia, who soaked them in water and allowed the nectar to ferment slightly. The effects of the beverage were described by Walter Roth as "exhilarating, producing excessive volubility" (Low 1990). Some plants from the Proteaceae contain obscure tropane alkaloids (Griffin & Lin 2000).

In the early 1900's, Eucalyptus spp. (Myrtaceae) leaf blends [from E. cinerea (a 'stringybark'), E. citriodora ('lemon-scented gum') and E. dives ('broad-leaved peppermint')] were marketed as cigarettes in Australia ["Take a whiff of the gum forests into your home", to quote one advertising slogan of the time] (Cribb & Cribb 1981). No psychoactivity was hinted at, the cigarettes presumably appealing simply due to their aromatic properties. However, as any Australian would know, Eucalyptus spp. leaves are rich in volatile oils and would quite possibly burst into flame rather than burn slowly and evenly. Thus, I suspect these cigarettes would have been cut with other herbs out of necessity. In Tasmania, the 'cider gum' [E. gunnii] was tapped for its sap, which was left to ferment in the holes cut in the tree. The resulting tasty and potent alcoholic cider was very popular amongst both indigenous people and white settlers (Cribb & Cribb 1981; Low 1990). E. microtheca ['coolibah'] bark has been burnt to ash for chewing with pituri in s.e. Queensland (Low 1990). As noted in the *Chemical Index*, some Eucalyptus spp. are potentially useful in the synthesis of *mescaline* from syringaldehyde, though these trees do not actually contain *mescaline*, nor are they known to contain alkaloids. The required syringaldehyde is prepared by oxidation of lignin from E. diversicolor ['karri'], E. obliqua ['messmate stringybark'] or E. regnans ['mountain ash'] (see Amos 1964). One person performed a tlc assay on the heartwood of an unidentified Eucalyptus sp. growing in the US, and tentatively identified the presence of *DMT* (Trout pers. comm.); this has also been observed with tlc by another researcher as a main or sole alkaloid in "wood and bark of a common Eucalyptus" (Appleseed 2002), again, probably one growing in the US.

Dried flowers of the European Ulex europaeus (Leguminosae) ['gorse', 'furze'] growing in Victoria, Australia [where it is a noxious weed], have also been smoked by modern experimenters as a mild narcotic. The effects are similar to those of smoked broom flowers [see **Cytisus**] (pers. comms.; pers. obs.). U. europaeus has been found to contain *cytisine* and related alkaloids [such as anagyrine], though plants growing in New Zealand were low or deficient in alkaloids (White 1943b). As well as plants discussed elsewhere in this book, *cytisine* has been found in Ammodendron spp., Anagyris spp., Baptisia spp., Colutea spp., Eucresta spp., Hovea spp., Lamprolobium fruticosum, L. grandiflorum, Plagiocarpus axillaris, Strongylodon macrobotrys, Templetonia spp. and Thermopsis spp. (Rätsch 1998).

'Mountain tobacco' [Arnica montana; Compositae] is said to be a powerful and acrid narcotic, and has been used as a tobacco and snuff. Willow leaves and bark [Salix spp.; Salicaceae] have also been used as tobacco ['big star tobacco'] in N. America by many tribes; Navajo healers ['stargazers'] are known to smoke it in healing ceremonies (Cooke 1860; Winter 1998). Willows are known to produce salicylic acid, which is an analgesic, and natural precursor to aspirin. The leaves may be infused and drunk to treat nervous insomnia. Oenothera albicaulis (Onagraceae) ['white-flowered evening primrose'] is mixed by the Navajo with the 'wild buckwheat' **Eriogonum** umbellatum, and smoked before retiring to ensure good dreams, as well as good luck. Flowers of Erigeron canadensis and E. philadelphicus (Compositae), 'fleabanes', are smoked by the Ojibway as a hunting charm. Young leaves of hawthorn [Crataegus spp.; Rosaceae] and hazel [Corylus avellana; Corylaceae] have been used as tobacco substitutes, the former in the first World War, when they were also used as tea [see **Camellia**], and the seeds ground as coffee [see **Coffea**] (Bremness 1994; Winter 1998). *Phenethylamine* has been found in Crataegus arnoldiana, C. mollis and C. monogyna (Hartmann et al. 1972). In Quebec, French fur traders have been known to drink a beverage made from 'reindeer lichen', Cladina rangiferina [Cladonia rangiferina] (Cladoniaceae), when their tea supplies run out. In Alaska, Aleut hunters eat Cladina spp. "to maintain their wind" when climbing, and may also drink them in tea to relieve chest pains. In Alaska and w. Canada, the 'kidney lichen' Nephroma arctium (Nephromataceae) is taken as an infusion to give strength to someone in a weakened state (Sharnoff undated).

Native Americans have used a great variety of herbs ['kinnikinnick' – see **Arctostaphylos**] for smoking either alone, or mixed with tobacco, some of which are covered elsewhere in this book. Some not otherwise mentioned are 'quinine bush' [Garrya elliptica; Garryaceae], 'leadplant' [Amorpha fruticosa; Leguminosae], Antennaria microphylla, A. rosea (Compositae), 'sandwort' [Arenaria spp. – see below], 'barberry' [Berberis spp.; Berberidaceae], 'sweet birch' [Betula lenta; Betulaceae], 'ironwood' [Carpinus caroliniana; Betulaceae], 'wild comfrey' [Cynoglossum virginianum; Boraginaceae], 'yerba santa' [Eriodictyon californicum; Hydrophyllaceae], 'wahoo' [Euonymus atropurpurea; Celastraceae], strawberry [Fragaria virginiana; Rosaceae], 'sweet grass' [Hierochlöe odorata – see below], 'mountain laurel' [Kalmia latifolia – see below], mint [Mentha aquatica & M. spicata; Labiatae], 'blazing star' [Mentzelia pumila; Loasaceae], 'cicely' [Osmorhiza occidentale - see below; Umbelliferae], red raspberry [Rubus idaeus; Rosaceae], 'mullein' [Verbascum thapsus – smoked to clarify thought, and as a hunting aid; Scrophulariaceae], corn silk [from Zea mays; Gramineae], pine [Pinus spp.] and 'Prince's pine' [Chimaphila umbellata; Pinaceae]. In Venezuela, a tobacco chewing mixture called 'chimo' is used with an alkaline ash – as well as tobacco, **Pimpinella** ansium, **Myristica** fragrans, **Syzygium** aromaticum, opium [see **Papaver**], 'tonka bean' [Dipteryx odorata; Leguminosae – said to be narcotic; produces coumarin when fermented (Lewis & Elvin-Lewis 1977)], 'cocui' liquor [from Agave cocui – see *Methods of Ingestion*], vanilla [Vanilla planifolia fermented, partially ripe fruit; Orchidaceae], brown sugar [Saccharum officinarum; Gramineae] and Palicourea chimo (Rubiaceae) leaves are added to the quid (Cooke 1860; Rätsch 1998; Siegel et al. 1977; Winter 1998). Taken with cacao [see **Theobroma**] or 'arrowroot' [Maranta arundinacea; Marantaceae], vanilla was used in central America as an aphrodisiac (Rätsch 1990); infusions of vanilla by itself are also reputedly aphrodisiac. Vanilla is regarded as a CNS stimulant and has been used to treat hysteria, melancholy, convulsions, impotence and rheumatism, and to "increase the energy of the muscular system". Numerous other Vanilla spp. are used for the same flavouring and medicinal purposes, but they are generally inferior to the vanilla from V. planifolia. The most important chemical from the fermented pods, vanillin, has been reported to act as a stimulant, aphrodisiac, tonic, antispasmodic, carminative and androgen, as well as aiding "protein synthesis and muscle regeneration" (Lawler 1984). Alkaloids have been detected in V. planifolia, V. chamissonis and V. pompona (Lüning 1967).

'Yarrow' leaves [Achillea millefolium; Compositae] have been used as a tobacco substitute [see **Nicotiana**], and added to beer to make it more intoxicating (Cooke 1860). The Winnebago of N. America use the smoke to revive the unconscious (Kindscher & Hurlburt 1998), and the Ojibway smoke the flowers of A. millefolium and A. lanulosa ceremonially (Winter 1998). A. millefolium is also "consumed as a tea in support of the vision quest", and the Navajo chew the stem or drink a tea of it as an aphrodisiac (Rätsch 1990). Achillea spp. contain *thujone*. *Thujone* is also found in the 'oak mosses', Evernia prunastri and E. furfuracea (Usnaceae) (Hall 1973). 'Coltsfoot' [Tussilago farfara; Compositae] has been claimed to have been smoked to induce visions by British peasants in the middle ages. It has been smoked also as a tobacco mixer along with betony, rosemary, thyme, **Anthemis**/**Matricaria** and lavender [see below]; it is usually used medicinally for coughs and other respiratory complaints. It is now banned in some countries due to the potential dangers of its pyrrolizidine alkaloids [in degrees of exposure too high to represent practical human usage] (Chiej 1984; Forsell 1993; Mabey et al. ed. 1990).

The Ainu of Japan smoke the leaves of Daphniphyllum humile (Daphniphyllaceae) as a tobacco substitute (Lewis & Elvin-Lewis 1977). In Ladakh, India, Rheum emodi (Polygonaceae) is smoked mixed with tobacco (Bhattacharyya 1991). 'Foxglove', Digitalis purpurea (Scrophulariaceae), is sometimes smoked with hashish [see **Cannabis**] in India – taken in excess, it may cause "delirium, insensibility and convulsions" (Cooke 1860). The plant is highly toxic, and can kill, containing powerful cardioactive glycosides. 'Fahan tea' or 'faham tea', Angraecum fragrans [Jumellea fragrans] (Orchidaceae), is a parasitic plant on trees. The leaves, stems and flowers have been decocted or infused in Mauritius and Bourbon as a tea or coffee substitute with sedative and digestive stimulant effects; later it was briefly popular in England and France. Leaves have been used in cigar flavouring. In w. Africa, Angraecum spp. bulbs are used in aphrodisiac preparations. The orchid Aceras anthropophora is used in Algeria as a fahan substitute, 'faham d'Algérie', said to taste better and have the same effects. Both plants contains coumarin [see **Justicia**]. A. anthropophora has also been used as a stimulant in the Middle East, and sometimes is used to make salep [see Orchis spp. below] (Lawler 1984; Von Bibra 1855). In Cuba, the leaves of Eurya theoides (Theaceae) are used as a tea substitute (Lewis & Elvin-Lewis 1977). The common garden shrub Hydrangea paniculata 'Grandiflora' (Saxifragaceae) has been suggested as a smokable **Cannabis** substitute, with 1 cigarette [and no more] being a dose; however, as well as hydrangin [umbelliferone] and saponins the plant contains cyanogens, so unless HCN poisoning is your idea of a good time, this is not recommended (Gottlieb 1992; Siegel 1976).

MISCELLANEOUS NARCOTICS, NERVINES and APHRODISIACS

Tylophora erecta (Asclepiadaceae) sap is used by indigenous peoples around the coast of n. Queensland, Australia, to prepare a 'love potion' with aphrodisiac effects; the plant contains isoquinoline alkaloids which are derivatives of tylophorine (Buckingham et al. ed. 1994; Lassak &

McCarthy 1990). T. asthmatica roots and aerial parts have yielded phenanthroindolizidine alkaloids, as well as *skimmianine* as a minor alkaloid of aerial parts, and γ-fagarine as a minor alkaloid of roots (Etherington et al. 1977). Leaf and stem of T. paniculata [harv. Mar., Qld] tested positive for alkaloids (Webb 1949). The common 'pomegranate' tree, Punica granatum (Punicaceae), was associated with the love goddesses Aphrodite, Venus and Astarte [as well as being said to have grown from the blood of Dionysus], and its fruits believed to have aphrodisiac properties. A stimulating and aphrodisiac wine may also be made from the crushed fruits (Rätsch 1990). Iranian Zoroastrians use an infusion of the leaves and twigs, with **Ephedra** and milk, to prepare a 'haoma' substitute beverage [see also **Peganum**] (Flattery & Schwartz 1989). The fruit rind and bark are used medicinally to help expel intestinal worms, though they can be toxic and should be used with caution (Chevallier 1996). Side effects may include "vertigo, dimmed vision, great weakness and cramps in the legs, formication, convulsive trembling, etc." with higher doses causing "mydriasis, partial blindness, violent headache, vertigo, vomiting and diarrhoea, profound prostration, sometimes convulsions." With the bark, 7g decocted is considered a dose in TCM. Bark may contain 20% tannins and 0.5-1% alkaloids [pelletierine and its derivatives] (Keys 1976). The plant has been claimed to contain MAOIs, and the root bark to contain *DMT* (Rätsch 1992), but supporting data is lacking. The south-east Asian 'durian' fruit, from Durio zibethinus (Bombaceae), is considered a "powerful aphrodisiac" eaten when ripe and fresh. The inner portion of the 'coco-de-mer' fruit of the Seychelles, Lodoicea maldivica (Arecaceae), is also used as an aphrodisiac, but the belief in this property may simply stem from the clear sexual imagery of the phallic male inflorescence and the yonic fruit or 'nut' (Rätsch 1990).

Chenopodium ambrosioides (Chenopodiaceae) ['American wormseed'] is known as 'slah-sam' in Meghalaya, n.e. India, where the juice of the plant is used to relieve nervous tension (Neogi et al. 1989). In Nepal, it is known as 'alimah' and is considered to be protective; shamans there sometimes use it as a ritual shamanic incense in place of mugwort [see **Artemisia**]. It may be used to transform water into 'amrita' if none of the preferred plants are available [see Thysanolaena maxima below] (Müller-Ebeling et al. 2002). In Malawi, the leaves have been used as an ingredient of a snuff also containing **Securidaca** longipedunculata root, Annona senegalensis roots [see below], and leaves of Asparagus africanus [see below]. This snuff is used to induce trance (De Smet 1998). The anthelmintic seeds of C. ambrosioides bear an oil which contains ascaridol, geraniol, d-*camphor*, p-cymene and l-limonene (Nadkarni 1976; Perry & Metzger 1980). In Atacama, Chile, leaves of C. arequipensis ['coquilla', 'pariente de la coquilla'] are chewed as a coca substitute [see **Erythroxylum**]. Other herbs used as coca substitutes include Cordia nodosa (Boraginaceae) [fruits of the Mexican C. boissieri are reputedly 'inebriating'], 'tabaco chuncho' [Andes]; Couma macrocarpa (Apocynaceae), 'sorva' or 'juansoco' [upper Amazon]; Cydonia oblonga (Rosaceae), 'membrillo' [Atacama]; Lacmellea lactescens and L. cf. peruviana (Apocynaceae) [upper Amazon]; a Rosa sp. (Rosaceae) [Atacama]; and Stylogyne amplifolia (Myrsinaceae), 'coca silvestre' or 'jipina coca' [Río Putumayo] (Rätsch 1998). See also **Erythroxylum**, **Dodonaea**, and Sonchus oleraceus, Urmenentea spp. and Werneria spp. below.

'Larkspur' [Delphinium spp.; Ranunculaceae] have been used as narcotics, but are known to be quite toxic in excess [the young leaves and seeds most toxic]. The herbs can produce sedation [to the point of stupefaction], nausea and nervous system depression. Other symptoms may include contact dermatitis, nervous excitement, depressed respiration and circulation, abdominal pain, tingling skin and burning sensation in the mouth. The Cherokee say the root "makes cows drunk and kills them" (Covacevich et al. ed. 1987; Emboden 1979a; Foster & Caras 1994; Hamel & Chiltoskey 1975). In parts of n. India, leaves of D. brunonianum are given as a sacred offering. The alkaloid delphinine, found in many members of this genus, is apparently an antidote to Aconitum spp. (Ranunculaceae) poisoning (Nadkarni 1976). Aconitum spp. ['monkshood', 'wolfsbane'] generally act as narcotics, analgesics and nerve paralysers (Bremness 1994; Nadkarni 1976). In n. Japan, the Ainu used Aconitum spp. to make arrow poisons for hunting (Bisset 1976). Some Nepalese Shivaites smoke and drink Aconitum spp. A. ferox and A. napellus are known as 'aghori' and are used as intoxicants (Rätsch 1998, 1999a), and are also acknowledged in Indian medicines as being powerful and dangerous narcotics (Nadkarni 1976). The Nepalese consider Aconitum spp. ['biss'] to be protective, although their name for the plants means 'poison'. Shamans may drink a carefully-dosed tea of the leaves and/or flowers [harvested March to May] to enter a visionary trance; leaves may also be burned as a ritual incense (Müller-Ebeling et al. 2002). A. napellus contains alkaloids – mostly neoline and napelline, with traces of *ephedrine* and sparteine (Freudenberg & Rogers 1976). *Salsolinol* has been found in A. carmichaeli (Buckingham et al. ed. 1994). It must be stressed that these plants are highly dangerous! In China, Musella lasiocarpa (Musaceae) sap is used as an antidote to Aconitum spp., as well as "to alleviate drunkenness". The pseudostem and rhizome are reputedly sometimes used to make a wine (Liu et al. 2003), presumably similar to palm wine.

Melilotus officinalis (Leguminosae/Fabaceae), 'melilot', is a mild sedative which soothes headaches, muscle and nervous stress, and insomnia; it contains coumarins (Chevallier 1996). Lotus wrightii (Leguminosae/Fabaceae) ['deervetch', 'Wright's horn clover'] is used for hunting magic by the Navajo, who say it is a "life medicine"; the roots are added to beer by the Apache to make it more intoxicating (Rätsch 1998). L. corniculatus ['bird's foot trefoil'] flowers are sedative, and the whole plant has effects similar to **Passiflora** incarnata. Lotus spp. produce a cyanogenic glucoside, linamarin. Lycopus europaeus and L. virginicus (Labiatae), 'gypsyworts', are sedative narcotics with cardiotonic properties, the latter species being more potent (Bremness 1994; Chevallier 1996; Conn 1973). Roots of 'paeony', Paeonia officinalis (Paeoniaceae), have been used to treat epilepsy (Nadkarni 1976); they act as a nerve tonic and antispasmodic. In England, the seeds were once infused in mead to prevent nightmares. The plant is potentially toxic (Bremness 1994), and inhibits plasma AChE (Orgell 1963b). The root and its major constituent, paeoniflorin, have been shown to reverse *hyoscine*-induced performance deficits in rats (Ohta et al. 1993). In Nepal, water from the flowers of P. emodi is considered a form of 'amrita' (Müller-Ebeling et al. 2002). Potentilla fruticosa (Rosaceae) is known as 'bhairunga pate' in Nepal and has numerous magical associations; the leaves are used in incense (Müller-Ebeling et al. 2002). A Potentilla sp. may have been an ingredient in European 'witches' ointments' [see *Methods of Ingestion*] (Rätsch 1998; Robinson 1996). 'Silverweed', P. anserina, may be applied externally to relieve pain (Bremness 1994).

Root and trunk of Ceanothus americanus (Rhamnaceae), 'New Jersey tea', have been used by native N. Americans as a sedative antispasmodic. The stem-bark of 'crampbark' or 'cranberry bush' [not related to true cranberries - see **Vaccinium**], Viburnum opulus (Caprifoliaceae), has similar actions (Bremness 1994; Hutchens 1973). *Phenethylamine* has been found in V. lantana (Hartmann et al. 1972), and traces of *tyramine* in V. odoratissimum leaf (Wheaton & Stewart 1970). Hedera colchica (Araliaceae), related to the English ivy [H. helix], has shown narcotic and antispasmodic effects in mice and rats (Brussell 2004). H. helix itself has long been rumoured to be psychoactive, causing a kind of delirium, especially when added to wine [see *Methods of Ingestion*]. Dried leaves are said to be psychoactive when smoked. The berries, made into a drink, have been said to guard against inebriation. However, the identification of 'ivy' referred to in historical accounts is doubtful, and may in fact refer to plants of the Convolvulaceae [eg. see **Argyreia**, **Ipomoea**] with a similar appearance [at least when not in flower]. H. helix contains a variety of substances, including *chlorogenic acid*, hederatannic acid, malic acid, formic acid, hederasaponins, inositol, glycosides and the alkaloid emetine (Rätsch 1998).

In China, roots and leaves of the 'indigo plant', Indigofera tinctoria (Leguminosae/Fabaceae), are used to treat depression (Bremness 1994). In Mexico, I. suffruticosa is used as an analgesic and antispasmodic for epilepsy and abortion (Jiu 1966); it also has tranquillising properties (Heffern 1974). Indigofera spp. are used in parts of Asia to treat epilepsy, and some may produce stupor in excess (Watt 1967). I have found I. australis to be mildly sedative when smoked – it should be noted, though, that many Indigofera spp. are hepatotoxic and have caused stock poisonings (Keeler 1975). Seeds of I. endecaphylla contain indospicine, a hepatotoxic and teratogenic amino acid (Miller & Smith 1973). Leaf of I. australis [from NSW, Australia] was shown to contain 0.04% alkaloids in one screening (CSIRO 1990); all parts of plants growing in New Zealand [harv. Sep.] contained no alkaloids (White 1951). Canavanine [see **Canavalia**] has also been found in many Indigofera spp. (Bell et al. 1978).

Tropaeolum majus (Tropaeolaceae), 'nasturtium', is said to be a rejuvenating aphrodisiac [the whole plant taken]. The related T. tuberosum bears edible tubers, which are anaphrodisiac, lowering testosterone. The candied autumn roots of Eryngium maritinum (Umbelliferae), 'sea holly', were popular in the 18th century as a tonic and aphrodisiac (Bremness 1994), and the Indian E. caeruleum root is also used as an aphrodisiac and nerve tonic (Nadkarni 1976). 'Horseradish' [Armoracia rusticana (Brassicaceae) root, which sometimes may look like male genitalia, is used as an aphrodisiac and for "renewing strength after sexual exhaustion" (Rätsch 1990). Fruits of 'saw palmetto', Serenoa serrulata [Sabal serrulata] (Palmaceae), were eaten by native N. Americans as a nutritive tonic with sedative, diuretic, anabolic and oestrogenic properties. However, they are also regarded to be aphrodisiac and to treat impotence. In s. US, they have been taken in 'love potions', combined with Osmorhiza occidentalis ['sweet anise'] root [see below]. They contain steroidal saponins, 1-2% essential oil, fixed oil, tannins and polysaccharides. The seeds of Echium vulgare (Boraginaceae) ['viper's bugloss'] have been decocted and added to wine to "comfort the heart and drive away melancholy"; the roots are apparently used for the same purpose. A leaf infusion acts as a nerve tonic, as well as relieving fevers and inflammation. Today, it is considered toxic by some (Bremness 1994; Chevallier 1996; Cribb & Cribb

1981; Grieve 1931; Rätsch 1990). Young shoots and roots of Arctium lappa (Compositae), 'burdock', can be infused to make a "strengthening aphrodisiac tonic"; the root has shown mild anti-tumour activity. 'Tamarack' or 'Eastern larch', Larix laricina (Pinaceae), may be drunk as a "weak tea to treat melancholy" (Bremness 1994). In Nepal, L. griffithii ['Himalayan larch', 'bargay salla'] is sometimes used for incense by shamans (Müller-Ebeling et al. 2002). In S. Africa, the Zulu refer to a number of plants from different genera as 'uBangalala', generally used to treat impotency. One of these plants was identified as Eriosema kraussianum (Leguminosae), used for its roots. The roots yielded pyrano-isoflavones named kraussianones, which had varying degrees of activity on rabbit penile smooth muscle, comparable to that of Viagra™ (Drewes et al. 2002). In Cairo, Arachis hypogaea (Leguminosae) seeds ['pistache de terre', 'ground nut'] are sold to be eaten as an aphrodisiac (Martindale 1889).

Orchis spp. (Orchidaceae), whose twinned tubers resemble testicles [hence the genus name, from the Greek for testicle], have a reputation as aphrodisiacs, clearly deriving at least partly from symbolism. The aphrodisiac 'satyrion' consumed in Dionysian rites was apparently an Orchis sp., and satyrs were said to get their sexual energy from eating orchids; interestingly, some orchids [see below] contain caproic acid, which smells of goat. In Europe, O. maculata and O. latifolia tubers were used against impotence or sterility caused by witchcraft, whilst witches were said to use O. mascula ['early purple orchid'] tubers in love potions; they have also been used as aphrodisiacs for reluctant stock animals as well as for people. Numerous species have been used to prepare the Arab beverage 'sahlab' ['fox testicle'], bastardised as 'salep' once its use spread to Europe; in London it was popular with the working class before cheap coffee and tea became common. It was often prepared mixed with sugar, milk and spices. Salep has been credited with aphrodisiac, tonic, nutritive and restorative properties which are now held in doubt. In Turkey it is used to make ice cream, and it has even been used to adulterate opium. The preferred species used for salep are O. latifolia, O. mascula, O. morio ['green-winged meadow orchid'] and Platanthera bifolia, though many other Orchis spp. have been used, as well as tubers from other orchid genera. For use, the new tubers [of the paired tubers, one is shrivelled from the previous year] are gathered after fruiting, then washed, skinned and dried before being powdered. Tubers of 'false salep', O. lutea and O. provincialis, have been used as analeptics and aphrodisiacs in Algeria, and in the US O. fragrans tuber has been used as a nervine stimulant. O. maculata, O. mascula and O. militaris have been used as weaker substitutes for fahan tea [see Angraecum above] in France. In Pakistan and n. India, O. latifolia has been used as a nerve tonic. O. morio was regarded as an aphrodisiac by the ancient Greeks, and members of the genus in general were valued as such in the far east. Coumarin has been found in O. coriophora, O. galeata, O. militaris, O. purpurea and O. simia; Orchis spp. also yield a glucomannan [degrading to mannose and sucrose in spring], protein, and a mucilage containing calcium oxalate crystals (Lawler 1984).

Many other orchids have been used as aphrodisiacs, such as Cynorchis purpurascens [bulbs, Madagascar], Listrostachys sp. [bulbs, w. Africa], Polystachya sp. [bulbs, w. Africa], Coelogyne ovalis [ayurvedic preparations], Eria muscicola [ayurvedic preparations; E. japonica used as 'shih-hu' substitute - see Dendrobium below; alkaloids found in genus], Himantoglossum hircinum [Satyrium hircinum; contains caproic acid; genus also used to make salep], Microstylis wallachii [bulbs, India; alkaloids found in genus] and Ophrys linifolia [bulbs, Mediterranean; genus also makes salep] (Lawler 1984; Lüning 1967). Young Zulu men use Ansellia gigantea [A. africana; 'leopard orchid'] and A. humilis roots to make girls temporarily sterile, for obvious reasons, and the stem infusion is also said to be aphrodisiac. A. humilis is also used to relieve nightmares, either by drinking a stem infusion or burning the root and holding the head in the smoke, and a leaf and stem infusion treats madness. A. gigantea is grown as a fetish plant by Bwiti leaders in Gabon; the whole plant contains an alkaloid. In e. Africa, Eulophia angolensis root sap is drunk as an aphrodisiac, and in S. Africa men take it "to ensure success in courting"; root sap also treats earache. E. cucullata [Lissochilus arenarius; 'foxglove orchid'] is used by the Zulu as an infusion to treat "barrenness or impotence due to lack of nervous or muscular power", and in S. Africa the root is used as a stimulant. E. campestris root has been used as an aphrodisiac in India, as has E. lindleyana root juice in Africa. E. campestris, E. herbacea, E. nuda and E. virens have also been used as salep in n. India/n. Pakistan. E. virens has been reported to cause madness in cattle who eat it. Alkaloids have been detected in the genus. Stems of a Lissochilus sp. are chewed by men in Transvaal, for the strong erections that result when the juice is swallowed. In Madagascar, roots of L. madagascariensis are used as an aphrodisiac, and L. beravensis is used for nervous disorders. The S. African L. krebsii is used as a sedative (Burkill 1985-1997; Lawler 1984; Lüning 1967; Watt & Breyer-Brandwijk 1962).

In N. America, the orchids Habenaria dilatata and H. viridis have been used in food as a female aphrodisiac; H. viridis, H. media and H. saccata have been used as love charms. In India, H. commelinifolia and H. pectinata have been used as salep. Alkaloids have been found in the genus. Ipsea speciosa tubers are reputedly aphrodisiac in Sri Lanka, and sorcerers use them to make love potions and charms; in India they are used as a stimulant. Gymnadenia spp. are reputed to be aphrodisiac in Norway. In Europe, G. conopsea has been used to treat epilepsy and nervous disorders; this species and G. odoratissima have yielded coumarin. Bulbophyllum spp. tubers have been used as aphrodisiacs in w. Africa, and B. japonicum has been used as 'shih-hu' [see Dendrobium below]; B. auricomum contains coumarin, and alkaloids have been detected in the genus. In Europe Spiranthes autumnalis has been used as an aphrodisiac, and S. spiralis reputedly has the same effects; the genus has been used as salep, and alkaloids have been found. In Ambon, Indonesia, seeds of Grammatophyllum scriptum are given to women, who reputedly must puruse the person who gave it to them. In the West Indies, an alcohol tincture of Brassia caudata is used to treat epilepsy and nervous disorders. In the US, Corallorhiza maculata stalks and C. odontorhiza roots have been used for their sedative properties. Natives of California drank a root decoction of Epipactis gigantea to treat mania and severe illness; a report by Perry & Metzger (1980) of E. mairei fruit decoction being tonic and stimulating hormone secretion may be in error. Members of the genus have also been used to make salep. In the Philippines, Spathoglottis plicata leaves were smoked as a tobacco substitute following the Japanese invasion in World War II; an alkaloid has been detected in S. lobbii. In Malabar, Pholidota pallida fruit has been used as a narcotic for insomnia, and to relieve headache and earache; alkaloids were not found in 4 species tested (Lawler 1984; Lüning 1967).

In Florida, some indigenous tribes have used the roots of Lachnanthes tinctoria (Haemadoraceae) ['spirit weed', 'red root'], in the words of a Dr. Byron, "to produce a brilliancy of the eye, a flushed and swollen face, a bold appearance, and eloquent speaking; after these peculiar stimulating effects pass off, the person becomes stupid and very irritable." Large doses of the plant can cause visual disturbance, pupil dilation and dizziness; the effects of such large doses have been compared to those of **Atropa** belladonna. The roots are ordinarily used to produce a dye (Felter & Lloyd 1898). Comandra pallida (Santalaceae), 'bastard toadflax', is apparently used by the Kayenta Navajo of N. America as a narcotic (Ott 1993). The related parasitic C. umbellata is used by the Cherokee steeped with **Cypripedium** acaule for kidney problems, and the juice of the plant is applied externally to wounds (Hamel & Chiltoskey 1975). Some tribes also use the sweet fruits as food (Usher 1974). Chemistry of these plants is obscure.

Adenanthera pavonina (Leguminosae/Mimosaceae) ['coralwood', 'red sandalwood', 'bead tree'] [note – *not* **Anadenanthera**] is a widespread tree in tropical zones; its shiny, red, uniform seeds are often used as necklace beads, and have been used as weights by jewellers and apothecaries. They may be roasted and eaten, but the raw seeds are said to be intoxicating. In India, the seeds are powdered to use as a plaster for soothing boils and headache, and are also sometimes used to treat paralysis. A leaf decoction is said to act as an aphrodisiac if used for any extended period. The wood is decocted as a tonic (Bremness 1994; Cribb & Cribb 1981; Kirtikar & Basu 1980; Nadkarni 1976; Patel et al. 1947; Watt & Breyer-Brandwijk 1962). The seeds contain c.14% oil, of which 25% is lignoceric acid, as well as O-acetylethanolamine, galacticol, β-sitosterol, stigmasterol, 2-amino-4-ethylidenepentanedioic acid, 2-amino-4-methylenepentanedioic acid, γ-methylene-*glutamine*, γ-methylene-*glutamic acid*, γ-ethylidene-*glutamic acid* and 1H-imidazole (International... 1994; Kirtikar & Basu 1980; Krauss & Reinbothe 1973); the leaf has yielded an alkaloid [from the 2.25% residue of the alcohol extract], which was not identified (Patel et al. 1947). Caution should be exercised with the seeds of this plant, as the nature of their "intoxicating" properties is unclear.

The guava tree [Psidium guajuva; Myrtaceae] has been decocted as an effective opium substitute; leaves or bark may be used, the latter being stronger in action. In coastal Ghana the leaves are chewed for "a central effect", as well as to treat insomnia and lessen the effects of alcohol. In many countries it is used to treat toothache, convulsions and gastric complaints (Lutterdodt & Maleque 1988; Perry & Metzger 1980; Rätsch 1998). The inner stem bark has yielded amritoside, leucocyanidin and egallic acid; leaves have yielded an essential oil, tannins, amritoside, leucocyanidin, guaijaverin, guaijavolic acid, crategolic acid, maslinic acid, egallic acid and quercetin. Flavonoid compounds appear to play a large role in the narcotic activity observed in mice after administration of the leaf extract, both i.p. and orally (Lutterdodt & Maleque 1988; Seshardi & Vasishta 1965a, 1965b). Numerous Latin American plants have common names indicating some relationship with opium poppies ['amapola'; see **Papaver**], though it is not known if they are used as opium substitutes. These include Althaea rosa (Malvaceae), 'amapola grande' [also known more commonly as 'hollyhock'; A. officinalis is the common 'marshmallow']; Hunnemania fumariaefolia (Papaveraceae), 'amapola'; Kosteletzkya paniculata (Malvaceae), 'amapola'; and Pseudobombax ellipticum [Bombax ellipticum] (Bombaceae), 'amapola', 'amapola blanca' or 'amapola colorada', 'amapola silvestre'. Another plant from the Malvaceae, Malva rotundifolia, has been reported from Afghanistan to

have inebriating seeds (Rätsch 1998). Chelidonium majus (Papaveraceae) has been known as 'hexenmilch' ['witch's milk'] and 'hexenveilchen' ['witch's violets'] in Germany (De Vries 1991), and as 'amapola amarilla' ['yellow poppy'] in Latin America (Rätsch 1998). C. majus alkaloid extract modulated binding to the *GABA*a receptor, enhancing the binding of *muscimol* (Häberlein et al. 1996). The plant has yielded *tyramine* (Smith 1977a), *protopine*, allocryptopine, chelerythrine, chelidonine, magnoflorine, sanguinarine, sparteine [see **Cytisus**, **Lupinus**] and numerous other alkaloids (Preininger 1986). See also **Argemone**, **Eschscholtzia**, **Ipomoea**, **Passiflora**, and Bernoullia flammea and Tabebuia below.

Annona palustris (Annonaceae), 'alligator apple', is said to be narcotic (Bremness 1994). In some parts of Africa, A. senegalensis root is used as a homicidal poison; the root bark contains diterpenes (De Smet 1998). The related 'soursop', A. muricata, has been shown to contain *GABA* (Durand et al. 1962), and *salsolinol* is found in A. reticulata (Buckingham et al. ed. 1994). Seeds of A. atemoya, a Taiwanese species, have been found to contain N-behenoyl-*tryptamine*, N-cerotoyl-*tryptamine*, N-lignoceroyl-*tryptamine*, N-nonadecanoyl-*tryptamine*, N-octacosanoyl-*tryptamine*, N-tricosanoyl-4,5-dihydroxytryptamine, N-lignoceroyl-4,5-dihydroxytryptamine, N-pentacosanoyl-4,5-dihydroxytryptamine, N-heptacosanoyl-4,5-dihydroxytryptamine, the non-indole alkaloids artemoine and cleistopholine, and a variety of acetogenins (Wu et al. 2005).

The wood of the 'box shrub' [Buxus sempervirens; Buxaceae] is narcotic and sedative – the plant is considered toxic (Bremness 1994), and inhibits plasma AChE (Orgell 1963b). In Tuscany, Italy, branches are kept in the trousers to prevent the 'evil eye' (Pieroni & Giusti 2002). Actaea alba ['white cohosh'] and Cimicifuga racemosa (Ranunculaceae) ['black cohosh'] of N. America have been used as nerve tonics to 'relax hysteria'; the whole plant of the former, and only the root of the latter, being used (Emboden 1979a). C. racemosa is known to be antispasmodic and sedative (Bremness 1994). Common 'sow-thistle' [Sonchus oleraceus; Compositae] has even been found to be an effective opium substitute when boiled and drunk (Emboden 1979a); in Australia, some Victorian indigenous tribespeople say the leaves can induce sleep (Low 1990). So far, no alkaloids have been found, but flavonoids [incl. *apigenin*] and phenolic acids [incl. *chlorogenic acid*] have been detected; the coumarins aesculetin [see **Aesculus**] and chichoriin have been found in some species (Giner et al. 1993). As 'wirikocha', it is chewed as a coca substitute [see **Erythroxylum**] in Atacama, Chile (Rätsch 1998).

The fruits of Salpichroa origanifolia [S. rhomboidea] (Solanaceae) are considered narcotic, producing "symptoms of drunkenness" when consumed in large quantities. The roots yielded small amounts of tropine, pseudotropine, hygrine, cuscohygrine, and possibly *hyoscyamine* (Evans et al. 1972a). Rhizome and roots of the N. American 'skunk cabbage', Symplocarpus foetidus (Araceae), have stimulant, narcotic, antispasmodic and emetic properties; in large doses, the roots and seeds can also cause vertigo, dim vision, nausea, vomiting and headache. It has been used to treat hysteria and epilepsy, amongst other things. *Serotonin* is one of the leaf constituents. The roots cause intense itching and inflammation on skin contact. The related Arisaema draconitum (Araceae) ['green dragon', 'dragon root', 'owl's foot'] is used in sacred bundles, to give the owner of the bundle "the power of supernatural dreams" (Croat 1994; Hutchens 1973; Plowman 1969; Schmidt 1984; Schneider et al. 1972). It is reputedly 'hallucinogenic', and the Ojibway "are said to have used the root to counteract witchcraft". The plant is rich in calcium oxalate crystals that can cause an allergenic reaction when touched or eaten (Rätsch 1998). Nepalese shamans regard Arisaema spp. ['gurbo', 'banko', 'cobra lily'] as potent plants for shamanic travel and spiritual teaching [usually A. griffithii and/or A. utile], although they are very dangerous and rarely used. Mere skin contact can be enough for effects to manifest - generally, violent vomiting, trembling, cold sweat and swollen tongue, although shamans are propelled into a trance. When taken internally by shamans, a small piece of root [5mm diam.] is first cooked with salt and **Zanthoxylum** piperitum fruit to detoxify it. The fruit of Arisaema spp. is considered food for 'nagas' [see **Naja and Ophiophagus**] (Müller-Ebeling et al. 2002).

Isatis tinctoria (Cruciferae), 'woad', may promote psychic sensitivity if taken regularly, though it is slightly toxic (Trout & Friends 1999). Flowers of Primula veris (Primulaceae), 'cowslip', are sedative and antispasmodic, with antihistamine actions; the roots contain salicylic acid-related compounds. Dried aerial parts of Pulsatilla vulgaris (Ranunculaceae), 'pasqueflower', are sedative, antispasmodic, analgesic and nerve tonic; the plant is considered toxic when fresh (Bremness 1994). P. alpina ssp. apiifolia flowering aerial parts were found to contain protoanemonin and anemonin, which have sedative properties [see **Clematis**, **Ranunculus**] (Martin et al. 1988). Lamium amplexicaule (Labiatae/Lamiaceae) ['deadnettle', 'henbit'] has caused a form of 'staggers' in stock animals in Australia, which is apparent when the animals are forced to move (Webb 1948).

Myrica gale (Myricaceae), 'bog myrtle' or 'sweet myrtle', is an aromatic shrub which has been used in brewing beer [see *Methods of Ingestion*], and to flavour alcoholic spirits. In beer, it acts as a preservative, flavouring, and narcotic. It was well known as an ingredient of 'gruit' beer, popular in Europe [including Britain and Scandinavia] before hops [see **Humulus**] became the legislated brewing herb [though enjoying a brief revival in European ales during World War II]. Gruit, although having many regional variations, consisted primarily of M. gale, 'yarrow' [see above], and **Ledum** palustre, as well as various other herbs and spices [including **Cinnamomum**, **Pimpinella**, **Myristica** fragrans, ginger (see below)], and was known to be particularly intoxicating and aphrodisiacal. In Scandinavia, braches of the plant [M. gale] were once situated in the home to repel evil spirits and attract good fortune. The whole plant contains an essential oil, and flavonoids related to the chalcones (Buhner 1998; Rätsch 1999b; Simpson et al. 1996). In e. Africa, M. kilimandscharica and M. salicifolia ['ol getalasu'] barks are used with other barks and roots [see **Acacia**, *Methods of Ingestion* and Albizzia spp. below] by the Masai as strong stimulant-excitants (Lehmann & Mihalyi 1982). Lichens have also sometimes been used in brewing beer. Lobaria pulmonaria [Sticta pulmonaria] (Stictaceae/Lobariaceae), often called 'lungwort' due to its appearance, has been used as such in place of hops in Siberia and Europe; it is also sacred to the Sechelt of British Columbia. Some monasteries in Russia and Siberia were known in the past for the "highly intoxicating" lichen-fortified beer they served to travellers, suggesting that the lichens are added not only for their bitter properties. In the Great Lakes region of N. America, the Menomini eat L. quercizans [S. glomulifera] growing on maple or hemlock trees, taking it in soup as a tonic medicine (Sharnoff undated).

Hibiscus spp. (Malvaceae) seeds are considered aphrodisiac in India (Nadkarni 1976). In Colombia, Paez shamans chew H. abelmoschus ['ush ni'in', 'culebrina', 'musk seed'] seeds with coca [see **Erythroxylum**], for their pungent aromatic flavour, and "potent magical charge"; medicinally, the seeds have nervine and stomachic effects (Antonil 1978). H. esculentus is an ingredient of a w. African millet beer called 'dolo', also containing **Acacia** camplyacantha, 'balanos' [Balanites aegytica], **Datura** stramonium seeds, and **Grewia** flavescens as additives [see *Methods of Ingestion*] (Rätsch 1992). Root bark of H. syriacus contains coumarins [such as *scopoletin*] with MAOI (Yun et al. 2001) and other properties [see *Chemical Index*].

Borago officinalis (Boraginaceae), 'borage', has been claimed to "make men and women glad and merry, to comfort the heart, dispel melancholy and give courage". Dioscorides and Pliny also claimed it was an ingredient of the 'nepenthe' wine mentioned in Homer's 'Oddysey', which brought "absolute forgetfulness" [see below]. The herb is a mildly analgesic adrenal tonic, as well as being a diaphoretic, antipyretic, emollient, expectorant and emmenagogue; the seed oil ['starflower oil'] is used for menstrual irritability (Bremness 1988, 1994; Chiej 1984; Mabey et al. ed. 1990; Ody 1993).

A commercially-available tincture said to be prepared from the 'California pitcher plant' or 'nepenthe' has been reported by one person to have 'disorienting' and 'mildly hallucinogenic' effects when taken at low doses. However, the identity of the plant is uncertain, as its common name may represent both Darlingtonia californica and Sarracenia purpurea [both Sarraceniaceae]. Nepenthes spp. [Nepenthaceae], another group of pitcher plants, might have similar effects (pers. comms.). Sarracenia flava has been found to produce *coniine* (Mody et al. 1976), so extra caution is advised when experimenting with these plants (pers. obs.). 'Nepenthes', as mentioned above, was the name of a drugged wine given to Helen as described in Homer's 'Odyssey', which caused her to forget her home after being abducted. Its actual identity has been long disputed, and will probably never be known with any certainty (Rätsch 1998).

The common 'snowdrop', Galanthus nivalis (Amaryllidaceae), has been convincingly proposed to have been the mysterious herb 'moly' of ancient Greek mythology. In Homer's 'Odyssey', the crew of Odysseus' ship were turned into pigs and made to forget their past by Circe, who had given them food laced with poisonous herbs. The descriptions strongly suggest the anticholinergic effects of Solanaceous plants such as **Atropa**, **Hyoscyamus** and **Datura**. Odysseus was given the herb 'moly' by Hermes, so that he would be able to resist the effects of Circe's drugs, and thus rescue his men. Botanically and pharmacologically, all fingers seem to point to G. nivalis as the identity of moly, which contains *galanthamine*, an alkaloid with anticholinesterase activity, which has been shown to be useful to produce "a safe and effective reversal of the central anticholinergic syndrome in man" (Plaitakis & Duvoisin 1983). Incidentally, Amaryllis vittata from the same family is rich in synephrine [see **Citrus**], yielding 0.0223% [w/w] from leaves, along with 0.008% *tyramine*, 0.0058% N-methyltyramine and <0.0001% octopamine; bulbs yielded much smaller quantities (Wheaton & Stewart 1970).

RHODODENDRONS and OTHER ERICACEAE

Rhododendrons of the genera Rhododendron and Azalea are known to have narcotic properties. The Siberian R. chrysanthemum is quite powerful, and the leaves have been used safely by humans. In some hill regions

of India, flowers of R. arboreum may be chewed as a narcotic when no others are available. In the Himalayas, dried ripe leaves may be used; young leaves are considered toxic. In Nepalese Himalaya, R. anthopogon var. hypenanthum, R. cinnabarinum, R. lepidotum and other Rhododendron spp. ['sun pati'] are burnt as ritual incenses; leaves, branches and/or flowers may be used. In Burma, R. moulmainense is known to be narcotic and stupefying, as is the honey made from it. However, in Tibet some eat it without harm. The N. American R. maximum is also considered narcotic and stupefying. In Papua New Guinea, R. macgregoriae ['womp'] is used to disperse the 'spell of death', and causes emesis and purging. In Japan, Rhododendron spp. leaves are used in folk medicine to treat hypertension. The fumes of these plants were reputedly inhaled by followers of Elijah amongst the Ossets of Caucasus, causing them to fall unconscious and experience prophetic dreams. Honey made from these genera is known to be toxic, having been responsible for many non-fatal poisonings in the past [from c.50-100gm of honey]. Symptoms begin 3-4 hours after ingestion with vertigo; this subsides, but returns periodically in more and more intense bouts, accompanied by vomiting, mental excitation, delirium, sometimes convulsions, followed by coma, after which subjects recover; in some cases there is no recovery, and death results from central paralysis. The species often responsible are R. ponticum [A. pontica] and R. luteum. The chemicals responsible are terpenoid glucosides called andromedotoxins [grayanotoxins], asebotoxins, rhodojaponins and lyoniatoxins [lyoniols], known from many toxic Ericaceae. Leaves of some species may contain, on average, 0.01% andromedotoxins. Grayanotoxin was also found in R. albiflorum, R. macrophyllum and R. occidentale. Extracts of the leaves of R. brachycarpum and R. metternickii var. pentamerum, administered to mice and rats regularly at doses of up to 0.25mg/kg per day [p.o.], did not reveal apparent toxicity, though 1mg/kg, 1/5 of the expected LD50, did cause some deaths. Other related plants of the family Ericaceae share narcotic and toxic properties. Kalmia angustifolia is narcotic; the sap has yielded grayanotoxin, dihydrochalcones such as phlorizin and phloretin, and 2',6'-dihydroxy-4-MeO-*acetophenone*. Grayanotoxin was also found in K. polifolia var. polifolia and K. polifolia var. microphylla. K. latifolia has yielded hyperin [see **Hypericum**], phlorizin and ursolic acid. Fruits of the Bolivian Befaria kindeniana [B. glauca var. coarctata], 'macha macha', cause 'dizziness and distress', as well as strong stimulation if used over time. The leaves of Andromeda polifolia are also known to be narcotic (Constantine et al. 1967; Cooke 1860; Festi & Samorini 1996; Hikino et al. 1979; Mancini & Edwards 1979; Müller-Ebeling et al. 2002; Ott 1993; Palmer-Jones 1965; Perry & Metzger 1980; Rätsch 1999a; Sakakibara et al. 1978; Stopp 1963).

The fruits of the 'strawberry tree' [Arbutus unedo] from N. America and Europe have been made into a narcotic wine (Emboden 1979a); they are said to be narcotic alone if consumed in large quantities (Bremness 1994). In Mexico, Arbutus spp. are generally known as 'madroño', and are considered to be narcotic (Jiu 1966). A. menziesii ['madroño borrachero', 'tomazquitl'] is hypnotic, and was used by the Aztecs, with other herbs, to dispel fatigue (Heffern 1974). In Nepal, Lyonia ovalifolia ['angeri'] has been used as a smoking herb by Kirati shamans to increase their spiritual energy; the leaves ['angeri kopat'] are used as a wrapping for 'bidi' or 'biribiri' cigarettes [see **Nicotiana**, and Shorea below], and also as a filling when that role is not taken by tobacco or **Cannabis**. The effect of smoking angeri is reported to be strong and *nicotine*-like (Müller-Ebeling et al. 2002). In China, the leaves and fruits have been used as a tonic. Otherwise, the plant is considered toxic, and has yielded andromedotoxin; L. ovalifolia var. elliptica has yielded lyoniatoxin from leaves and lyoniols A-C from sprouts (Perry & Metzger 1980).

Erica spp. ['heather'] were used for centuries throughout much of Europe in brewing beer and mead [see *Methods of Ingestion*], though their use was best known from Scotland. In the British Isles, their use is at least 4,000 years old. Heather is thought to have been an important plant to the Druids, used for sacred fermented beverages. The Picts also used it ceremonially, and revered those responsible for the brewing process. Honey from heathers is highly nutritious, and high in protein. European species that have been commonly used include E. cinera ['Scotch heather'], E. vagans ['Cornish heather'], E. vulgaris ['ling' or 'broom heather'] and E. tetralix ['cross-leaved heather', 'bell heather']. Flowering tops are the parts used in brewing, and must be used soon after harvesting, as they lose their aroma quickly. They are sedative and mildly narcotic. A white powdery moss known as 'fogg' grows on the stems of species such as E. vulgaris and E. tetralix. This moss [botanical identity not known to me] has "narcotic and mildly hallucinogenic properties", and is host to a yeast that aids fermentation. Heather ale made from thoroughly washed tops is commercially available, though it may be difficult to find (Buhner 1998). E. lusitanica has been shown to contain 4-MeO-*phenethylamine* (Smith 1977a).

BAMBOOS (Gramineae)

Roots of black bamboo [Phyllostachys nigra] are apparently sometimes used as an anxiolytic (Bremness 1994). Another bamboo, thought to be an Arundinaria sp., is known as 'nigalo', 'tama' or 'ringal bans' in Nepal, and its shoots have been consumed for shamanic travel and learning of secret knowledge by some Kirati shamans, who say they learnt of it from the bear. Shamans also use it for strength, mixed with ginger [see below]. The best shoots are believed to be of 7 sections, and the top 4 are cut leaving 3 behind; this 4-section piece represents one dose. Before its use was known, another author had identified nigalo as being either Drepanostachyum intermedium or Thamnocalamus spathiflorus. If actually an Arundinaria sp., this is most likely to be A. racemosa [A. maling], as it is the only species of Arundinaria recorded in Nepal. One shaman stated that "all types of bamboo can become a spiritual binoculars or spiritual microscope", and to the Kirati, bamboos are sacred also because of their many uses in making things, including musical instruments and ritual paraphernalia (Müller-Ebeling et al. 2002; Rätsch 1999a; Stapleton 1994). In China, leaves of the bamboo A. densiflora are used as a stimulant, tonic and anthelmintic; leaves and rhizomes of A. amabilis are also considered tonic. Joints and culms of some bamboos of the genus Bambusa contain high concentrations of nearly pure silicic acid – this is known as 'tabashir', and was held in high esteem by ancient peoples. It has been used to treat nervous disorders, paralysis, childhood epilepsy, rheumatism and catarrh, and is stimulant, aphrodisiac and antispasmodic. The leaves of B. arundinacea are also considered aphrodisiac and antispasmodic. It should be noted that some bamboo shoots yield cyanogenic glycosides, which may be removed by parboiling at least three times, rendering the shoots edible (Chevallier 1996; Culvenor 1970; Nadkarni 1976; Perry & Metzger 1980). Some bamboos [eg. Phyllostachys reticulata] contain *serotonin* (Smith 1977b). Phyllostachys spp. leaves contain alkaloids, coumarins, steroids, saponins, triterpenoids, anthraquinones, glucosides, reducing sugars, proteins, amino acids, organic acids and tannins; flavonoids are also found in some species (Zhou 1992). Some bamboos may be infected by fungi, such as the Nepalese Cavimalum indicum (Clavicipitaceae), 'nigalo phoke cyau', of unknown chemistry and activity (Müller-Ebeling et al. 2002).

EUPHORBIACEAE

Some Euphorbiaceae are said to be psychoactive, though the latex that they bear is frequently toxic, and should not be brought into contact with eyes. Mildbraedia fallax is said to be narcotic, emetic, purgative and irritant [contains methylamine]. Euphorbia convolvuloides, E. helioscopia, E. pubescens and E. tiruealli are also said to be narcotic (Watt 1967). E. hamata is fed by Afrikaaners to their tired oxen, to give them renewed strength and vigour (Jacobsen 1960). Roots of E. davyi and E. decussata have been used in southern Africa to make indigenous beers or meads; pieces of the root are soaked and rinsed a few times before being added to the brewing process, and are said to greatly increase the strength of the finished beverage (Hargreaves 1999). In Israel, E. hierosolymitana is known to be narcotic. The latex has been used in traditional healing to treat "excessive libido", and is applied to wounds and warts; the seeds are decocted to treat depression and fear (Palevitch et al. 1986).

In s.e. Asia, E. hirta is decocted as an anticonvulsant, and also has mild narcotic properties (Perry & Metzger 1980). It has shown anxiolytic activity in mice, as well as sedative activity at high doses (Lanhers et al. 1990). In the Philippines, the leaves are smoked with those of **Datura** metel in cigarettes for asthma (Perry & Metzger 1980). In Germany, Euphorbia spp. have been known as 'hexenkraut' ['witch herb'], 'hexenküglein' [roughly 'witch droppings' (?)] and 'hexenmilch' ['witch milk'] (De Vries 1991). In some parts of Africa, E. balsamifera, E. kaokoensis, E. poissonii, E. subsala, E. tirucalli, E. trigona and E. unispina are used for their latex as homicidal poisons (De Smet 1998).

In India, the seed-capsules of E. lathyrus "are used to intoxicate" (Nadkarni 1976). *L-DOPA* has been found in the latex of E. lathyrus [1.7% w/w] and E. dendroides (Adinolfi 1966; Liss 1962). In Nepal, E. pulcherrima ['lalu pate'] leaves are used in ritual incense. In Nepal Phyllanthus emblica is the sacred 'amala' tree, which is considered a form of 'amrita' and is used in ceremonies, though it is unclear whether it is ingested (Müller-Ebeling et al. 2002). In Brazil, the Makú use P. brasiliensis to stupefy fish (Prance 1972). Some Phyllanthus spp. contain *securinine*-type alkaloids, such as P. discoides, which yielded 0.4% from root bark, 0.2% from stem bark and 0.06% from leaf (Bevan et al. 1964).

In Peru, the Shipibo-Conibo give a tea of an unidentified Euphorbia sp. ['curo', 'ai curo'] to apprentice shamans, "to improve the view during the ayahuasca intoxication" [see **Banisteriopsis**], as well as to "ameliorate the voice to sing icaros and taquinas" (Trout ed. 1998 citing Amazonia Peruana 5(10):91-118 [1984]). In Brazil, the Makú use E. cotinifolia to stupefy fish (Prance 1972). In Peru, this species [as 'timora'] is reportedly sometimes taken with San Pedro [see **Trichocereus**] (Davis 1983; Rätsch 1998), as are the Euphorbiaceous Pedilanthus tithymaloides ['cimora misha'] and P. retusus [P. tithymaloides ssp. retusus; 'misha' – see **Brugmansia**] (Davis 1983; Rätsch 1998; Schultes 1967a). In Lima, Peru, P. retusus is reputed to be a 'strong hallucinogen' and to contain a *mescaline*-like substance (Rätsch 1998). Members of the genus have a reputation for protecting against sorcery (Rätsch 1992). As 'Japanese poin-

settia', 'devil's backbone', 'redbird flower' or a variety of other colloquial names, P. tithymaloides is a horticultural plant which sometimes causes poisonings due to its irritating latex. The toxicity of oral ingestion is apparently low, though symptoms such as irritation of the mouth and throat, vomiting and diarrhoea have been observed (Russell et al. 1997).

The dried root of Manihot anomala ssp. anomala, 'sienejna', is reportedly smoked by Ayoreo shamans in Paraguay to contact the spirit realm; however, some Ayoreo say it doesn't work, and bioassays have been negative for any psychoactivity (Rätsch 1998). This genus is better known for 'manioc' or 'cassava', M. esculenta, which is used for its starchy root to make alcoholic beverages [see *Methods of Ingestion*].

MISTLETOES (Loranthaceae)

European mistletoe [Viscum album], a parasitic plant growing on various trees, has yielded 1-ethyl-*tryptamine* [pharmacology unknown] (Shulgin & Shulgin 1997), *phenethylamine*, *tyramine* [tentative] (Smith 1977a), *acetylcholine*, *choline*, *histamine*, viscalbine, viscoflavin, viscotoxins [polypeptides], glycoproteins, lignans [eg. syringin, eleutheroside E – see **Eleutherococcus**], flavonoids, inositol, mannitol, saponins, resins and vitamin C. It is a sedative, hypnotic, anxiolytic, antispasmodic, hypotensive, vasodilator, heart tonic, immune stimulant, emetic, purgative and antiseptic; medium and large doses depress the respiratory system. It also has some tumour-inhibiting properties, and is toxic in large doses (Bremness 1994; Bruneton 1995; Chevallier 1996; Chiej 1984; Nadkarni 1976). The plant was sacred to the Druids, who harvested it in autumn, or particularly Mid-summer's day, with a gold-bladed sickle [in one stroke, without the herb touching the ground]. They used 16 basic herbs for healing, with mistletoe being the one extra added to all preparations. Mistletoe growing on oak [Quercus spp.] was favoured, oak being one of their most sacred trees [see also **Castanopsis**]. In the preparations, it was to act as an "energy catalyst, to trigger the healing power of the herb". It has been associated with fertility and protection from evil (Cunningham 1994; Monroe 1992; Rätsch 1992, 1998). In Germany, it has been known as 'hexenkraut' ['witch's herb'], 'hexenast' ['witch's branch'], 'hexenbeere' ['witch's berry'], 'hexenbesen' ['witch's broom'], 'hexenbusch' ['witch's shrub'], 'hexennest' ['witch's nest'], 'hexenstock' ['witch's stick'] and 'hexenstrunk' ['witch's stalk'], pointing to a long association with magical practices (De Vries 1991).

Another mistletoe, V. cruciatum, is used as an epilepsy remedy in Morocco, yet locals believe ingestion of only one twig can cause madness (Watt 1967). In southern Africa, V. capense stems have been used by Europeans to treat epilepsy and St. Vitus' Dance [see **Claviceps**]. The Hottentot regard Viscum spp. as sacred, and use them to prepare an aphrodisiac (Watt & Breyer-Brandwijk 1962). In India, V. articulatum has been used as an aphrodisiac (Cribb & Cribb 1981). Some Voodoo cults consume V. album together with the mistletoe Phrygilanthus eugenoides; this latter plant is also said to be psychoactive. It is used as an ayahuasca additive [see **Banisteriopsis**, *Methods of Ingestion*] by the Culina and Sharanahua of Peru, as 'ko-ho-bo' or 'miya' (Pinkley 1969; Rätsch 1998; Rivier & Lindgren 1972).

In India, the mistletoe Loranthus falcatus is chewed as a narcotic betel nut substitute [see **Areca**]. Bark of L. longiflorus treats mania, amongst other conditions. L. monoicum is used as a **Strychnos** substitute (Nadkarni 1976). The Kalahari Bushmen may possibly use L. oleaefolius ['chichi'] to aid in reaching trance states for healing (Rätsch 1992). In Zimbabwe, L. spp. growing on Vitex payos [see below] are consumed to 'arouse spirits' (De Smet 1998). In Tanganyika, a Loranthus sp. is used in witchcraft, and a s. Rhodesian species growing on Ficus spp. [see below] is used as a poison (Watt & Breyer-Brandwijk 1962). A mistletoe growing on the Malpighiaceous shrub Acridocarpus spectabilis [see below] is macerated to prepare a wash, used on babies who have been 'attacked by sorcerers' (Burkill 1985-1997). Leaves of L. quandong [see **Santalum**] growing in Queensland [Australia] tested positive for alkaloids (Webb 1949). See also **Acacia** and **Duboisia**.

American mistletoes [Phoradendron spp.] may contain *tyramine* [0.027% (w/w) in leaf of a Phoradendron sp.] (Wheaton & Stewart 1970); P. flavescens has yielded *tyramine*, *phenethylamine* and *hordenine* (Smith 1977a); P. wattii yielded 0.1% *tyramine*; P. rubrum var. gracile yielded *GABA* (Durand et al. 1962). P. flavescens is carried as a charm by some followers of Voodoo (Rätsch 1992). P. vernicosum, 'xkeu', is used in Mexico to treat insanity, epilepsy, paralysis, and pain in childbirth (Heffern 1974).

AFRICAN OBSCURITIES

In some parts of Madagascar, Myrothamnus moschatus [Myosurandra moschata] (Myrothamnaceae) is known as 'riadiatra' or 'maharaoka'; it is a small herb growing on rocks. When grassland fires scorch the rock vegetation, locals collect the ready-dried herb to smoke as a euphoric inebriant, "believed to be exhilarating and, above all at the early stage, will provoke unrestrainable fits of laughter. However, those who smoke this plant habitually will soon become taciturn, cut themselves off from others and enter a state of growing autism. This may even lead to a schizophrenoid condition accompanied by abnormal irascibility which can gradually degenerate into fearful fits of violence" (Boiteau 1967; Samorini & Festi 1999).

Exomis microphyllum (Chenopodiaceae) is decocted to treat epilepsy in South Africa – a water decoction is said to be stupefying. The leaf contains saponins. Rhoicissus erythrodes (Vitaceae) also treats epilepsy, and the Masai decoct the root as a stimulant. The east African Gymnosporia spp. (Celastraceae) are used by the Karanga to treat epilepsy and madness (Watt 1967). Musanga cecropioides (Cecropiaceae) bark is used by the Fang of Guinea to treat schizophrenia (Akendengué 1992). 'Common rue' [Ruta graveolens; Rutaceae] has been used to treat epilepsy and hysteria in Africa, and is said to be narcotic, hypnotic and analgesic (Watt 1967). Iranian Zoroastrians may use it as a substitute for **Peganum** or **Ephedra** and pomegranate [see Punica granatum above] in 'haoma' beverages (Flattery & Schwartz 1989). However, it is also known to be toxic in large amounts (Chevallier 1996). In Germany, it has been known as a witch's herb ['hexenkraut'] (De Vries 1991). The source of the dye 'henna' [Lawsonia inermis; Lythraceae] is used in Ghana to treat hysteria and nervous disorders (Watt 1967). The powdered seed is also used in India, said to be a cerebral stimulant and cure for insanity; the flowers, bark and root bark have been used there as a soporific (Kirtikar & Basu 1980; Nadkarni 1976; Watt 1967). In Mexico, the plant is known as 'cuauxihuitl', and is used as a sedative; the crushed leaves and flowers are given in wine to treat hysteria (Diaz 1979; Heffern 1974). Moringa pterygosperma [M. oleifera] (Moringaceae) seed oil ['oil of Ben'] is used in central Africa to treat hysteria, and the root is used in India to treat this as well as epilepsy. The flowers, decocted in milk, are taken as an aphrodisiac. The plant contains alkaloids with an *ephedrine*-like action, and another that paralyses the CNS (Nadkarni 1976; Watt 1967). Morinda longiflora (Rubiaceae) ['brimstone tree'] is used in west tropical Africa to treat insanity and female sterility. M. lucida leaves are added to manioc wine in Ubangi, to flavour it and increase the potency. In Ghana, the tree has been used to ward off evil spirits (Burkill 1985-1997). Also in Ghana, leaves of Vernonia conferta (Compositae), 'flakwa', are added to palm wine for their aphrodisiac effects (Bremness 1994).

Anagallis arvensis (Primulaceae), 'scarlet pimpernell', was once used to treat mania and hydrophobia, and to 'dispel melancholy'; indeed, the generic name of this herb comes from a Greek word roughly meaning 'to laugh'. However, according to the 19th century botanist William Woolls, it has been reputed that "three drachms... are sufficient to kill a dog" (Cribb & Cribb 1981; Low 1990). In Africa, the herb of A. arvensis and bark of Andira inermis (Leguminosae) are said to be narcotic (Watt 1967). In Rhodesia, Anacampseros rhodesica (Portulacaceae) is used in making beer, and is thought to be narcotic; it was outlawed in Zimbabwe, and has been known as 'quilika' and 'tirika', names also given to Zantedeschia albomaculata (Araceae). In Zimbabwe, A. rhodesica is apparently used as a hallucinogen (De Smet 1998; Hargreaves 1999; Watt & Breyer-Brandwijk 1962). The roots of A. rhodesica, as well as those of A. alstoni, A. papyracea, and A. ustulata, have been used to brew the potent indigenous beer 'khadi' in S. Africa, as well as similar beverages in other regions [see also **Delosperma**, **Sceletium**] (Hargreaves 1999). In Tanganyika, Uvaria leptocladon (Annonaceae) roots are decocted to treat insanity and spirit-possession (Watt 1967). U. elliotiana has yielded 3,6-bis(γ,γ-dimethylallyl)indole (Husson 1985). In Congo, Heinsia crinita [H. pulchella] (Rubiaceae) ['bush apple'] root bark is added to palm wine as an aphrodisiac; in Tanganyika, the powdered root bark and leaf sap are taken to treat epilepsy (Burkill 1985-1997). Lichtensteinia interrupta (Umbelliferae) has been used in s. Africa to prepare snuffs, and the roots are used to prepare 'narcotic' beverages (De Smet 1998; Watt & Breyer-Brandwijk 1962). Tinospora bakis (Menispermaceae) roots have been used as a snuff ingredient by the Kusai of n. Ghana [see **Piper 1**]. It is also used to treat fevers and rheumatic pain, and has yielded palmatine (De Smet 1998). T. cordifolia ['guduchi'] is a Soma-substitute [see **Amanita**] in India, and is also used as a tonic. It is regarded as having the properties of 'amrita' (Müller-Ebeling et al. 2002).

In Gabon, Fagara altissima (Rutaceae) leaf is given with lemon juice to treat mental disease. In South Africa, F. capensis is used by Europeans to treat epilepsy, and its bark has analgesic properties. Bark of the w. African F. macrophylla is narcotic (Watt 1967). F. xanthoxyloides root bark is an ingredient of the n. Ghanan snuff mentioned above (De Smet 1998). In Brazil, the Jamamadi use a Fagara sp. known as 'balala' as an ingredient of their arrow-poison (Prance 1972). *Phenethylamine*-conjugates have been found in F. hyemalis [coryneine, tembamide] and F. rubescens [rubescamide]; candicine and *skimmianine* are also reported from the genus (Budavari et al. ed. 1989; Lundstrom 1989). In Liberia, Sabicea ferruginea (Rubiaceae) leaves are snuffed to give protection against malicious sorcery, and to empower the user to 'bewitch' their enemies; in Ivory Coast, the plant is snuffed for headache. In Ghana, S. calycina leaves are ground and rubbed on the legs of young children, to help them walk, and in Lagos, an infusion of the leaf is used as a memory tonic. The Yoruba invoke the plant in order to cause someone to lose their property. In Basutoland, Melolobium alpinum (Leguminosae) is given as a comforting sedative to the bereaved. The Southern Sotho rub the powdered ash of M. eriocalyx

[mixed with the gall from a black sheep] into brow scarifications to ward off evil spirits. The related M. candicans is suspected of causing stock poisonings. Ungernia minor (Amaryllidaceae) is said to be hallucinogenic, but this may be in confusion with **Boophane** disticha. *Hordenine* has been found in U. ferganica, U. trisphaera and U. victoris. Cardiospermum halicacabum (Sapindaceae), introduced to South Africa, treats nervous diseases. Children have developed 'epileptiform convulsions', probably from extreme excitation, after eating the seeds in quantity. The plant contains an alkaloid, quebrachitol. Carissa edulis (Apocynaceae) root is used in southern Africa as an aphrodisiac and stimulant. Also in s. Africa, the leaf of Hartogia capensis (Rutaceae) is chewed to prevent fatigue, quench thirst and suppress hunger (Burkill 1985-1997; Smith 1977a; Watt 1967; Watt & Breyer-Brandwijk 1962).

Mostuea gabonica and M. stimulans (Loganiaceae), called 'sata mbwanda' or 'sete mbwunde' in Gabon, are used there as an aphrodisiac and intoxicant. Grated chunks of the root are chewed either alone or with iboga [see **Tabernanthe**], to dispel sleep in long nights of drumming and dancing. It produces euphoria, and intoxication in higher doses, and has been compared to iboga in effect. M. stimulans roots yielded 0.15% alkaloids, the root bark 0.33%, and stem with leaves 0.06%. The alkaloids have not been identified, but two of those found in the root bark had similarities to gelsemine and sempervirine, alkaloids found in the 'yellow jessamine' [Gelsemium sempervirens; Loganiaceae] which has poisoned children who sucked on the flower nectar [in which the alkaloids are highly concentrated]. Symptoms of yellow jessamine poisoning include visual disturbances, dizziness, headache, muscular weakness, nausea, dry mouth, sweating and death in some cases (De Smet 1996, 1998; Foster & Caras 1994). As well as these alkaloids, G. sempervirens root contains *scopoletin* (Buckingham et al. ed. 1994). These symptoms, however, do not seem reminiscent of those accompanying Mostuea ingestion, and presumably, the chemistry may be more complex.

Picralima nitida (Apocynaceae) is used in central Africa for its psychoactive seeds, though with the bark and roots, they are also used to treat respiratory disorders and pneumonia (Arens et al. 1982). The plant is also used to poison fish, and the fruit has been used as a homicidal poison (De Smet 1998). Tissue cultures yielded the indole alkaloids pericine and pericalline, which showed opioid-receptor agonist properties. The plant has also yielded pseudoakuammigine, which is responsible for the cholinergic action of the drug, due to inhibition of butyrylcholinesterase (Arens et al. 1982). Sutherlandia frutescens (Leguminosae), 'cancer bush', is valued in southern Africa for its leaves and young stems, which are used as a panacea, treating internal tumours, inflammation, wounds, stomach ailments, colds, diabetes and other disorders. In Namaqualand, the seeds and leaves may be smoked as a substitute for 'dagga' [see **Cannabis**, **Leonotis**] (Van Wyk & Gericke 2000; Van Wyk et al. 1997). The Southern Sotho smoke Cineraria aspera (Compositae) ['mohodu-wa-pela'] leaves to relieve asthma and tuberculosis; although the herb is noted to be 'as intoxicating as **Cannabis** sativa (Watt & Breyer-Brandwijk 1962), it was not noted whether it is specifically smoked for this purpose also [I would presume it is!]. Aerial parts have yielded cinalyratyl angelate, sitosterol, and acetylenic compounds. In Zimbabwe, Heteropyxis dehniae (Myrtaceae) leaves are sometimes smoked and chewed "for the arousal of spirits". Members of the genus contain essential oils. Also in Zimbabwe, roots of Cynodon dactylon (Gramineae) [in Nepal, known as 'dubhotar', it is considered a form of 'amrita' (Müller-Ebeling et al. 2002)], Diplolophium zambesiacum (Umbelliferae) and/or Hyparrhenia filipendula (Gramineae) are consumed to 'arouse spirits'. Zulu healers sometimes consume roots of plants such as Canthium ciliatum (Rubiaceae), Hippobromus pauciflorus (Sapindaceae) or Turraea floribunda (Meliaceae) before 'divining dances', to induce trance and produce vomiting. The Zulu use roots and stems of Brachylaena discolor (Compositae) to "communicate with the ancestors"; aerial parts have yielded onopordopicrin and other compounds (De Smet 1998).

Masai warriors are known to ingest [amongst other drugs – see elsewhere in this chapter, also **Acacia**] Agauria salicifolia (Ericaceae) ['en gomani'], Euclea schimperi [E. kellau; 'ol gireni'] (Ebenaceae), bulbs of a Haemanthus sp. (Amaryllidaceae) ['ol gitende'; H. katharinae leaf has yielded traces of *tyramine*, N-methyltyramine and synephrine], Maesa lanceolata (Myrsinaceae) ['ol odoa', 'ol onorua'] fruits and Olinia vokensii (Oliniaceae) ['ol gireni'], as stimulant-excitants. For this purpose they are often eaten with meat, enriched with extracts from the same plants [see *Methods of Ingestion*]. The Masai have also been recorded as preparing a similar intoxicating beverage with honey, water, and roots of either an Aloe sp. (Liliaceae) ['steppe Aloe'; see below] or Kigelia aethiopica (Bignoniaceae) (Lehmann & Mihalyi 1982; Wheaton & Stewart 1970). In Tanzania, K. aethiopica fruit is also added to beer to strengthen it, though the addition can cause strong headaches. In Kenya, K. africana fruit is added to beer (De Smet 1998; Watt & Breyer-Brandwijk 1962). Regarding Euclea spp., E. natalensis ['Natal guarri'] is reportedly smoked as a hypnotic (Van Wyk & Gericke 2000; Van Wyk et al. 1997), and E. divinorum ['magic guarri'] has been administered as an ordeal poison (pers. comms.).

In Tanzania, Lachnopylis platyphylla (Loganiaceae) leaf is added to sugar-cane beer; it is believed to enhance fermentation, and/or increase the intoxicating powers of the beer (Watt & Breyer-Brandwijk 1962). Roots of Millettia usaramensis (Leguminosae) are soaked in palm wine [see *Methods of Ingestion*] to give it aphrodisiac properties. Root of the related M. sanagana is sometimes used as a homicidal poison. Members of the genus have been found to contain rotenone [see **Lonchocarpus**]. Pericopsis laxiflora [Afrormosia laxiflora] (Leguminosae) roots are known to be slightly intoxicating, and for this reason are sometimes added to palm wine. Unspecified parts of the plant have been used to prepare arrow poison, and as an ingredient of composite stimulant drugs. N-methyl-*cytisine* has been tentatively identified as one of the alkaloids present in the stem and root barks (De Smet 1998).

In s. Africa, the Zulu, Swazi, Tsonga, Venda and Sotho use the ripe fruits of Sclerocarya caffra [S. birrea ssp. caffra] (Anacardiaceae) ['marula', 'umganu'], S. birrea ['marula'] and/or S. schweinfurthii to brew beers known as 'ukanya' which are particularly intoxicating (De Smet 1998; Emboden 1979a). S. caffra has been suggested to have been the 'kanna' referred to by early explorers amongst the Hottentot, rather than members of the genus **Sceletium** (Emboden 1979a). The root is consumed in Zimbabwe to 'arouse spirits' (De Smet 1998).

The Basuto are said to use a white-flowered plant believed to be a Myosotis sp. (Boraginaceae) ['forget-me-not'] in the initiation of their shamans. It is known to them as 'sethuthu', and as 'lephukhuphukhu' to the Zulus. It is said to have "great powers of acting on the brain and developing mental faculties, especially the memory", aiding the shaman in learning about medicinal plants, and other functions and abilities required of them. This herb is also the main ingredient of a composite medicine given, by the shaman, to one who is suffering from hysteria. Other ingredients are claimed to include the roots of Agapanthus umbellatus (Amaryllidaceae) ['leta la phofu'], **Galium** witbergense ['seharane'], a **Polygala** sp. ['bolao ba maqekha'], and a Polygonum sp. (Polygonaceae) ['morara o moholo'; see below]. The preparation is supposed to cause the patient to 'dream' of medicinal plants that s/he must collect the next day. Sethuthu is also reportedly the main ingredient of an ointment used to anoint a new bride before she consummates her marriage (Laydevant 1932). A Peruvian Myosotis sp. known as 'buena esperanza' is taken as a water infusion to treat debility (De Feo 2003).

Several African plants of the Malpighiaceae [eg. see **Banisteriopsis**] have some interesting uses recorded. Acridocarpus natalitius is used by the Tsonga of Mozambique, as a "war medicine and in the purification rites after death". Tsonga shamans use the plant to protect against malevolent sorcery from competitors. The Xhosa use sticks from the plant to protect against sorcerers and lightning. A. plagiopterus twigs are used as an aphrodisiac in the Lower Casamance; stems and leaves are macerated to prepare a body-wash which acts as a 'strengthening tonic'. The root is credited with 'magical properties' in Senegal and Guinea, and has been used to 'exorcise devils'. A. spectabilis root is chewed as a cola nut substitute [see **Cola**] in parts of Gambia and Senegal. Tenda singers chew it raw to 'strengthen the voice for singing'. Sphedamnocarpus pruriens is used by the Chopi with **Securidaca** longepedunculata to treat possession by evil spirits (Burkill 1985-1997; Watt & Breyer-Brandwijk 1962).

Numerous Aizoaceous succulents [besides **Delosperma**, **Nananthus**, **Sceletium** and others discussed under **Sceletium**] from southern Africa seem to have psychotropic potential. Unidentified species from the genus Conophytum have been reported to be 'narcotic' (Watt 1967; Watt & Breyer-Brandwijk 1962). This, and several other Aizoaceous genera, have species commonly known as 'living rocks', due to their similarity in appearance to small rocks or pebbles protruding from the ground. Pleiospilos bolusii, which has a 'living-rock'-like appearance, has recently been bioassayed, and reported to be psychoactive, most likely containing *mesembrine*-type alkaloids (friendly pers. comm.). Gibbaeum dispar is another living rock which has been found to be psychoactive when snuffed or smoked [prepared as for **Sceletium**] (Van Wyk & Gericke 2000; Van Wyk et al. 1997). Many other Aizoaceous genera also fit the 'living-rock' appearance – such as members of the genera Argyroderma, Dinteranthus, Lithops, Ophthalmophyllum and Titanopsis.

The related Psilocaulon absimile ['asbos', 'loogbos'] has yielded 4.5% piperidine [see **Piper 1**] (Henry 1939), an alkaloid, psilocaulin [which might be piperidine – Ed.], 8.66% oxalic acid [see **Sceletium**], 11.02% malic acid and 0.069% tartaric acid. The plant has caused stock poisonings, as well as causing death in rabbits [from a dose of 100g fresh plant], although rabbits did not suffer any negative effects when given 50g a day for 2 days. However, 50g of a wilted plant [an unidentified Psilocaulon sp.] was sufficient to kill rabbits in another experiment, although 120g of fresh plant cultivated from this population later caused no toxicity. This unidentified species is sometimes used in dipping tobacco [see **Nicotiana**]. Toxicity is believed to be due to the oxalic acid and alkaloid content. Piperidine is considered toxic, and has activities comparable to those of *nicotine*, *coniine* and *lobeline* (Steyn 1934; Watt & Breyer-

Brandwijk 1962).

Aloe spp. (Liliaceae), succulents unrelated to the above plants, are best known for their famed representative A. vera [A. barbadensis], the sap of which is widely applied to wounds or burns, and used as a laxative (Chevallier 1996). In the Kalahari, A. ferox ['umhlaba'] has been portrayed in Bushman rock paintings; its flower nectar is reputedly narcotic. Apparently, bees raised on A. greatheadii var. davyana ['kgophane'] flowers become "unusually vicious". The Kgatla use the plant in rain magic. Leaf sap from A. globuligemma ['gava kava'] has been used in arrow poisons, and contains coniceine [see **Conium**]. Tea made from the root and leaf of A. arborescens is sometimes drunk to relieve stress, hypertension and arthritis. Dried, powdered A. marlothii leaves ['mokgopha'] are sometimes mixed with psychotropic snuffs (Van Wyk & Gericke 2000; Van Wyk et al. 1997) such as those prepared from tobacco [**Nicotiana**]. Sometimes it is burnt to an alkaline ash for this purpose, and sometimes such Aloe spp. ash is snuffed by itself, which may be common in parts of the Transvaal. In Basutoland, A. aristata and A. saponaria var. ficksburgensis are similarly snuffed with tobacco, as is the unrelated Cussonia spicata (Araliaceae) in Transvaal (Watt & Breyer-Brandwijk 1962).

Recently, Silene capensis (Caryophyllaceae) was reported to be the major shamanic plant of Xhosa diviners ['amagqirha'] in S. Africa. The roots, known as 'undlela ziimhlophe' ['white ways' or 'white paths'], are powdered and drunk with water on an empty stomach, for divination. The effects manifest during sleep, as lucid prophetic dreaming with content rich in significance. There are usually no perceived effects in the waking state, though one apprentice diviner noted wandering thoughts shortly after ingestion; 20 mins after ingestion, he perceived "wavy lines of light in the air", which reminded him of "the reflections of light on the surface of moving water". It is fitting to note that amongst the Xhosa, divination is associated with going under water. A dose for divination may be c.200-250mg of powdered root; in larger doses, it is used as an emetic. Most interestingly, the plant is reputed to have no mental effects in people who are not predisposed to being diviners. Chemistry of S. capensis is unknown, but due to the foam created when the powdered roots are mixed with water, it probably contains saponins. Dianthus albens (Caryophyllaceae) ['impendulo', 'ubulawu'] might have similar properties (Hirst 2001), but this was not made clear.

In s. Nigeria, numerous ferns and fern-allies are used in manners indicating psychotropic and magical properties. Dryopteris filix-mas (Dryopteridaceae) ['common wild fern', 'erinji', 'ihi'] leaves are infused and taken as an aphrodisiac (Nwosu 2002). In Nepal, tips of D. filis-mas ['uniw pati'] and other D. spp. have been used in ritual incense (Müller-Ebeling et al. 2002). The 'royal fern' or 'eboshi', Osmunda regalis (Osmundaceae), is consumed in the form of an extract of the whole plant, to treat psychosis and 'moon-madness', and "chase away evil spirits". The 'savannah fern' ['ami ogwu', 'usele'], Gleichenia linearis (Gleichenaceae), is similarly prepared and consumed to relieve convulsions in children, followed by a cold bath and occasionally incantations from the local healer to drive away illness-causing evil spirits. Nephrolepsis cordifolia (Nephrolepidaceae) ['erect swordfern', 'nma ozo'] fronds are infused and taken by the elderly to treat amnesia. Equisetum diffusum (Equisetaceae) ['branched horsetail', 'aziza', 'eru'] roots are decocted and taken to treat psychosis (Nwosu 2002). In central America, the Lacandon Maya use a tea of fresh E. myriochaetum as a male aphrodisiac (Rätsch 1990). See also Cyathea spp., Cheilanthes spp. and Hypodematium spp. below.

OBSCURITIES FROM PAPUA NEW GUINEA, including SOME NOTES ON GINGER and SCENT GLANDS

It is well worth mentioning that the common spice ginger [Zingiber officinale; Zingiberaceae] is known to produce psychotropic effects when consumed in large amounts. Leaves and rhizomes of ginger are chewed by the Nkopo of Papua New Guinea [PNG] as a dance stimulant. The Bimin-Kuskusmin use special 'ritual' strains of different ginger types in the first 3 stages of their 12-stage initiation procedures. In stage 1, **Alpinia** sp. ['khraaniik'; see **Kaempferia, Alpinia**] and a Hornstedtia sp. (Zingiberaceae) ['khraanuuk'] are used; stage 2 uses Z. officinale ['muukhraar']; stage 3 uses Z. officinale ['naasiir'] and what is probably Z. zerumbet ['naasuur']. After successively extended periods of fasting and sleep deprivation, ginger leaves [young shoots from near the rhizome] are crushed and placed in the nostrils, and peeled rhizomes are eaten. The initiate is exposed to the heat of a fire during this stage. As well as the expected burning sensations in the gut, the ginger taken under these circumstances produces blurred vision, visual and auditory hallucinations, disorientation, dissociation, trembling, dizziness, immobility, nausea and dehydration. However, it is to be expected that the effects of the ingested ginger are greatly exacerbated by the conditions under which it is taken, and the other plants involved – ie. 'nettles' (Urticaceae) [Fleuryia sp. – 'abioomkhyr'; Laportea spp. – 'ganganyiin' and 'gukhaabiom'; see also **Urtica**] being rubbed on the body, inhalation of vapours from crushed leaves [**Evodia** sp. – 'saakop'; Elatostema sp. (Urticaceae) – 'waar'; Achyranthes sp. (Amaranthaceae) – 'suung'] and the consumption of **Pandanus**, **Dodonaea**, Eugenia sp. [see **Syzygium**], the fern Cyathea sp. (Pteridophyta) ['faam'], 'spiderwort' leaf Commelina diffusa (Commelinaceae) ['saamkop'] [these two aiding in alignment of personal spirit-aspects; some Commelina spp. contain β-carbolines – see below] and nuts of Lithocarpus spp. (Fagaceae) ['aramaar', 'baang' and 'kong' – produces dizziness, promotes 'ritual insight'], as well as other plants for which there is no evidence of psychoactivity (Poole 1987; Schmid 1991; Weil 1969). A Laportea sp. (Urticaceae) ['salak'] is also used by the Komba of Morobe to become 'magically powerful', and the Minyamin of Yominbip flagellate themselves with a Laportea sp. as a stimulant for long journeys. The Wopkaimin use a Laportea sp. ['bimgalgol'] in ritual medicine (Thomas 1999, 2001a). See also the related Dendrocnide spp. above.

Ginger [Z. officinale] contains over 500 chemical constituents, some of which have psychoactive potential. Ginger is known to be a stimulant, and is also anti-inflammatory, antibacterial, anthelmintic, antifungal, antiviral, antioxidant, lowers cholesterol, regulates hormones and body temperature, counteracts nausea, and has many other recognised medicinal actions. The ancient Chinese claimed long-term use would "put a person in contact with the spiritual effulgences"; the Koran referred to it as a beverage of the holiest heavenly spirits; and in Persia it was recognised as having head-clearing properties. It is also much regarded in Asia as an aphrodisiac. It is very important in magical and ritual practices throughout Asia and the south Pacific (Perry & Metzger 1980; Rätsch 1992; Schulick 1996), and makes a great beer (Buhner 1998; pers. obs.)! The Kirati of Nepal regard ginger ['yari', 'deshukpa'] as very important shamanically, playing a part in many rituals. A piece may be eaten to aid entry into trance, and it is said to "bring clarity to the spirit" (Müller-Ebeling et al. 2002). In Siberut, Indonesia, shamans drip ginger juice into the eys of their apprentices, so that they may 'see' (Rätsch 1998). In Amazonia, Z. officinale ['ajej'] is consumed by Shuar, Achuar and Aguaruna shamans as a 'hallucinogen', to 'gain power'. The Cariña mix it with tobacco and apply it to the eyes of apprentice shamans – this apparently allows them to 'see spirits' (Bennett 1992).

Going back to our friends the Bimin-Kuskusmin, we find that their extended initiation rituals are a very complex process, involving ingestion of many different combinations of different substances, and an abundance of taboos and special procedures regarding the use of the major herbs which the rituals revolve around – that is ginger [stages 1-3], **Nicotiana** [stages 4-9] and mushrooms [see **Boletus** and **Psilocybe**; stages 10-12 – not compulsory, but required to be a fully initiated elder]. They are conducted at dawn, dusk, and night, respectively, and gradually increase the intensity of the experience at each stage. Methods used include mainly increasing degrees of fasting, sleep-deprivation, and exposure to harsh elements [proximity to fire, 1-3; rain and cold wind, 4-9; rain, cold wind, lightning and thunder (with drumming in rhythm with the latter), 10-12] (Poole 1987). Full details are too complex to enter into further, unfortunately.

Casuarina equisitifolia (Casuarinaceae) is used in Enga, PNG – the inner bark is scraped, and its juice used as a sedative for aggressive or mentally disturbed people. It has been used for a similar purpose in Malaysia. Leaves of 'pehea' or 'aseki' [Fagraea bodenii; Gentianaceae] are chewed by some warriors as a stimulant before battle (Woodley ed. 1991). Throughout Polynesia, Fagraea spp. are associated with "gods and the afterlife". Incidentally, F. berteroana flower essential oil is said to "restore mental clarity and purposefulness", reduce drug cravings, especially for **Cannabis**, and reduce sexual urges. In Cambodia, F. fragrans bark is infused and drunk as a tea by the elderly to prolong life; freshly cut bark of this species is reported to give contact dermatitis. The plant contains the iridoid gentianine. In Sarawak, leaves and bark of F. racemosa are decocted as a tonic; in Sabah, as 'todopon puok', roots are used as an analgesic and local aneasthetic. The roots contain lignins [(+)-pinoresinol, (+)-lariciresinol, (+)-isolariciresinol] and phenols [syringaldehyde, 7,8-dihydro-7-oxyconiferyl alcohol] which share these activities in animals (Motley 2004).

Ginger, Endospermum formicarum (Leguminosae) and a Homalanthus sp. (Euphorbiaceae) are used to 'make young warriors fierce' (Paijmans ed. 1976). In Mt Hagen and the Jimi Valley of the Western Highlands, Endospermum maluccanum has been used for the same purpose. In the Chimbu area, a Palmeria sp. (Monimiaceae) has also been used as a battle stimulant (Thomas 1999). In the Bismarck Archipelago, fruit of Ptychococcus paradoxus (Arecaceae) is chewed as a betel nut substitute [see **Areca**]. The Adzera chew fruits of a Costus sp. (Zingiberaceae) ['jangun', 'jangun fagata'] as a betel nut substitute (Thomas 2001a). Incidentally, in Congo the stem of a plant known as 'mukhuisa' [also spelled 'munkwiza', 'nkwisa', 'nkuisa'], which may be a Costus sp. such as C. lucanusianus, is chewed by medicine men and the juice spat at people gathered around; all present then drink a beverage made from the plant. The purpose of this ritual is to drive out evil spirits (De Smet 1998). In Nepal, C. speciosus ['kusha'] may be used as ritual incense by shamans if none of the preferred substances are available; however, it is not thought to have any psychotropic effect (Müller-

Ebeling et al. 2002). The Gimi of the Eastern Highlands ritually smoke an Amaracarpus sp. (Rubiaceae) with tobacco, to enter trance. In the Kema Valley, a Beaumontia sp. (Apocynaceae) is sometimes smoked as a tobacco substitute. The Baining of New Britain chew Cryptocarya aromatica (Lauraceae) bark with lime and leaf of a **Piper** sp., as a betel nut substitute; in n.e. Irian Jaya, bark of C. aromatica is chewed 'to contact supernatural beings'. The Baining also consume tubers of an Alocasia sp. ['wild taro'] and/or Colocasia esculenta ['taro'] (both Araceae) during their dancing ceremonies, whilst chewing betel nuts, and having been chewing betel nuts for the last 5 days. Laportea sp. leaves [see above] are also ingested to counteract the toxicity of these plants. In East Sepik, an Alocasia sp. is used by the Komba for 'malevolent sorcery'. On Mabuiag, w. Torres Strait, root and leaves of a Capparis sp. (Capparaceae) ['kara'] are eaten by shamans 'to become wild'; the unripe fruits are eaten by novices during their initiations (Thomas 2001a). In some parts of Africa, C. tomentosa root is used as a homicidal poison; the plant contains alkaloids and saponins (De Smet 1998). At Mt. Hagen, Pteridium aquilinum (Polypodiaceae) ['pugl'] juice is used as a stimulant; Drymaria cordata (Caryophyllaceae) ['romp-romp'] is eaten in small amounts either raw with alkaline ashes, or cooked with a vegetable, as a stimulant. Locals also obtain bark of an unidentified plant, known as 'tipo', from other tribes. Its use is still mysterious, but drinking a decoction is said to cause the consumer to lose their wits (Stopp 1963).

Inhabitants of Nokopo, in the Madang & Morobe provinces of PNG, use a number of obscure substances for ritual and inebriation. A number of plants are used as narcotic intoxicants – including 'muk muk' [Dendrobium spp.; Orchidaceae] leaves, 'kuya' [Garcinia sp.; Guttiferae] bark [sometimes chewed as an intoxicant with betel nut – see **Areca**; the African G. kola is known as 'bitter kola' – see **Cola**], 'dsopang' [Heterospathe sp.; Palmaceae] fruits, 'marapinpin' [Nicolaia elatior; Zingiberaceae] fruits and 'kiyang kiyang' [Viola gibbilimbum; Violaceae] leaves. Plants, and even animal parts, are also chewed as stimulants for long sessions of singing, chanting and dancing at night, such as 'deeng karang mondsin' [Dendrobium sp.] shoots, 'waumung' [Pittosporum sp.; Pittosporaceae] root cortex [the scent of the crushed root of P. venulosum is said to be aphrodisiac by Queensland natives (Lassak & McCarthy 1990), and bark of P. floribundum is considered narcotic in India, when taken in small and safe doses (Nadkarni 1976)], 'mokei' [possibly a Pterostylis sp.; Orchidaceae] leaves, 'nyingwaol dsaap' [an orchid] leaves, 'keenem katam' or 'upmung kwik' [a fern] fronds, and herbage of 'bumumak mondsin' and 'temiyat kwik kwak' [members of the Labiatae]. 'Katam', the anus glands of the 'dusky wallaby' [Thylogale brunii], 'forest wallaby' [Thylogale sp.; 'pademelon'], 'silky cuscus' [Phalanger sericeus], 'spotted cuscus' [Spilocuscus sp.] and 'eastern ringtail' [Pseudochirulus forbesi] marsupials are sometimes combined with these plants. Other plants are crushed and rubbed on the body by men before sleeping, in order to meet bush spirits ['sinduk'] who teach them new songs and rhythms, which are valued for the vital energy they carry as gifts from the forest. A 'club moss' [**Lycopodium** squarrosum] is mentioned under its own entry – also used are 'dsimok' [possibly a Dendrobium sp.] and 'suva yut' [possibly a Epiblastus sp.; Orchidaceae] (Flannery 1995 [for marsupial identification]; Schmid 1991).

Regarding Dendrobium spp., many have interesting uses where they occur, so we will temporarily diverge to discuss them. Stems, leaves and pods of D. hancockii promote a feeling of wellbeing and psychic sensitivity when taken regularly (Trout pers. comm.). In s.e. Asia, D. pulchellum flowers are fed to hunting dogs to improve their skill, and D. ceraia has been used to treat phobias, epilepsy, nervous complaints, rheumatic pain and debility. D. crumenatum is also used for nervous or mental problems, and the bulb sap used to treat earache. In Vietnam, D. ceraia is decocted to make a refreshing tonic beverage. In Seram, Indonesia, men wore D. acinaciforme in their armbands for courage during raids. In Taiwan, D. moniliforme is taken "to fortify the person" and their kidneys. In TCM, D. nobile and sometimes other species have been used as 'shihhu', as a strengthening longevity tonic, aphrodisiac, analgesic with many other properties; the stems are used in a dose of 5-10g [dried]. The alkaloid dendrobine is the primary active component. D. devonianum nectar has a narcotic effect on visiting insects, as does nectar from the orchids Catasetum spp., Cycnoches spp., Diuris pedunculata, Gongora spp., Pterostylis recurva, P. sargentii and Stanhopea spp.; S. tigrina is used in Mexico to relieve weakness and sunstroke (Lawler 1984). Of these, alkaloids have been detected in Catasetum spp., Cycnoches spp., Gongora spp. and Stanhopea spp. (Lüning 1967). The orchids Arethusa bulbosa ['dragon's mouth'], Cymbidium devonianum ['Devon's Cymbidium'; alkaloids found in genus] and Goodyera pubescens ['rattlesnake orchid'; alkaloids found in genus] also contain 'narcotic' compounds (Lüning 1967; Rätsch 1992). The latter has been used as an analgesic by the Cherokee (Hamel & Chiltoskey 1975), as has G. menziesii by other tribes (Lawler 1984).

To diverge again, in relation to the use of anus glands just mentioned, many animal secretions have aphrodisiac and/or psychotropic effects. The scent gland secretions of the Canadian beaver, Castor fiber, have been used as an aphrodisiac (Rätsch 1990); they have been found to contain a number of alkaloids, some of which are related to compounds found in **Nymphaea** – 0.12% castoramine, 0.024% isocastoramine, 0.008% deoxynupharidine, and lesser amounts of other compounds (Maurer & Ohloff 1976). In India, the dried secretions [which smell of cat urine; the product is presumably imported] are used in doses of 1-2g as a nervous stimulant and antispasmodic to treat hysteria, epilepsy and asthma. The secretion also acts as a uterotonic and emmenagogue. Also in India, secretions from the pouch between the anus and genitals of the civet cat Viverra civetta ['gandha-marjara', 'zebad'] are taken as a stimulant, aphrodisiac, nervine and antispasmodic, as well as being used as a perfume ingredient. The secretion [the 'civet'] contains zibetone, a compound with a similar structure to muscone, a major active principle in 'musk'. Musk, an aromatic testicular secretion from certain Asian musk deer [such as Moschus moschiferus or M. sifanicus] released when rutting, is used in Ayurveda as an exhilarating nerve stimulant, respiratory stimulant, antispasmodic, cardiac tonic and aphrodisiac; with prolonged exposure or high doses, it acts as a soporific narcotic. In China, it has long been claimed that musk could "increase the intelligence quotient of children". In TCM, as 'she xiang', it is taken in doses of up to 200-375mg as a stimulant and cardiotonic, and is generally used to treat stroke, shock or convulsions. In larger doses, however, it acts as a CNS depressant. Side effects may include dizziness, nausea and vomiting. It can stimulate the production of male sex hormones, and promote contraction of the uterus (Huang 1993; Landerer 1883; Nadkarni 1976). Incidentally, the velvet antlers from the deer Cervus elaphus have been shown experimentally to inhibit *morphine* tolerance and dependence, when extracts were administered repeatedly to mice (Kima et al. 1999). 'Ambergris' is another famed aphrodisiac animal secretion also used in perfumery, and originates from the intestines of the 'sperm whale' Pyseter macrocephalus; the fact that it is usually found floating in the sea fortunately means the whales are [usually] not killed to obtain it. The genitalia, horns and other body parts of a great variety of other mammals have been thought to be aphrodisiacs, and some others not listed here are mentioned by Rätsch (1990).

The boar pheromone 5α-androstenol, also secreted by male humans and found in urine of female humans, has been found in 'black truffles' [Tuber melanosporum] and 'white truffles' [T. magnatum], and appears to have an aphrodisiac effect on humans (Claus et al. 1981). It was thought to be the chemical which attracted sows to underground truffles, but this action appears to be due entirely to the dimethylsulphide produced by the fungi (Talou et al. 1990). Sows are, however, 'turned on' by the boar pheromone 5α-androstenone (Claus & Hoppen 1979). These truffles have a reputation as human aphrodisiacs, possibly due to the aroma of 5α-androstenol, though it is unclear whether they are effective (Schaecter 1997).

The infamous scent of skunk [Mephitis spp. and Spilogale spp.] has been reported to act as a strong stupefacient. One boy who inadvertently inhaled 'skunk perfume' on the suggestion of his friends suffered "total unconsciousness, muscular relaxation, a temperature of 94°[F] and pulse of 65, together with cool extremities" (Conway 1881).

LATIN AMERICAN OBSCURITIES

There exist many little-known plants of Central and South America which may have psychoactive properties, of which the following is a selection, including discussion of related species from elsewhere in the world. No doubt many more remain to be discovered by us.

Abuta grandifolia (Menispermaceae), 'abuta caimitillo' or 'sanango' is sometimes added to ayahuasca [see **Banisteriopsis**] (McKenna et al. 1995); it may be taken by itself as a plant teacher (Luna 1984). Root tea is used in Ecuador to make children strong, and relieve their nervousness and/or colic. One cup of such a brew is considered strong enough to produce strengthening effects lasting for a year. The plant is used by various Amazonian tribes in preparing 'curare' arrow poisons. The barks of A. grisebachii, A. imene, A. obovata, A. rufescens, A. sellowana and A. splendida have also been used in preparing curares or other arrow poisons for hunting, as have many other plants from the Menispermaceae – such as members of the genera Anomospermum, Chondrodendron [see below], Cissampelos [see Cocculus below], Curarea, Orthomene [see below], Sciadotenia and Telitoxicum [see also **Strychnos**] (Schultes & Raffauf 1990). A. grandifolia contains oxo-aporphines, including palmatine; bark tested positive for alkaloids (McKenna et al. 1995).

'Achunisanango' [unidentified] is used in Peru as a potent male sexual tonic; the root is taken in alcohol with honey (Bear & Vasquez 2000).

Anemopaegma mirandum [A. arvense] (Bignoniaceae), 'catuaba' or 'tree of togetherness', is used for its root by the Tupi of S. America as a CNS-stimulant, relaxant, and aphrodisiac nerve tonic (Baill pers. comm.; Mors & Rizzini 1966; Usher 1974).

Anthurium oxycarpum (Araceae), 'yeurycumajé', is used in Amazonian Peru and Brazil to flavour tobacco [see **Nicotiana**], as it is aromatic when shade-dried; it may also be snuffed alone as an aphrodisiac (Plowman 1969). The dried, powdered leaves are said to be made into a 'hallucinogenic concoction' by the Yumbo and the Quichua of Ecuador (Croat

1994) but this is referenced to Schultes & Raffauf (1990), who only identified the plant so used by its herbarium number, as A. sp. Bv 2936.

Aristolochia medicinalis (Aristolochiaceae) is used by the Kubeo for its root, which is made into a tea to treat epilepsy. If taken in excess, it can cause 'permanent' mental derangement and sometimes muscular paralysis. The genus contains aporphine and berberine-type alkaloids, as well as nitrophenanthrene derivatives and essential oil (Schultes 1993; Schultes & Raffauf 1990). Leaves of species growing in Queensland [Australia], A. deltantha, A. elegans, A. praevenosa and an unidentified species, tested strongly positive for the presence of alkaloids (Webb 1949). In India, A. indica is reputed to be a potent aphrodisiac (Islam et al. 1991).

Astrophytum myriostigma ['peyote cimarrón', 'birrete de obispo', 'mitra'], A. asterias ['peyote'] and A. capricorne ['peyote'] (Cactaceae) are known as kinds of peyote in n. Mexico, though this is thought to be due only to a superficial resemblance to true peyote [see **Lophophora**]; they have been shown to contain "traces of toxic alkaloids" (Bravo 1937; Schultes 1937a, 1937b). However, the reference by Schultes (1937b) to A. capricorne being a 'peyote' may be in error, as he referred this to Britton & Rose, who did not mention any such information, except for A. asterias (Britton & Rose 1963 [note – orig. publ. 1922]). One person claimed to have eaten small [5cm diam. or less] nursery-bought specimens of A. myriostigma on numerous occasions, with 1½-5 specimens required for noticable psychotropic effects; however, the same person reported eating a larger, much more fibrous specimen [c.7.5cm diam.] which "sat very heavily" in his or her stomach and produced no CNS effects (R.D. 2002). Some cactus growers in s. California have reportedly observed jackrabbits nibbling on the ribs of A. myriostigma becoming noticeably intoxicated, as well as returning for more when the effects appeared to have worn off (Anon. 1998)!

Bernoullia flammea (Bombaceae) ['amapola blanca'] seeds are smoked in Guatemala near the Mayan ruins of Tikal , as an 'opium-like' narcotic [see **Papaver**] (Rätsch 1998).

Bletia campanulata (Orchidaceae) has been known as 'peyote cimarrón' (Schultes 1937b) and 'peyote' (Smith 2000) [see **Lophophora**], though it is not known whether this orchid has medicinal or psychotropic uses. It contains an alkaloid (Lüning 1967). B. hyacinthina has been used medicinally in China, Mongolia, Tibet and Japan as a lung tonic and blood purifier, though it is also "said to produce a state of euphoria" (Lawler 1984).

Browningia spp. (Cactaceae) are large, columnar cacti from S. America, many being quite similar to some **Trichocereus** in appearance. The 'El Candelabro' marking amongst the famous 'Nazca Lines' [made by the Peruvian Nazca culture, c.300-800AD] has been proposed to represent B. candelaris, a prominent species of the area. Although its significance is not known, it is suspected that the cactus represented was known to the Nazca as a visionary plant (Ostolaza 1987, 1997). The only analysis of the genus for alkaloids I'm aware of detected no *mescaline* in B. candelaris or B. microsperma, but did not look for other alkaloids (Cjuno et al. 2007). The stunningly beautiful B. hertlingianus [Azureocereus hertlingianus, A. nobilis] is common in horticulture, though its slow growth and unwillingness to take from cuttings has probably hindered human bioassay. It is also unfortunately quite frost sensitive, at least when young (pers. obs.).

Buddleia humboldtiana (Loganiaceae), as 'tepozan', is used in Mexico as a hypnotic, anaesthetic, diuretic and anodyne; it is a CNS-depressant (Jiu 1966). B. americana has been reported from Mexico, Guatemala and Costa Rica to have roots with hypnotic and sedative properties. In Brazil, B. quinquenaria has been used in infusion as a nerve sedative. In n. India, roots of the related B. asiatica have been used to make a 'fermented liquor'; in some parts of the Philippines, the smoke of the plant is used to soothe irritated babies. In China, leaves of B. curviflora have been used to stupefy fish (Houghton 1984). In Nepal, B. asiatica ['bhimsen pate'] and B. paniculata ['narayan pati'] leaves are used in ritual incense (Müller-Ebeling et al. 2002). Butterflies have also been observed in an intoxicated state from feeding on flowers of a Buddleia sp. growing ornamentally in England (Smullen 1989).

Bursera bipinnata (Burseraceae) has been proposed to have been the tree known to the Aztecs as 'teuvetli', the resins from which were applied to wounds on sacrificial victims to induce a semi-trance (Case et al. 2003; Emboden 1979a). However, there is no actual evidence to support this tentative identification, apart from the copious resin-production of the plant. B. bipinnata has been used as an additive to 'pulqué' [see *Methods of Ingestion*] (Rätsch 1998). The oleo-resin contains epi-lupeol and α-amyrin. B. graveolens, from Colombia and Peru, is used for its leaves, which are decocted to relieve muscular fatigue. The oleo-resins from B. gummifera and B. tomentosa, which are used to treat tumours, contain *elemicin* (Pernet 1972). In Sonora, Seri shamans hold bundles of B. microphylla twigs in their curing ceremonies; they also use fetishes carved from B. hindsiana wood, which may be hired out to others for domestic use. The Seri also drink a tea of B. laxiflora bark [the dark portion] to relieve pain from scorpion stings or 'black widow' spider bites [see below] (Felger & Moser 1974). Seri shamans drink a tea of B. microphylla branches throughout their 4-day vision quests [in which fasting is observed] (Felger & Moser 1985). B. copallifera and many other members of the genus are used as sources of 'copal' incense resin in Mexico (Case et al. 2003).

Cacalia cordifolia (Compositae) is known as 'peyote' by the Tarahumara [see **Lophophora**], and is sold in markets in Jalisco [Mexico] as an aphrodisiac and sterility cure (Schultes 1937a, 1937b). C. decomposita has been reported to be used to stun fish in n. Mexico (Pennington 1958).

Carludovica palmata (Cyclanthaceae) ['bonbonaje'] root is said to be cooked and eaten by some shamans in the Peruvian Amazon as part of a strict diet – the shaman is said to 'become powerful and filled with the spirit of the bonbonaje plant', dreaming 'sacred and spiritual things'; however, the truth of this information is uncertain (Montgomery 1997a, 1999). Fibres from this tree make the famous Panama hats (Usher 1974). C. divergens ['tamshi'] bark is used as an ayahuasca additive [see **Banisteriopsis**] (Trout ed. 1998); it is used medicinally to treat baldness and cramps. The tree is said to grow from the dead body of a large, stinging ant ['isula']; the spirit of the tree is able to transform into this ant (Luna & Amaringo 1991).

Cedrelinga castenaeformis (Leguminosae) is known as 'paricà' in parts of Brazil [see **Anadenanthera**, **Virola**] (Schultes 1955a), and as 'huayracaspi' in Peru. It may be taken after a 30-day diet diet for 'spiritual travel' and dreams of flying, yet it is said to not cause visions. Bark from the side of the tree facing the morning sun is harvested, and 100-200g is ground and infused in water overnight. The next day, the liquid is strained, blessed with icaros by a shaman, and consumed. Partly due to the sturdy nature of the tree, it is used as a magical plant for defense (Bear & Vasquez 2000; Luna 1984; McKenna et al. 1995).

Cephalocereus melanostele (Cactaceae) has been claimed to contain *mescaline* (Rätsch 1992, citing Jiminez, A.C. 1977. Folklore Americana 23:89-100), which may be in error.

Cereus acranthus and C. peruvianus [C. repandus] (Cactaceae) have been claimed to contain *mescaline* (Rätsch 1992, citing Jiminez, A.C. 1977. Folklore Americana 23:89-100), which may be in error. C. peruvianus has often been sold misrepresented as **Trichocereus** peruvianus [even though they look quite different from one another] (pers. obs.). It has been found to contain *tyramine* (Agurell 1969a).

Cheilanthes ferruginea (Polypodiaceae), 'cola de zorra', is a fern used to treat epilepsy in Mexico; in animals, CNS-depressant effects have been observed (Heffern 1974).

Choisya ternata (Rutaceae), 'flor de clavo', is sometimes used in southern Mexico as a sedative antispasmodic, to relieve nervous excitement (Heffern 1974).

Chondrodendron tomentosum (Menispermaceae), 'pareira brava' or 'amphihuasca' ['poison vine'], is used in Brazil to treat madness and dropsy. Otherwise, it is used in n.w. Amazonia to preparae 'curare' arrow poisons for hunting, as are the barks or stems of C. iniquitanum, C. limaciifolium, C. platyphyllum and C. toxiferum (Schultes & Raffauf 1990).

'Chundur', an unidentified plant, is regarded as very important in Paez magic, for which the tuberous root swellings are chewed. Varieties with more swollen roots are known as 'chundur ñúsha' or 'chundur de Castilla'; those with thinner, more fibrous roots are known as 'chundur de arco' or simply 'chundur' (Antonil 1978).

Columnea picta (Gesneriaceae) leaves are sometimes smoked as a stimulant tobacco substitute [see **Nicotiana**] by the Siona-Secoya of Ecuador (Schultes & Raffauf 1990).

Copaifera spp. (Leguminosae/Caesalpiniaceae) are used in S. America to produce oleoresin known as 'copaíba', which is taken externally and internally as a medicine. Amongst its many curative properties, it is regarded as an aphrodisiac (Plowden 2004).

Cotyledon caespitosa (Crassulaceae) is known as 'peyote' by the Tarahumara, and is believed to cause insanity; it contains "a powerful glycoside" (Schultes 1937a, 1937b).

Coutaria latiflora (Rubiaceae), as 'colpalchi de jojulta', is used in Mexico as a tranquilliser and febrifuge (Jiu 1966).

Cranichis speciosa (Orchidaceae) has been known as 'peyote cimarrón' (Schultes 1937b) and 'peyote' (Smith 2000) [see **Lophophora**], though it is not known whether this orchid has medicinal or psychotropic uses.

Croton zehntneri (Euphorbiaceae) is used in Brazilian folk medicine – the bark and leaves are infused to treat nervous and gastric disturbances. The essential oil of the plant contains primarily *estragole* [59%], *anethole* [27%] and *methyleugenol*. Oil of the seeds of some species is very toxic. Stem bark of C. ururucana [the red sap of which is called 'sangre de drago', or 'dragon's blood' – used to heal wounds] contains clerodane diterpenes of unknown activity (Albuquerque et al. 1995; Batatinha et al. 1995; Peres et al. 1998). An unidentified Croton sp. might represent the 'tipuru' sometimes added to ayahuasca by the Shuar (Bennett 1992). The essential oil of C. nepetaefolius contains *elemicin* (Harborne & Baxter ed. 1993).

Dioon edule (Cycadaceae), known as 'hierba loca' and 'chamal' in Mexico, is known to intoxicate animals, making them act unusually, and is thus reputed to be psychoactive. Seeds are used locally to treat neuralgia. Flavonoids are found in the plant, mainly amentoflavone (Rätsch 1998;

Schultes & Hofmann 1980), a BZ-receptor ligand (Nielsen et al. 1988).

Echinocactus visnaga (Cactaceae) has been proposed to have been the unidentified 'aikutsi' plant of the Huichol, which was sometimes eaten with peyote [see **Lophophora**] to "prevent one from becoming too intoxicated" (Smith 2000). However, E. visnaga might not be a valid name (Trout ed. 1999). The common 'golden barrel cactus' E. grusonii has been sold as 'peyote' in a Mexico City market, probably for medicinal purposes (Smith 2000). In ancient Mexico, some Echinocactus spp. were important in religious rituals, and were known as 'comitl', 'huitznahuac' and/or 'metzollin'; some were even considered to be incarnations of Tlaloc, the rain god [see also **Mammillaria**]. Spines of an Echinocactus sp. were possibly used in sacrificial rituals in the temple of Huitznahuacteopan (Bravo 1937). E. polycephalus may contain extreme traces of *mescaline* (Gennaro et al. 1996), though this was not clearly indicated. E. polycephalus var. xeranthoides and E. caespitosus were found to contain unidentified alkaloids (Brown et al. 1968).

Echinocystis lobata (Cucurbitaceae), a 'wild cucumber' [see **Momordica**], grows in Mexico where the unripe seeds have apparently caused "hallucinogenic intoxication" in children who have eaten them (Heffern 1974). One psychonaut has also claimed that a tea made from the roots of what was probably E. lobata produces effects similar to those from ingesting mushrooms containing *psilocybin* and/or *psilocin* (B.K. 1998).

Enterolobium cyclocarpum (Leguminosae) is a fragrant plant called 'hueynacaztli' in the Badiano Codex; it might represent the Aztec 'teonacaztli' mentioned in the Florentino Codex, which is said to "intoxicate like the mushrooms" [see also **Cymbopetalum**] (Diaz 1979).

Espostoa lanata (Cactaceae), commonly called 'Peruvian old man cactus', is known as 'pishcol negro' where it grows in the Huancabamba Valley of Peru [see also **Armatocereus**]; it has been proposed to possibly be used in the same manner as **Trichocereus** pachanoi, though there does not seem to be any evidence for this (Smith 2000). Ethanol extracts gave negative reactions when tested for presence of alkaloids with Mayer's reagent; E. huanucensis has yielded 0.004% *tyramine*, 0.002% N-methyl-*tyramine*, 0.002% *hordenine* and traces of two other alkaloids (Mata et al. 1976).

Fabiana imbricata (Solanaceae), 'pichi-pichi' or 'k'oa', is burned as incense in the Andes of n. Chile to dispel evil spirits and ward off disease; in higher doses, it may be intoxicating. The twigs contain *scopoletin*, and the entire plant contains an alkaloid [fabianine] and an essential oil (Rätsch 1992, 1998).

Ficus insipida (Moraceae), 'ojé' or 'renaco', is used for its latex in some parts of the n.w. Amazon. When consumed under diet, it is said to be a very powerful plant-teacher. The latex is also a strong purgative; it is usually taken for this purpose mixed with 'aguardiente' liquor [2tsp per bottle], in a dose of 1tsp 3 times a day. It is also sometimes added to ayahuasca [see **Banisteriopsis**], and contains biphenylhexahydroindolizines and phenanthroxoindolizines. F. ruiziana ['renaco'] is also sometimes used in ayahuasca, and contains triterpenes and furocoumarins. The juice of the shoots of Ficus spp. may be taken under a 6 month diet, to be able to "travel under the water", where shamanic knowledge is learned (Bear & Vasquez 2000; Desmarchelier et al. 1996; Luna 1984; McKenna et al. 1995; Schultes & Raffauf 1990). A Ficus sp. known as 'renaquilla' is used by the Shipibo, who ingest it under special diet conditions, so that the female spirit of the plant will teach them to heal in their dreams (Luna & Amaringo 1991). F. anthelmintica fruit is taken in Brazil as an aphrodisiac and memory stimulant, and F. atrox latex is used as an ingredient of one 'curare' arrow poison (Schultes & Raffauf 1990). The Nkopo of PNG use F. gul ['kildsek'] in their initiations, and they use another Ficus sp. ['kwanam'] in rituals to achieve harmony with natural forces (Schmid 1991). In that continent, the use of Ficus spp. in rain magic and to combat sorcery is widespread (Paijmans ed. 1976). The Mbowamb of Mt. Hagen eat leaves of a Ficus sp. ['mbon'] to protect against the 'spell of death' (Stopp 1963). On Rossel Island, near PNG, F. subnervosa leaves are chewed as a betel nut substitute [see **Areca**] (Thomas 2001a). In Africa, Zulu men drink a decoction of F. soldanella bark as a 'strengthening tonic' (Watt & Breyer-Brandwijk 1932). In some parts of Africa, unspecified parts of F. sur have been used as a homicidal poison (De Smet 1998). The *phenethylamine* alkaloid synephrine has been obtained from the 'banyan tree', F. bengalensis [0.0081% (w/w) from leaves] (Wheaton & Stewart 1970), which is considered sacred in India and Sri Lanka (Schultes & Raffauf 1990).

A Fuchsia sp. (Onagraceae), 'contrahechizo' [a name shared by **Iochroma** grandiflorum, which is used in the same way], is sometimes added to **Trichocereus** pachanoi brews in Peru (Rätsch 1998).

Gloeospermum sphaerocarpum (Violaceae), 'tamarillo' [not to be confused with Cyphomandra betacea (Solanaceae), whose fruits are the common tamarillo or 'tree tomato'], is used by the Waunana in the Amazon, drinking a cold water leaf infusion as a "ceremonial hallucinogen" (Duke & Vasquez 1994).

Guaiacum [Guayacum] sanctum (Zygophyllaceae) wood ['guayaca wood'] is used in c. America as an aphrodisiac and to treat intestinal worms; in Europe it was also used to treat syphilis. The wood contains an aromatic resin (Rätsch 1990). See also G. officinale in *Methods of Ingestion*.

Gymnocactus beguinii (Cactaceae) was recently shown to contain 0.0004-0.0012% *mescaline* by fresh weight (Gennaro et al. 1996), as well as N-methyl-*phenethylamine*, N-methyl-*tyramine* and *hordenine* (West et al. 1974).

Heisteria pallida (Olacaceae), 'chuchuhuasi' [see also **Maytenus**], is used by the Machiguenga of the Amazon for its stem bark, which acts as a male aphrodisiac (Desmarchelier et al. 1996).

Helenium mexicanum (Compositae) is known as 'yerba de las ánimas' ['herb of souls'] in Mexico, though it is not known to be used as a psychotrope (Diaz 1979).

Helianthus annuus (Compositae), 'sunflower', is a well-known central American plant; besides its nutritious seeds, the flower petals have been used to treat rheumatism and gastrointestinal problems, but most interestingly the Mayans made an aphrodisiac drink from them. It has been suggested they may have the same effect cooked in oil and eaten with salt and pepper. Petals and leaves contain *chlorogenic acid*; seeds contain vitamin E, which might also act as a sexual nutrient (Rätsch 1990).

Hiposma carnea (Convolvulaceae), known as 'chalviande' and 'matacabra' ['goat killer'], has been said to be used as a "hallucinogen" around coastal Ecuador, but this may be a confusion with **Ipomoea** carnea (Rätsch 1998).

Hura crepitans (Euphorbiaceae), 'catahua', is used as for Ficus insipida [see above]. The Tikuna know it as 'wa-chee-va', and use the fermented latex as a potent fish-poison. It has also been used as an ayahuasca additive [see **Banisteriopsis**], and in Peru is taken alone as a 'powerful plant teacher'. To consume the plant, a diet must be kept for up to several months [if you wish to avoid the possibility of death]; a reliable shaman cooks the latex carefully in a double-boiler, and sings potent 'icaros' over it. When slightly gelatinous, a few mls are consumed. The resin is said to 'burn the intestines', though this is less pronounced when properly prepared. Over time, the plant strengthens one, and protects against sorcery when taken in this way. It contains tigliane diterpenes, lectins and piscicidal compounds (Bear & Vasquez 2000; Desmarchelier et al. 1996; Luna 1984; Luna & Amaringo 1991; McKenna et al. 1995; Trout ed. 1998).

Hymenaea courbaril (Leguminosae/Caesalpiniaceae) trunk resin is used as a source of 'copal' incense in Mexico; as well as mundane medicinal uses, this and other copals are important in divination and other rituals (Case et al. 2003).

An Iresine sp. (Amaranthaceae) is sometimes added to ayahuasca [see **Banisteriopsis**] in s. Colombia (Schultes 1967a). Members of the genus are reputed to 'cure insanity' (Schultes & Hofmann 1992). In n. Argentina, I. diffusa stalks are sometimes used to prepare the alkaline reagent used with coca [see **Erythroxylum**] (Hilgert 2001). An Iresine sp. [perhaps I. celosia] is reputedly sometimes added to **Trichocereus** pachanoi brews, along with other plants (Davis 1983; Schultes & Hofmann 1992). I. celosia and I. herbstii are known as 'borrachera' ['intoxicant'] in the Sibundoy Valley of Colombia (Bristol 1969), and in Huancabamba, Peru I. celosia is known as 'timora' (Davis 1983) and is reputedly 'magic and dangerous' (Schultes 1967a). In n.e. Peru I. herbstii is known as 'cimora señorita', and has been used by rural people for 'black magic', sometimes "to take possession of another's identity". It is said to be used by shamans with San Pedro [see **Trichocereus**] for divination and diagnosis. Aerial parts are used to treat skin conditions and fever; a water extract has sedative effects in mice (De Feo 2003; De Feo et al. 1996). Some Iresine spp. contain cinnamic acid amides (McKenna et al. 1995).

Juanulloa ochracea (Solanaceae) is known as 'ayahuasca' in Colombia [see **Banisteriopsis**], and might be an additive to ayahuasca, or an inebriant in its own right. The Karijona of the Rio Apaporis say that it has 'magical properties'. The trunk and leaves are normally used to treat wounds. The alkaloid parquine [see **Cestrum**] has been found in the genus (Schultes 1972; Schultes & Raffauf 1990).

Kyllinga brevifolia (Cyperaceae) rhizome is used in Paraguay as a sedative and to relieve stress; the rhizome extract given to mice was non-toxic orally, and caused "decrease of spontaneous motor activity, piloerection, passivity, palpebral ptosis, catatonia and a stereotyped behaviour", as well as decreased rate of respiration (Helliön-Ibarrolaa et al. 1999).

Lepidium meyenii [L. peruvianum] (Brassicaceae), 'maca' or 'Peruvian ginseng', is used in the Peruvian Andes for its tubers as an aphrodisiac, tonic, energiser, adaptogen, immunostimulant and nutritious supplement. It has more recently been marketed to the rest of the world for its medicinal virtues. Traditionally, the tubers have mainly been used as a nutritious food, from c. Peru to Bolivia and n.w. Argentina. They may also be made into an alcoholic beverage ['maca chicha'] and when dried, sometimes flavour the local sugar cane rum or 'aguardiente' (Muhammad et al. 2002; Ochoa & Ugent 2001; http://rain-tree.com/maca.html). Leaves, sprouts, hypocotyls and seeds contain glucosinolates [see **Brassica**], such as benzylglucosinolate and p-MeO-benzylglucosinolate (Li et al. 2001). Tubers have yielded the pyridine alkaloid macaridine, and alkamides named macamides (Muhammad et al. 2002), as well as saponins, tannins, sugars, starches, fatty acids, 13-16% protein and minerals such as iron and iodine (Ochoa & Ugent 2001). The Eurasian L. sativum is used in India for its aphrodisiac seeds (Nadkarni 1976). The plant has yielded

bis-benzyl imidazole derivatives (Muhammad et al. 2002).

Leucaena guatemalensis (Leguminosae) has been known as 'yajé' in Guatemala [see **Banisteriopsis**] (Trout ed. 1998); although suggestive of some psychotropic properties associated with ayahuasca, this is unusual because the beverage is not known to have been prepared or consumed there traditionally.

A Loricaria sp. (Compositae) known as 'corona de cristo' is used in Peru for its aerial parts, which are infused in sugared water and drunk to treat "physical and psychological weakness and anemia" (De Feo 2003).

Lucuma salicifolia (Sapotaceae), as 'zapote borrachero', is used in Mexico as a soporific and anti-periodic (Djerassi et al. 1956; Jiu 1966). The fruit flesh can bring about an alcohol-like inebriation, and is sometimes added to brandy or cheap alcohol to make it more intoxicating (Rätsch 1998). See also **Casimiroa**.

Matayba guianensis (Sapindaceae), 'para-para' from Venezuela, is reported to have toxic fruits that can make the consumer 'crazy' (Rätsch 1998).

Matucana madisoniorum [Borzicactus madisoniorum, Submatucana madisoniorum] (Cactaceae) has been claimed anecdotally, from numerous sources, to be used by shamans in Peru, in combination with **Trichocereus** pachanoi, and possibly also by itself. It is unclear, however, whether this cactus fulfils a visionary purpose, though more definite information is apparently nearing publication. This plant, similar in appearance to **Lophophora** williamsii, is also rumoured to contain *mescaline* (Smith 2000). At the time of writing it seems likely that these rumours may be unsubstantiated. A recent GC-MS analysis of this species could not detect any *mescaline* (Trout pers. comm.). A human bioassay of two old, cultivated specimens [c.190g] resulted in no noticeable psychoactivity (Stuart 2002).

Melocactus peruvianus (Cactaceae) has been claimed to contain *mescaline* (Rätsch 1992, citing Jiminez, A.C. 1977. Folklore Americana 23:89-100), which may be in error.

Metteniusa edulis [Pentandria monogynia] and M. nucifera (Metteniusaceae; sometimes assigned to Alangiaceae or Icacinaceae), known as 'canyí', are ritually important to the Kogi of Colombia, whose shamans regard the fruits as being a strong psychotrope. However, in Venezuela M. edulis fruits are eaten after cooking as a [presumably] harmless food (Rätsch 1998).

Miconia willdenowii (Melastomataceae) leaves are used as a tea substitute [see **Camellia**] in Brazil. They have yielded 0.2% *caffeine* (Lewis & Elvin-Lewis 1977).

'Murcuhuasca' or 'murcohuasca', either Marcgravia williamsii (Marcgraviaceae) or Rourea amazonica (Connaraceae) (Luna & Amaringo 1991), is a Peruvian vine which may be taken under a strict 1-2 month diet to become agile and "gain the ability to travel very rapidly through the jungle". The parts used are small ball-like sap deposits found within the stem (Bear & Vasquez 2000).

Myrcia acuminata [M. fallax] (Myrtaceae), 'umsim' or 'yacuma negra', is considered a powerful magical herb by the Paez, who chew its seeds with coca [see **Erythroxylum**] for pútia rituals (spitting a spray of masticated coca, sometimes with tobacco [see **Nicotiana**] and aguardiente, for the purposes of blessing or ritual cleansing) (Antonil 1978).

Myroxylon balsamum [M. pereirae] (Leguminosae), 'ta'atsa' or 'tache' [a.k.a. 'balsam of Peru'], is used by some Paez shamans for its seeds, which are chewed and regarded as "powerful". The resin from this tree was used in the past as an incense to repel insects (Antonil 1978).

Nectandra acutifolia (Lauraceae) is used by the Kubeo of n.w. Amazonia in the form of a bark and leaf decoction, which acts as a strong stimulant for elderly people suffering fatigue or narcolepsy. Contains alkaloids, and essential oil in its leaves (Schultes 1993). N. megapotamica from São Paulo state, Brazil, has yielded 0.01% *N-methyltryptamine* and 0.0042% N-methyl-*pinoline* from the bark; the plant is used locally to relieve pain (Filho & Gilbert 1975); N. polita wood has yielded *eugenol*, *methyleugenol*, dehydrodieugenol, O-methyldehydrodieugenol and di-O-methyldehydrodieugenol (Suarez et al. 1983). N. pichurim is known as 'canélla' [see **Canella, Drimys**], 'purchury bean' and 'pichurim' [see **Licaria**].

Neoraimondia macrostibas (Cactaceae) might sometimes be added to **Trichocereus** pachanoi brews in Peru, reputedly as part of the mysterious 'cimora' complex [see **Trichocereus**] (Schultes 1967a). Neoraimondia spp. have been depicted in Nazca and Moche ceramic artwork, particularly in relation to the edible fruits (Ostolaza 1997, 1998). This species has also been known as N. aticensis, N. gigantea, N. peruviana, N. roseiflora and N. arequipensis. N. arequipensis var. roseiflora was shown to contain less than 0.01% each of *DMPEA* and 4-OH-3,5-dimethoxy-*phenethylamine* (Ma et al. 1986). N. macrostibas has been claimed to contain *mescaline* (Rätsch 1992, citing Jiminez, A.C. 1977. Folklore Americana 23:89-100), which may be in error.

'Ninacaspi' (Gramineae?; unidentified) is a small bamboo-like plant, which may be taken under diet as a plant teacher. It may be prepared by crushing c.20 stems, with leaves attached, and boiling thoroughly in water. Initial effects consist of unpleasant stomach sensations and feelings of extreme heat, followed by a visionary stage (Bear & Vasquez 2000).

Niphogeton scabra (Umbelliferae), as 'hornamo toro', is sometimes added to **Trichocereus** pachanoi brews in Peru (Rätsch 1998).

Obregonia denegrii (Cactaceae) is another 'peyotillo' with superficial resemblance to peyote [**Lophophora**]; it has yielded 0.01-0.1% [w/w] alkaloids, mostly *tyramine*, with lesser amounts of *hordenine*, traces of N-methyl-*tyramine* and unidentified compounds (Bruhn & Bruhn 1973).

Ocotea pretiosa [O. cymbarum] (Lauraceae) trunk-wood is used to obtain 'Brazilian sassafras oil' [see **Sassafras**], though it is less used now due to over-harvesting. Trees from the region in which it was most harvested [the state of Santa Catarina] are rich in *safrole* (FAO 1995); the species has also yielded O-*methyleugenol* (Harborne & Baxter ed. 1993) and *phenethylamine* (Smith 1977a). *Apiole* is found in Ocotea spp. (Harborne & Baxter ed. 1993). In the Mitú region of Amazonia, O. opifera fruits are mixed with coca powder [see **Erythroxylum**] to increase its strength, when taken "for certain dances". The Kubeo burn leaves of O. simulans to prepare an ash for use with coca "for certain ceremonies"; this ash is said to make the coca 'stronger' and to add a pleasant taste. The Kofán use O. venenosa fruit in one of their arrow poisons (Schultes & Raffauf 1990). In Africa, the Zulu snuff the powdered bark, or inhale the smoke, from O. bullata to relieve headaches (Watt & Breyer-Brandwijk 1962).

An Onoseris sp. (Compositae), as 'hornamo blanco', has been tentatively identified as an additive to **Trichocereus** pachanoi brews in Peru (Rätsch 1998).

Orthomene schomburgkii (Menispermaceae) is used by the Kofán as a soporific, in the form of a leaf tea. The Tikuna use the bark mixed with Anomospermum reticulatum [see above] to prepare one of their 'curare' arrow poisons (Schultes & Raffauf 1990).

Ovidia pillopillo (Thymelaeaceae) is reportedly one of the four major 'hallucinogens' used by the Mapuche of Chile (Rätsch 2001).

Pagamea macrophylla (Rubiaceae) from Colombia is known as 'manu-su-ka-ta' to the Barasana, and as 'ma-na-shu-ke-ma' to the Makuna. Barasana medicine men have been reported to snuff the powdered leaves during divination rituals, though it is not known what effect is produced by the snuff. The Barasana also commonly use a tea of the leaves and bark to remedy the stomach bleeding which may result from their heavy use of coca [see **Erythroxylum**]. The plant is regarded as toxic by the Makuna. The related P. coriacea is used by the Taiwano as a strong stimulant, to restore use of the legs in elderly people. For this purpose, the bark is scraped from young branches, and when still fresh, decocted; this tea is drunk over several weeks. Stems and leaves have given a negative result in one alkaloid screening; Schultes obtained a positive result from a spot-test on fresh leaves. Chemistry of the genus is otherwise unknown (Schultes 1980). Based on its seemingly shamanic useage and relation to **Psychotria**, P. macrophylla has been suspected of containing *tryptamine* alkaloids (Ott 1993).

Parkia spp. (Leguminosae) are known as 'paricà' in parts of Brazil [see **Anadenanthera**, **Virola**] (Schultes 1955a).

'Pashaco' (Leguminosae; unidentified) seeds are dried, powdered and snuffed by the Yagua of Peru, in order to increase sensory acuity for hunting. When ground with the dried or toasted seeds of 'bubinsana' [see **Calliandra**], the snuff is said to produce visionary effects. Sometimes this is fortified with the dried and powdered venom of a 'poisonous toad' [which may refer to a frog – see **Phyllomedusa**] – "Sniffing about one gram of this powder, they would enter into an ecstatic flight. It would also open up their noses to smell more clearly" (Bear & Vasquez 2000). Albizzia spp. [see below], Parkia spp., Macrolobium acacaefolium and Schizolobium excelsum [see below] [all from the Leguminosae] have been commonly known as 'pashaco'. Derivations of this name have also been used – Albizzia spp. as 'pashaco blanco', **Acacia** spp. as 'ura pashaco', Parkia igneiflora as 'goma pashaco', P. multijuga as 'pashaco curtidor', and P. pendida as 'pashaco colorado'.

Pelaea cordata (Polypodiaceae) is thought to have been used by the Nahua of Mexico as an inebriant, though this is in need of confirmation (Diaz 1979).

Peperomia spp. (Piperaceae) – two unidentified species, known as 'shugués' and 'shupeñín', are sometimes chewed fresh with coca [see **Erythroxylum**] by Paez shamans of high-altitude regions, usually also with another unidentified plant ['shulape'], and less frequently today, a Sphagnum sp. ['shu'] (Antonil 1978). Peperomia spp. are thought to represent 'tsemtsem', a plant used by some Shuar groups as a 'mild hallucinogen'. It is given to children so that they may contact their soul or 'arutam' (Bennett 1992). As 'congona' or 'piri-piri' [see **Cyperus**, **Balansia**], P. flavamenta, P. galioides and perhaps other Peperomia spp. are sometimes taken with San Pedro [see **Trichocereus**] in Peru. This addition is said to lend a feeling of clarity and brightness to the San Pedro experience (Rätsch 1998). Some Peperomia spp. contain alkaloids (Schultes & Raffauf 1990) and essential oils (Rätsch 1998).

Persea americana (Lauraceae) is best known for its fruit [avocado], though the peel is regarded to be excitant and aphrodisiac in Mexico (Heffern 1974); the seed and fruit flesh have also been claimed to be aphrodisiac (Rätsch 1990). In the leaves, *estragole* has been detected in large quantities of Mexican cultivars, but not those from West Indies or Guatemala (King & Knight 1987). The whole fruit yielded 0.001% *serot-*

onin, 0.0023% *tyramine* and 0.0004-0.0005% *dopamine* (Udenfriend et al. 1959). In the Canary Islands, the related P. indica is known to be intoxicating, and it is said this effect can even be passed on from sleeping under the tree, or handling the wood. Goats eat the bark and leaves habitually to become intoxicated, though too much can kill. It is not used by local humans due to its toxicity (De Vries 1993). P. gratissima bark has been found to contain *estragole* in its essential oil (Harborne & Baxter ed. 1993), and the seed has been taken in Amazonia as a contraceptive (Schultes & Raffauf 1990).

Petiveria alliacea (Phytolaccaceae), 'zorillo' [also known as 'pachyé', 'hierba de las gallinitas'], is used in Mexico to treat hysteria, nervous disorders and numbness, and as an antispasmodic (Heffern 1974). In Peru, it is known as 'mucura', and may be taken under diet as a plant teacher; it is also sometimes added to ayahuasca by Yagua shamans (Luna 1984; McKenna et al. 1995). The plant is used as an ingredient in some Haitian zombi antidotes [see *Methods of Ingestion*], and also reputedly has aphrodisiac properties (Davis 1988a). It has yielded trithiolanes, oligo sulfides and triterpenes (McKenna et al. 1995).

Peumus boldus (Monimiaceae) ['boldo'] from Chile and Peru [also naturalised in w. US, and the Mediterranean region] is a liver tonic commonly drunk as a tea in Argentina, but the foliage is said to have hypnotic, analgesic, and perhaps 'hallucinogenic' effects when taken in larger amounts. It contains c.0.25-0.535% alkaloids, including c.0.1% [of leaf] boldine [a hypnotic sedative, and analgesic as potent as *cocaine*, causing excitation and even respiratory paralysis in acute doses], sparteine [see **Cytisus**] and pachycarpine, as well as boldoglucin, ascaridol, and 2-2.6% of an essential oil. The leaves have been administered by healers in Chile, rolled into a cud with two types of seaweed [a Gracilaria sp. and Durvillaea antarctica] (Chevallier 1996; Gore 1997; pers. comm.; Schindler 1958).

Pfaffia paniculata [Gomphrena paniculata] (Amaranthaceae) is known as 'suma', or 'Brazilian ginseng', and its roots are used in Brazil [and today in other parts of the world, such as Australia] as a ginseng-like tonic, adaptogen, and aphrodisiac [see **Panax**], as well as an antidiabetic remedy; it has yielded 11% nortriterpenoid saponin glycosides [including pfaffosides], allantoin, stigmasterol, sitosterol, germanium, vitamins, amino acids, electrolytes and trace minerals (Nishimoto et al. 1984; Schultes & Raffauf 1990; http://www.rain-tree.com/suma.htm). It has been shown to improve the sexual performance of 'sexually sluggish' or impotent rats, whilst having no discernable effect on potent rats (Arletti et al. 1999). P. iresinoides ['marosa'] has been used by the Shipibo as an entheogen, but its use is fading; it is also used to prepare for the ayahuasca ceremony [see **Banisteriopsis**] (Trout ed. 1998 citing Amazonia Peruana 5(10):91-118 [1984]). In Paraguay, roots of the related P. glomerata ['vatatilla', 'little sweet potato'] are macerated or infused to make a refreshing, diuretic beverage (Basualdo et al. 1995). In rodents, an alcohol extract of P. glomerata roots was shown to act as a CNS-depressant when given i.p., but appeared to be inactive orally in this regard (De Parisa et al. 2000).

Philodendron scandens (Araceae), 'heartleaf philodendron', has reportedly been used in Peru as a "narcotic[...] to induce sleep". It has allergenic properties and contains 5-heptadecatrin-8(Z),11(Z),14(Z)-benzylresorcinol (Rätsch 1998).

Pinus pseudostrobos (Pinaceae), 'pitch pine', is thought to be the source of the 'pom' incense resin used by the Lacandon Maya [previously identified as Protium copal - see below]. It is ritually burnt as an offering to the gods, who are said to consume the fumes as their main form of food (Case et al. 2003). In Nepal, Pinus spp. ['salla'] such as P. roxburghii and P. wallichiana are sometimes used for incense by shamans (Müller-Ebeling et al. 2002). *Estragole* has been found in Pinus spp., and *methyleugenol* in P. sylvestris (Harborne & Baxter ed. 1993). P. contorta, P. nigra, P. ponderosa and P. sylvestris contain piperidine alkaloids (Stermitz et al. 2000).

Piqueria trinervia (Compositae), as 'hierba de San Nicholas', is used in Mexico as a depressant; it also treats rheumatism and fever (Jiu 1966).

Piscidia erythrina [P. piscipula] (Leguminosae), known variously as 'Jamaica dogwood', 'fish poison tree' and 'fish fuddle', has been used as an opium substitute [see **Papaver**]. Roughly 20 drops of a fluid extract of the plant were said to be "more decidedly hypnotic than opium", though with a shorter duration of action. It was reported to produce no anorexia, headache, constipation or digestive disturbance (Anon. 1881d).

A Pleurothallis sp. or an Epidendrum (Epidendron) sp. (Orchidaceae), as 'hornamo caballero', has been tentatively identified as an additive to **Trichocereus** pachanoi brews in Peru (Rätsch 1998); E. radiatum reportedly has a 'narcotic' smell, but this could either be descriptive of the odour or of its effects when inhaled. In Mexico, E. pastoris bulbs have been used to make a salep substitute [see above] (Lawler 1984). Alkaloids have been found in both genera (Lüning 1967).

Plumeria rubra (Apocynaceae) flowers were used by the Aztecs to relieve fatigue and dispel fear (Heffern 1974).

A Polypodium sp. (Polypodiaceae) tree fern, known as 'incapcocam', 'cucacuca' and 'coca del Inca', was reputedly used by the Incas as a coca-substitute [see **Erythroxylum**], and is also said to be used instead of tobacco [**Nicotiana**] to 'clear the head'. Roots of another unidentified Polypodium spp. have been taken orally with **Anadenanthera** colubrina seeds (Rätsch 1998). Roots of the common 'oak fern' P. vulgare have been claimed to contain *glycyrrhizin* (Grieve 1931).

Pourouma cecropiaefolia (Moraceae), 'uvilla', is used in Amazonia when **Cecropia** is not available; the leaves are burnt to ash and used with powdered coca [see **Erythroxylum**]. Root scrapings infused in water are reputed to cause permanent sterility (Schultes & Raffauf 1990).

Protium spp. (Burseraceae) such as P. copal ['pom', 'copal negro'] are amongst a variety of Central American trees whose resins are used as 'copal' incense, used to communicate with the gods as well as for a wide range of other ritual and medicinal applications. The Brazilian P. heptaphyllum has yielded *diallapiole* (Case et al. 2003).

A Pseuderanthemum sp. (Acanthaceae) known as 'dormidero' is reported to be used as a narcotic in Peru (Rätsch 1998).

Quararibea funebris (Bombaceae) flowers have been suggested to represent the Aztec drug 'poyomatli', and the Zapotecs once held funerary rites under the branches of the tree. The highly aromatic flowers ['flor de cacao'] are used today in Oaxaca as a spice additive to drinks made from cacao [see **Theobroma**], called 'ponzonque' or 'tejate'. They are also used in local folk medicine, to 'control psychopathic fears', relieve coughs, and regulate menstruation (Raffauf et al. 1984; Rosengarten 1977). Preliminary tests by some have not yet revealed psychoactivity (Ott 1993), though these people might have been expecting a visionary experience. One psychonaut reported '*GHB*-like' euphoric effects from a tea made from several grams of the flowers (theobromus pers. comm.). The flowers contain compounds derived from γ-butyrolactones, such as the quabalactones, and the novel pyrrole lactone alkaloids funebral, funebrine and funebradiol (Raffauf et al. 1984; Zennie & Cassady 1990; Zennie et al. 1986). An unidentified Quararibea sp. from Peru, called 'espingo' or 'ispincu', is used for its seeds as a shamanic inebriant. It may also be added to ayahuasca or **Trichocereus** preparations [as 'ishpingo'] (Ott 1993). Q. putumayensis is also used to make 'curare' arrow poisons by the Kofán of n.w. Amazonia (Schultes & Raffauf 1990).

Retiniphyllum concolor (Rubiaceae), known in the Amazon as 'o-no-ka' or 'ka-hoon-cha'', is known to be a 'strong witchcraft plant', and is suspected of being mildly psychoactive. Some tribes burn it for the smoke to have purifying and therapeutic effects in cases of tuberculosis (Schultes & Raffauf 1990).

Rheedia macrophylla (Clusiaceae), 'achuni-caspi' or 'achuni-casha', is used in the Amazon as a powerful male aphrodisiac, as well as for sorcery and love magic (Luna & Amaringo 1991).

Rivinia humilis (Phytolaccaceae) ['coralillo', 'hierba mora'] is suspected of being the Aztec inebriant 'amatlaxiotl' mentioned in the Florentine Codex, though further investigation is needed (Diaz 1979).

Rollinia mucosa (Annonaceae) ['anonillo', 'anonita del monte', 'cherimoya'] is a Mexican tree, whose edible fruits are used in local medicine. The seeds have been found to contain new and interesting *tryptamine* alkaloids of unknown pharmacology – N-palmitoyl-*tryptamine*, N-stearoyl-*tryptamine*, N-arachidoyl-*tryptamine*, N-behenoyl-*tryptamine*, N-tricosanoyl-*tryptamine*, N-lignoceroyl-*tryptamine*, N-cerotoyl-*tryptamine* and N-pentacosanoyl-*tryptamine* [as well as lignans and acetogenins] (Chávez 1999).

Rudgea retifolia (Rubiaceae) is known in Peru as 'chacruna', a name usually applied to **Psychotria** spp., and may have once been used for similar purposes as an ayahuasca additive [see **Banisteriopsis**] (Ott 1993).

Ruellia albicaulis (Acanthaceae), 'hierba del chivo', is decocted in Mexico as a "potent aphrodisiac" (Heffern 1974).

Sanango racemosa [S. durum; Gomara racemosa; Gomaranthus racemosa] (Loganiaceae) leaf is used as 'sanango' in the Peruvian Amazon as an inebriant; little more is known (Rätsch 1998). I am unsure whether there is some confusion here with the unrelated plants known by the same common name [see **Tabernaemontana**].

A Sanchezia sp. (Acanthaceae) known as 'cimora macanche' is regarded in n.e. Peru as a 'powerful cimora' [see **Trichocereus**]; it is used by young people as a psychoactive drug. Another unidentified Sanchezia sp., perhaps the same one, has been claimed "to have hallucinogenic properties when smoked" (De Feo 2003; Schultes & Raffauf 1990).

Schizolobium amazonicum and S. parahybum (Leguminosae) are known as 'paricà' in parts of Brazil [see **Anadenanthera**, **Virola**] (Schultes 1955a).

Scleria catharinensis (Cyperaceae), 'yuts-kái' or 'curíbano', bears a root with a strong taste, sometimes chewed with coca [see **Erythroxylum**] by Paez shamans, considered to add to the power of the shaman; however, some Paez shamans consider it to be dangerous and confine its use to that of sorcery. A related variety or species, unidentified, is known as 'chindaalco' or 'pata de perro'; its root is more swollen and bears a "rather more pleasant and musky flavour", and may be used in the same way. Both are infused to treat stomach complaints (Antonil 1978).

Scoparia dulcis (Scrophulariaceae), 'sweet broom', is also known as 'vacourinha', and used as an antispasmodic (Grieve 1931); in the Amazon, as 'bati matoshi' or 'piqui pichana', the leaves are smoked as a **Cannabis**-substitute (Duke & Vasquez 1994).

Sebastiana pavonia (Euphorbiaceae) is claimed to be 'hallucinogen-

ic', and the crushed seeds are said to have been used as a fortifying tonic by the Yaqui of Mexico (Rätsch 1998). The Tarahumara sometimes use S. pringlei bark to stupefy fish (Pennington 1958).

Selenicereus grandiflorus [Cactus grandiflorus, Cereus grandiflorus] (Cactaceae), 'night-blooming cereus' or 'queen of the night', is often confused with **Epiphyllum**. The flowers and young stems, harvested in summer and immediately made into a tincture, have been used as a heart tonic. They also treat rheumatism, and the juice of the plant has been used in the Caribbean as an anthelmintic (Chevallier 1996; Felter & Lloyd 1898). In large doses, the tincture "produces gastric irritation, and also affects the brain, causing confusion of mind, hallucination, and slight delirium. In excessive doses, a quickened pulse, constrictive headache, or constrictive sensation in the chest, cardiac pain with palpitation, vertigo, dimness of sight, over-sensitiveness to noises, and a disposition to be sad or to imagine evil, are among its many nervous manifestations" (Felter & Lloyd 1898). The plant has yielded 0.3% *tyramine* and *hordenine* (Trout ed. 1999), as well as the flavonoid isorhamnetin (Chevallier 1996); an early study observed 7 unidentified alkaloids (Brown et al. 1968). Modern-day psychonauts have reportedly used the plant in combination with **Trichocereus** pachanoi, or even as a substitute for it. One individual also reported ingesting the residue from an alcohol extract of 45cm dry S. grandiflorus, and experienced a strong stimulation (Trout pers. comm.). Given these reports it seems likely that other, more active, compounds will be found in this cactus.

Senegalia spp. (Leguminosae) are known as 'paricà' in parts of Brazil [see **Anadenanthera**, **Virola**] (Schultes 1955a).

'Shahuan peco' (Bromeliaceae?) is an unidentified 'parasitic' [perhaps epiphytic?] plant with small, three-fingered leaves that grows in branch forks of tall trees. The Shipibo-Conibo of Peru once used it as a powerful initiatory shamanic plant. The middle leaflet was crushed and either mixed with tobacco and smoked, or mixed with tobacco water and drunk, as well as rubbing the diluted plant juice over the body. The visionary experience, said to be much stronger than that from ayahuasca, takes some 12hrs to take effect and is said to also last 12hrs (Rätsch 1998).

Sloanea laurifolia (Elaeocarpaceae), 'taque', bears fruits known as 'arepa de maiz' ['maize breads' - see Zea mays below]; in Venezuela, the fresh fruit has been reported to cause a 'loco' or 'crazy' feeling when consumed (Rätsch 1998).

Smilax spp. (Liliaceae) such as S. officinalis, generally called 'sarsaparilla', are known as a male sexual tonic; the root is consumed in Mexico as a tonic aphrodisiac, and is also an ingredient of root-beer. The herb treats skin conditions, and has been used to treat syphilis – the success of many species for this latter disease is doubtful, though the Chinese S. glabra has shown positive activity. Smilax spp. contain steroidal glycoside saponins similar to testosterone and progesterone (Chevallier 1996; Kindscher & Hurlburt 1998; Mabey et al. ed. 1990; Nadkarni 1976; Ody 1993; Schultes & Raffauf 1990).

Sphenoclea zeylanica (Sphenocleaceae) is native to Asia, but now exists in the humid tropics of both hemispheres – it is known in Colombia as 'borrachero' or 'borrachito', referring to its intoxicating properties, and has been responsible for cattle poisoning. Fresh material contains alkaloids (Schultes & Raffauf 1990).

Sterculia excelsa (Sterculiaceae), as 'mahot cochon', has reportedly been used by at least one Guianan, who made a liquid snuff from the ashes of this plant and the leaves of a wild tobacco [see **Nicotiana**] (Plotkin 1993); the described effects, however, may merely relate to the tobacco present. In w. India and Pakistan, 'tula tree' [S. alata; syn. Pterygota alata] seeds ['bekaro'] are used as an opium substitute [see **Papaver**] (Cooke 1860; Emboden 1979a; Nadkarni 1976). They are eaten in parts of Indo-China, "despite the tingling and drowsiness they cause" (Perry & Metzger 1980). Seeds of the Asian S. scaphigera contain traces of *caffeine* and *theobromine* (Keys 1976), and *caffeine* was also detected in S. platanifolia seeds (Webb 1948). HCN has also been reported from the genus (Pammel 1911). Mature seeds of S. foetida cultivated in Port Douglas, Queensland [harvested Aug.] tested positive for alkaloids (Webb 1949). S. foetida leaf, root and fruit also produce HCN (Watt & Breyer-Brandwijk 1962). An alcohol extract of the leaf acted as a hypnotic-sedative in mice, and showed antiinflammatory activity in rats (Mujumdar et al. 2000). In Ghana, the stems are decocted as an asthma treatment; preliminary animal studies have supported this useage (Noamesi et al. 1986).

Strombocactus disciformis (Cactaceae) is known as 'peyote' in Mexico [see **Lophophora**], though it is not known to have been used as a psychotrope (Bravo 1937; Bruhn & Bruhn 1973; Schultes 1937a, 1937b). It has given positive tests for the presence of alkaloids (Smith 2000).

Tabebuia heteropoda (Bignoniaceae), 'tahuari', is sometimes added to ayahuasca [see **Banisteriopsis**]. Said to cause sickness or death if the special diet and sexual abstinence are broken; it contains lapachol, dibenzoxanthines, and naphthoquinones. Tobacco pipes made from a Tabebuia sp. ['tahuari'] are used to release old spirits for their curing powers. May be taken alone as a plant teacher (Luna 1984; Luna & Amaringo 1991; McKenna et al. 1995). The inner bark of the related T. lapacho [T. flavescens; Tecoma lapacho], known as 'three way', 'divine tree' or 'lapacho', also contains lapachol, and is used as a 'ginseng-like' tonic and adaptogen [see **Panax**] (Jones 1995). T. pentaphylla is known as 'amapola' ['poppy', 'opium' – see **Papaver**] in Latin America (Rätsch 1998). T. impetiginosa ['taheebo'] inner bark has yielded volatile compounds with antioxidant properties, including [d/w] 0.0034% *elemicin*, 0.0034% trans-*anethole*, 0.0053% 4-MeO-benzaldehyde, 0.004% 4-MeO-phenol and 0.003% 4-MeO-benzyl alcohol (Park et al. 2003).

A Thevetia sp. (Apocynaceae) is thought to be the identity of 'cabalonga blanca', a Colombian magical plant with psychotropic activity; it is also said to be used as an ayahuasca additive [see **Banisteriopsis**]. The 'true' cabalonga is believed to be a **Strychnos** sp. [see also **Jatropha**]. T. peruviana [T. neriifolia] is also known as 'cabalonga', 'cabalonga la huasteca', 'calabonga de tabasco', 'palo de San Antonio' and 'yellow oleander', but is not known to be psychoactive; 8-10 seeds may kill an adult (Rätsch 1998).

Tibouchina longifolia (Melastomataceae), 'palo del susto' or 'palo del espanto', is used in n.e. Peru to treat a complex psychosomatic complaint in which physical and psychological weakness result from phobias; for this, 50g of leaves are soaked in a litre of water before filtering and drinking 2-3 cups a day whilst on a vegetarian diet. After a week the effects are terminated by drinking 'arranque' [see **Citrus**] (De Feo 2003).

'Ucullucuycasha' [unidentified] from Peru may be taken under diet as a plant teacher. It causes a burning sensation [the tree is associated with the sun], physical weakness, and powerful visions (Bear & Vasquez 2000).

Urechites andrieuxii (Apocynaceae), as 'raiz de la vibora', is used to treat nervous disturbances in Mexico, and the root has shown CNS-depressant activity (Jiu 1966).

Urmenentea tomentosa (Compositae), 'coca de los pobres', is chewed as a coca substitute [see **Erythroxylum**] in the Atacama Desert of Chile (Montgomery 1999), as is U. atacamensis ['coca del suri', 'coquilla'], which is also effective smoked, in a dose of 300mg (Rätsch 1998).

Vitex agnus-castus (Verbenaceae) ['chaste tree'] is sometimes used in Brazil as a type of 'jurema' [see **Mimosa**, **Pithecellobium**] (Ott 1997/1998, 1999), although originating from the Mediterranean region and w. Asia. The dried fruit has been chewed by monks to reduce sexual desire. It is now used to regulate irregular menstruation and treat premenstrual tension. Compounds found include the alkaloid viticine, the flavonoid casticin, the iridoids aucubin, agnoside and eurostoside, and an essential oil containing cineol (Bremness 1994; Chevallier 1996). V. negundo, 'indrasura' ['Indra's inebriating drink'], has been used as a Soma substitute, and is considered to be a form of 'amrita'; it contains flavonoids with antiadrogenous effects, and an essential oil (Müller-Ebeling et al. 2002; Rätsch 1998). See also *Methods of Ingestion*.

A Voyria sp. (Gentianaceae), as 'tuiruibanto', is used by the Machiguenga of e. Peru to treat headache, and the juice is used as eyedrops to sharpen the senses for hunting; the plant used to be added to Machiguenga ayahuasca brews [see **Banisteriopsis**] (Russo undated).

Werneria ciliolata and W. poposa (Compositae), 'akhana', are bitter herbs sometimes chewed with coca [see **Erythroxylum**] by the Aymara and Quechua of c. Andes (Antonil 1978). W. dactylophylla leaves are also reportedly used for the same purpose (Rätsch 1998).

Zea mays (Gramineae) [corn] flowers [not the same as cornflour!] were used by the Atzecs, as 'eloxóchitl', to relieve fatigue (Heffern 1974). The anther filaments [corn silk] are used as a 'kinnikinnick' smoking herb in N. America, and in Peru where they are claimed to have inebriating effects (Rätsch 1998). As reported in *Influencing Endogenous Chemistry*, sweet corn has been found to contain traces of *melatonin*, *tryptamine*, N-(p-coumaryl)-*tryptamine*, N-ferulyl-*tryptamine*, *tyramine* and desmethyl-*diazepam* (Ehmann 1974; Hattori et al. 1995; Schneider et al. 1972; Smith 1977a; Unseld et al. 1989).

ASIAN OBSCURITIES

Chinese and Indian medical traditions use a plethora of herbs for their tonic effect on the nervous and immune systems – they are often known to increase mental efficiency and enhance physiological harmony. As they are too numerous to cover fully in the main text, some are outlined here, as well as those other Asian herbs with more intoxicating effects, and uses of related species from elsewhere in the world.

Abies spectabilis (Pinaceae) ['talis patra'] and A. webbiana [A. densa; 'gobray salla', 'dunshing'] are fir trees used as incense by Nepalese shamans; the former species is regarded as a 'sister plant' to 'nigalo' bamboo [see Arundinaria above] (Müller-Ebeling et al. 2002). A. balsamea, A. bifolia and A. concolor contain piperidine alkaloids (Stermitz et al. 2000).

Abutilon indicum (Malvaceae), 'kanghi', is used in India for its leaves, which are aphrodisiac and sedative (Nadkarni 1976).

Acalypha indica (Euphorbiaceae), 'kuppu', is hypnotic, cathartic and emetic, and aerial parts are used in India to treat mania and hysteria (Nadkarni 1976). A. insulana [A. hellwigii] leaves are sometimes smoked in Papua New Guinea; leaves of A. hellwigii var. mollis have also been used as wrappers for smoking tobacco [see **Nicotiana**] (Thomas 2001a).

Aerva lanata (Amaranthaceae), or 'polpala', is used in Ayurveda as a flowering top decoction, which acts as a stimulant [in Sri Lanka, it was

drunk before tea (see **Camellia**) was introduced]. In Indonesia, it is considered a strengthening tonic (Bremness 1994).

Ailanthus altissima [A. glandulosa; A. peregrina] (Simaroubaceae), 'Tree of Heaven', is from China, though naturalised in Europe and the US. A Pennsylvanian herbarium note stated that the plant may be narcotic (Rätsch 1998). In TCM, the dried root bark or stem bark is known as 'chun pi', and is used as a haemostatic, and to treat diarrhoea, dysentery and other ailments. It produces an effect "very similar to that which occurs in beginning smokers while smoking tobacco" [see **Nicotiana**], and also acts as a muscle relaxant. Side effects can include nausea, vomiting and vertigo. The plant has yielded afzelin, amarolide, ailanthone (Huang 1993) and 5% ailanthin [quasiin] (Rätsch 1998), as well as [in roots] 1-carbomethoxy-β-carboline [also in leaves], 1-carbomethoxy-4-MeO-β-carboline, 1-carbamoyl-β-carboline, 1-aceto-4-MeO-β-carboline, 4-MeO-1-vinyl-β-carboline [dehydrocrenatine], 1-(2'-hydroxyethyl)-4-MeO-β-carboline, 1-(1',2'-dihydroxyethyl)-4-MeO-β-carboline, 1-(1-OH-2-MeO)ethyl-4-MeO-β-carboline, 1-carbomethoxy-4,8-dimethoxy-β-carboline [also in leaves] and 1-propionic acid β-carboline. A. malabarica bark and root have yielded 1-ethyl-β-carboline, 1-ethyl-4-MeO-β-carboline, 1-carbomethoxy-β-carboline, 1-carbamoyl-β-carboline, 1-aceto-4-MeO-β-carboline, 4-MeO-1-vinyl-β-carboline, 4,8-dimethoxy-1,2,3,4-tetrahydro-β-carboline [crenatidine] and 4,8-dimethoxy-1-vinyl-β-carboline [dehydrocrenatidine] (Ohmoto et al. 1981; Shulgin & Shulgin 1997; Souleles & Kokkalou 1989).

Alangium chinense (Cornaceae), 'bajiaofeng' in TCM, is a CNS depressant, muscle relaxant and anti-hypertensive, containing *anabasine* (Zhu et al. 1996a). The root of the Indian A. lamarckii is known to be a strong purgative and emetic, and has yielded an alkaloid, alangine. A. villosum is a paralytic poison in frogs, and A. salvifolium ssp. hexapetalum has shown hypotensive activity (Nadkarni 1976; Webb 1948).

Albizzia julibrissin and A. lebbeck (Leguminosae/Mimosaceae) are used for their dried bark in TCM, as 'ho-huan-pi' or 'he-huan-pi'; it is sweet and neutral, acting on heart, spleen, and lung meridians. It is said to enliven the spirit, relieve depression, control pain and invigorate circulation, and is used in doses of 9-30g to treat restless anxiety, insomnia, ulcers, carbuncles, muscle trauma and bone fracture, as well as showing stimulant, tonic, analgesic, anthelmintic, diuretic and oxytocic effects (Hsu et al. 1986). I have read reports of individuals smoking the bark for the same CNS effects. The rachillae, laminae and secondary pulvini of A. julibrissin yielded *serotonin* [0.0003, 0.00027 and 0.00047%, respectively] and *norepinephrine* [0.00034, 0.00028 and 0.00046%] (Applewhite 1973). Leaves have also yielded compounds responsible for closing [potassium-β-D-glucopyranosyl-11-OH-jasmonate] and opening [cis-p-coumaroylagmatine] the leaflets (Ueda & Yamamura 1999). Flowers of A. julibrissin have yielded quercitrin and isoquercitrin, flavonol glycosides with sedative activity (Kanga et al. 2000). The chloroform fraction of the ethanol extract of A. lebbeck leaf showed anticonvulsant [except for *strychnine*-induced convulsions], anxiogenic and CNS-depressant activity, as well as increasing brain levels of *GABA* and *serotonin*, and antagonising the effects of *amphetamine* in animals (Kasturea et al. 2000). A. lebbeck and some other A. spp. contain saponins known as 'sapotoxins', which can interfere with cellular respiration and weaken vital functions to the point of death (Davis 1988a). A. inopinata leaves yielded mixed alkaloids, which had CNS-depressant activity in mice [10mg/kg i.p.] (Assis et al. 2001). A. procera leaf [from a 3yr old seedling] tentatively tested positive for *5-methoxy-DMT*, along with two other compounds (Trout ed. 1997d); the whole plant also tested positive for HCN (Watt & Breyer-Brandwijk 1962). A. adinocephala leaves and stem bark yielded spermine alkaloids, budmunchiamines, which inhibited the malarial enzyme plasmepsin II (Ovenden et al. 2002). The Zulu use A. adianthifolia [A. gummifera] as a "love-charm emetic"; in some parts of w. Africa, the gum of the tree is used to ward off evil spirits (Watt & Breyer-Brandwijk 1962). In Jimi, Papua New Guinea, an Albizzia sp. is used in warrior rituals for fighting (Paijmans ed. 1976). In some parts of Africa, A. ferruginea stem bark is used as a homicidal poison (De Smet 1998), and in w. Africa the Efik used A. zygia bark as an ordeal poison (Davis 1988a). The Kalahari Bushmen may possibly use A. anthelmintica ['k ydi'] to aid in reaching a trance state for healing (Rätsch 1992), and it is used by the Masai [as 'ol mokotan'], mixed with food, as a stimulant-excitant. It is also known to act as an emetic and purgative. When consumed in large amounts [as it often is], it is said to cause "a form of berserk rage during which the warrior trembles from excitement and the saliva flows from the mouth" (Lehmann & Mihalyi 1982). In excess, it may reputedly be lethal (Davis 1988a); in small amounts, the bark is taken by Masai women as an aphrodisiac. In n. Rhodesia, beer made with the root of A. antunesia is also used as an aphrodisiac. A. versicolor roots have been used to make an arrow poison in e. Africa. In China, A. chinensis is used to stupefy fish (Watt & Breyer-Brandwijk 1962). See also A. lebbeck in *Methods of Ingestion*.

Alhagi pseudalhagi [A. camelorum; A. maurorum; A. persarum; A. pseudoalhagi; Hedysarum alhagi] (Leguminosae/Fabaceae), 'camelthorn', is a thorny plant originating in Asia, now widespread as a weed. It yields a sugary exudate known as 'manna' or 'Caspian manna', which is used medicinally in India and parts of the Middle East, and is reported to have aphrodisiac properties. The plant is also used in India to treat "certain brain affections". In the Concan, the plant is smoked mixed with **Datura**, **Nicotiana**, and Carum copticum seeds to treat asthma (Ghosal et al. 1974; Nadkarni 1976; Parsons & Cuthbertson 1992). The plant has yielded a variety of *phenethylamine* and tetrahydroisoquinoline alkaloids, as well as other compounds. The stems and roots contain essentially the same alkaloids, but the roots give a poorer yield – stems yielded *phenethylamine* [*PEA*; 0.00174%], N-methyl-*PEA* [0.00069%], *hordenine* [0.00036%], N-methyl-*mescaline* [0.00008%], N-methyl-*tyramine* [traces], coryneine [3,4-dimethoxy-N,N,N-trimethyl-*PEA*; 0.00017%], 4-OH-3-MeO-trimethylphenethylammonium and salsolidine [6,7-dimethoxy-1-methyl-THIQ; 0.0004%]; as well as 0.00215% *choline*, cholesterol, δ-7-avenasterol, ergost-5-en-3-ol, stigmast-5-en-ol, 24-ethylcholesta-5,22-dien-3-ol, 3-β-stigmasta-5,24-dien-3-ol and ursolic acid. The flavonoids catechin, epigallocatechin, leucodelphinidin and 3,3',4',5,5',7-hexahydroxyflavan were only found in the aerial parts (Ghosal & Srivastava 1973a; Ghosal et al. 1974; International... 1994).

Alisma plantago-aquatica (Alismaceae), 'ze xie', is used in TCM for its stems and tubers. It acts as a diuretic and is believed to "stimulate the female genitalia" (Keys 1976). It has been claimed that "taken for a long time, the eye and ear become acute, hunger is not felt, life is prolonged, the body becomes light, the complexion becomes radiant, and one can walk upon water [a reference to spiritual powers]" (Trout pers. comm., quoting Teeguarden).

Angelica sinensis (Umbelliferae), 'angelica', is called 'dang-gui' in TCM. The root is used to treat menstrual disorders, and is considered an excellent female tonic. It is also analgesic and sedative, as well as stimulating the immune system and improving muscle tone, strengthening the liver and improving circulation. It contains phytoestrogens, coumarins, essential oil and the sedative xanthotoxol – the latter has anti-AChE activity at low doses and anti-*acetylcholine* activity at high doses, as well as antiadrenergic, anti-*serotonin* and anti-*histamine* activities. Many Angelica spp. seem to have similar properties to A. sinensis (Chevallier 1996; Reid 1995; Sethi et al. 1992). A. polymorpha root essential oil contains *safrole* and *isosafrole*, and is also used in China as a sedative and analgesic [dose 5-10g] (Keys 1976). Angelica can be stupefying (Conrad 1988), and has been chewed as a narcotic in Lapland (Cooke 1860). The essential oil of A. archangelica is considered revitalising and restorative; it is stimulating in small quantities, and sedating in large quantities (Lawless 1994). Japanese angelica root, from A. acutiloba, has been shown to reverse *hyoscine*-induced performance deficits in rats (Ohta et al. 1993); *scopoletin* has been found in the plant (Buckingham et al. ed. 1994).

Aquilaria agallocha (Thymelaeaceae), 'Aloes wood', 'eaglewood' or 'calambat', is called 'chen hsiang' in TCM. Its heavy, resinous, fossilised root is tonic and stimulant, and treats nervous disorders [tension, exhaustion, neurosis etc.]. Burned as an incense in monasteries, its scent is calming and relaxing (Reid 1995). In Tibetan psychiatric medicine, it is used as an incense to dispel 'demonic spirits' (Clifford 1984). Kirati shamans in Nepal invoke it "with a mantra at the beginning of every shamanic session", and its aroma is used to bring one back from trance. Known there as 'agar' or 'agur pati', it is associated with Garuda, the shamanic bird spirit (Müller-Ebeling et al. 2002). Often, wood from other plants is sold falsely in place of A. agallocha (pers. obs.).

Aralia manshurica and A. shmidtii (Araliaceae) have been shown in Russian testing to have some **Panax**-like adaptogenic and stimulant properties; however, they appear to be more toxic than **Panax** and other well known tonic herbs. Their roots contain triterpenoid saponins which are glycosides of oleanolic acid, called aralosides. The LD50 of total aralosides from A. manshurica was 0.47g/kg in mice (Brekhman & Dardymov 1969b). A. nudicaulis, 'wild sarsaparilla', has been used in the US to treat coughs and as a stimulant and diaphoretic. It is sometimes used as a substitute for true sarsaparilla [see Smilax above]. Fruits of A. racemosa ['Indianroot'] are used in root beer (Brussell 2004).

Araucaria spp. (Coniferae), 'dangre salla', are used as incense by Nepalese shamans (Müller-Ebeling et al. 2002).

Asparagus lucidus (Liliaceae), 'tien men dung' in TCM, or 'shiny asparagus', is used for its roots, which when taken regularly act as a nutritive tonic, inducing a feeling of well-being and psychic sensitivity (Reid 1995; Trout pers. comm.). A. africanus leaves have been used as an ingredient of a snuff used in Malawi to induce trance [see above] (De Smet 1998).

Astragalus membranaceus (Leguminosae/Fabaceae), 'huang-chi' in TCM, is used for its root, which boosts the immune system, increases stamina, lowers blood pressure and increases protection from cold; it is also tonic to the lungs and spleen (Chevallier 1996; Reid 1995). In Sweden, A. baeticus has been used as a **Coffea** substitute (Von Bibra 1855). In Ladakh, India, goats have been known to die from eating too much A. tibetanus herbage (Bhattacharyya 1991). Some N. American Astragalus spp. are known as 'locoweeds', as they cause intoxication in stock animals, as well as cellular damage. Species recorded as locoweeds include A. argillophilus, A. bigelovii, A. earlei, A. hornii, A. lentiginosus, A. mollissimus, A. nothoxys, A. oocarpus, A. pattersonii, A. thurberi and A. wootonii. A Dr. Chestnut described the progressive symptoms of locoweed poisoning – "Two stages are recognised. The first, which may last

several months, is a period of hallucination or mania accompanied by defective eyesight, during which the animal may perform all sorts of antics. After acquiring a taste for the plant it refuses every other kind of food, and the second stage is ushered in. This is a lingering period of emaciation, characterised by sunken eyeballs, lusterless hair, and feeble movements. The animal dies as if from starvation, in periods ranging from a few months to one or two years." Some Astragalus spp. can accumulate toxic quantities of selenium, causing a poisoning unrelated to 'locoism' (Anon. 1888b; Kingsbury 1964; Oehme et al. 1968; Pammel 1911). A. miser has caused incoordination of hind legs, chronic paralysis and respiratory disturbances in cattle and sheep. The toxin responsible in this case is believed to be miserotoxin [3-nitro-1-propyl-β-D-glucopyranoside] (Keeler 1975). A. lentiginosus has yielded the toxic alkaloids swainsonine and swainsonine N-oxide [see **Swainsonia**] (Foster & Caras 1994; Keeler 1975; Molyneux & James 1982). Toxic amino acids such as selenocysteine and selenomethionine have also been found in some species (Culvenor 1970), and many species have been found to contain canavanine [see **Canavalia**] (Bell et al. 1978).

Avena sativa (Gramineae) fruits, 'wild oats', are said by some to be aphrodisiac, and act as a nerve, heart and thymus gland tonic. The decocted ripe plant may be used to treat depression, colds, excess cholesterol and menopausal oestrogen-deficiency. In Indian Ayurvedic medicine, they have been used as part of treatment for opiate addiction [see **Papaver**]. Also in India, A. fatua is used as a poison (Bremness 1994; Chevallier 1996; Emboden 1979a; Hutchens 1973; Nadkarni 1976). An alcohol extract of the plant was also shown to reduce tobacco cravings [see **Nicotiana**] in the majority of test subjects (Anand 1971).

Canna indica (Cannaceae) ['Indian shot', 'sabbajaya'] is used in India for its rhizome and fruit, which are credited with narcotic properties. The rhizome is also a diuretic, diaphoretic and demulcent, and is used to treat fever and dropsy. The seed is also stimulating and aids in healing wounds; the warmed juice is used as eardrops to relieve earaches. The rhizome is also boiled in rice-water with pepper [see **Piper 1**] and given to treat cattle who have eaten 'poisonous grass' (Nadkarni 1976).

Canscora decussata (Gentianaceae), 'shankhini', is used in India in the form of a paste of the whole plant taken with milk, as a nervine tonic; the fresh juice is given to treat insanity, epilepsy and nervous debility. Taken as a powder compounded with Saussurea lappa root [see below], Achyranthes aspera, Asparagus racemosus root, **Terminalia** chebula fruit, **Acorus** calamus and two other plants ['baberang' and 'gulancha'], for 3 days, it is said to "enable a student to learn by rote a thousand couplets of poetry" (Nadkarni 1976). The plant has yielded the xanthone *mangiferin*, which has weak MAOI effects (Bhattacharya et al. 1972), and the flavonoid diffutin, which is a mild CNS-depressant and anxiolytic (Harborne & Baxter ed. 1993).

Carlina biebersteinii (Compositae) was shown in Russian testing to have some **Panax**-like adaptogenic and stimulant properties; it has yielded 0.6-3.4% flavone glycosides (Brekhman & Dardymov 1969b).

Cedrus deodora (Pinaceae), 'Himalayan cedar' or 'deva daru' ['tree of the gods'], is used in ritual incense by Nepalese shamans (Müller-Ebeling et al. 2002). The Egyptians regarded C. libani ['tree of the Lord', 'cedar of Lebanon'] wood and oil as magical substances associated with Osiris, and used them in incense (Rätsch 1992). Aromatherapists use the essential oil to relieve "chronic anxiety" (Bremness 1994).

Celastrus paniculatus (Celastraceae), the 'black-oil tree' or 'intellect tree' of India, gives oils from its seeds – a deep-scarlet to yellow oil obtained by expression, and a black aromatic oil from distillation. The former is used externally for rheumatism, or burned, and the latter is a strong stimulant when taken as 10-15 drops, twice daily; it is also a strong diaphoretic. The seeds are considered to be aphrodisiac and brain tonic, increasing the intellect and memory; they also treat headache, asthma and some stomach disorders. The leaves and bark apparently share these actions. The leaf juice has been used to treat opium poisoning [see **Papaver**]. The seed oil has been shown to reduce turnover of *norepinephrine*, *dopamine* and *serotonin*, and reverse *hyoscine*-induced memory and performance deficits [in large oral doses in rats – 50-400mg/kg over 14 days]; it contains sesquiterpene polyol esters (Chopra et al. 1958, 1965; Gattu et al. 1997; Kirtikar & Basu 1980; Nadkarni 1976; Nalini et al. 1995; Perry & Metzger 1980; Tu et al. 1991). Bark from both aerial and subterranean parts of the related C. scandens of N. America ['false bittersweet'] are reputed to have 'narcotic' properties (Felter & Lloyd 1898).

Chrysanthemum morifolium [C. sinense] (Compositae) flowers ['ju hua'] are used in TCM in doses of 4-10g as a sedative, hypotensive, and refrigerant for influenza and headache; they are also applied as a poultice for tired eyes and skin disorders. The flowers contain an essential oil, stachydrine, *choline*, adenine, betaine, vitamin B1, sesquiterpene lactones, flavonoids [including *apigenin*] (Chevallier 1996; Keys 1976) and N-isobutyl-6-(2-thienyl)-2E,4E-hexadienamide, a compound with numbing properties (Shahata et al. 2001). Flowers of C. indicum were reputedly an ingredient of some Taoist 'elixirs of immortality' [see *Methods of Ingestion*] (Bremness 1994), and have been used in TCM as a digestive. As well as tannins and an essential oil, it contain 'chrysanthemine', a mixture of stachydrine and *choline* (Keys 1976).

Cistanche salsa (Orobanchaceae), or 'broomrape', is known as 'rou tsung rung' in TCM. The fleshy stem is used as an aphrodisiac – it enhances fertility in women, and in men increases sexual vitality and decreases involuntary ejaculation. It is considered an important tonic as it prevents semen loss [semen being thought to contain life essence, not an unwise assumption!] (Reid 1995).

Cleyera japonica var. wallichiana (Theaceae), 'chhasing', is used by Sherpas and others in Nepal as a stimulating tea-substitute [see **Camellia**]. Leaves are picked in late winter and prepared by boiling in water with wood ash [1 litre water and 200g ash for 1kg fresh leaves], cooling, washing with cold water, and sundrying before storing in a dry place for an extended period. For use a portion is boiled with water, milk and sugar for 10-15 minutes, then churned with a small amount of salt in a tall bamboo vessel before drinking. The taste and effects are reported to be practically identical to those of 'real' tea, yet no *caffeine* was detected in the herb. Other names for it are 'kalo bakalpate' and 'bhotechiya' (Chaudhary & Taylor 2004).

Clitoria terneata (Leguminosae), 'shankpushpi' [also many other beautiful names, such 'Vishnu-kranta'], is used in India for a wide variety of ailments; the root, bark, leaves and seeds are all used (Nadkarni 1976). More interesting is the Indian use of this herb as a brain tonic, to improve memory and intelligence. In rats, high oral doses of extracts from the root and aerial parts were shown to improve memory retention; this was believed to be due to an increase in brain *acetylcholine* levels, and AChE activity (Taranalli & Cheeramkuzhy 2000).

Cocculus lacunosus [C. populifolius; C. suberosus; Anarmita cocculus; Cissampelos cocculus; Menispermum cocculus and many other synonyms] (Menispermaceae), the 'cocculus bush' or 'kakmari' from India, bears toxic fruits sometimes known as 'crazy seeds' which were once added to beer to make it more intoxicating [see *Methods of Ingestion*]. In Indian medicine they are also regarded as emetic and are used to treat *morphine* poisoning. They contain the highly toxic CNS-excitant picrotoxin [1.5-5%; can cause delirium and coma] as well as aporphine- and berberine-type opiate alkaloids including menispermine (Harborne & Baxter ed. 1993; Nadkarni 1976; Rätsch 1998). C. leaeba and C. pendulus are also reputedly psychoactive (Schultes & Hofmann 1980). C. cordifolius [Tinospora cordifolia] root and stem, 'guduchi' or 'amrita', are used in India for a variety of ills and are known as a "potent vegetable tonic", acting as a rejuvenative, aphrodisiac and nöotropic. They contain berberine (Nadkarni 1976).

Codonopsis tangshen, C. pilosula and/or C. lanceolata (Campanulaceae), as 'dang-shen' or 'tang-sêng' [also sometimes called 'bastard ginseng'], are used in TCM as a cheaper substitute for ginseng [see **Panax**]; the root is used in a similar way to ginseng, though the effect is weaker and shorter-acting, requiring an average dose of 10-15g in decoction. It has an affinity for the spleen and lungs, and makes a useful asthma treatment. The root contains saponins, triterpene sterols, glycosides, resins, inulin and traces of alkaloids (Chevallier 1996; Hsu et al. 1986; Huang 1993; Reid 1995; Wong et al. 1983).

Coix lacryma-jobi (Gramineae) seeds ['Job's tears'] have many medicinal uses in Asia, and are considered tonic, sedative and cancer-preventative (Bremness 1994). The Lodha of w. Bengal add a paste of the roots of C. lacryma-jobi to their homemade liquor to increase its strength (Pal & Jain 1989).

Convallaria majalis (Liliaceae) ['lily of the valley'] roots and flowers have been snuffed in China to clear the head, restore speech and memory and "comfort the heart". It is potentially toxic (Bremness 1994).

Corydalis ambigua and C. soldida [C. yanhusuo] (Papaveraceae) rhizomes are used in TCM as 'yan hu suo' or 'yen hu suo', as a sedative, analgesic and antispasmodic. They contain opiate-type alkaloids such as corydaline [analgesic], corydine [irritant, adrenolytic, CNS depressant], l-tetrahydropalmatine [strong sedative, hypnotic, tranquilliser, analgesic; D1, D2 & D3 *dopamine*-receptor antagonist; blocks effects of *cocaine* in rats, and used in China as Rotundine to relieve cravings, withdrawal symptoms and relapse in human heroin addicts; depletes monoamines, particularly *dopamine*, but also *norepinephrine* and *serotonin*, as well as striatal *acetylcholine*], *protopine* and bulbocapnine [sedative narcotic, induces muscular rigidity]. C. bulbosa has also been used as a hypnotic and 'hallucinogen', and contains *protopine*. C. pallida whole plant has yielded d-tetrahydropalmatine, dl-tetrahydropalmatine, capaurine and capauridine. These and similar alkaloids are also to be found in other Papaveraceae not already mentioned, such as Bocconia, Dicentra, Dicranostigma, Fumaria, Glaucium [see below], Hunnemania, Hypecoum, Macleaya, Meconopsis and Stylophorum (Chevallier 1996; Keys 1976; Liu et al. 1982; Manske 1940; Mantsch et al. 2007; Marcenac et al. 1986; Onda & Takahashi 1988; Preininger 1975, 1986; Reid 1995; Szekely & Spiegel 1954). In Germany, Corydalis clava has been known as 'hexenscheiss' ['witch's shit'] (De Vries 1991).

Cryptomeria japonica (Taxodiaceae), 'dhupi salla', is used by shamans in Nepal as incense (Müller-Ebeling et al. 2002).

Cupressus tortulosa (Cupressaceae), 'Himalayan cypress', is known in Nepal as 'rai salla' and its heartwood is used by shamans as incense ['dhupi'] (Müller-Ebeling et al. 2002).

Cucumis trigonus (Cucurbitaceae), 'bitter gourd', fruit is mashed with milk, boiled, and applied externally in India to "prevent insanity, strengthen the memory and remove vertigo" (Nadkarni 1976).

Cucurbita maxima (Cucurbitaceae), 'red gourd', is used in India for various medicinal purposes; of most interest is the seed oil, which acts as a nervine tonic (Nasdkarni 1976). Seeds of this species and of C. pepo ['squash'] are considered aphrodisiac, and are used in tantric rituals (Rätsch 1990).

Curculigo ensifolia (Amaryllidaceae), 'hsien yu' in TCM, is also known as 'Brahmin ginseng' and was once imported from India. It is a nerve tonic, stimulant and aphrodisiac, and treats impotence and premature senility (Keys 1976; Reid 1995).

Cycas circinalis (Cycadaceae) male flower bracts are powdered and consumed in India as a narcotic, aphrodisiac and stimulant (Nadkarni 1976). In e. New Britain, the Tolai use the pollen as a narcotic. In Mabuiag, w. Torres Strait, sorcerers have been reported to eat young leaf shoots of an unidentified Cycas sp. ['budzamar'] "to become wild" (Thomas 2001a). Caution is advised, as Cycas spp. are generally considered highly toxic without adequate preparation. In Australia, indigenous peoples are known to use the seeds as food after extensive preparation to leach out the toxins, the exact process differing from region to region (Low 1989, 1991a). Cattle ingesting the leaves of some plants from the Cycadaceae have been known to suffer "neurological disorders[...]involving the irreversible paralysis of the hindquarters". Seeds and leaves of all Cycas spp. have been shown to contain the neurotoxin α-amino-β-methylaminopropionic acid; highest levels were found in C. circinalis and C. revoluta (Dossaji & Bell 1973).

Cynomorium coccineum (Orobanchaceae) is 'suo yang' in TCM; its root and stem treat premature ejaculation, and are tonic, aphrodisiac and promote semen production (Keys 1976; Reid 1995). The related 'thyme broomrape' [Orobanche alba] is a sedative and treats impotence (Bremness 1994).

Didymocarpus albicalyx (Gesneriaceae), 'kumkum pati', is used in ritual incense in Nepal; all parts may be used, though the root is the most potent (Müller-Ebeling et al. 2002).

Duchesnea indica (Rosaceae) is known as 'lyniang' in Meghalaya, n.e. India, where the root and lower stem are chewed as a betel nut substitute [see **Areca**] (Neogi et al. 1989).

Echinopanax elatum (Araliaceae) has been shown in Russian tests to have some **Panax**-like adaptogenic and stimulant properties, and is of similarly low toxicity (Brekhman & Dardymov 1969b).

Eclipta prostrata (Compositae) ['white eclipta'] is used in Ceylon as a general and brain tonic, said to change "a morbid state to one of health, without causing distress"; the roots are purgative and emetic. In Meghalaya, n.e. India, the leaves are used in the form of a paste mixed with mustard oil [see **Brassica**], rubbed on the forehead as a brain tonic and to relieve headaches (Neogi et al. 1989). Interestingly, the plant has yielded *nicotine* [as E. alba, though the synonymy of these two taxa is doubted by some], as well as a coumarin, wedelolactone (Lassak & McCarthy 1990; Nadkarni 1976; Pal & Narasimham 1943; Rimpler 1965).

Ephemerantha macraei [Dendrobium macraei; Flickingeria macraei] (Orchidaceae) tubers have been consumed by tantric magicians to enter a divinatory trance, as with **Vanda** (Rätsch 1992), and capsules also used as an aphrodisiac; it is one of the plants known as 'jivanti' in India and used as a strengthening, stimulant, demulcent tonic that treats "debility due to seminal loss". The plant contains an alkaloid, jibantine, as well as jibantic acids (Lawler 1984; Nadkarni 1976).

Epilobium angustifolium (Onagraceae) ['fire-weed', 'rose-bay willowherb'] juice, boiled down in water to form a sweet and thick 'liquor', is sometimes mixed with **Amanita** muscaria in Siberia. It is said to make the drink stronger. E. angustifolium is thought to be psychoactive (Brekhman & Sam 1967; Emboden 1979a; Saar 1991), and has shown tranquillising properties (Belozertsev 1966). The flowering tops, taken as a tea or vodka-based tincture, caused mild intoxication in one human (theobromus pers. comm. 2001). In Germany it has been associated with witches [known as 'hexenkraut'] (De Vries 1991). The related E. hirsutum is used to treat epilepsy in Morocco; eating the plant has caused cramps and coma (Watt 1967).

Epimedium sagittatum (Berberideae), or 'horny goatweed', is used in TCM for its leaf, 'yin yang huo'. It is an aphrodisiac in men, tonic, and a vasodilator. It strengthens the nerves and improves cerebral blood flow (Reid 1995). E. macranthum is also used as an aphrodisiac (Keys 1976).

Eucommia ulmoides (Eucommiaceae) is used in China [dose – 5-10g] for its tonic bark ['du zhong']; it has sedative, 'mental relaxant', aphrodisiac, analgesic and hypotensive effects. The bark exudes a latex that is known as 'gutta percha' (Keys 1976; Perry & Metzger 1980).

Euryale ferox (Nymphaeaceae), or 'foxnut', is called 'chien shih' in TCM. Its seeds are used to retard aging, and as a tonic nutrient to restore sexual potency and vigour in men, and are also analgesic (Keys 1976; Nadkarni 1976; Reid 1995).

Eurycoma longifolia (Simaroubaceae) root, 'pasakbumi' or 'tongkat ali', is used in Malaysia as a male aphrodisiac, reputed to increase virility and prowess. It is also used to treat dysentery, malaria, glandular swelling and other complaints. The root has been found to contain a variety of β-carboline and other alkaloids - canthin-6-one, 5-MeO-canthin-6-one, 9-MeO-canthin-6-one, 10-MeO-canthin-6-one, 4,5-dimethoxycanthin-6-one, 9,10-dimethoxycanthin-6-one, 8-OH-9-MeO-canthin-6-one, 9-OH-canthin-6-one, 5-OH-methylcanthin-6-one, 5-OH-methyl-9-MeO-canthin-6-one, 1-OH-9-MeO-canthin-6-one, 1-OH-canthin-6-one, canthin-6-one 3N-oxide, 9-MeO-canthin-6-one 3N-oxide, 9-OH-canthin-6-one 3N-oxide, canthin-6-one 9-O-β-glucopyranoside, β-carboline-1-propionic acid, 7-MeO-β-carboline-1-propionic acid, methyl-β-carboline-1-carboxylate, N-pentyl-β-carboline-1-propionate, eurycomanone [a quassinoid] and picrasidines L & Q (Kardono et al. 1991; Kuo et al. 2003). In n.e. Thailand, E. harmandiana ['ian don'] root is used as an aphrodisiac, bitter tonic, antimalarial and anticancer herb. It has yielded canthin-6-one, canthin-6-one N-oxide, 9-OH-canthin-6-one, 9-MeO-canthin-6-one, 9,10-dimethoxy-canthin-6-one, canthin-6-one 9-O-β-glucopyranoside, β-carboline 1-propionic acid, 7-OH-β-carboline 1-propionic acid and 7-MeO-β-carboline 1-propionic acid (Kanchanapoom et al. 2001).

Gastrodia elata (Orchidaceae) tuber is called 'tien ma' in TCM; it is sedative, anticonvulsant and stimulant to cerebral functions, and is used in doses of 5-10g as a tonic for myoneuralgia, vertigo, headache and rheumatism, and to expel toxins (Keys 1976; Reid 1995; Taguchi et al. 1981). It is believed to give "strength and virlity". Dried young stalks have also been used in TCM to treat headache and dizziness, and as an aphrodisiac longevity tonic. Roasted, steamed or raw, the tubers have also been eaten as food (Lawler 1984). An extract prolonged the effects of *hyoscine* in rats, and showed antioxidant properties. The tuber has yielded 0.146% 4-(β-D-glucopyranosyloxy)benzyl alcohol, 0.027% 4-OH-benzaldehyde [4-formylphenol], 0.021% 4-OH-benzyl alcohol, 0.0054% 4-OH-benzyl methyl ether, 0.041% parishin, 0.0026% gastrodioside, gastrodin, and several other related compounds (Taguchi et al. 1981; Wu, C.-R. et al. 1996). Of these, 4-OH-benzaldehyde inhibits *GABA* transaminase and the peroxidation of brain lipids (Haa et al. 2000). Vanillin has been reported from the tubers, but this needs confirmation (Lawler 1984).

Glaucium corniculatum (Papaveraceae) has sedative properties, and has been used to adulterate opium [see **Papaver**] in Iraq (Chakravarty 1976). The plant has been shown to contain many typical poppy-alkaloids, including allocryptopine, berberine, chelerythrine, coptisine, *protopine*, reticuline and sanguinarine (Preininger 1986).

Gordonia obtusa (Ternstroemiaceae) from India has leaves with stimulating properties similar to those of tea [see **Camellia**]; an alkaloid has been isolated, but not identified, and is said to be 'similar to *caffeine*' (Nadkarni 1976).

Gossypium indicum (Malvaceae) ['Indian cotton'] seeds are used in India for their nervine, aphrodisiac, expectorant, demulcent and laxative properties; they are also used to treat epilepsy. A syrup made from the flowers is said to be 'stimulating and exhilarating'. Seeds of G. herbaceum are also aphrodisiac (Nadkarni 1976), a property also attributed to the root bark. However in China, root bark is used to "inhibit the production of semen" (Rätsch 1990). G. hirsutum ['cotton'] fruits contain *serotonin* (Schneider et al. 1972). In the Ivory Coast of Africa, roots of Gossypium spp. are said to be used as a mild euphoriant and relaxant (Samorini 1995b).

Gynostemma pentaphyllum (Cucurbitaceae), 'Chinese sweet tea vine' or 'jiao gulan', is used in TCM as an energising immune stimulant (Bremness 1994).

Helminthostachys zeylanica (Ophioglossaceae) is known as an intoxicant and anodyne in India, but other details are scarce (Nadkarni 1976).

Hemerocallis lilioasphodelus (Liliaceae) ['daylily', 'hsuan ts'ao'] young leaves have been eaten in China to produce a mild intoxication that "allays sorrow". In larger amounts, they are claimed to be able to "heighten awareness and cause hallucinations" (Erhardt 1992; Wells 1997). The roots have yielded hemerocallin [stypandrol], a toxin which can cause mydriasis, blindness, paralysis, and lesions in the nervous system. This species, as well as H. altissima, H. esculenta, H. minor and H. thunbergii are considered toxic, and Hemerocallis spp. roots have caused human deaths in China. Hemerocallin is probably widespread in the genus, and has also been found in Dianella revoluta ['blue flax lily'] and Stypandra imbricata [the aptly-named 'blind grass'] (Wang et al. 1989). The related H. flava is used in Taiwan to treat insomnia and fever; it acts as a motor-depressant in animals, increasing the concentrations of 5-OH-indoleacetic acid and homovanillic acid in the brain stem, and vanilylmandelic acid in the cortex, as well as decreasing concentrations of *dopamine* and *serotonin* in the brain stem, and *norepinephrine* in the cortex (Hsieh et al. 1996).

Holarrhena pubescens [H. antidysenterica] (Apocynaceae), 'kurchi' or 'rainbow tree', is known as 'indrajow' in Nepal, and is considered a form of 'amrita' and is associated with Indra (Müller-Ebeling et al. 2002). The seeds are regarded as tonic and aphrodisiac in some Arab regions; the bark is a bitter anthelmintic and febrifuge, which is used to treat dysentery. Bark has yielded up to 1.2% alkaloids, and seeds 0.025%, consisting of kurchine and kurchicine, and possibly conessine and holarrhenine (Nadkarni 1976).

Kalopanax septemlobum (Araliaceae) has been shown in Russian tests to have some **Panax**-like adaptogenic properties, but is poorly studied;

the roots yielded saponin glycosides called, imaginatively, kalopanax-saponins (Brekhman & Dardymov 1969b).

Lagerstroemia flos-reginae (Lythraceae) of s.e. Asia has narcotic seeds; the bark and leaves are purgative, and the root is a stimulant, febrifuge and astringent. L. indica ['crepe myrtle'], a common horticultural plant, also has narcotic seeds; the bark is a stimulant and febrifuge, the leaves and flowers are purgative, and roots are astringent. L. speciosa seeds are also narcotic; leaves are purgative and diuretic (Burkill 1985-1997; Fong et al. 1972; Kirtikar & Basu 1980; Malone & Rother 1994; Nadkarni 1976; Watt 1967). L. indica contains alkaloids concentrated in the seeds and seed pods, with only traces in leaves and stems; mature seeds yielded 0.03-0.3% alkaloids, consisting of lagerstroemine [16%], lagerine [10%], decinine [2.8%], decamine [0.8%], dihydroverticillatine [0.5%] and decodine [traces] (Ferris et al. 1971). L. fauriei leaves from Tanegashima Isl. [Japan], harvested before flowering in June, yielded 0.013% *cryogenine* and 0.027% lythrine; leaves from a slightly different plant from the same place, designated as L. fauriei 'Tanegashima type', or L. subcostata var. fauriei, yielded 0.4% *cryogenine*, 0.2% lythrine and 0.04% lythridine. True L. subcostata leaves from Amamiohshima Isl. [Japan], harvested under the same conditions, yielded 0.0025% lasubine-I, 0.0029% lasubine-II, 0.0003% subcosine-I and 0.0025% subcosine-II (Fuji et al. 1978). See also **Heimia**.

Ligustrum japonicum (Oleaceae), 'Japanese wax privet', has berries called 'nu jen dze' in TCM. The activity is found in the seeds, which are tonic, nutrient and increase vitality. They prevent tumour formation and build immunity (Keys 1976; Reid 1995). L. lucidum, 'Chinese glossy privet', strengthens muscles and bones, aids clear vision and hearing, and treats insomnia (Bremness 1994).

Limmonium macrorhabdos (Plumbaginaceae) ['staspak'] is used as an intoxicant in Ladakh, India. The dried leaves are crushed, fried, then sun-dried for 7-8 days, before being powdered; this is mixed with water and put in a tightly corked bottle, and aged for a week before consumption. The nature of the effects was not made clear, but the drink ['staspakchek'] is reported to be dangerous in large doses (Navchoo & Buth 1990). L. vulgare has yielded *tyramine* (Smith 1977a).

Lycium chinense (Solanaceae) fruit, 'gou ji zi' or 'Chinese wolfberry', is used in TCM as a tonic and stimulant, also treating dimmed vision due to malnutrition. It 'lifts the spirits' and may be used to slow the aging process by promoting muscle growth and healthy hair and skin. The dried fruits are usually used, but sometimes the bark and leaf are also (Bremness 1994; Huang 1993). L. chinense has been shown to contain calystegine N1 [see **Convolvulus**] (Bekkouche et al. 2001). L. europaeum is used as an aphrodisiac in India (Nadkarni 1976). L. ferocissimum ['African box thorn'] has been suspected of causing a narcotic poisoning in both humans and pigs, and L. halimifolium and L. barbarum have been reported to have caused deaths in livestock (Webb 1948), though L. barbarum fruits are the edible 'Himalayan goji berries' currently popular as a nutritive health tonic (pers. obs.). In Germany, Lycium spp. have been known as 'hexenstrang' ['witch strand'] (De Vries 1991). Withanolides [see **Withania**] have been found in Lycium spp., and *hyoscine* has been found in L. barbarum (Rätsch 1998). L. chinense fruit has also yielded 9-formyl-*harman* and 1-carbomethoxy-β-carboline (Shulgin & Shulgin 1997).

Mangifera macrocarpa (Anacardiaceae) fruit from Indonesia acts as a hypnotic, and bark of M. odorata is used with other plants to treat hysteria and epilepsy; these trees are related to the mango, M. indica (Perry & Metzger 1980).

Marsilia minuta (Marsileaceae) stolons are decocted by Lodha women in w. Bengal, to treat insanity. The leaves are infused in cold water by the Santals as a soporific (Pal & Jain 1989). In s. Nigeria, M. quadrifolia ['water shamrock', 'akwa nmili'] is planted in gardens for protection; married couples take an extract as an aphrodisiac and to give fertility (Nwosu 2002).

Mesua ferrea (Guttiferae), 'ironwood tree' or 'mesua', is used in Indonesian medicine for its flowers, to treat mental disturbances. It is considered sacred, and is often grown near Buddhist temples (Bremness 1994). In Nepal, the fruit ['nagheshowr'] and wood ['rupkesari'] are used in ritual incense (Müller-Ebeling et al. 2002).

Mikania cordata (Compositae) leaves are used in India to treat itching and wounds; the root extract has strong narcotic and analgesic effects on mice (Rätsch 1998).

Morindae officinalis (Polygalaceae) root is called 'ba ji tien' in TCM; it is tonic, astringent, aphrodisiac, strengthens bone and sinew, and "increases willpower" (Reid 1995).

Nardostachys grandiflora (Valerianaceae), 'jata makhi', 'jatamansi' or 'jatamichi', is used in Nepal for its rhizome as an ingredient of 'bokshi dhup', an incense used to protect against witches (Müller-Ebeling et al. 2002).

Nitraria schoberi (Zygophyllaceae) is an Asian and Australian plant, of interest for containing tetramethylene-THβC (Pakhritdinov et al. 1971), *tryptamine* and *serotonin* in the aerial parts, as well as the new indole alkaloid nazlinin [which has serotonergic activity], and other alkaloids [nitramine, nitraramine, nitraroxine, nitraraine, dihydronitraraine, nitramidine, nitrarine, schoberine and schoberidine] (Üstünes & Özer 1991). N. komarovii has yielded 1-quinolin-8-yl-1,2,3,4-dihydro-β-carboline [komarovidine], 1-quinolin-8-yl-3,4-tetrahydro-β-carboline [komarovicine], 1-quinolin-8-yl-β-carboline [lomarovine], 1-quinolin-2-yl-β-carboline [nitramarine], 1-quinolin-5-yl-β-carboline [isokomarovine] and 1-quinolin-6-yl-β-carboline [komarovinine] (Shulgin & Shulgin 1997).

Panicum sarmentosum (Gramineae) roots are chewed as an aphrodisiac, with betel nut [see **Areca**], in the Malay Peninsula (Perry & Metzger 1980).

Pennisetum cenchroides (Gramineae) is said in India to pass on "a slightly intoxicating effect" to milk of buffalos that have eaten it [see also **Claviceps**] (Nadkarni 1976). In some parts of Africa, roots of P. spp. are used as a homicidal poison. Alkaloids have been detected in the genus (De Smet 1998).

Periplocea sepium (Asclepiadaceae) root bark ['gangli-upi', 'xiang jian pi', 'Chinese silk vine'] treats congestive heart failure and arthritis, also showing cholinergic, CNS and anti-inflammatory actions. Extracts of some species bind strongly to BZ receptors (Zhu et al. 1996a).

Physalis alkekengi var. franchetii (Solanaceae), 'suan-chiang' or 'suan-jiang', is used in TCM for its root, which "calms the mind, supplements ch'i, clears vision, dispels fever with irritability, and clears water". It contains 3-α-tigloyloxytropane, histonin and physalins A-C (Hsu et al. 1986); withanolides have been found in the genus (Rätsch 1998). The plant is also known as 'cape gooseberry' or 'winter cherry', and the ripe fruits are edible (Chevallier 1996). In Nigeria, P. angulata roots and leaves are said to be narcotic (Watt 1967). In the early convict days of Sydney, Australia, P. peruviana [another 'cape gooseberry'] leaves were used in brewing beer, to give bitterness (Low 1990). Fruits of P. minima produce HCN (Watt & Breyer-Brandwijk 1962).

Phytolacca acinosa (Phytolaccaceae) root, 'shang-lu', was decocted by ancient Taoists to 'see spirits' and treat intestinal worms. The root was associated with folk beliefs similar to those of 'mandrake' [see **Mandragora**]; sorcerers were said to carve the root into human form, which would divine the future. Reddish-purple roots are thought to be the psychoactive and toxic type – types with a white root [generally P. acinosa var. esculenta] are edible when cooked with several changes of water. The toxic types of the plant are known to be so poisonous as to be able to kill, and are used only externally for medicinal applications [for inflammation]. The ripe fruits have been used in the past to counteract sterility (Li 1978; Thompson 1968). Leaf and fruit have tested strongly positive for alkaloids (Webb 1949). P. americana [P. decandra], the 'pokeroot' of N. America, is known to be narcotic and toxic, causing "stupor, dullness, giddiness, and vertigo", and in overdose, death from respiratory paralysis (Emboden 1979a). In Tanganyika, P. dodecandra [P. abyssinica] is used as an epilepsy remedy. Most members of the genus are very toxic, and should not be ingested (Foster & Caras 1994; Watt 1967). Even when consumed after cooking with several changes of water, fatalities have occurred (Trout pers. comm.).

Picea smithiana [P. morinda] (Pinaceae), 'Himalayan spruce', is known as 'jhule salla' in Nepal, where shamans use it as incense (Müller-Ebeling et al. 2002). P. breweriana, P. omorika, P. pungens and P. sitchensis contain piperidine alkaloids; P. breweriana also contains pyrrolidine alkaloids (Stermitz et al. 2000).

Pinellia ternata (Araceae) tuber is called 'ban hsia' in TCM, and is sedative, cardiac sedative, antispasmodic, antitussive, antiemetic and expectorant; it is also used to "smooth the upward adverse flow of chi", and is an antidote to **Strychnos** poisoning. It is apparently toxic when fresh. It has yielded 0.002% *ephedrine* (Huang 1993; Keys 1976; Oshio et al. 1978; Reid 1995). P. pedatisecta, which is used to treat arrhythmia, has yielded *norharman* (Chin et al. 1981).

Podophyllum pleianthum (Berberidaceae) root ['k'uei-chiu'] was once taken in ancient China with **Cannabis** sativa fruit and **Acorus** gramineus rhizome to 'see spirits' [see **Cannabis** for further discussion] (Li 1978).

Polygonum multiflorum (Polygonaceae) root is known as 'he shou wu' in TCM. It is a mild sedative, as well as being a rejuvenative, nervine and blood tonic. It lowers cholesterol, counters infection, promotes fertility, and strengthens bone and sinew. Up to 3.7% lecithin has been found in the tubers (Chevallier 1996; Keys 1976; Reid 1995). P. hispidum has been used as a tobacco substitute [see **Nicotiana**] in S. America (Bailey 1880). In Meghalaya, n.e. India, P. hydropiper leaves and achenes are used as a fish poison (Neogi et al. 1989). P. punctatum ['korisowa'] and P. pennsylvanicum ['watonáka'] are used by the Tarahumara of n. Mexico to stupefy fish; they are known to cause contact dermatitis (Pennington 1958).

Poria cocos (Polyporaceae), a truffle sometimes known as 'Indian bread', is called 'fu ling' in TCM [younger, more desirable specimens are called 'fu shen']; it is a sedative, nervine, tranquilliser and stomachic, used to treat insomnia, schizophrenia, jaundice, palpitations, coughs and other complaints. It has some anti-cancer properties, enhancing immune response. Constituents include polysaccharides [pachyman, pachymaran] and organic acids [pachymic acid, pinicolic acid, eburicoic acid, tumulosic acid and 3β-hydroxylahosta-7,9(11),24-trien-21-oic acid] (Huang 1993; Huang et al. 1999; Keys 1976; Reid 1995).

Raponticum carthamoides (Compositae) has been shown in Russian

tests to have some **Panax**-like adaptogenic properties, and is of similarly low toxicity (Brekhman & Dardymov 1969b).

Rhodiola rosea (Crassulaceae), 'golden root' or 'rose root', is used in Siberia in an infusion to treat coughs and pain, yet if taken in excess it causes mild euphoria and a hangover. The root has been used in Scandinavia and n. Asia as a general and nerve tonic, and to give stamina and fertility; Vikings reputedly used it to increase their strength and endurance. Russian investigations showed the root to have **Panax**-like adaptogenic properties, and to be similarly non-toxic (Brekhman & Dardymov 1969b; Bremness 1994; Brown et al. 2002). As well as increasing blood-brain barrier penetration of *dopamine* and *serotonin* precursors, the root has been found to stimulate CNS effects of endogenous *norepinephrine*, *dopamine*, *serotonin* and *acetylcholine* [at nicotinic receptors]. The roots have yielded phenylpropanoids [rosin, rosarin and rosavin], flavonoids [rodiolin, rodionin, rodiosin, acetylrodalgin and tricin], phenylethanol derivatives [salidroside (rhodioloside) and tyrosol], monoterpenes [rosaridin and rosiridol], triterpenes [daucosterol and β-sitosterol] and phenolic acids [*chlorogenic acid*, hydroxycinnamic acid and gallic acid] (Brown et al. 2002). In China, R. sachalinensis ['red-spotted stonecrop', 'gao shan hong jing tian'] is "used for eliminating tiredness" (Huang et al. 1999).

Rotula aquatica [Ehretia viminea, Rhabdia viminea] (Boraginaceae) is known as 'kallur vanchi' in Kerala, India. Besides tropical Asia, it also occurs in Africa and Brazil, but has only been reported to be used as a psychotrope in Kerala. The Kani take it in small amounts in the morning as a euphoric stimulant, and in larger amounts in the evenings for enjoyment, relaxation, and to ensure a good sleep. For use, the leaves and tender stems are finely sliced, dried in the sun for 30min. [or in a pot over a fire], and mixed [by rubbing] with 'bidi' tobacco [see **Nicotiana**, **Datura**, Lyonia] in equal proportions. Sometimes, the sliced R. aquatica is stuffed into a hollow reed portion, which is then blocked up and the contents aged for 3 days. The slightly decayed herb is then removed and dried for use; the decay is reputed to strengthen the effects of the herb [see also **Aspergillus**]. After either initial preparation, the resulting mixture is rolled into cigarettes [c.8cm long, 0.75cm diam. at the lighting tip] containing c.3g R. aquatica and 3g bidi tobacco; sometimes a small amount of powdered tea [see **Camellia**] is added to enhance the effects. Bidi leaves, Ochlandra spp. leaves, or leaves from plants of the Marantaceae and Zingiberaceae, are used as wrappers for the cigarettes. Experienced users may feel the effects after smoking about half of a cigarette, though alcoholics or people with heavy **Cannabis** habits may require 2 in a row for the same level of satisfaction. Alternately, R. aquatica leaves and stems [c.10-15g] may be ground into a paste, mixed with coconut milk [c.100ml] and drunk. The initial stimulating effects soon give way to sedation and an urge to sleep, and smoking too much can result in vomiting; lime juice [see **Citrus**], buttermilk, or tamarind water may be drunk to reduce the effects if required (Nayar et al. 1999).

Sarcostemma brevistigma (Asclepiadaceae) is sometimes used in India as a 'Soma' substitute [see **Amanita**], and the milky sap has been said to be intoxicating and blood purifying. The dried stems are also used there as an emetic, being quite toxic. S. viminale has poisoned sheep, causing *strychnine*-like convulsions followed by paralysis. The latex has been used as a fish poison (Emboden 1979a; Tyler 1966; Watt 1967). In Sonora, Mexico, the Seri decoct S. cynanchoides as an external wash to relieve headaches. They may also drink a tea of the plant to treat 'black widow' spider bites [see below] (Felger & Moser 1974).

Saussurea lappa (Compositae), 'costus', is used in India for its medicinal root, which acts as an expectorant, aphrodisiac, tonic and narcotic [amongst other properties]. The powdered root has been smoked as an opium substitute [see **Papaver**], and in Nepal [as 'kuth'] it is used in ritual incense. It contains an alkaloid [saussurine], glucosides and an essential oil (Müller-Ebeling et al. 2002; Nadkarni 1976).

Schefflera arbicola, S. kwangsciensis and S. venulosa (Araliaceae) are used as 'qi ye lian' in China, and are sedative, hypnotic, analgesic, anticonvulsant, antispasmodic bronchodilators (Zhu et al. 1996a).

Securinega suffruticosa (Euphorbiaceae) leaves, flowers, and young branches are used in TCM as 'yi ye chau', to treat schizophrenia, depression, neurasthenia, neuralgia, paralysis and other complaints. It is mildly toxic due to its main active constituent, *securinine*, as well as the other related alkaloids found (Huang 1993). Roots have yielded 0.42% *securinine*, which is also found in the leaves (Mukherjee et al. 1963). S. virosa leaves have yielded 2-methyl-THβC (Shulgin & Shulgin 1997).

Shorea robusta (Dipterocarpaceae), 'Indian dammar', 'sal' or 'sakhewa', is used by Nepalese Kirati shamans for its bark resin ['salu pati'], or occasionally dried flowers, burned as a potently psychoactive incense for shamanic trance and travelling. However, it is used more often by witches, and shamans prefer to use it in blends with other substances. The leaves ['salkopat'] are sometimes used to roll 'bidi' cigarettes [see **Nicotiana**, and Lyonia above] (Müller-Ebeling et al. 2002). In Indian medicine the resin is said to have aphrodisiac, stimulant and astringent properties (Nadkarni 1976).

Spatholobus parviflorus (Leguminosae) might be the Nepalese 'debra lahara' or 'lache lahara' ['snaking/winding vine'], the roots of which are used by Kirati shamans for shamanic travel. After drying for 3-4 years, 1-3 "fingernail-sized pieces" of it are sufficient for a dose. It is preferably taken as an ingredient of 'bobkha' cakes, consisting of 5 parts lache lahara root, 5 parts rice, 5 parts **Piper** chaba root, 5 parts Bergenia ciliata seeds, 5 parts **Cannabis** flowers [including seeds] and 1 part **Datura** seeds. This is all ground and mixed, moistened with water, kneaded to a dough, and dried in the sun (Müller-Ebeling et al. 2002).

Stephania rotunda (Menispermaceae) roots are used in Vietnam as an effective opium substitute [see **Papaver**] (pers. comm.); they have yielded tetrahydropalmatine [see Corydalis above], stepharine, stepharotine and tuduranine (Tomita & Kozuka 1966; Tomita et al. 1966). In Japan, S. tetrandra is decocted to treat neuralgia and arthritis. In Bouganville, S. salomona leaves are rubbed on the skin to relieve pain (Perry & Metzger 1980).

Styrax tonkinense (Styraceae) yields a resin called 'benzoin' or 'an-hishsiang', which is burned as an incense to repel evil spirits and treat respiratory complaints. It may have been used by early Taoists in their 'elixirs of immortality' [see *Methods of Ingestion*]. A Mali shaman was reported to perform a ritual deep in the jungle, where benzoin was burned, and the shaman would make magical incantations to transform into a tiger and back again at will (Morton 1977; Rätsch 1992).

Thysanolaena maxima (Gramineae), 'tiger grass', is the 'amlisau' plant which, in myth, witches were tricked into eating by Shiva, to reduce the extent of their magical powers so they might be controlled. Nepalese shamans still believe it protects against witches, and it may be used to transform water into 'amrita' (Müller-Ebeling et al. 2002 [note: this work also erroneously refers to the plant as Thysandaena maxima]).

Toddalia aculeata (Rutaceae), 'kanchana', is an Indian plant known to have strong stimulant properties in all parts (Nadkarni 1976). In some parts of s.e. Africa, the ash of the plant is used against witchcraft (Watt & Breyer-Brandwijk 1962).

Trichopus zeylanicus (Trichopodaceae), 'arogyapacha', has fruits that are eaten by the Kani of Kerala, India, for instant stamina, better health and amelioration of old-age related disorders. The leaf extract was shown to be aphrodisiac in male mice; this property was destroyed by heating the extract in alcohol solution. The plant also has anti-ulcer, anti-fatigue, immunomodulating and anti-hepatotoxicity actions (Subramoniam et al. 1997).

Trigonella foenum-graeceum (Leguminosae/Fabaceae) ['fenugreek'] seeds have been a reputed aphrodisiac since ancient times; they act as a revitalising tonic, antipyretic, demulcent, anthelmintic, digestive, galactagogue and uterotonic. Seeds contain steroid saponins similar to those in **Dioscorea** [including *diosgenin*, yamogenin, gitogenin, tigogenin and neotigogenin] as well as flavonoids, and the alkaloids *choline* and trigonelline (Bremness 1994; Dawidar et al. 1973; International… 1994; Nadkarni 1976; Simonetti 1990).

Tsuga dumosa [T. brunoniana] (Pinaceae), 'thigre salla', is used by Nepalese shamans as incense (Müller-Ebeling et al. 2002).

An Usnea sp. (Usnaceae) [a lichen] is sometimes added to 'kava' [see **Piper 2**] in Pentecost, Vanuatu to cause excessive inebriation in a 'pretentious' kava-drinker (Lebot et al. 1992). Usnea spp. are often known as 'old man's beard', due to their shaggy appearance. In China, U. diffracta and U. longissima are known as 'Lao-tzu's beard', and are used after shade-drying to relieve dizziness, sweating, pain, cold and phlegm (Sharnoff undated, citing Strickmann, M. unpublished notes). A species growing on old wooden posts in central Victoria [Australia] was found to be psychotropic when smoked in small amounts, though I suspect regular use or high doses of this lichen would be toxic (pers. obs.). Chemicals found in various Usnea spp. include salazinic acid [possibly the same as usnaric acid], d-usnic acid, barbatic acid and other acids (Watt & Breyer-Brandwijk 1962).

Xanthium strumarium (Compositae), 'lokra', is used in Meghalaya, n.e. India; young leaves are edible, and fruits are "mildly narcotic" (Neogi et al. 1989).

FURTHER INTERESTING ESSENTIAL OILS AND AROMATIC HERBS

Phenylpropenes with psychoactive potential are widely distributed in essential oils. Some of the plants containing them, not mentioned elsewhere, are presented here:-

Myristicin is found in oils of Levisticum officinale seed ['Scotch lovage'; fresh root and herbage used as an aphrodisiac (Rätsch 1990)], Pastinaca sativa root ['parsnip'; also found in seed of cultivated, but not wild, varieties], Crithmum maritimum leaf, Ridolfia segetum flower, Phellandrium aquaticum leaf, Pseudorlaya miniscula and P. pumila seed, Oenanthe stolonifera fruit, seeds of O. aquatica, O. crocata, O. pimpinelloides and O. silaifolia (all Umbelliferae) (Harborne et al. 1969), and Orthodon spp. (Labiatae) (Weil 1965). Of these, Pastinaca sativa root also contains the boar pheromone 5α-androstenone (Claus & Hoppen 1979).

Elemicin is found in the oils of Aniba spp. (Annonaceae), Dalbergia spruceata (Leguminosae), Backhousia myrtifolia, Choricarpia leptopetala, Melaleuca bracteata, M. squamophloia [81% of essential oil in one chemotype] (Myrtaceae), Monopteryx uaucu (Leguminosae), Cleome

viscosa (Capparaceae) (Bock unpubl.; Harborne & Baxter ed. 1993; pers. comm.), Perilla citriodora (Labiatae) [17.8% of oil in one study] (Ito et al. 2000) and in Bridelia retusa (Euphorbiaceae) stem bark (Jayasinghe et al. 2003).

Asarones are found in the bark of Guatteria gaumeri (Annonaceae); it also contains asaraldehyde and a bisbenzylisoquinoline alkaloid, guattegaumerine [antitumour]; the genus is also rich in aporphine alkaloids (Dehaussy et al. 1983; Leboeuf et al. 1982; Leclercq et al. 1987; Lopez, J.A. et al. 1993). The Jamamadi of Brazil use G. cf. megalophylla as an ingredient of their arrow poison (Prance 1972). *Asarones* have also been found in Aniba hostmanniana (Annonaceae) and Caesulia axillaris (Compositae) (Buckingham et al. ed. 1994).

Anethole is found in the oils of Aster tartaricus (Compositae), Backhousia anisata, Clausenia anisata and Pelaea christophersenii (Rutaceae) (Harborne & Baxter ed. 1993).

Apiole is found in the oils of Crithmum maritimum root and seed, Levisticum officinale seed, Oenanthe aquatica, O. crocata, O. pimpinelloides and O. silaifolia seeds (Umbelliferae) (Harborne et al. 1969).

Dillapiole is found in the oils of Crithmum maritimum (Harborne & Baxter ed. 1993), Ligusticum scoticum fruit (Harborne et al. 1969), Bunium spp. seed, Heckeria umbellata, Oenanthe stolonifera (Buckingham et al. ed. 1994), Nothosmyrnium japonicum [76% of oil; also contains 18% nothoapiole (thought to be 2,3,6-trimethoxy-4,5-methylenedioxy-allylbenzene)] (Umbelliferae) (Saiki et al. 1970), Erigeron spp. (Compositae) and Orthodon formosanus (Labiatae) (Harborne & Baxter ed. 1993).

Estragole is found in the oils of Pinus spp. (Pinaceae), Agastache foenicula and A. rugosa (Umbelliferae), Solidago odora (Compositae), Dictamnus albus [see below] (Rutaceae) and Monopteryx spp. (Leguminosae) (Harborne & Baxter ed. 1993).

Eugenol is found in the oils of Origanum majorana (Labiatae), Achillea fragrantissima (Compositae), Rosa rugosa (Rosaceae) (Harborne & Baxter ed. 1993) and Litsea cubeba fruit (Lauraceae). As well as *safrole* [see below], L. cubeba essential oil [2-9% yield] is also rich in *citral*, and contains its isomer geranial, *citronellal*, α-*pinene* and numerous other components; it has antispasmodic and bronchodilatory activity (Tubtim & Wasiksiri 2007).

Methyleugenol is found in the oils of Dacrydium frankenii (Lauraceae) (Harborne & Baxter ed. 1993), Backhousia myrtifolia, Eucalyptus behriana, E. brassiana, E. globulus ssp. globulus, E. gomphocephala, Melaleuca bracteata (Bock unpubl.), M. leucadendra [74% from 0.1% essential oil; another sample contained none] (Myrtaceae) (Aboriginal Communities 1988), Lagorostrobus frankliuii ['Huon pine'] (Podocarpaceae) (Bock unpubl.), Prostanthera striatiflora (Labiatae) [0.4% of 0.2% essential oil] (Labiatae) (Aboriginal Communities 1988), Anemopsis californica (Saururaceae) [55.3% of root essential oil] (Acharya & Chaubal 1968) and Pinus sylvestris (Pinaceae) (Harborne & Baxter ed. 1993).

Methylisoeugenol is found in traces in Prostanthera striatiflora [0.02% of 0.2% essential oil] (Labiatae), and in Melaleuca leucadendra [22% of 0.1% essential oil; another sample yielded 0.06% from 0.9% essential oil] (Aboriginal Communities 1988).

Isosafrole is found in the oils of Ligusticum acutilobum and Murraya koenigii (Rutaceae) (Harborne & Baxter ed. 1993). Murraya exotica contains 3-formyl-indole; M. koenigii contains an array of indole alkaloids from the carbazole group, such as murrayazoline, murrayazolidine, exozoline and bicyclomahanimbine (Husson 1985).

Safrole is found in the oils of Aniba spp. (Annonaceae), Eucalyptus camaldulensis (Myrtaceae), Nemuaron humboldtii (Atherospermataceae) (Bock unpubl.; Harborne & Baxter ed. 1993), Litsea elliptica [leaf], L. cubeba [fruits] (Lauraceae) and Dryobalanops aromatica (Dipterocarpaceae) wood (Lakanavichian 2007; Tubtim & Wasiksiri 2007). D. aromatica, 'Borneo' or 'Sumatra *camphor*', also contains *borneol* and has been used to treat hysteria (Nadkarni 1976).

Bock (unpubl.) gives a good referenced overview of the occurrence of the above phenylpropenes in Australian plants.

Asaricin [sarisan] is found in Heteromorpha arborescens [H. trifoliata] leaves (Umbelliferae), along with falcarindiol (Villegas et al. 1988); the Zulu give a leaf-infusion as an enema, to treat abdominal disorders (Watt & Breyer-Brandwijk 1962).

Osmorrhizole and *isoosmorrhizole* seem to be uncommon; both occur in the rhizome essential oil [0.83% yield] of Osmorhiza aristata [Chaerophyllum aristatum] (Umbelliferae), 'xian gen qin', at 10-22% and 60-80% of oil respectively, as well as *anethole* [7%], *estragole* [1-3%], anisaldehyde, 2,4-dimethoxybenzaldehyde and a sterol. These compounds were previously incorrectly reported from Nothosmyrnium japonicum ('Japanese gao ben'), which does not contain them according to modern analysis, and it is presumed that O. aristata is the correct identity for the herbal drug 'Japanese gao ben', which is used in doses of 3-5g as a sedative, analgesic and antispasmodic (Keys 1976; Konoshima et al. 1967; Saiki et al. 1970). Root and rhizome of Ligusticum jeholense and/or L. sinense are used as 'Chinese gao ben' as a diaphoretic and to treat headaches and dermatitis; a claim of nothosmyrnol [*isoosmorrhizole*] in this drug (Huang 1993) may be due to confusion with O. aristata and N. japonicum (pers. obs.). L. sinense root essential oil contains 3-butylphthalide [26%], cnidilide [16%], *methyleugenol* [3%] and an unidentified 'compound X' [25%] (Saiki et al. 1970). *Osmorrhizole* has also been found in Anthriscus sp., Myrrhis sp. and Pinus spp. (Buckingham et al. ed. 1994).

Celery, Apium graveolens (Umbelliferae), has an essential oil in the seeds with CNS-depressant, tranquillising and anticonvulsant properties; alkaloids are also found in the seeds, contributing to the tranquillising effects (Nadkarni 1976; Rastogi & Mehrotra ed. 1990-1993). *Myristicin* has been found in the leaf, but not in the seed (Harborne et al. 1969). Celery root also has a reputation as an aphrodisiac (Rätsch 1990), and contains the boar pheromone 5α-androstenone [see Tuber spp. above] (Claus & Hoppen 1979). 'Geranium' oil [usually from 'rose geraniums', Pelargonium spp. (Geraniaceae) has some reputation as an aphrodisiac (Jalali-Heravi et al. 2006) and antidepressant (Bremness 1994), and although many people enjoy the aroma, I find it quite revolting! In recent years, 'geranium oil extracts' or 'geranamine' have made an appearance as legal party drugs and weight-loss/bodybuilding aids, often combined with other substances (pers. obs.). 'Geranamine' is a current marketing name for methylhexaneamine [2-amino-4-methylhexane; 1,3-dimethylamylamine], initially synthesised in the 1940's as an adrenergic drug (Budavari et al. ed. 1989). It has reportedly been isolated as a minor component of some P. graveolens essential oil [0.66% of the oil] (Zang et al. 1996), although I have not been able to verify this. Users say that c.25mg geranamine is sufficient for strong stimulant activity (pers. comms.). P. citronellum essential oil contains mainly geranic acid [36%], but also useful amounts of geranial [see *citral*] (Lalli et al. 2006). Melaleuca quinquenervia ['tea tree'] bears a potent essential oil, and bees feeding on the flower nectar have been observed to fall under an aggressive intoxication (Lassak & McCarthy 1990), the aggression perhaps caused by disorientation and the subsequent collisions between individual bees.

Besides the well-known catnip/catmint [see **Nepeta**], 'Chinese cat powder' [see **Actinidia**] and valerian [see **Valeriana**], there are also other cat-attracting plants, which might be psychoactive in humans. These include:-

Boschniakia rossica [growing parasitically on the roots of Alnus spp.] – contains boschniakine, boschnialactone and onikulactone; Menyanthes trifoliata ['bog myrtle'] – contains mitsugashiwalactone; Myoporum desertii – contains *nepetalactone*; Tecoma stans and T. radicans ['trumpet creeper'] – contain boschniakine, the former also containing *actinidine*, 4-nor-*actinidine* and other compounds; Nemophila menziesii ['baby blue-eyes']; Origanum dictamnus ['dittany of Crete']; Lippia javanica; Viburnum opulus ['cranberry bush'; see above]; and Teucrium marum ['cat thyme'] – contains dolicholactones C and D [most prominent in the essential oils of Sardinian plants] (Gross et al. 1972; Tucker & Tucker 1988). Some Teucrium spp. are toxic to the liver, and some also contain neo-clerodane diterpenoids [see **Salvia**]. Many members of the genus are commonly known as 'germander' (Chevallier 1996). T. argutum, 'native germander' from Queensland, Australia, has caused some interesting farmyard capers – "The roots are stated to cause a form of excitement in pigs, which rush madly about but recover after a short time" (Webb 1948). Regarding Boschniakia rossica mentioned above, it is known in China as 'bulaocal' and 'cao cong rong', and is used as a male sexual tonic (Huang et al. 1999).

Many members of the mint family, the Labiatae or Lamiaceae, have actions on the nervous sytem that have long been known to aromatherapists. These are now gaining more attention since the discovery of the neo-clerodane diterpenoid *salvinorin A* from **Salvia** divinorum. Similar diterpenoids have been found in other plants from the Labiatae, including members of the genera **Salvia**, **Scutellaria** and other relatives. It could be said the search is on for other diterpenoid compounds to compare to the tremendous effects of *salvinorin A*! Here we will briefly look at some of the well known Labiatae that have not been covered elsewhere in the book [bearing in mind that essential oils should generally not be consumed orally at risk of gastric irritation and liver toxicity].

'Bugle' [Ajuga reptans] – has been used as a mild narcotic; it is also analgesic when applied to bruises and small wounds (Bremness 1994). The related A. parviflora has been shown to contain new withanolides [see **Withania**], ajugins A & B (Khan et al. 1999a, 1999b), as well as neoclerodane diterpenoids (Beauchamp et al. 1996).

'Horehound' [Marrubium vulgare] – tea is sedative, muscle-relaxant, expectorant and antiseptic (Bremness 1994) – and is very bitter (pers. obs.)!

'Large-flowered calamint' [Calamintha grandiflora] – leaf tea is an invigorating tonic for "all afflictions of the brain", according to Culpeper. It contains *camphor*-like essential oil constituents (Bremness 1994).

'Lavender' [Lavandula spp.] – flower tea treats anxiety, dizziness, headaches and nausea. The essential oil is relaxing, mildly sedative and analgesic, and can treat insomnia and depression (Bremness 1994; Lawless 1994; Worwood 1995). The Indian L. stoechas is said to "strengthen brain powers, expel brain crudities and clarify the intellect" (Nadkarni 1976). In mice, a flower extract acted as a sedative, anticonvulsant and anti-

spasmodic; it appears to act as a calcium-channel blocker (Gilania et al. 2000).

'Lemon balm' [Melissa officinalis] – leaf tea is relaxing, sedative, and tonic. It soothes headaches, indigestion and nausea. The essential oil is anti-depressant, and narcotic and soporific in large doses (Bremness 1994; Conrad 1988; Lawless 1994; Worwood 1995). An extract of the herb bound to nicotinic- and muscarinic-*acetylcholine* receptors, displacing *hyoscine* (MacKenzie 2000; Wakea et al. 2000). See also *Producing Plant Drugs*.

'Patchouli' [Pogostemon cablin] – whole plant considered stimulant and antidepressant (Bremness 1994).

'Peppermint' [Mentha piperita] – inhalation of the essential oil vapours treats shock and nausea, while improving concentration. 'Mints' [Mentha spp.] can be stupefying in large doses (Bremness 1994; Conrad 1988; Lawless 1994). Hall (1973) mentioned a case in which a person "developed a toxic psychosis from addiction to mentholated cigarettes" [menthol is a major component of peppermint oil].

'Rosemary' [Rosmarinus officinalis] – essential oil of the flowering tops is invigorating and stimulates the CNS; it is said to act as a nerve tonic (Bremness 1994; Lawless 1994; Worwood 1995).

'Sweet marjoram' [Origanum majorana] – tea soothes nerves and relieves headaches (Bremness 1994). The essential oil is sedative, nervine, analgesic and comforting; it is stupefying in large doses (Lawless 1994). 'Oregano' [O. vulgare] can induce vertigo, stupefaction, trembling and obscured memory (Conrad 1988). In Germany, it has been known as a 'hexenkraut' ['witch herb'] (De Vries 1991).

'Thyme' [Thymus vulgaris] – essential oil of the leaves and flowering tops is a stimulant, nerve-tonic and antiseptic which strengthens the immune system and treats depression, colds and muscle pain (Bremness 1994). 'Wild thyme' [T. serphyllum] is sedative, and has been known in Germany as a 'hexenkraut' (De Vries 1991).

'Wood betony' [Stachys officinalis = Betonica officinalis; not to be confused with **Pedicularis**] – tea of aerial parts is a mild sedative and anxiolytic, being tonic to the nervous and circulatory systems. May be effective as a brain tonic (Bremness 1994). Has been used in brewing beer [see *Methods of Ingestion*] in Europe (Buhner 1998). Other Stachys spp. are also known to be psychoactive. S. arvensis ['stagger weed'] has caused stock intoxications in Australia; plants in seed are said to be more toxic (Everist 1974; Gardner & Bennetts 1956). S. tenuifolia is used by the Winnebago as a tea substitute [see **Camellia**] (Kindscher & Hurlburt 1998). In Africa, the Suto burn S. aethiopica var. glandulifera in the hut of a person who is delirious from fever, to exert a calming effect (Watt & Breyer-Brandwijk 1932). In Germany, S. annua has been known as a 'hexenkraut' (De Vries 1991). I have found the common horticultural plant 'lamb's ears' [S. byzantina = S. lanata] to be fairly stupefying and inebriating when smoked; the dried leaves are strongly aromatic when crushed. S. sylvatica leaf is also psychoactive when smoked (pers. obs.).

Incidentally, I have read of an experience from a man with a liver dysfunction, making him more easily affected by various chemicals [Claude Rifat (see http://dog.net.uk/claude)]. He consumed 20 drops of lavender essential oil [from Lavandula hybrida] combined with 20 drops of **Valeriana** officinalis essential oil, which after 40 minutes produced a cholinergic-like stimulation, combined with abstract simple hallucinations [experienced in darkness]. For those more tolerant to chemicals than Claude, the amount of essential oil that would need to be consumed to replicate this would presumably be toxic to the liver.

MORE β-CARBOLINES and MAO-INHIBITORS

There are many plants containing β-carboline alkaloids which have uncertain status as human MAOIs – such as *harman*, for example. Some of these plants are listed here in case future research shows them to be of value. An excellent overview of the β-carbolines is found in Shulgin & Shulgin (1997), which should be consulted for further listings [there's a lot!]. Unfortunately, references are not allocated to each listing. See also the section on Marine Life, below. Also added here are plants containing β-carbolines that have known human activity, but can only be mentioned briefly because I couldn't find enough information for a full entry, or the chemical information was found at the last minute.

Agropyrum repens (Gramineae), 'English couch grass' or 'twitch grass' – 6-OH-THβC 3-carboxylic acid, in roots and rhizomes (Shulgin & Shulgin 1997).

Apocynum cannabinum (Apocynaceae), 'dogbane' or 'Indian hemp' from N. America – *harmalol* in roots (Lutomski et al. 1968c) and cardioactive glycosides such as apocannoside (Trabert 1960; Turner & Szczawinski 1991). Toxic; root tea treats rheumatism, asthma, pox and whooping cough (Hamel & Chiltoskey 1975; Pendell 1995).

Arenaria kansuensis (Caryophyllaceae) – yielded *harmine* (Shulgin & Shulgin 1997), 1-acetyl-*norharman*, 1-acetyl-7-OH-*norharman* [arenarine D], 1-acetyl-7-MeO-*norharman* [arenarine C], 1-(2-MeO-1-OH-ethyl)-*norharman* [arenarine B], 1-MeO-methylcarbonyl-β-*norharman* [arenarine A] and 1-MeO-carbonyl-*norharman*. As 'xue ling zhi', the whole plant has been used in Chinese folk medicine to treat influenza, lung inflammation, jaundice and rheumatism (Wu et al. 1989). Known as 'sandwort', Arenaria spp. are smoked as a 'kinnikinnick' in N. America [see **Arctostaphylos**] (Siegel et al. 1977).

Calligonum minimum (Polygonaceae) – *harman*, *tetrahydroharman* [major alkaloid], *tetrahydroharman* N-oxide, *harman* N-oxide and calligonidine in all parts, as well as 2 unidentified alkaloids. Alkaloid content in roots was lowest during fruiting, but increased thereafter (Abdusamalov & Sadykov 1963; Abdusamalov et al. 1965).

Cayratia japonica (Vitaceae) has yielded flavonoids with MAOI activity in mouse brain; *apigenin*, luteolin and quercetin were most potent of these [strongest with MAO-A], with *apigenin*-7-O-β-D-glucuronopyranoside, luteolin-7-O-β-D-glucopyranoside, taxifolin [(+)-dihydroquercetin] and aromadendrin [(+)-dihydrokaempferol] being weaker (Han et al. 2007).

Chrysophyllum lacourtianum (Sapotaceae) – *norharman* and another β-carboline (Allen & Holmstedt 1980); the genus contains saponins and coumarins, and some are cyanogenic (Schultes & Raffauf 1990). C. prunifolium is a remedy for mental disease in Zambia (Watt 1967).

Cinchona succirubra (Rubiaceae) bark contains the alkaloids quinine, cinchonicinol and cinchonaminone, all of which inhibit MAO (Mitsui et al. 1989).

Commelina communis (Commelinaceae) – THβC [noreleagnine], *norharman*, *harman* and 1-carbomethoxy-*norharman* (Shulgin & Shulgin 1997).

Coriolus maximus (Agaricaceae) from West Indies, C. America and Old World tropics – *harman* (Allen & Holmstedt 1980). C. consors is an immune stimulant and antibiotic (Hobbs 1995). C. versicolor ['kawaratake', 'yun zhi'] is used medicinally in China and Japan, and contains polysaccharides [PSK and PSP] with potent antitumour properties (Willard & Jones 1990).

Cortinarius infractus [Phlegmacium infractus] (Agaricaceae) from Europe – novel β-carbolines infractine [*norharman* 1-propionic acid methyl ester], infractopicrine and 6-OH-infractine (Steglich et al. 1984). Many Cortinarius spp. are considered inedible or suspect; C. orellanus is poisonous, containing a polypeptide toxin [orellanine] which acts on the kidneys, and has an incubation period of 3-14 days or more. It has caused fatalities (Benedict 1972; Haard & Haard 1980). Some species, such as C. gentilis, can be very similar in appearance to some **Psilocybe** mushrooms, but for their lack of a bluing reaction (pers. obs.). Indeed, one case of a woman who obtained and consumed what she believed to be 'magic' mushrooms, suffering nausea, abdominal pain, flatulence, vomiting and diarrhoea for 5 days after [beginning 8hrs after consumption; no psychoactivity was reported], probably consumed a Cortinarius sp.; she suffered renal failure but recovered (Raff et al. 1992).

Cudrania tricuspidata (Moraceae), 'silkworm thorn', has yielded the isoflavones gancaonin A, alpinumisoflavone and 4'-O-methylalpinumisoflavone from its fruits; these compounds inhibited mouse brain MAO, with gancaonin A being selective for MAO-B (Han et al. 2005).

Cyathobasis fruticulosa [Girgensohnia fruticulosa] (Chenopodiaceae) from Turkey was found to contain 0.002% N-methyl-THβC, 0.0008% N-methyl-N-formyl-*tryptamine*, 0.004% *hordenine*, 0.0033% N-methyl-N-formyl-4-OH-β-*phenethylamine*, p-OH-benzaldehyde, p-aminobenzoic acid and p-MeO-benzoic acid in mixed roots and aerial parts (Bahçeevli et al. 2005).

Dictamnus albus (Rutaceae) aerial parts have yielded *skimmianine*, and four coumarins which acted as MAOIs in mouse brain [xanthotoxin, umbelliferone, auraptene and 7-(6'R-OH-3',7'-dimethyl-2'E,7'-octadienyloxy)coumarin] (Jeong et al. 2006).

Diospyros sp. (Ebenaceae) 'lemuni hitam' is a Malaysian medicinal plant which, though not known to contain β-carbolines, has shown MAOI-activity; the herb has yielded naphthoquinone/naphthalene compounds, including lemuninol A, which was the strongest MAOI in mouse liver, of the compounds tested (Okuyama et al. 1999). On Mabuiag, w. Torres Strait, a Diospyros sp. is chewed with unidentified plants by novices undergoing intitiation to become 'magicians' (Thomas 2001a). In some areas of s. Nigeria, a Diospyros sp. is used as a fish poison (De Smet 1998). Numerous species have edible fruits of varying degrees of desirability, such as 'Oriental persimmon' [D. kaki], 'American persimmon' [D. virginiana], 'Mexican persimmon' or 'zapote pieto' [D. texana], 'poor man's persimmon' or 'date plum' [D. lotus], 'mabolo' [D. discolor] and 'black sapote' [D. digyna] (Glowinski 1997). *Scopoletin* has been found in Diospyros spp. (Buckingham et al. ed. 1994).

Flindersia laevicarpa (Rutaceae) from n. Queensland, Australia – leaf yielded 0.035% *harmalan*, 0.035% acetyl-*harmalan*, 0.005% acetyl-*harmalan* dimer, 0.00096% of an unidentified *tryptamine*-derivative, 0.11% carpachromene, 0.73% flindersolide, 0.13% hesperidin and 0.0008% flindercarpin-2; bark yielded salicylic acid, hesperidin, lupeol, β-sitosterol, flindercarpins 1 & 2, nerolidol, (+)-threo-1,5-diphenylpentane-1,3-diol, flindersiachromone, 2,3-dihydro-flindersiachromone and 8-MeO-flindersiachromone; wood has yielded *skimmianine*, hesperidin, β-sitosterol and two alcohols (Picker et al. 1976). Many other species growing in

Queensland have tested positive for alkaloids, including F. acuminata, F. australis, F. bennettiana, F. bourjotiana, F. collina, F. oxleyana, F. pimenteliana and F. schottiana (Webb 1949).

Gentiana lutea (Gentianaceae) yielded 5-OH-flavanone, 2-MeO-3-(1,1'-dimethylallyl)-6a,10a-dihydrobenzo(1,2-c)chroman-6-one and 3,3"-(2'-OH-4-O-isoprenylchalcone)-(2"'-OH-4"-O-isoprenyldihydrochalcone), which inhibited MAO-B more than MAO-A (Haraguchi et al. 2004).

Gymnacanthera paniculata var. zippeliana (Myristicaceae) from Papua New Guinea – yielded 1,5-dimethoxy-3-(dimethylaminomethyl)-indole [1,5-dimethoxy-*gramine*] and N-methyl-THβC, as well as an unidentified *gramine*-like alkaloid [total 0.05-0.1% base alkaloids from leaves]. Orally in mice, the total base extract caused slight depression, moderate decrease in activity, slight mydriasis and hypothermia at 100mg/kg; twice this dose led to death. 100mg/kg [p.o.] produced analgesia in 30% of the mice (CSIRO 1990; Johns et al. 1967).

Hippophae rhamnoides (Elaeagnaceae), 'sea buckthorn' from Eurasia – *harman*, *harmol* and *harmalol* in whole plant [only *harmalol* in twigs and leaves] (Allen & Holmstedt 1980; Gill & Raszeja 1971; Lutomski et al. 1968c); *serotonin* in roots (Smith 1977b); and flavonoid glycosides in fruits (Hörhammer et al. 1966); leaves have also yielded quebrachitol (Plouvier 1951), astragalin and isorhamnetin (Rasputina et al. 1976). One alkaloid screening found no alkaloids in leaf, c.0.003% in bark and c.0.03% in root bark (Hultin & Torssell 1965). Berries used for skin eruptions, diarrhoea and dysentery; they are edible, but said to be poisonous in some locales (Bremness 1994; Chiej 1984; Kirtikar & Basu 1980).

Hypodematium squamuloso-pilosum (Hypodematiaceae), a fern from Asia and n. Africa, yielded 1-acetyl-β-carboline and 1-acetyl-8-OH-β-carboline (Zhou et al. 1998).

Lithospermum erythrorhizon (Boraginaceae) root has yielded the quinones shikonin, acetylshikonin and shikonofuran E, which inhibited mouse brain MAO (Choi et al. 2005).

Nauclea diderrichii [Sarcocephalus diderrichii; S. trillesii] (Rubiaceae), 'West African boxwood' – *harman*, 3-carbomethoxy-*harman* and 1-carbomethoxy-*norharman*; as well as pyridine alkaloids, an alkaloidal glycoside, quinovic glycoside-saponins and monoterpenoids in bark. In w. & c. Africa, the bark is decocted to treat stomach pain, fever and diarrhoea (Buckingham et al. ed. 1994; Lamidi et al. 1995; McLean & Murray 1970, 1971a, 1971b; Murray et al. 1971). In Congo, N. vanderguchii wood is macerated in water, and a glassful of the liquid drunk at morning and night to treat 'senile impotence' (Burkill 1985-1997).

Newbouldia laevis (Bignoniaceae) – *harman* (Allen & Holmstedt 1980).

Ophiorrhiza japonica [O. eyrei] (Rubiaceae), 'snakeroot herb' or 'shê kên ts'a' – yielded *harman*, 6-OH-*harman*, ophiorines A & B, lyalosidic acid and 10-OH-lyalosidic acid (Aimi et al. 1986). O. acuminata ['payang-payang gubat' ('mongoose plant')] leaves yielded *harman*, as well as lyalosidic acid and palicoside (Nonato et al. 1995). Leaves, stems and roots of the related O. mungos strongly inhibit the herpes virus (Tafur et al. 1976), and the root bark is sedative and laxative (Nadkarni 1976).

Oxalis tuberosa (Oxalidaceae), 'oca', is a tuberous food crop in the Andes – tuber found to secrete *harmine* and *harmaline* as major components [oddly, psychotropic effects are not known from this commonly-consumed plant] (Bais et al. 2002).

Pauridiantha callicarpoides (Rubiaceae) – *harman*, pauridianthine and pauridianthanine.

Pauridiantha dewevrei (Rubiaceae) – *harman*, cadambine and dihydrocadambine (Jacquesy & Levesque 1987; Levesque et al. 1983).

Pauridiantha hirtella (Rubiaceae) – leaves contain a small amount of alkaloids, with greater amount in the stem and root (Burkill 1985-1997).

Pauridiantha lyalli (Rubiaceae) – *harman* [16% of root bark alkaloids, 8% of trunk bark alkaloids and 5% of leaf alkaloids], pauridanthanol, pauridianthoside, lyaline, lyadine, lyalidine, OH-lyalidine, lyaloside and isopauridianthoside (Jacquesy & Levesque 1987; Levesque et al. 1983).

Pauridiantha viridiflora (Rubiaceae), this and the above Pauridiantha spp. all African plants – 0.08% *harman*, 0.007% pauridianthine, pauridianthinine, an anthraquinone and a glycoside from the bark (Burkill 1985-1997).

Polyalthia acuminata (Annonaceae) – contains dl-*tetrahydroharman* in leaf and bark, as well as 2-methyl-THβC [see **Tabernanthe**] (Shulgin & Shulgin 1997).

Rhazya stricta (Apocynaceae) is an Arabian shrub known as 'harmal' – it is abundant in alkaloids, and has varied medicinal uses. The whole plant, including the seed, is used to treat halitosis, chest pain, conjunctivitis, constipation, diabetes, fever, skin rash, intestinal worms, and as a galactogogue. The leaves and stems are burnt on a fire and the smoke inhaled to relieve chest pains, and the leaf juice is used for eyedrops. Overall, the plant is said to be sedative, antibacterial, antiinflammatory, and respiratory stimulant (Ali et al. 1998; Ghazanfar & Al-Sabadhi 1993). The seeds have been claimed to have yielded *harmine*, *harmaline* and *harmalol* (Ghazanfar & Al-Sabadhi 1993), though no reference was provided for this statement, and may have arisen through a colloquial confusion with **Peganum** harmala, which is also commonly known as 'harmal'. A large number of other alkaloids have been reported from the plant, most of them indole alkaloids – including *akuammidine*, vincadifformidine, (-)-quebrachamine, (+)-eburenine, rhazicine, rhazizine and (-)-nor-C-fluorocurarine (Buckingham et al. ed. 1994; Ganzinger & Hesse 1976). Leaves show sedative and antidepressant activity in animals, and have also been shown to inhibit MAO-A in rat brain, through increasing the activity of endogenous *tribulin*; low doses increased MAO-A activity, intermediate doses reduced it, and high doses had no effect. Low doses administered over 21 days decreased MAO-A activity, and increased MAO-B activity. Upon further investigation, it was noted that the butanol extract of the leaves decreased MAO-A inhibiting activity, whilst the weakly basic chloroform extract increased it (Ali et al. 1995, 1998, 1999).

Simira klugei, S. maxonii, S. mexicana, S. rubra, S. salvadorensis, S. tinctoria and S. williamsii (Rubiaceae) from C. and S. America – *harman* in barks (Shulgin & Shulgin 1997)

Symplocos racemosa (Symplocaceae), 'lodh tree' from n.e. India – 0.24% *harman* in bark [as 'loturine', thought to be a mix of *harman* and abrine], as well as 0.06% loturidine, 0.02% colloturine and quinovin (Allen & Holmstedt 1980; Nadkarni 1976); the plant also contains pelargonidin-glucosides (Rastogi & Mehrotra ed. 1990-1993). Some species contain salicylic acid, an analgesic aspirin precursor. Used in India as an aphrodisiac, astringent, antiinflammatory and emmenagogue (Kirtikar & Basu 1980).

MORE TRYPTAMINE ASSAYS

Thin Layer Chromatography [TLC] testing of various plants by well-known underground researcher 'Johnny Appleseed' and friends has [apart from those already mentioned elsewhere] revealed the tentative presence of psychedelic *tryptamine* alkaloids in hitherto unsuspected genera. Many of the results mentioned below still need confirmation using better techniques, and some might turn out to have been incorrect. Unfortunately, it seems that such research may not currently be published in mainstream science journals – however, such journals have recently reported the natural occurrence of several new *tryptamine*-derived alkaloids with unusual structures [see below]. New and familiar alkaloids of interest are showing up everywhere!

Bromus breviaristatus, B. sp. (Gramineae) – bands corresponding to *DMT*, sometimes some *5-methoxy-DMT* [*5-MeO-DMT*]. Only present in winter (Trout ed. 1997d; Trout pers. comm.). In published data, B. hordeaceus [B. mollis] and B. secalinus tested positive [c. 0.003%] for alkaloids (Hultin & Torssell 1965).

Dactylis glomerata (Gramineae), 'cock's foot' – tested positive for alkaloids [c.0.003%] (Hultin & Torssell 1965) and would be a good candidate for further investigation (Trout pers. comm.). It has been observed to support the endophytes Epichloë typhina [see **Festuca**] (Cabral et al. 1999) and **Claviceps** purpurea (pers. obs.).

Digitaria sanguinalis (Gramineae), 'crab grass' – strong band corresponding to *5-MeO-DMT*; only observed in hot summer (Trout ed. 1997d; Trout pers. comm.).

Elymus spp. (Gramineae), 'wild rye' – several species may contain *DMT* and *5-MeO-DMT*, pending further investigation (Trout ed. 1997d; Trout pers. comm.). Incidentally, E. canadensis has been observed to support an unidentified Epichloë sp. endophyte [see **Festuca**] (Cabral et al. 1999), and E. arenarius [Leymus arenarius] is known to host **Claviceps** purpurea (Alm 2003).

Gleditsia triacanthos [G. horrida] (Leguminosae), 'honey locust' – roots appeared to contain *DMT*, though the root harvest severely stressed the plant (Trout pers. comm.). Earlier formal studies found *tyramine*, N-methyl-*phenethylamine* and triacanthine in the leaves (International... 1994; Smith 1977a).

Hierochlöe odorata (Gramineae), 'sweet grass' – faint band corresponding to *DMT* (Trout ed. 1997d; Trout pers. comm.).

Leucoagaricus spp. (Agaricaceae) mushrooms, including the edible L. pudicus, are suspected of containing novel 6- or 7-substituted *tryptophan* or *tryptamine* derivatives, although these are probably not psychoactive (Stijve 2003; Stijve & de Meijer 1993).

Peristrophe hyssopifolia (Acanthaceae), which is similar in appearance to **Justicia** pectoralis – leaves tested faintly positive for *5-MeO-DMT* (Trout ed. 1997d; Trout pers. comm.).

Sorghum halapense (Poaceae), a.k.a. 'sorghum grass', 'Egyptian millet', 'aleppo grass', 'Johnson grass' – rhizome tested positive in varying strengths for *DMT*; most assays gave very weak results, though a late summer assay showed a very strong band corresponding to *DMT* (Trout ed. 1997d; Trout pers. comm.). This species and others also contain a cyanogenic glucoside called dhurrin, which is most prevalent after flushes of new growth, declining in concentration as the plant matures (Cheeke 1995; Lamp et al. 1990); *hordenine* has been found in S. vulgare (Lundstrom 1989).

Typha sp. (Typhaceae), 'cat tail' – tested positive for small amounts of *DMT*, along with many unidentified alkaloids (Trout pers. comm.).

Umbellularia californica (Lauraceae), 'California bay laurel' – yielded *bufotenine* (Shulgin & Shulgin 1997), though others state this to be *5-*

MeO-DMT instead (Rätsch 1998). Leaves contain an essential oil [containing 40-60% umbellulone] which can cause skin irritation, headache and even unconsciousness (Hall 1973).

Wisteria sp. (Leguminosae) – leaf and stem of an unidentified 3-4yr-old horticultural species tested strongly positive for *DMT*, as well as at least 4 other compounds (Trout ed. 1997d; Trout pers. comm.). Other Wisteria spp., such as W. brachybotrys and W. floribunda, contain flavonoids, terpenoids and terpenoid saponins [such as wistariasaponins, dehydrosoyasaponin in knots of the former species]; seeds and seedlings of the latter species have also yielded alkaloids, such as agmatine, spermine, spermidine, stizolamine, 1,5-pentanediamine, (3-aminopropoxy)guanidine, 1,4-butanediamine and 4,4'-diaminobutylamine (International… 1994; Konoshima et al. 1991); seeds of W. floribunda have also yielded 12.26% canavanine [see **Canavalia**] (Rosenthal 1977). W. sinensis seeds and pods contain a glycoside, wistarin [similar to *cytisine* in effect, but weaker], and a resin. These plant parts have poisoned children, with symptoms including "severe gastroenteritis with repeated vomiting, abdominal pain and diarrhoea, sometimes collapse". A brush-tailed rock-wallaby in captivity was poisoned by eating 1 large leaflet – 4-5hrs later, it became sleepy, and over the next 52 hrs its condition worsened until it was in a coma; 20hrs later, it was dead (Everist 1974; Picchioni 1965; Rätsch 1998).

The Australian shrub Hodgkinsonia frutescens (Rubiaceae) from Queensland contains a complex *tryptamine*-derived alkaloid [similar to those described under **Psychotria**] called hodgkinsine. Given orally to mice, 25-50mg/kg produced mild sedation and loss of balance; 100-500mg/kg also caused CNS depression, hypersensitivity to external stimuli, and vasodilation. Abundant indoles are also found in another Australian plant, Bleekaria coccinea [Excavatia coccinea] (Apocynaceae), which yielded *reserpine*, isoreserpiline and reserpiline from stem bark and leaf. Stem bark and wood also contain ellipticine and 9-MeO-ellipticine, which have antitumour activity (CSIRO 1990).

Lastly, stems and leaves of the New Caledonian plant Myrtopsis myrtoidea (Rutaceae) yielded 0.15% N-benzoyl-*tryptamine*, as well as 0.35% O-methyl-N-benzoyl-*tyramine*, 0.015% benzamide, 0.007% *skimmianine*, 0.005% γ-fagarine and 0.002% dictamnine (Hifnawy et al. 1977).

SOME OBSCURE FUNGAL NOTES

As the story goes… [according to Stephen Peele] In the late 1970's, an unidentified Lepiota sp., fruiting July to August in Florida, was claimed to be psychoactive by Peele, who named it after himself ['Lepiota peele']. He claimed to have encountered some mushroom pickers in a cow pasture who were picking this mushroom, claiming that they preferred its effects to those of **Psilocybe** cubensis. The mushroom was reported to grow on mats of 'Bermuda grass' [Cynodon spp. – see above] in pastures, forming from a dense mycelial layer; soil was reportedly pH 4-5.6, from morning urination by pasture cows. Substrate conditions were claimed to be very important for this species to be psychoactive. The fungi were also said to bruise 'beet red' to 'brown maroon'. Consumption of 3 'average-sized' specimens by Peele produced visual alterations [undulating black lines] and a feeling of lightness. A yellow liquid exuding from the mycelium was also reported to be psychoactive, as were dried mushrooms when smoked. Initial chemical screenings by Jeremy Bigwood were claimed to have revealed an unnamed active compound [unstable, with a shelf-life of 1-2 days], *ergine*, *DMT*, and many other compounds [later analysis by Stijve did not detect these alkaloids, nor a variety of other psychedelic alkaloids or known mushroom toxins; only *tryptophan* and urea were found]. Apparently work on this mushroom was mysteriously discontinued in the mid-1980's after Bigwood's lab was claimed to have been broken into and sabotaged, and the topic has been publicly ignored by major researchers in these fields (Peele 1993; Toro 2004). Unfortunately Jeremy Bigwood, a researcher of known repute, is now deceased, ruling out the possibility of seeking his comments on the matter (pers. comm.). Based on spores obtained from Peele's mail-order company, Peele's rudimentary description and photographs from a High Times article on the mushroom, it was later identified as probably being Lepiota humei ['Hume's Lepiota']. Fresh specimens of L. humei were then located in pastures "with a reputation for 'magic mushrooms'", tested numerous times for the presence of amatoxins [see below], and then consumed in a number of bioassays, increasing dosage each time. Even the largest doses consumed, 5-6 'robust specimens', produced no effects whatsoever (Akers 1992).

It should be noted that many Lepiota spp. are poisonous, and some have been shown to contain amatoxins [see **Amanita**] (Benedict 1972; Bresinsky & Besl 1989; Southcott 1974). Much care should be taken with identification. It should also be noted that most people with an opinion on the matter consider Peele's claims to have derived from questionable research, which some describe as 'fraudulent', others dismissing the entire story as an outright hoax (pers. comms.). We may never know the full story, but beware the rumour mill when it comes to ingesting potentially lethal substances!

Chlorophyllum molybdites [Lepiota morganii], the 'green-gilled parasol', has been reported from Africa to be psychoactive based on animal studies, and the Yoruba name for it, 'a jegba ariwo-orun' [roughly translated as "eat and see voices from heaven"]. In some areas it is commonly believed to be edible (Guzmán et al. 2000), but it also often causes poisoning, though some people appear to be immune. It is recorded as being toxic whether raw or cooked, though one person who had been eating it for years well-cooked experienced toxicity only after eating some raw. Symptoms are mainly gastrointestinal, with nausea, vomiting, abdominal pain, diarrhoea etc., though drowsiness and "neurologic dysfunction" have also been reported (Southcott 1996). It may be confused with the toxic Macrolepiota spp. (Bresinsky & Besl 1989). In Switzerland, Hydnum repandum ['hedgehog fungus'] is sometimes known to be intoxicating, although it is commonly held to be edible. In Japan, the genus Hydnum are known as 'yamabushi take' ['mushrooms of the mountain priests'] (Rätsch 1998). Another mushroom of the Hydnaceae, Sarcodon atroviridis, has been found to contain 4 *tryptamine*-derivatives which have so far not been identified (Wurst et al. 2002). S. imbricatum has been found to contain *tryptamine* and β-indoleacetic acid (Turowska et al. 1970). The European 'false chanterelle', Hygrophoropsis aurantiaca [Cantharellus aurantiacus], is "said to be edible but known to cause alarming symptoms [hallucination] in some cases" (Phillips 1981). One curious researcher ate 20 specimens without effect (Morgan 1995). Nothing is known of the chemistry of this species [see also **Hygrocybe** and **Hygrophorus**]. In India, the morel Morchella esculenta is considered an aphrodisiac and narcotic (Nadkarni 1976).

In Australia, Schizophyllum commune has been reported to be 'hallucinogenic' (Southcott 1974), though I have been unable to find the supporting reference for this claim. In s.e. Asia this species is sometimes consumed in soup as an edible fungus (Heim 1963b). Various strains of S. commune, as well as its culture medium, have yielded *isatin*, as well as other indoles indigotin [indigo], indirubin, schizocommunin and tryptanthrin as pigments (Epstein & Miles 1967; Hosoe et al. 1999).

Coprinus narcoticus, C. niveus and C. patouillardii have been included in lists of psychoactive mushrooms on the internet, though apart from general suggestions of a dosage in excess of 50 specimens, no further information is offered. C. narcoticus may have been included because of its suggestive specific name, though it appears that the species got its name from its 'strongly narcotic' odour, rather than from any knowledge of its pharmacology. I have no idea how the other two species came to be included on these lists. Some Coprinus spp. are known to cause non-psychoactive intoxication when consumed with alcohol (Bresinsky & Besl 1989). Heim tentatively included C. narcoticus as a psychotropic mushroom [under the classification "Mycétisme cérébral"] (Heim 1963b), though he gave no indication that this was due to anything other than the implications of its specific name. In Nepal, a Coprinus sp. known as 'gobre chyau' ['dung mushroom', a name also applied to Agaricus bisporus] is said by shamans to have mild psychoactivity, as are Omphalina aff. ericetorum ['kake chyau' ('crow mushroom')] and an Auricularia sp. ['shyamu' ('umbrella mushroom'), a name also applied to **Amanita** muscaria and mushrooms in general] (Müller-Ebeling et al. 2002).

C. atramentarius is reportedly used by some teenagers in s. Poland as a psychotrope. A dose of 30-50 fresh specimens [eaten] was reported to take effect within half an hour, resulting in visual and auditory hallucinations, dizziness, mydriasis and mumbled speech. The duration of effects was 2-5hrs (Kucharz et al. 1999). The mushroom has been shown to contain *tryptamine* [c.0.0027% in specimens from Rhode Island, US], *tryptophan* (Worthen et al. 1962), arginine, histidine, urocanic acid, imidazoleethanol, imidazolepropionic acid and *imidazole-4-acetic acid* (List & Reith 1961). Some researchers have reported finding tetraethylthiuram disulfide [disulfiram; Antabuse™, a chemical used in treating alcoholics [inhibits aldehyde hydrogenase in liver, which is involved in alcohol metabolism]; other researchers have failed to isolate this compound (Worthen et al. 1962).

One case of psychedelic intoxication attributed to C. comatus was presumed to have been a misidentification, based solely on the unexpected nature of the effects for this species (Toro 2004). C. comatus has been shown to contain *tryptamine* [c.0.006% in specimens from Rhode Island], *tryptophan* (Worthen et al. 1962), ergothionine, spermine, herzynine, *histamine*, dimethyl-*histamine*, *phenylalanine*, *tyramine*, *choline*, *aspartic acid*, *glutamic acid*, *glycine*, *methionine* and other amino acids (List 1959). C. micaceus has been shown to contain *tryptamine*, *tryptophan*, *phenethylamine*, isoamylamine, hypoxanthine, citrulline, ergothionine, *choline* and other amino acids (List & Hetzel 1960; Worthen et al. 1962).

Also, a word of caution regarding the genus Galerina – the toxicity of some members of this genus [and their similarity to some psychedelic species] has been mentioned elsewhere (eg. see **Psilocybe**; see also Benedict 1972). However one species, G. steglichii, was recently shown to yield 0.21-0.51% *psilocybin*, 0.08-0.21% *psilocin* and 0.02-0.07% *baeocystin* (Rätsch 1998). This warrants caution, due to the very likely possibility of confusion with deadly species – it is thus strongly suggested that searches for visionary Galerina spp. be discouraged for any but experts. Dangerous

temptation may also exist within the genus Clitocybe. Clitocybe gallinacea has been reported to contain unidentified lysergic acid-like alkaloids [see **Claviceps**, **Ipomoea**] (Heim 1963b); it has also been claimed to be 'narcotic' and to contain imidazole-derivatives (Norland 1976), though no information was given to support these latter assertions. C. gallinacea is often considered a variety of, or synonymous with, C. candicans. C. subilludens mycelial culture has yielded *ergonovine*, *ergotamine* and other ergot alkaloids [see **Claviceps**] (Foote et al. 1953), though later analysis of fruiting bodies did not observe these alkaloids (Tyler 1961). Specimens from Texas yielded 0.18% atromentin, a terphenylquinone with smooth muscle stimulant effects (Sullivan & Guess 1969). This compound was also found in the mycelium, along with thelephoric acid (Sullivan et al. 1971). C. clavipes is known to cause toxicity when consumed with alcohol, in a manner analogous to the disulfiram-like reactions well known with Coprinus spp. [see above] (Cochran & Cochran 1978). The phosphorescent Clitocybe illudens is known to cause intoxications, with symptoms including "violent gastro-intestinal disturbances with vomiting and diarrhoea, accompanied by great prostration." Deaths have not been reported in humans, and recovery is complete after a couple of days (Ford 1910/1911b). C. sudorifica [C. illudens var. sudorifica] is toxic to animals, and has muscarine-like actions (Ford et al. 1913). Muscarine [see **Amanita** for a brief discussion] is found in some related Clitocybe spp., even when very old, such as C. cerussata [0.012%], C. dealbata [0.01-0.18%], C. hydrogramma, C. illudens [0-0.0075%], C. infundibuliformis [C. gibba], C. rivulosa [0.035%] and C. vermicularis (Benedict 1972; Clark & Smith 1914; Genest et al. 1968; Stadelmann et al. 1976).

Dictyophora phalloides [D. indusiata], an obviously phallic mushroom with a 'challenging' texture, has been ritually consumed [as the 'male'] with **Psilocybe** mexicana [the 'female'] for divination in the Chinantec region of Oaxaca. No indication was given of its effect, if any. There must be a good reason, as this is not a mushroom you'd eat without one! Clavaria truncata [Clavariadelphus truncatus] and Gomphus floccosus [Neurophyllum floccosum] are used in similar ways. In Thailand, D. phalloides is obscurely used in sorcery, as well as for purposes of murder by poisoning. In Madagascar, the Tanala and Betsimisaraka also use it in sorcery, as they do with Lentinus tuber-reginum – again, details as to this use are scant. The related Phallus impudicus has been claimed to possess aphrodisiac properties – however, this may relate merely to the provocative form of the fungus. It has also been used in TCM as an analgesic for rheumatic pain (Guzmán 1990; Heim 1963b; Hobbs 1995; Ott 1993), and has yielded *imidazole-4-acetic acid* (Buckingham et al. ed. 1994), *phenethylamine* and *tyramine* (Smith 1977a). D. phalloides has yielded dictyophorins A & B [which stimulate nerve-growth factor (NGF) synthesis], and monoterpene alcohols (Ishiyama et al. 1999).

In Peru, the Lamista recognise a "yellow lichen-like fungus which grows on damp dead tree trunks", known as 'ampy-callampa'. It is associated with a snake, and singing its icaro is said to act against witchcraft, cure snake bites, and reveal treasures. The use of the fungus is said to be "very difficult" (Luna & Amaringo 1991).

The Fang Bwiti of Gabon are known to have used a mushroom known as 'duna', 'dune', 'kuna', 'difinyi' and/or 'lifunyi' in their iboga-related rites, although they now associate it with witchcraft. It is a large fungus which grows on withered trunks of Pycnanthus angolensis [see **Tabernanthe**] and Schyphocephalium ochocoa. Some Gabonese tribes use the dried, powdered mycelium in magic rites (Samorini 1993, 1997a). The Yoruba of Nigeria are very familiar with their local fungi, and many species have mythological associations. In contrast to the Fang, they regard mushrooms growing on living trees as being poisonous. Yoruba medicine men use Coprinus ephemerus in the preparation of some magical charms. Various Termitomyces spp., edible fungi which grow in contact with termite nests, are also used in preparing charms or offerings, along with other herbal ingredients, to procure good luck. T. robustus may also be roasted with Ceiba pentandra bark [see *Methods of Ingestion*] and Adansonia digitata bark, the mixture being eaten periodically for divination. Yoruba hunters also chew a mixture of T. globulus, Aframomum melegueta ['alligator pepper'; 7 seeds] and Phyllanthus floribundus leaf [see above]. The masticated mixture is rubbed on the bow and arrow, or gun, whilst making incantations. This is meant to make the game "drowsy and easy to kill" (Oso 1975, 1977).

Other anecdotal evidence [of doubtful validity] exists regarding the indigenous use of psychoactive fungi in the Ivory Coast. One, called 'tamu' [or 'the mushroom of knowledge'], was claimed to have effects reminiscent of *psilocybin* inebriation [see **Conocybe**]; the other, 'mushroom of action' [no traditional name given], was claimed to possess effects reminiscent of those of **Amanita** muscaria (Samorini 1995b). It has also been reported that 'mushroom churches' [also known as 'hand-clapping', 'hand-beating' or 'vision-seeking' churches] are widespread in parts of w. Africa (Walters 1995-1996). Further details about the actual involvement of fungi are not known to me.

The reader may be aware of the 5,300 year-old mummy found in a glacier in northern Europe, who has been named 'Ötzi'. He had two polypore mushrooms attached to him by a leather cord – one of these has been identified as either the 'birch-polypore' Piptoporus betulinus or the 'larch-polypore' Lacriformes officinalis [the former has known medicinal properties (Hobbs 1995), and has tested weakly positive for alkaloids (Spilsbury & Wilkinson 1961)], but the unidentified species [or identity not divulged] was surprisingly found to contain 'LSD-like' alkaloids, leading to speculation on a shamanic use for the fungus. Such speculations have been disapproved of officially, and results of further analysis [and even the detailed results of the initial analysis] have not been made public (Rätsch 1998; Stamets 1999).

It appears polypores may have a more extensive sacred usage than previously known. In N. America, the Blackfoot and Cree, amongst others, used Haploporus odorus for 'sacred purposes', and believed it to give 'spiritual power'. Besides its medicinal uses [as a styptic for wounds], it has been burned as a smudge or incense, giving off an anise-like scent [see **Illicium**, **Pimpinella**]. This may be done to purify an area before sacred rituals. One Cree healer said that it "opens the door to the spirit world and allows me to see and hear the spirits". Beads made from this polypore have been found decorating ceremonial robes, and within medicine bundles (Blanchette 1997). Also widespread is the indigenous use of Phellinus igniarius, growing on birch trees [Betula spp.], throughout N. America, north from the northern Plains region. This polypore was, and still is, burnt to ash and rolled into quids with powdered tobacco [see **Nicotiana**] for chewing, smoking or snuffing, to give a 'powerful kick'. The polypore has also been reported to have been smoked alone for its effects. Finely-crafted containers are often made to store the fungus ash. In the past, the identity of the fungus used has been incorrectly reported as Fomitopsis pinicola and **Ganoderma** applanatum (Blanchette 2001). Fomitopsis officinalis [Fomes officinalis] has a long history of medicinal use, for a wide variety of ailments. It may sometimes cause nausea and purging, as well as CNS-depression. In TCM, it is recommended that one not take more than 1g per day (Hobbs 1995). It is known as 'bread of ghosts' by some indigenous groups of the n.w. coast of N. America, and has been believed to be endowed with spiritual powers. The sporophores were carved into spirit figures, to act as guardians for the graves of shamans, or to facilitate healing ceremonies by acting as protective spirit totems. Unidentified polypores are reported to have "echo-making powers" by indigenous inhabitants of Vancouver Island [and the adjacent mainland]. "Some Ditidaht [Nitinaht] families who owned the right to tree fungus protective powers could use the fungus to reflect any evil or malicious thought directed towards members of the family back to the person who sent them" (Blanchette et al. 1992). Fomes pini has yielded *hordenine* (Smith 1977a).

Laetiporus sulphureus [Polyporus sulfureus; 'chicken mushroom', 'sulfur shelf'] is a mushroom usually considered edible in the US, though inedible in Britain, where some poisonings have occurred – causing nausea, abdominal pain and dizziness. In Canada, it has been recorded as causing a colourful psychedelic inebriation in a 6-year old girl. It is thought such a phenomenon may be an example of the great variability of individual response to various fungi and other foods (Appleton et al. 1988). It may be that psychoactive compounds derive from other smaller fungi growing on the fruiting body of the larger, more visible host. This may have been so in at least one other case of L. sulphureus poisoning, which was reported to have resulted in what were described as mild 'LSD-like' symptoms (http://www.bio.net/hypermail/MYCOLOGY/9805/0026.html). In Nepal, as 'kukhure chyau' or 'shakti chyau', it is sometimes used for shamanic travel (Müller-Ebeling et al. 2002). This species has been shown to contain *tyramine*, N-methyl-*tyramine*, *hordenine* [though one sample did not contain these alkaloids] (Lee et al. 1975), *phenethylamine*, isoamylamine, colamine, hypoxanthine, trigonelline, homarin, *choline*, *glutamic acid*, *glycine*, *methionine*, *phenylalanine*, alanine, adenine, arginine, asparagine, cystine, cysteine, histidine, leucine, lysine, proline, threonine, γ-butyrobetaine (List & Menssen 1959a, 1959b) and *imidazole-4-acetic acid* (Buckingham et al. ed. 1994). Another polypore, Meripilus giganteus, also contains *tyramine*, N-methyl-*tyramine* and *hordenine*, and has been known to cause "dizziness and disorientation" (Guzmán et al. 2000). In Nepal, a Polyporus sp. known as 'shakti chyau' is eaten by Sherpa shamans to obtain shamanic power (Müller-Ebeling et al. 2002).

Ustilago maydis [U. segetum], 'corn smut' or 'cuitlacoche', is a fungus parasitic on corn [Zea mays - see above], very similar in appearance to **Claviceps** gigantea, which also grows on corn [U. zeae is a similar species which also grows on corn]. The distasteful-looking sclerotium is eaten as a nutritious food in Mexico, and has been used traditionally by some N. American peoples in small doses as an abortifacient, uterine stimulant, and to stop post-partum bleeding. It has also been used in TCM as a tonic for the liver, stomach and intestines. Roughly a century ago, it was briefly used by westerners in N. America and Europe for the same purposes; its use was discontinued because although safer than **Claviceps**, its action was weaker and less reliable. On occasion, U. maydis has been noted to be a "cerebral stimulant, with attendant narcotic and hallucinogenic ef-

fects". Overdose can cause loss of hair, abortion, convulsions and sometimes death (Buhner 1998; Hobbs 1995). It seems probable that there is widespread variation in the alkaloid content of different strains. Earlier in the 20th century, researchers isolated alkaloids that appeared to be related to those found in ergot [see **Claviceps**] – ustilagine [stimulates uterine contractions and smooth-muscle; compared with ergotinine] and ustilagotoxin [compared to 'ergotoxin'], as well as 4 uncharacterised compounds, ustimaidines A-D (Heim 1963b). 6-MeO-benzoxazol-2-one has also been isolated (List 1960). In Yugoslavia, intoxications from consuming corn parasitised with this fungus have been observed in children, and dubbed 'infantile ustilaginism'. U. tritici has caused death in laboratory animals (Heim 1963b).

Mould fungi have been suggested to be responsible for a variety of unusual symptoms related to prolonged exposure to old books and musty, dank libraries. Headache is most commonly reported, though inhalation of the spores of some moulds could possibly induce 'hallucinations' or other psychotropic activity, with sufficient chronic exposure. In a whimsical and simplistic summation, mycologist R.J. Hay wrote that "the source of inspiration for many great literary figures may have been nothing more than a quick sniff of the bouquet of mouldy books" (Hay 1995). Of course, inhalation of mould spores is, in general, a very risky practice that can lead to serious health problems (eg. see Etzel 2002, and **Aspergillus**). Psychotropic moulds have also been suggested as a possible causal factor behind the perceptive phenomenology of 'haunted houses' (Goodman 1995; de Rivaz 1995).

Recently, health concerns have arisen in the US related to widespread mould growth in water-damaged buildings [often using poor quality building materials]. The mould most commonly found in these situations has been Stachybotrys chartarum [S. atra]; it produces trichothecene toxins [including satratoxin, trichodermol and trichodermin], as well as phenylspirodrimanes and stachybotrylactones. The trichothecenes and the phenylspirodrimanes suppress immune function, amongst other things. Symptoms of inhalation include chronic fatigue, cough, sore throat, tightness in the chest, nose bleeding, dyspnoea and mild fever. It is suspected of having caused pulmonary haemorrhage in infants. Memnoniella echinata has also been found growing in these situations, sometimes with S. chartarum; it has been found to produce the trichothecenes trichodermol and trichodermin, as well as griseofulvins (Etzel 2002; Jarvis et al. 1995, 1996; Johanning et al. 1996).

One biochemist, William Sherwood, experienced unusual mental alterations after exposure to a treated extract of the mould Neurospora crassa. A substance isolated from the mycelium, dubbed 'BGE' [thought to be β-OH-pseudo-*tryptophan*], had been cyclised by exposure to an acid, to form an eseroline compound, which when heated with a base emitted fumes which were accidentally inhaled on several occasions. Sherwood described his experiences – "The first symptom which I mentioned of inhaling the fumes was a sudden, severe headache. This lasted but a short time and was followed by a feeling of deep remoteness. I began to walk aimlessly. I did not speak. Sometimes I merely sat and stared at my laboratory notes. The simplest physical manipulations became impossibly difficult. I thought the same thought over and over, repeatedly. I felt unable to communicate with others. When forced to speak to others, including members of my own family, I felt anger or hostility. When I did speak, I felt that another person, whom I called to myself, 'the Outside Talker', was speaking, rather than I. I never felt that anything was wrong with me, but that I was different from all others. I could not recognize that anything was wrong with me – but others, of course, did. My wife finally concluded that I was, upon these occasions – and each episode lasted for several days – insane, and she blamed it directly on my work at the laboratory." Later he found that the intoxication could be reversed by taking 100mg of Frenquel, a piperidyl drug (Sherwood 1957). A mutant strain of this species, N. crassa '47904', has been found to accumulate *2-dimethylaminoethanol* (Honegger & Honegger 1959).

It is interesting to note that chloroform, an inebriating volatile solvent, may be produced by some fungi and released into soil air. Species shown to achieve this biosynthesis include Agaricus arvensis, a Bjerkandera sp., Caldariomyces fumago, **Mycena** metata, Peniophora pseudopini and Phellinus pini (Hoekstra et al. 1998). Rickenella straminea, a mushroom related to the genera **Mycena** and Gerronema [see **Mycena**], has been found to contain 0.1% *5-hydroxytryptophan* (Stijve & de Meijer 1993).

BEES, WASPS and SPIDERS

Interestingly, honey bees [Apis mellifera] contain some psychoactive chemicals in their stings. By dry weight, honey bee venom contains 0.13-1% *dopamine*, 0.1-0.7% *norepinephrine* [NE], 0.6-1.6% *histamine*, 0.8-1% *GABA*, 0.02% β-aminoisobutyric acid, 1% adolapin [analgesic] and 3% *apamin*. Other peptides are also found – 40-50% melittin, 1.4% procamines A & B, and others in lesser amounts. Enzymes are present, such as 1% acid phosphomonoesterase, 1.5-2% hyaluronidase, 1% lysophospholipase, 10-12% phospholipase A2 and 0.6% α-glucosidase. Glucose [0.7%] and fructose [0.9%] are also present. *Dopamine* levels rise rapidly to a maximum in 20-25 day-old bees; *NE* is highest in 40 day-old bees (Pick 1984; Shipolini 1984).

A close friend of mine recalled an incident where he had taken some LSD in a Botanical Garden, and part way through the trip he stepped on a bee [he was barefoot] which stung the sole of his foot. As well as experiencing the pain from the sting and its venom, he was surprised to notice his trip greatly potentiated at the same time (Gutterson pers. comm.)! I can only presume this was due to the injection of the compounds discussed above, synergising with the already present effects of the LSD in the nervous sytem of my friend. Others have claimed reaching a "kind of hallucinatory mild delirious state" from bee stings. Some people have been experimenting with 'apitherapy' [intentional stinging by honey bees for therapeutic purposes] to treat arthritis and other complaints – reported effects include analgesia and feelings of well-being (pers. comms.).

Bees, of course, can not be ignored for their honey! Besides the intoxicating honeys that can be produced by the concentration of plant toxins from the pollen and nectar that are collected by the bee (see Ott 1998a; Palmer-Jones 1965), honey has a mild 'narcotic' action (Nadkarni 1976), and is highly nutritious and medicinal when unfiltered and unheated. The medicinal virtues vary depending on the predominant plant species from which the honey is derived, though those demonstrated so far include immunostimulant, antibiotic, antiviral, antiallergenic, antiinflammatory, antianaemic, expectorant, laxative and tonic properties. And, of course, honey may be made into mead, as it has been for thousands of years [see *Methods of Ingestion*] (Buhner 1998). Honey, 'royal jelly' and bee pollen are reputedly aphrodisiac (Rätsch 1990).

Neurotransmitter-substances are also found in wasp and hornet venoms [Vespideae]; wasp venoms may contain varying amounts of *serotonin*, *histamine*, *epinephrine*, *NE* and lesser amounts of *tyramine* and *dopamine*; hornet venoms may contain large amounts of *acetylcholine* (Nakajima 1984; Welsh & Batty 1963). The larvae and nests of the hornet Polistes mandarinus, and ashes of Vespa spp. wasp nests, are reputedly aphrodisiac (Rätsch 1990).

To the Tachi Yokut of s. California, the 'black widow' spider [Latrodectus spp.] is known as 'métsa' ['true, real, big, and powerful'], the same name they give to their shamans. They regard Black Widow as "the supreme dream helper of powerful shamans" (Groark 1996), though they have not been reported to ingest black widow venom in any way. Some spider venoms have potential for psychoactivity, though their use is definitely a risky, even desperate venture! The venoms generally are neurotoxic, causing extreme excitation in the central and peripheral nervous sytems. The most notable example is Latrodectus venom, which causes an explosive release of *acetylcholine* from cholinergic neurons, followed by a depolarisation blockage of all nicotinic receptors. Physiological effects include extreme pain, muscle spasms, profuse sweating, extreme nervousness and anxiety, the feeling of 'going mad', cell necrosis, and injuries of the liver, kidneys, spleen, lymph nodes, thymus and adrenals. Death can result from respiratory paralysis. Venom from L. mactans has been shown to stimulate the release of met-*enkephalin*-like substances in in vitro rat tissue. Other spiders bearing such neurotoxic venoms include Theraphosa spp. [so-called 'tarantula'], Phoneutria spp., Trechona spp., Atrax spp. ['funnel-web spiders'], and Harpactirella spp. (Bucherl 1971b; Geren & Odell 1984; Janicki & Habermann 1983; Kruk & Pycock 1983). *Serotonin* is found in the venoms of Acanthoscurria spp., Lasiodora spp., Lycosa spp., Pamphobeteus spp., Pterinopelma spp. and Phoneutria spp. (Welsh & Batty 1963). The 'Sydney funnel-web' spider, Atrax robustus, yields interesting chemicals from its venom – the female secretes traces of *5-methoxytryptamine*, and the male secretes *serotonin*; both venoms also contained *tyramine*, octopamine, spermine, spermidine, *glycine*, glycerol, *GABA*, glucose, citric acid, lactic acid, phosphoric acid and urea, as well as the potent atraxotoxin. The female secretes more venom, though the male is more toxic (Duffield et al. 1979; Geren & Odell 1984).

Of some dubious interest is the phenomenon of 'tarantism' or 'tarantismo', originating and primarily observed in Taranto, Apulia, s. Italy, and said to be related to venomous bites from 'tarantulas'; however, in this region all poisonous or scary-looking spiders are regarded as kinds of tarantula [American tarantulas are different again]. Tarantism occurs in summer each year [when the spider venom is believed to be most toxic], affecting many people who may or may not have actually been bitten by a spider. They may appear stupefied or manic, or complain of a variety of symptoms; as quickly as possible, musicians and a crowd gather, as the musicians play melodies known as 'tarantellas' which build to a frenzy [tarantellas are also formalised folk tunes accompanied by courtship dances, and have also appeared in ballet and classical music; these originated in Naples and are unrelated to the phenomenon discussed here]. The music incites the 'bitten' person/s to dance excitedly until collapsing, and later the process repeats. The dancing is thought to help affect a cure by moving the poison out of the system, although once bitten, tarantism may recur each following year without a further bite; other treatments, including bloodletting, have been recorded for the condition, though dancing to this specific kind of music is the primary method. As interesting

all of this sounds, it has fairly been explained as a case of culturally-specific mass hysteria rather than being actually due to spider bites [at least in the majority of cases - sometimes necrosis at the site of the bite is reported alongside other symptoms, suggesting that sometimes a real spider bite is involved]. It is likely that the phenomenon arose as a continuation of similar dances associated with the cults of Bacchus and Cybole, established prior to Christian rulers taking control of the region, which was once part of the Greek empire; in this way, villagers could continue their practices under the guise of curing tarantula bite [or scorpion bite, which was believed to result in the same effects and require the same treatment]. Others believe it to be due to heatstroke and drinking too much wine in the sun [this is the hottest region of Italy], although it would be odd to encourage dancing in order to cure heatstroke. Regarding the identity of spiders believed to be involved in real or imagined cases of spider bite, the 'wolf spider' Lycosa tarantula was said to be the main spider responsible, although it is now known to have a fairly harmless bite. The 'malmignatle', Latrodectus tredecimguttatus [L. mactans tredecimguttatus; 'Mediterranean black widow'], is probably the actual culprit if there is one (Russell 1979); its venom contains α-latrotoxin [LD50 in mice (s.c.) - 0.02μg/g], which stimulates *norepinephrine*, *dopamine* and *GABA* release and depletes *acetylcholine* (Geren & Odell 1984). A S. American tarantula, Psalmopoeus cambridgei, has yielded the peptide psalmotoxin 1, which has potent analgesic activity linked to indirect activation of *enkephalin* pathways (Mazzuca et al. 2007).

Many years ago I received a report of an individual of an experimental nature who smoked 'red-back spider' venom [Latrodectus hasselti; L. mactans hasselti], resulting in temporary paralysis and an altered state of consciousness reminiscent of an anti-cholinergic syndrome [eg. see **Datura**] (pers. comm.). Remarkably, or ridiculously, some people claim to have smoked spider webs for psychotropic effects, if Time magazine can be taken seriously – "given a receptive state of mind, it is possible to turn on with practically anything – or virtually nothing. Witness the fact that some undergraduates, dissatisfied with mellow yellow [see **Musa**], are already beginning to tout the high potentiality of yet another new ingredient: spider webs" (Moore 1967).

GIANT CENTIPEDES, MILLIPEDES and SCORPIONS

Centipedes of the genus Scolopendra are capable of inflicting venomous bites on humans, which act partly on the CNS, and also cause toxic effects. Symptoms include great mental anxiety, dizziness, vomiting, irregular pulse, headache, local pain and inflammation. S. viridicornis venom acts powerfully on the nervous system, stimulating glands with smooth muscle, accelerating respiration, and causing loss of equilibrium, sweating and vomiting; death may sometimes occur following convulsions and respiratory paralysis (Bucherl 1971a). This symptomology is similar to that induced by cholinergic neurotoxins found in spider and cobra venoms [see above, and **Naja**]. The biting apparatus have yielded 0.00087% *serotonin*, though the venom itself would contain much higher concentrations (Welsh & Batty 1963).

S. subspinipes ssp. multidens is used in TCM as 'wu-kung' [also 'tien-lung' or 'pai chiao']; it is considered pungent, warm and poisonous, acting on the liver meridian. The dried, powdered body is given in doses of 1-2.5g to treat convulsions, tetanus and snakebite; it is antispasmodic and antibacterial, as well as contributing some hypotensive activity. The centipede contains c.70% protein substances, and two toxic substances with histaminergic and haemolytic activity (Hsu et al. 1986). *Histamine* itself has also been found in the venom of S. subspinipes and S. oraniensis ssp. institania (Numata & Ibuka 1987). A Scolopendra sp. taken in wine is reportedly an aphrodisiac (Rätsch 1990). In Thailand, unidentified species of giant centipede are sometimes soaked in 'mekong whiskey', and the tincture drunk as an aphrodisiac; it is also reputed to have toxic properties (pers. comm.).

Madagascan brown lemurs [Eulemur fulvus] have been observed using unspecified millipede species as a probable psychotrope and medicament. The lemurs will take a single millipede, place it in the mouth, and bite it gently, prior to rolling it across the skin and fur for apparent antiparasitic and insect-repelling properties. Presumably from absorption of millipede toxins through the mouth, the lemurs display "an expression of blissful pleasure" for c.20 minutes. "As it applies its medication, the lemur drools copiously and its eyes glaze over." In S. America, 'wedge-capped capuchin' monkeys [Cebus olivaceus] use millipedes in the same manner, with the additional detail that "up to four capuchins may share a millipede, passing it around like a marijuana cigarette" (Downer 2002). 'Owl monkeys' [Aotus trivirgatus] have also been observed in captivity [in Florida] using millipedes in a similar way, biting them and then rubbing the insects on the fur of their backs. The monkeys were observed to writhe around in apparent excited bliss; with milder intoxications, "their eyes glaze over and they're completely focused on what they're doing". In this latter case, the millipedes were identified as Anadenobolus monilicornis, possibly accidentally imported on plants or fruit from the West Indies or S. America (Ovalle 2002).

Some millipedes secrete their deterrent toxins as droplets from granular pores when harassed. Such secretions may be irritating [such as the pyrrolidine alkaloid polyzonimine from Polyzonium rosalbum] (Numata & Ibuka 1987) or cause 'burning' and lesions when brought into contact with the skin or eyes [such as with secretions from Polyconoceras spp. (Salpidobolus spp.)] (Hudson & Parsons 1997; Radford 1975). Other secretions may simply repel predators due to an offensive odour, such as those from Ommatiulus sabulosus, which contain toluquinone, and repel mice. Toluquinone has been found to decrease the pain threshold in mice (Capone et al. 2002). Buzonium crassipes secretes chemicals which repel ants, including β-*pinene* [35%], limonene [6%] and the alkaloid buzonamine [59%] (Wood et al. 2000); this is also the case with Eucondylodesmus elegans, which secretes (1E)- and (1Z)-2-nitroethylenebenzenes (Kuwahara et al. 2002). Some millipedes, such as Floridobolus penneri, secrete benzoquinone derivatives (Attygalle et al. 1993), and some [such as Glomeris marginata] secrete piperidine alkaloids such as glomerin and homoglomerin (Numata & Ibuka 1987).

Unidentified scorpions were recently reported to be used as a psychotrope by heroin addicts in Quetta, Pakistan. One user reported sun-drying the tail stings, before grinding and smoking them – he further remarked that "when I smoke scorpion, then the heroin is like nothing to me" (Reuters 2001)! Scorpion venom itself can be dried to a greyish powder, which remains potent for years if stored in refrigeration. Scorpions were often represented on monuments of the ancient Egyptians, and were also prominently depicted on monuments relating to the mystery cult of Mithras in n. Africa (Balozet 1971). One company has even begun marketing 'Scorpion Mezcal' [see Agave spp. and 'pulqué' in *Methods of Ingestion*], with an unidentified scorpion in each bottle, but the sting has been removed and thus the scorpion probably does not impart any psychotropic activity to the beverage (http://www.scorpionmezcal.com/mezcals/faq.shtml).

The dried, processed whole body of the Korean and Manchurian scorpion Buthus martensis is used in TCM as 'chuan-hsieh' or 'quan-xie'; the tail used alone is called 'hsieh-hsiao'. It is considered pungent, neutral and slightly poisonous, acting on the liver meridian. In doses of 1.2-6g, it treats convulsions, tetanus, hemiplegia, venomous bites, and controls pain. It has a weaker antispasmodic effect than the centipede, and is antifungal, nervine and strongly sedative, also causing vasodilation and inhibiting *epinephrine* release. B. martensis contains cholesterol, stearic acid, palmitic acid, lecithin, trimethylamine, betaine, *taurine*, buthoic acid and katsutoxin [buthotoxin], which has similar action to the neurotoxins in snake venom [see **Naja**] (Hsu et al. 1986; Keys 1976). Its venom is highly toxic. The haemolytic activity of its venom is in contrast to most other scorpions, stings of which do not cause haemolysis (Balozet 1971). B. tamulus [Mesobuthus tamulus concanensis] has caused frequent poisonings in India resulting from its sting – symptoms include restlessness, agitation, fear, hyperexcitability, disorientation, pain, hypertension, hyperthermia, tachycardia, pulmonary oedema and sometimes convulsions. The venom has shown anxiogenic activity in rats, as well as inhibiting MAO by *tribulin* activity; it appears to have a marked action on cholinergic and adrenergic receptors, and an indirect action on bradykinin, as well as increasing peripheral angiotensin levels (Bhattacharya 1995).

Wild scorpions generally produce more venom than captive ones. Scorpion venom consists mostly of proteins, and generally loses toxicity when treated with ammonia or iodine. Its toxicity is located primarily in the water-soluble fraction. Scorpion venoms are generally neurotoxic, with stings causing severe local pain [followed by a prickling sensation and then desensitisation], agitation, increased muscle tone with contractions, suppressed reflexes, crying, salivation, perspiration, mydriasis, impaired vision, arrhythmia, impaired respiration, hyperglycaemia, feelings of anguish, and sometimes fainting, vomiting and diarrhoea. In severe cases death may result from respiratory paralysis. Sometimes, there may be a relapse of symptoms after an apparent recovery. Even handling scorpions or inhaling the air over their enclosures can result in spasmodic sneezing. Venoms of many scorpion species, such as Buthotus minax, Centruroides gracilis, Leiurus quinquestriatus, Opisthocanthus cavaporum, Parabuthus hunteri, Tityus bahiensis, T. serrulatus, T. triniatus, T. trivittatus and Vejovis spinigerus, contain *serotonin*, which is responsible for causing the local pain of a scorpion sting but is not otherwise thought to contribute to the intoxication (Balozet 1971; Numata & Ibuka 1987; Welsh & Batty 1963). One person noted marked stimulation and mood-enhancement after being stung by a scorpion of the genus Centruroides the night before (C.S.C. 2002).

ANTS and ASSORTED 'BUGS'

There have been several reports of Californian 'Indians' ritually ingesting unidentified large, red ants for their psychoactive effects. Young men amongst native American groups in s. California, who are usually acquainted with **Datura** and **Nicotiana** as their main shamanic plants [Kitanemuk, Kawaiisu, Tubatulabal, Northern Miwok, Yawelmani, Wikchamni, Yawdanchi, Bokninwad, Yokod, Palewyami and Hokan-

speaking Chumash groups], sometimes ritually consume ants in vision quests to gain 'dream helpers'. These ants are actually regarded as being more powerful than **Datura** as a shamanic ally, and consuming them is a matter of individual choice, rather than an enforced initiation procedure. Different groups differ in the details of their procedures, though there are also many common elements. In winter [though some do it in summer], fasting and nightly vomiting are practiced for at least 3 days before the quest, particularly excluding salt, grease, meat and blood. During the day, the 'novice' is taken to an isolated and exposed place, and laid on his back. The appointed elder [the 'ant doctor'] feeds him live ants that have been collected on moist balls of eagle down, which are thoroughly swallowed in large quantity. Up to 90 or more such balls may be swallowed in a single session, each holding 5 or so ants. Bloodshot eyes and lassitude indicate a sufficient dose, upon which ingestion ceases. Shortly after, the ant doctor sneaks up on the novice and shakes him, to agitate the ants into biting, causing him to fall into a stupor for about 8-10hrs. After awakening, hot water is drunk to induce vomiting, the balls of down being regurgitated with the ants still alive [when ingested for curing, it may be taken as a bad sign if the ants are dead]. Occasionally, after awakening, more ants may be consumed, continuing the process for several days if required. Following the ritual, further dietary restrictions may be adhered to for some time, as well as behavioural restrictions including isolation and not speaking. The experience induces visions in a dream-like state, and aids in the gaining of 'supernatural powers' thought to be necessary for everyday survival.

The ants used have not yet been specifically identified, though Pogonomyrmex californicus ['California harvester ant'] seems to be the most likely candidate. There has been a report of the ritual consumption of yellow ants amongst the Tubatulabal, and if accurate, the ants in this case might be Myrmecocystus testaceus ['yellow honey ant']. Various red ants have also been used in smaller doses medicinally [internally and/or externally] to treat rheumatism, paralysis, body pain, stomach aches, heavy colds and some gynaecological disorders, in ways that reflect some facets of the ritual ingestions, though visions are usually not sought or received. All tribal groups who use ants ritually also use them medicinally, but not all who use them medicinally use them ritually. Californian 'ant ordeals', in which boys are made to lie over a disturbed ant nest until losing consciousness from the bites, seem to be unrelated to the ritual uses mentioned above, and were performed as "general preventative medicine which imparted strength, fortitude, and endurance" (Groark 1996). Interestingly, in 1967 [earlier than any published reports of ritual ant ingestion], the Californian band 'The Ant Trip Ceremony' released their album '24 Hours', complete with great psychedelic cover-art suggesting a possible knowledge of the ritual ant ingestions mentioned above.

In parts of the Peruvian Amazon, large ants known as 'isula' [possibly Paraponera clavata] are used in shamanic initiation (Luna & Amaringo 1991); unfortunately, I do not have access to further details, which are referred to Luna (1986) [Vegetalismo Shamanism Among the Mestizo Population of the Peruvian Amazon. Stockholm, Almquist & Wiksell Int.].

Interestingly, ants have been used as an aphrodisiac stimulant in wine, said to have been consumed by soldiers to give courage for battle. Large, sour-tasting ants were said to be the best to use in the preparations. One consisted of macerating 2 handfuls of ants in a gallon of wine for a month, before distilling and repeating the procedure 3 times with fresh batches of ants. Cinnamon [see **Cinnamomum**] was added to the combined distillates, and the oil floating on top removed. A second preparation used 1 handful of ants, 200 ant eggs, 100 wood lice and 150 bees [see above], macerated for a month in 2 pints of wine, which was then decanted and stored for use (Heydon 1662). An early issue of High Times magazine contained an article on smoking ants for psychotropic effects (friendly pers. comm.), though I lack further details. A more recent report stated that in Dubai, Bahrain, teenagers have been arrested for being intoxicated after "smoking ants or sniffing the fumes they emit when crushed" (Anon. 1997). In China, ants and ant extracts are known as 'ma yi' and are commonly taken daily [6-10g] as a tonic food and medicine, used to treat sexual disorders, rheumatoid arthritis, hepatitis, diabetes, pain, convulsions, asthma, cancer, anxiety and insomnia. They also stimulate the spleen, thymus and immune system, and may retard aging; toxicity appears to be a non-issue. The ants usually used are Polyrhachis spp. such as P. vicina and P. lamellidens [types of 'weaver ants'], and Formica fusca ['fuscous ant']; they are killed by steam before processing. Wild-harvesting appears to be driving these ants to extinction, making farming operations preferable as a source. These weaver ants may contain 42-67% protein, as well as amino acids, vitamins and minerals, with particularly high levels of zinc; F. fusca has also yielded formic acid, farnesene, isoxanthopterin, biopterin, 2-amino-6-OH-pteridine and aliphatic hydrocarbons (Chen & Alue 1994; Huang et al. 1999; Kou et al. 2005); F. rufa contains *norepinephrine* (Numata & Ibuka 1987). A bioassay of one 'red and black ant' extract was described as "very nice [...] clean, clear, energising but not overamping or jittery" (Trout pers. comm.).

Ant venoms are highly complex, and their chemistry is still relatively poorly known. As well as being useful in defense, constituents of ant venoms also sometimes serve as pheromones for communication purposes. Venoms of Pogonomyrmex spp. ['harvester ants'] are reported to be the most toxic insect venoms known, the most potent being from P. maricopa; ants from this genus are notorious for the intense, piercing pain resulting from their bites. They contain neurotoxic peptides, as well as haemolysins, and enzymes such as phospholipase A2, phospholipase B, hyaluronidase, lipase, acid phosphatase, and 4 esterases. Some species contain substances with kinin-like agonist properties, though P. badius did not contain any appreciable levels of kinin-like peptides [eg. bradykinin – see *Neurochemistry*] (Groark 1996; Schmidt & Blum 1978).

Piperidine alkaloids have been found in 'fire ants' [Solenopsis spp.], and some 'thief ants' [Solenopsis subgenus Diplorhoptrum] contain piperidines, pyrrolidines and indolizidines. Pyrrolidines and indolizidines have also been found in Monomorium spp. Some 'leaf-cutting ants' [Atta spp. and Acromyrmex spp.], as well as Tetramorium caespitum, Wasmannia auropunctata, Calomyrmex spp., Hypoponera opacior, Odontomachus spp. and Ponera pennsylvanica contain pyrazines. *Anabasine* has been found in the venoms of Aphaenogaster fulva and A. tennesseensis. Venom from Myrmecia spp. is rich in *histamine*. The indole skatole has been found in Acanthomyops claviger, Lasius aliensus, L. neoniger, Neivamyrmex nigrescens and Pheidole fallax (Numata & Ibuka 1987). Many ants have been found to contain potentially psychoactive cat-attracting lactones, previously known from **Nepeta** and **Actinidia** [also see above]. An Australian ant, Dolichoderus diceratoclinea scabridus, and an Argentinian ant Iridomyrmex humilis, contain iridomyrmecin; another Australian ant, I. nitidus contains isoiridomyrmecin as well as isodihydro-*nepetalactone*; a N. American ant, I. pruinosus analis contains iridomyrmecin; the 'common meat ant' I. purpureus contain dihydro-*nepetalactone* and iridomyrmecin; and the N. American 'odorous house ant' Tapinoma sessile contains isoiridomyrmecin (Numata & Ibuka 1987; Tucker & Tucker 1988). *Actinidine* has been found in T. erraticum and T. melanocephalum (Buckingham et al. ed. 1994).

In TCM, the cast-off skin of the 'cicada' Cryptotympana atrata is used as a sedative, anticonvulsant and hypothermic, properties which have been verified experimentally; sedative effects may be due to increased serotonergic activity and decreased catecholaminergic activity in the CNS (Hsieh et al. 1991). The cicadas Cicada sp. and Huechys sp. are also said to have aphrodisiac properties, as are some other insects not mentioned elsewhere, including Chrysomya sp. ['blow fly'] pupae, Cybister tripunctatus ['yellow fire beetle'], Dynastes hercules ['Hercules beetle'], Golofa aegon ['saw beetle'], Libellula spp. ['dragonflies'], Lytta vesicatoria ['Spanish fly' - see *Methods of Ingestion*], Meloë spp. ['oil beetles'; related to Lytta spp., and also contains cantharidin], Mylabris cichori and M. sidas ['ban mao', 'blister beetles'], Oryctes rhinoceros ['rhinoceros beetle'], Oxynopterus mucronatus ['fast beetle'], Phyllophaga spp. ['June bugs'; sacred to Freya, Germanic love goddess], Polyphaga plancyi ['tree bug'] and 'whirligig beetles' of the Gyrinidae (Rätsch 1990). 'Scarab beetles' [a.k.a. 'dung beetles'], Scarabaeus sacer, have been ritually consumed in Sudan by adherents of a supposed remnant Osiris cult (Emboden 1979b); it was not reported whether there was any pharmacological basis for this. In Garwhal, India, the 'plant-hopper' or 'lantern insect' Phromnia marginella has been used as an obscure narcotic (Reichel-Dolmatoff 1975).

In e. Namibia and Botswana, the Kung use pupae of the beetles Diamphidia nigro-ornata, D. vittatipennis and Polyclada flexuosa (Chrysomelidae) to prepare arrow poisons for hunting. The host plants for these pupae are Commiphora angolensis, C. africana (Burseraceae) and Sclerocarya caffra [see above], respectively. Commiphora spp. are used to produce the incense 'myrrh'. At least one Kung Bushman has been observed smoking the dried and pulverised pupae of one of these species with tobacco [see **Nicotiana**]; this person "fell into an inebriated and hallucinogenic state". These three species are sometimes parasitised by 'carabid beetles' of the genus Lebistina (Carabidae), which are reputedly more toxic than the pupae which they infest. For this reason, parasitised specimens are preferred for use in arrow poisons. D. nigro-ornata pupae have yielded diamphotoxin, a polypeptide which acts as a potent neuromuscular blocker and haemolytic, as well as showing some cardiotoxicity. In mice, 1.15μg/kg [i.v.] was lethal (De Smet 1998; Robertson 2003).

'Ladybirds' of the genus Coccinella have been claimed to be aphrodisiac (Rätsch 1990). At least one individual in the US has reportedly smoked crushed and dried shells of 'common ladybugs' [species or description not reported] for the "*morphine*-like" effects they produced (Trout pers. comm. [note – it was not Trout who actually did this!]). Though I would not encourage such a practice, and the person involved may have been an unreliable source of information, alkaloids have been found in the defensive secretions of some species of ladybugs/ladybirds. These secretions consist of droplets of blood containing deterrent chemicals. The secretions of Coccinella septempunctata ['common European ladybug'] have been found to contain coccinelline and precoccinelline. A homotropane alkaloid, adaline, has been found in Adalia spp. secretions, and the similar euphococcinine was found in secretions from Cryptolaemus montrouzieri ['Australian mealybug ladybird']. Other ladybug alkaloids include convergine, harmonine, hippocasine, hippodamine, myrrhine, n-octylamine and propyleine (Numata & Ibuka 1987).

In Arnhem Land, n. Australia 'bush cockroaches' [Cosmozosteria sp.] are used for analgesic purposes, producing a quick-acting "sensation of numbness" to relieve stings. The cockroaches are either crushed and rubbed on the skin, or they are heated over a fire and the juices dripped onto the skin (Low 1990). Many cockroaches contain uric acid, and pteridines such as xanthopterin, isoxanthopterin and 2-amino-6-OH-pteridine. *Dopamine* and *serotonin* have been found in the nerve cord of the American cockroach Periplaneta americana (Numata & Ibuka 1987).

Several different insects have been found to contain detectable levels of neurotransmitters and other substances of interest. A 'mealworm beetle' [Tenebrio moritor] contains *epinephrine*, *norepinephrine* and *dopamine*; housefly larvae [Musca domestica] also contain these compounds, as do 'earwigs' of the genus Forficula. The defensive secretions of the 'harvestman' [Sclerobunus robustus] contain mostly N,N-dimethyl-*phenethylamine*, as well as *nicotine* (Numata & Ibuka 1987). The 'mealy bug' Nipaecoccus aurilanatus contains *hypericin* (Buckingham et al. ed. 1994). Other insects, besides the ants mentioned above, have also been found to contain cat-attracting compounds which may be psychoactive. 'Rove beetles' of the genera Cafius, Creophilus, Gabrius, Hesperus and Philonthus produce *actinidine* in their defensive secretions; Creophilus maxilosus also produces dihydro-*nepetalactone*. Defensive secretions of the 'coconut stick insect' [Graeffea crouani] contain *nepetalactone* (Tucker & Tucker 1988). Various female aphids produce *nepetalactone*-derivatives as pheromones; mixtures of (4aS,7S,7aR)-*nepetalactone* and (1R,4aS,7S,7aR)-nepetalactol are found in the 'black bean aphid' [Aphis fabae], 'vetch aphid' [Megoura viciae], 'greenbug' [Schizaphis graminum], and Cryptomyzus galeopsidis, C. maudamanti and C. ribis; the 'damson-hop aphid' [Phorodon humuli] produces only (4aR,7S,7aS)-nepetalactol (Guldemond et al. 1993). Spines of the 'stinging caterpillar' Automeris sp. [possibly A. ilustris] have yielded 0.0235% *serotonin* (Welsh & Batty 1963).

MOTHS, BUTTERFLIES and THEIR LARVAE

The larva of the moth Myelobia smerintha (Pyralidae/Crambidae), known as 'bicho de tacuara' ['bamboo worm'], was consumed by the Malali of Brazil [Minas Gerais province] for several purposes. Usually, the head and intestinal-tube were removed, and the flesh either sucked out, or cooked over a fire into a greasy mixture, eaten as a delicacy. They may be dried and powdered to speed the healing of wounds. Most interestingly, they were eaten [dose – 1 grub] dried with the 'poisonous' head [but not the intestinal tube] removed as an ecstatic narcotic, causing a sleep-like state with vivid imagery lasting more than a day. The grubs are found in flowering bamboo [see above] stalks [Guadua sp., Merostachys neesii, M. rideliana, Nastes barbatus], feeding inside the internodes, and were gathered when full size, shortly before metamorphosing (Britton 1984; Saint-Hilaire 1824). Descriptions of it may be found in Dusenia 12(3):73-94(1980), 14(3):95-111(1984) and 14(4):161-173(1984). Presumably the larvae accumulate psychotropic compounds from the bamboo on which they feed. Butterfly larvae of the Lepidoptera have been known to do just this with phytochemicals from other host-plants – such as the grubs of Battus philenor [aristolochic acid], Danaus chrysippus, D. plexippus [cardenolides][see below], Pachlioptera aristolochiae [aristolochic acid] and Papilio antimachus [cardenolides]. Some secrete their own toxins, such as Arctia caja [β,β-dimethylalcrylvyl-*choline*], Callimorpha jacobaeae [*histamine*], Utethesia bella [β,β-dimethylalcrylvyl-*choline*] and Zygaena spp. [hydrocyanic acid] (Rothschild et al. 1970). *Histamine* has been found in moths of the genera Euproctis, Bataraea, Dirphia, Latoia, Megalopyge and Monema (Numata & Ibuka 1987).

Many people will be aware of the widespread belief that the worms ['gusano de mescal', actually larvae] found in many bottles of mezcal or mescal [a liquor distilled from Agave spp. - see *Methods of Ingestion*] have psychedelic properties. Some say you must drink the mezcal then eat the worm (pers. comms.); others say eating 2-3 worms is sufficient for a dose (Rätsch 1998). In Japan they are considered aphrodisiacs (Walker 2005). However, no psychoactive effects have been confirmed and it seems most likely that this modern mythological drug acts as a placebo for people who are already drunk and may have the false belief that mezcal is made from a *mescaline*-containing cactus (pers. obs.). The addition of the worms is not traditional, but has persisted largely because western consumers have come to expect it (Walker 2005). Actually, several different types of 'worm' are added to mezcal and then, only the cheaper varieties; top-shelf mezcal, and tequila - which is a specialised kind of mezcal made from a particular Agave spp. in a particular area of Mexico - contain no worm. The most commonly used are the moth larvae of Hypopta agavis (Cossidae), known as 'gusano rojo', 'chilocuil', 'chinicuil' or 'tecol', which feed on Agave spp.; they are also eaten by humans as food. Larvae of the 'Agave snout weevil' or 'picudo del Agave', Scyphophorus acupunctatus (Curculionidae), are occasionally added to mezcal; these larvae also live on Agave spp. and are eaten as a food, but they are a serious pest and damage the crops. There are other larvae that live on Agave spp. and are eaten by people, such as the larvae ['white maguey worms'] of the 'tequila giant skipper' butterfly Aegiale hesperiaris, but they are not known to end up in mezcal (http://en.wikipedia.org/wiki/Mezcal_worm and embedded links).

The silk pod of the 'silk worm moth' Bombyx mori is said to be aphrodisiac in India (Nadkarni 1976). In TCM, the silk worm moth itself is taken as a nerve stimulant and impotence treatment; the excrement of the larva is used as a sedative and analgesic (Keys 1976). B. mori larvae infected with the fungus Beauveria bassiana are used as 'jian can' in TCM, and act as a hypnotic, sedative, anticonvulsant and spasmolytic (Huang 1993). B. mori feeds on **Morus** spp., and accumulates some of the alkaloids from these trees; B. mori feeding on M. alba was shown to contain 0.188% 1-deoxynojirimycin, 0.0125% fagomine, 0.0021% 3-epi-fagomine, 0.0065% 1,4-dideoxy-1,4-imino-D-arabinitol and 0.0041% 1,4-dideoxy-1,4-imino-(2-O-β-D-glucopyranosyl)-D-arabinitol (Asano et al. 2001); 3-OH-L-kynurenine [see *Neurochemistry* for kynurenine] has also been isolated from B. mori (Tokuyama et al. 1967), as well as kynurine, xanthurenic acid, 4,8-dihydroxyquinoline, dimethylamine, putrescine, spermidine, and a range of pteridines (Numata & Ibuka 1987).

Several people in New Zealand have reported an unusual practise – the consumption of the left wing of a 'monarch butterfly' [Danaus plexippus], for an experience described as "like a mushroom/acid trip that lasts about 20min." (pers. comm.). The truth of these claims would seem to be dubious at best – the insistence on the use of only the left wing, and the claim that only one wing is consumed, are the most obvious points to raise suspicion. However, these reports should not be ignored out of hand – they may turn out to be true! Nevertheless, I would not encourage the maiming of innocent butterflies in order to find out.

D. plexippus usually feeds on Asclepias spp., and contains 3-alkyl-2-MeO-pyrazines as odour compounds. Danaus spp. males have also been found to contain the pyrrolizidine alkaloid danaidone, and the aldehydes danaidal and 3-OH-danaidal, in their wing pockets; danaidone acts as an aphrodisiac pheromone during courtship. For this purpose, the butterflies first dip their abdominal scent organs ['hair pencils'] into the wing pockets to obtain a coating of danaidone. The danaidone, and related compounds, are thought to be biosynthesised from pyrrolizidine precursors ingested from their plant diet, such as lycopsamine, from Heliotropium spp. (Numata & Ibuka 1987). Wings of some butterflies [eg. **Heliconius**, Ithomiinae] have been found to contain the pigment 3-OH-L-kynurenine (Tokuyama et al. 1967), which might have psychoactive effects [see *Neurochemistry*]. Buckingham et al. ed. (1994) erroneously reported these butterflies to contain kynurenine yellow [1,2,3,4-tetrahydro-4-oxo-2-quinolinecarboxylic acid], instead. Wings of butterflies commonly contain pteridine alkaloids. Larvae of the butterfly Vanessa urticae contain *dopamine* and *norepinephrine* (Numata & Ibuka 1987). The butterfly Papilio xuthus contains 5-MeO-*N*-*methyltryptamine* in its oviposition-stimulating complex (Buckingham et al. ed. 1994). See also **Acraea** and **Heliconius**.

MARINE LIFE

Many marine life-forms are being found to bear some interesting alkaloids and other chemicals. Here we will look at a few which contain β-carbolines, *tryptamine*s, or other compounds of potential psychoactivity.

Astroides calycularis (Anthozoaceae) from the Bay of Naples has yielded *tryptophan*-derivatives such as aplysinopsin, 6-bromoaplysinopsin, and their N-propionyl derivatives (Fattorusso et al. 1985).

A Bryopsis sp. (Bryopsidaceae) 'hair algae', associated with marine reefs and used in aquariums, has yielded 5-bromo-*DMT* and 5,6-dibromo-*DMT* (Kochanowska et al. 2008).

Conus spp. (Molluscidae), marine snails known as cone shells and associated with reefs, paralyse their prey with highly toxic venom. These venoms have been found to produce interesting polypeptides with therapeutic potential. One such compound undergoing human clinical trials is omega-conotoxin MVIIA [Ziconotide, Prialt and SNX-111 are some commercial names] from C. magus, used to treat chronic pain. It acts as a voltage-sensitive N-type calcium channel blocker. Though more effective than *morphine* as an analgesic, it must be administered intrathecally [into the meninges of the spinal cord; usually 1 microgram per hour], and higher doses give rise to side effects such as nausea, vomiting, dizziness, confusion, delirium, amnesia, hallucinations, 'psychosis', impaired concentration, slowed thinking, tunnel vision, sedation, nystagmus, constipation, urine retention, abnormal gait and hypotension. On the positive side, it does not produce respiratory depression, tolerance or withdrawal symptoms, and has a wide margin of safety (Charapata & Ellis 2002; Levin et al. 2002; Taqi et al. 2002; Wang & Bowersox 2000; Webster, L. et al. 2001). Recently, conotoxin Vc1.1 [named ACV1 for commercial development] was isolated from C. victoriae (Livett pers. comm. 2003) and found to act as an analgesic more potent and of longer duration than either *morphine* or other known conotoxins, as well as accelerating tissue repair in damaged nerves. Further advantages are that it showed no adverse effects in rats over 12 weeks, and can be adminsitered i.m. It acts as an antagonist of nicotinic *acetylcholine* receptors (Brown 2002; Sandall et al. 2003; Satkunanathan et al. 2003). The varying affinities of some cono-

toxins for nicotinic receptor subtypes should aid in learning more about such subtypes, which are still little-known (Nai et al. 2003). C. textile has been found to contain novel conotoxins, epsilon-TxIX and Gla(1)-TxVI (Kalume et al. 2000), as well as peptides named contryphans (Jiminez et al. 2001). C. lynceus has been found to contain the peptide conantokin-L. Conantokins are NMDA receptor antagonists and act as powerful anticonvulsants (Jiminez et al. 2002).

Costaticella hastata (Bryozoaceae) from Tasmanian waters has yielded 0.11% alkaloids, consisting of 0.016% *harman*, 0.006% 1-ethyl-β-carboline and 0.006% 1-(1'-hydroxyethyl)-β-carboline; another collection yielded 0.051% *harman*, 0.0048% 1-ethyl-β-carboline, 0.002% 1-(1'-hydroxyethyl)-β-carboline and 0.018% pavettine [1-vinyl-β-carboline] (Blackman et al. 1987).

Cribricellina cribraria (Bryozoaceae) from New Zealand waters has yielded 0.003% *harman*, 1-vinyl-β-carboline, 0.01% 8-OH-1-vinyl-β-carboline, 0.002% 1-ethyl-4-methylsulfone-β-carboline, 0.058% homarine and 1-ethyl-β-carboline (Prinsep et al. 1991).

Dendrodoa grossularia (Styelidae), a 'tunicate', has yielded 5 indole alkaloids – dendrodoine, 3-indolylimidazol-4-one, grossularine-1, grossularine-2, and an unnamed alkaloid (Loukaci et al. 1998).

A Didemnum sp. (Didemnidae), another tunicate, has yielded *norharman*; D. candidum yielded 0.015% 6-bromo-*tryptamine*, as well as 0.023% 2,2-bis(6'-bromo-3'-indolyl)ethylamine and 0.01% 2,5-bis(6'-bromo-3'-indolyl)piperazine (Fahy et al. 1991).

Eudistoma fragum (Ascidiaceae), a 'sea squirt' from near New Caledonia, has yielded 0.02% 5-bromo-*DMT* and 0.01% woodinine [6-bromo-1-(N-methylpyrrolid-2-yl)-1,2,3,4-tetrahydro-β-carboline] (Debitus & Laurent 1988).

Eudistoma glaucus has yielded 1,2,3,4-tetrahydro-β-carboline and some of the compounds found in Eudistoma olivaceum, which has yielded a wide array of β-carbolines called eudistomins, some of which have been shown to possess antiviral properties (Blunt et al. 1987; Kobayashi et al. 1984; Rinehart et al. 1984).

Flustra foliacea (Bryozoaceae), 'hornwrack', has yielded [w/w] 0.005% flustrabromine [6-bromo-2-(1,1-dimethylallyl)-N-formyl-*N-methyltryptamine*], 0.002% 6-bromo-N-methyl-N-formyltryptamine, 0.005% flustramine A [a physostigmine-derived bromo alkaloid], flustramine C, flustraminols A & B, and 7-bromo-4-(2-ethoxyethyl)quinoline (Wulff et al. 1981, 1982a, 1982b). It is found worldwide in waters below 25m, as greenish-brown branching colonies adhering to broken shells and coral moss (Grzimek 1974).

A Lissoclinum sp. (Didemnidae) has yielded 6-bromo-*tryptamine*, and L. fragile has yielded 1-(indol-3-yl)-3,4-dihydro-β-carboline (Shulgin & Shulgin 1997).

Noctiluca miliaris (Dinoflagellidae/Noctilucaceae), a 'dinoflagellate', has yielded *harman* and *norharman* (Shulgin & Shulgin 1997).

Pachymatisma johnstoni (Geodiidae) from near Britain has yielded 6-bromohypaphorine [6-bromo-N,N,N-trimethyl-*tryptophan*], *tryptophan*, thymine, uracil, cholest-4-en-3-one and 24-methylenecholest-4-en-3-one (Raverty et al. 1977). See **Erythrina** for discussion on the potential uses of hypaphorine.

Paramuricea chamaeleon (Paramuriceidae) ['violet horny coral'], a 'sea fan' from the Bay of Naples 20m and below, yielded *tryptamine*, *serotonin*, 0.0025% *DMT*, 0.005% *bufotenine* and 0.015% *N-methyltryptamine* (Cimino & De Stefano 1978), as well as 0.045% *caffeine* (Imre et al. 1987). It is large [1m] and multicoloured, from carmine-red, to violet to bright yellow (Grzimek 1974).

Pseudoactinia flagellifera and P. varia (Annelidae) ['sea worms' or 'anenomes'] have yielded an unidentified 5-hydroxy indole (Christopherson 1985).

A Raspailia sp. (Raspailiidae) [a New Zealand 'sea sponge'] has yielded clerodane diterpenes [see **Salvia**], raspailol and raspailenone (West et al. 1998).

Securiflustra securifrons (Bryozoaceae) has yielded unidentified bromoindoles, as has Chartella papyracea (Christopherson 1985).

Some Thorecta spp. (Demospongiae) and Verongia spp. (Verongiidae) [sea sponges] have yielded the indole N-methylaplysinopsin, which is an antidepressant and short-term competitive MAOI (Christopherson 1983; Fattorusso et al. 1985). V. cauliformis and V. fistularis have yielded 2,6-dibromo-4-acetamido-4-OH-cyclohexadienone, which has antibiotic properties (Baslow 1977).

Verongula gigantea (Verongiidae) ['giant marine horny sponge'], found near coasts in the Caribbean, has yielded 5,6-dibromo-*DMT* and aureol from one sample; others did not contain them at all, and they are believed to be of dietary origin. This species is usually known to produce bromo-tyrosine derivatives and other brominated compounds, such as the aeroplysinins and verongamine (Ciminiello et al. 2000). V. rigida from Key Largo, Florida, yielded 0.35% 5,6-dibromo-*DMT*, 0.00142% 5-bromo-*DMT*, 0.0154% aplysinopsin, 0.00094% 6-bromo-aplysinopsin [binds to 5-HT2 receptor subtypes], 0.00047% 5,6-dibromo-abrine, 0.00236% ilimaquinone, 0.00094% aureol, 0.00014% arborescidine C and 0.000047% makaluvamine (Kochanowska et al. 2008).

Villagorgia rubra [a 'sea fan' from New Caledonia] has yielded *tryptamine*, *N-methyltryptamine*, 1,2,3,4-tetrahydro-β-carboline [noreleagnine], *caffeine*, villagorgin A [anticholinergic] and villagorgin B; the villagorgins have structural similarity to *yohimbine* and corynantheine, as well as to eudistomin A (Espada et al. 1993).

It has been suggested that the Maya used molluscs of the genus Spondylus as a 'hallucinogen'. The Maya are known to have revered these molluscs to some degree; they are associated with Chaak, the rain god, and are "often found in graves and sacrificial depositories" by archaeologists (Grube et al. ed. 2001). Molluscs in general are associated with Aphrodite and the female reproductive organs, due to their physical form; as such, they are also widely credited with aphrodisiac properties (Rätsch 1990). Pearls from 'pearl mussels' such as Mytilus margaritiferus [Pinctada margaritifera] are reduced to ash in India and used as a strong stimulant, tonic and aphrodisiac. In TCM, they are used in doses of 0.4-1.1g as a sedative to treat insomnia, headache and convulsions. And, of course, oysters [Ostrea spp.] are eaten raw or cooked as an aphrodisiac. The shells of the 'sea ear' or 'abalone' [Haliotis gigantea] and the 'cowrie' [Cypraea macula] are used as sedatives (Keys 1976; Nadkarni 1976). C. pantherina, C. moneta and Haliotis spp. flesh has also been eaten as an aphrodisiac. Other molluscs credited with this property include Achatina sp. ['African snail'], Donax sp. [a clam], Crassostrega gigas [another kind of oyster], Helix pomatia [edible snail], Murex brandaris, M. truncata, Octopus sp. [octopus], Sepia sp. ['cuttlefish'], Strombus sp., Turbinella pyrum, and 'scallops' of the Pectinidae (Rätsch 1990). The opercula of sea snails or so-called 'conch shells' from the genera Ampularia, Chicereus, Fasciolaria, Murex and Turbinella ['true' conches being Strombus spp.] are used by Nepalese Brahmins in incense, known to the Kirati as 'kulkelengma' or 'narawi' [and known as 'onchya' and 'onyx' in the past]. They are regarded as a protectant. The incense is said to smell like burning hair on its own, "but adds an interesting note to a blend" (Müller-Ebeling et al. 2002).

The ovaries of various species of 'sea urchin' [Echinidae] have been eaten as aphrodisiacs of debatable efficacy. In Japan, as 'uni', they are used in sushi. These ovaries are often referred to as the 'roe' or 'eggs', which is not accurate (Rätsch 1990; Sushi FAQ 2008). Ovaries of Paracentrotus lividus have been found to contain small amounts of *anandamide* and related palmitoyl- and stearoyl-ethanolamides (Bisogno et al. 1997); in rabbits, the ovaries have caused "loss of reflexes, exophthalmos, micturition, lacrymation, dilatation, tonic and clonic convulsions, respiratory distress, muscular paralysis and death". Spines of sea urchins also contain little-known toxins. For example, in humans, a Toxopneustes pileolus sting can cause "severe pain, respiratory distress, giddiness, paralysis of the lips, tongue and eyelids, relaxation of the muscles in the limbs, difficulty in speech and loss of control of facial muscles", with the facial paralysis being the most long-lasting symptom [6 hrs] (Baslow 1977). Perhaps they contain tetrodotoxin, amongst other things?

Tetrodotoxin [TTX] is a potent neurotoxin, best known from 'puffer fish' such as Takifugu spp. ['fugu']. Fugu fish are a popular luxury cuisine, prepared by specially trained chefs who remove the toxic portions [ie. most of the fish] leaving just enough TTX to give the diner "tingling lips and a mild sense of euphoria", though mistakes can prove fatal (Booth 1988; Davis 1988b; Kodama et al. 1986). TTX can cause feelings of weakness, dizziness and anaesthesia; the tingling may spread from the lips to the extremities, and in acute intoxication there is often nausea, vomiting, sweating, salivation, respiratory difficulties and cyanosis; muscular paralysis and death can occur 6-24hrs after ingestion, with a sufficient dose (Baslow 1977). The related Tetraeodon [Tetrodon] fahaka, a freshwater Egyptian fish known as 'fahaka' or 'tambera', appears to have been venerated in the temples on Elephantine, an island in the Nile, until at least 2500-1500BC. The absence of bones of this species amongst fish bones found in the temples is thought to perhaps be due to careful disposal of the remains [if it was a sacred food], or the existence of a tabu on its consumption. This fish is known to be tetrodotoxic (Brewer & Friedman 1989). See also *Methods of Ingestion* for use of similar tetrodotoxic fish in zombi powders.

TTX has also been found in small amounts outside of this group of fish, such as in the 'marine flatworm' Planocera multitentaculata (Miyazawa et al. 1986), the 'starfish' Astropecten latespinosus and A. polyacanthus (Maruyama et al. 1984), the 'blue-ringed octopus' Hapalochlaena maculosa (Sheumack et al. 1978) and some amphibians [see below].

The poor 'sea horse' Hippocampus coronatus is used in TCM [dose 4-10g] as a tonic stimulant (Keys 1976), and members of the genus are reputedly aphrodisiac. Other sea creatures not yet mentioned which are said to have aphrodisiac properties include the red coral Corallinum rubrum, Solenognathus hardwickii ['sea dragon'; taken dried , in wine], Alburnus alburnus ['ukelei' fish], Barbus spp. ['barbel' fish], Diodon hystrix ['spotted porcupine fish' - see *Methods of Ingestion*; all parts used except liver and gall bladder], Siniperca chuatsi ['kuei', 'mandarin fish', 'Chinese perch', 'Chinese bass'], eels, carp gall bladder, and various crustaceans – Brachyura spp. [crab], Homarus grammarus [lobster], Natantia spp. [prawn], Palinurus vulgaris [crayfish] and Penaeus setiferus [shrimp] (Rätsch 1990).

AMPHIBIANS

Skins of two frogs, Litoria angiana ['kuuroorong'] and Phyrnomantis lateralis ['kuutuuk'], are consumed along with other psychoactive substances in the 11th and 12th stages, respectively, of Bimin Kuskumin initiation in Papua New Guinea [PNG] (Poole 1987). Phyrnomantis spp. are known as 'rubber frogs', and some species are known to exude toxic secretions, contact with which may cause rash, inflammation, pain, local paraesthesia, respiratory difficulty, headache, dizziness, tachycardia, diaphoresis and nausea (Pantanowitz et al. 1998). *Histamine* has been found in secretions of some Phyrnomantis spp. (Daly et al. 1987).

Litoria dentata [Hyla dentata] skin has yielded 0.075% *bufotenine*; L. pearsoniana [H. pearsoniana] skin yielded 0.075-0.7% *bufotenine*, with 0-0.035% bufotenidine [see **Bufo**, **Arundo**]; L. peroni [H. peroni] skin yielded 0.001-0.0015% *bufotenine*. *Bufotenine* is also found in the skins of L. adelaidensis [0-0.01%, as well as 0.03-0.12% bufotenidine, 0.015-0.06% *serotonin*, 0.0075-0.014% N-methyl-*serotonin*, and other indoles], L. chloris [0-0.002%] L. ewingi [0.087-0.23%, as well as 0.027-0.028% bufotenidine], L. gracilenta [H. gracilenta] [0.0025%], L. lesueuri [H. lesueuri] [0.0005%], L. rubella [H. rubella] [0.001-0.006%] and L. thesaurensis [0.0035%, as well as 0.035% bufotenidine] (Erspamer et al. 1966, 1976; Roseghini et al. 1976). Bufotenidine has also been found in the skins of L. angiana [0.0065%], L. booroolongensis [0.185%, as well as 0.05% *serotonin*], L. citropa [0.13%, as well as 0.16% *serotonin*], L. cyclorhynchus [0.08%, as well as 0.015% *serotonin*], L. glandulosa [0.6%, as well as 0.025% *serotonin*], L. latopalmata [0.003-0.019%], L. micromembrana [0.006%] and L. raniformis [0.16%, as well as 0.04% *serotonin*]. L. moorei skin has yielded 0.37-0.55% bufotenidine, 0-0.0008% *bufotenine*, 0.06-0.17% *serotonin*, 0.004-0.02% N-methyl-*serotonin* and 0.003-0.005% N,N,N-trimethyltryptamine (Roseghini et al. 1976), of unknown pharmacology. Synthetic 7,N,N-trimethyltryptamine has been shown to inhibit synaptosomal uptake of *serotonin* [and to a lesser extent, *norepinephrine* and *dopamine*] in rat brain (Glennon et al. 1978).

The common Australian green tree frog Litoria caerulea contains powerful peptides in its skin secretions. A single 'milking' by electrical stimulation of the parotoid glands produces a mixture of c.50mg peptides [20% caerulein, 10% of a mix of 6 different caeridins and 70% of a mix of 17 different caerins (mostly caerin 1.1)]. *Histamine* was also found in the skin [0.014-0.032%], as well as *serotonin* [0.018-0.05%]. L. gilleni has yielded caerulein, 3 caeridins and 12 caerins, as well as 0.006% *serotonin* from the skin. L. splendida has yielded c.70mg peptides per milking from its rostral and parotoid glands [c.23% caerulein, 36% caerin 1.1, 17% caerin 3.1, 7% caerin 2.1 and 3% caeridin 1]. Caerulein has analgesic effects, and acts potently on gastrointestinal smooth muscle, as well as affecting blood pressure (Erspamer et al. 1966, 1993; Roseghini et al. 1976; Stone et al. 1992, 1993; Waugh et al. 1993); it has been injected into schizophrenics in Japan, to alleviate psychotic symptoms for about 1 month (Morgan 1995; Tyler 1995).

Leptodactylus pentadactylus pentadactylus has yielded *histamine*, *tyramine*, 0.004% [of dry skin] candicine [4-OH-N,N,N-trimethylphenethylamine], large amounts of *serotonin*, leptodactyline [a phenolic quaternary alkaloid] (Erspamer et al. 1963) and 0.003-0.004% caerulein-like peptides. L. rugosus skin was found to be very rich in caerulein-like peptides [0.5%]. L. pentadactylus labyrinthicus has yielded 0.035-0.052% caerulein-like peptides (Erspamer et al. 1986), spinaceamine and 6-methylspinaceamine [see salamanders below], as well as *histamine*, N-methylhistamine, N-acetylhistamine and N,N-dimethylhistamine. L. laticeps also contains spinaceamine, as well as *histamine*, leptodactyline, *serotonin* and 0.07-0.1% caerulein-like peptides. L. pentadactylus dengleri has yielded 0.01-0.015% caerulein-like peptides, *histamine*, *serotonin*, bufotenidine, leptodactyline and possibly traces of candicine. *Bufotenine* and dehydrobufotenine have also been found in the genus. Other indole-containing genera of Hylidae frogs include Acris [dehydrobufotenine] and Nyctimystes [*bufotenine*, bufotenidine, N,N,N-trimethyltryptamine, N-methylhistamine, spinaceamines and indole] (Cei et al. 1968; Daly & Witkop 1971; Daly et al. 1987; Erspamer et al. 1964, 1986; Roseghini et al. 1986). Nyctimystes tympanocryptis skin yielded 0.51-0.95% bufotenidine; N. vestigea skin yielded 0.0065-0.055% bufotenidine; N. disrupta skin yielded 0.43% bufotenidine, 0.12% *serotonin*, 0.04% N-methyl-*serotonin*, 0.006% 5-OH-indoleacetic acid, 0.002% 5-OH-tryptophol, and 0.015% of an unidentified indole (Roseghini et al. 1976)

Rana temporaria also contains *bufotenine* (Cei et al. 1968; Daly & Witkop 1971), and numerous other Rana spp. have been found to contain peptides, such as ranatensin, bradykinins and bombesins (Erspamer et al. 1986). Leg flesh of Rana spp. is reputedly aphrodisiac (Rätsch 1990). Cyclorana alboguttatus skin has yielded 0.003-0.01% bufotenidine, 0.0005-0.0025% *serotonin*, 0.005-0.01% N-methyl-*serotonin* and 0.01-0.015% unidentified indoles; C. platycephalus skin has also yielded bufotenidine [0-0.004%], as well as 0.0007-0.001% *serotonin*, 0-0.008% N-methyl-*serotonin* and 0.01-0.015% unidentified indoles. Scaphiopus hammondii hammondii skin yielded 0.007% bufotenidine and 0.06% *serotonin* (Roseghini et al. 1986). Osteocephalus langsdorffii, O. oophagus and O. taurinus, Brazilian spiny-backed tree frogs, have been found to contain *bufotenine* (Costa et al. 2005); O. taurinus skin also contained 0.00015% leptodactyline and 0.00025% *serotonin* (Roseghini et al. 1986). Melanophryniscus moreirae toads from Brazil yielded large amounts of *bufotenine* [0.26-0.37% in skin], as well as *serotonin* [0.0025-0.003%] and N-methyl-*serotonin* [0.0022-0.0037%]; pumiliotoxin [see **Phyllomedusa**] has also been found. M. stelzneri skin also yielded *bufotenine* [0.0005%] (Cei et al. 1968; Daly et al. 1987). Melanophryniscus spp. have also been found to contain humopumiliotoxins, indolizidines, quinolizidines, pyrrolizidines and decahydroquinolines (Garraffo et al. 1993). A novel β-carboline, 1-(3-guanidinopropyl)-THβC, is found in the skin of the African frogs Hylambates maculateo and Kissina senegalensis (Shulgin & Shulgin 1997).

Tetrodotoxin [TTX; see above] has been found in the toads Atelopus chiriquiensis [also contains chiriquitoxin], A. ignescens [traces], A. oxyrhynchus [also contains 4-epi-TTX and 4,9-anhydro-TTX], A. spumarius [also contains 4-epi-TTX and 4,9-anhydro-TTX], A. spurrelli [minor component], A. varius [also contains 4-epi-TTX and 4,9-anhydro-TTX] and A. zeteki [traces; also contains zetekitoxin] (Daly et al. 1994; Kim et al. 1975; Yotsu-Yamashita et al. 1992), and a TTX-like compound, ephippiotoxin, was found in the frog Brachycephalus ephippium (Sebben et al. 1986). TTX has also been found in skin of the frog Colostethus inguinalis (Daly et al. 1994), as well as in some newts [Cynops sp., Notophthalmus sp., Taricha sp. and Triturus sp.] (Wakely et al. 1966).

Some salamanders have been rumoured to possess venoms with psychotropic activity. It has been claimed that a Dr. Edmund Brodie [famous herpetologist], who is very reluctant to discuss the incident anymore, was apparently fond of the practice of quickly licking the backs of amphibious specimens, to determine [by bitterness] whether or not they deserved chemical investigation. He tried this on a 'lungless salamander' from the cloud forests of Guatemala, Bolitoglossa resplendens. He noticed an immediate bitter burning taste and light-headedness, followed by bright 'psychedelic' lights and patterns, and apparently some degree of dissociation or amnesia. An eastern US species of Plethodon is also rumoured to be similarly active (pers. comms.). B. subpalmata skin has been found to contain 0.003-0.0035% *serotonin* (Roseghini et al. 1986). In addition, Salamadra sp. skin is reputedly aphrodisiac (Rätsch 1990).

Salamanders have long been associated with superstitions, and particularly with fire – sometimes they may nest in hollow logs, that would be unknowingly thrown on a fire, and the salamander would come running out, appearing to have been 'living' in the fire, which salamanders have been believed to do. The heat of the fire would no doubt induce the salamander to secrete venom as a reflexive protective measure (pers. comms.).

It is, of course, of interest to note that a 'salamander brandy' is made and consumed in mountain areas near Ljubljana, Slovenia, and reputedly has been since the Middle Ages, although it is an uncommon and fairly secretive pursuit. This beverage is made by one of several methods, using live salamanders [Salamandra salamandra]. They may either be placed in a barrel with fruit to ferment, dying before the resulting liquid is distilled; they may be placed in a sieve and soaked in brandy; or they may be suspended from a rope with warm, freshly distilled brandy being dripped over them. The last method is said to be best, and with the last two methods some expertise is required to delay the death of the salamander so that the maximum amount of venom is excreted [another method uncovered by Kozorog (2003) is passing the distillate vapour over the body of a dried salamander, before being condensed]. To make 30 litres of brandy, 5-6 mature salamanders may be used; a small amount of wormwood [see **Artemisia**] is also often added at the end to colour the drink and improve palatability; the brandy is aged with the wormwood for a couple of weeks before being ready. Salamander brandy needs to be shaken before drinking, to evenly distribute the cloudy venom residue; 50-200ml may be a dose. The effect of the drink is said to be similar to that of *muscimol*, *ibogaine* and *strychnine*, and to have a strong aphrodisiac element. The only side effects reported are occasional blackouts and amnesia of the experience. Regardless, larger doses may be more dangerous, as eating a single salamander can kill a dog. Many psychedelic enthusiasts believe making or consuming salamander brandy to be highly unethical, and decline to use it due to the belief that the drink contains negative energies derived from the torture involved in its production (Rätsch 1998; Valenčič 1996, pers. comms.).

However, later field work has cast doubt on the scenario described above. It appears that salamander brandy is indeed sometimes made, although as a means to produce intoxicating brandy in times of year when the required fruits are not in season. Such a practice is seen as deceptive and reprehensible by most locals, as these beverages are sold under the premise of being genuine quality brandy, and also are reputed to have the side effect of lower-limb paralysis. Also, 'salamander brandy' is often used as a general term for all suspect and adulterated brandies. This is reported to be the reason why its manufacture and dispersal are so secretive - social stigma rather than the hiding of esoteric knowledge. It seems that the only people who prepare and themselves consume brandy fortified with salamander venom, hoping for psychedelic effects, are city folk made curious

by the initial media reports (Kozorog 2003).

All salamanders have venom glands on their skin, and some of their venoms have toxic constituents [alkaloids and hemolytic proteins] that may cause excitation, convulsions and mydriasis, followed by increased blood pressure, depression and paralysis. Death sometimes occurs from respiratory paralysis. Antimicrobial, irritant, local anaesthetic and stomach-cramping actions have also been noted. Most of the alkaloids found in such venoms are of the oxazolidine [such as samandarine and samandarone, the major compounds from S. salamandra] and carbinolamine type [such as cycloneosamandaridine]; some contain *histamine*-derivatives called spinaceamines. *Tryptamine* is also found in the family Salamandridae [in S. maculosa and Triturus cristatus], as is tetrodotoxin [in some Ambystoma spp.]. *Serotonin* has been found in S. maculosa (Cei et al. 1968; Daly & Witkop 1971; Daly et al. 1994; Habermehl 1971; Mebs & Pogoda 2005; Shulgin & Shulgin 1997; Witkop & Gossinger 1983) and Bolitoglossa subpalmata [0.003-0.0035% in skin] (Roseghini et al. 1986).

REPTILES

Various species of turtle have been known to cause poisonings in humans who have eaten them; this is known as 'chelonitoxication'. Species implicated include Chelonia mydas ['green sea turtle', 'rock turtle', 'sand turtle'], Eretmochelys imbricata [Chelonia imbricata; 'hawksbill turtle', 'scute turtle', 'spectacled turtle'], Dermochelys coriacea ['leatherback turtle', 'seven-banded turtle'] and Terrapene carolina ['eastern box turtle']. The toxicity of these turtles is believed to derive from their diets, rather than from endogenously-produced toxins. In the case of the first three species mentioned, algae is believed to be responsible [see **Acanthurus et al.**], and E. imbricata also eats sponges [see above, and **Smenospongia**] which may also be involved in chelonitoxication; **Amanita** mushrooms have been hypothesised as the dietary toxin in the case of T. carolina. Such dietary toxins are apparently non-toxic to turtles, but may accumulate in flesh and thus are passed on to predators (Buden 2000; Halstead 1988; Kennedy 1982). Despite occasional toxicity, C. mydas is otherwise often eaten as food. This may also apply to other species involved – with toxicity only seen at some times of year or in certain locales, the flesh being safe and edible in other times and/or locales (Halstead 1988).

Kennedy (1982) claimed [without describing symptoms] that "the symptom picture sounds like indolic poisoning", hinting at some desirable psychotropic effect, yet the symptoms of chelonitoxication usually described seem rather undesirable and unrelated to symptoms of indole alkaloids in general. Symptoms may emerge from several hours to several days after consumption, initially consisting of severe pain in the upper gastric tract, nausea, vomiting, diarrhoea, vertigo, pallor, sweating, cold extremities and a burning sensation of mouth and throat. Sometimes there is tightness in the chest, and often difficulty in swallowing, excessive salivation, lethargy, diminished reflexes and headache. The tongue may also develop a white coating, followed by halitosis, and a covering of small red pustules which may remain for several months and sometimes turn into ulcers. Pronounced somnolence is often a sign that the victim is about to lapse into a coma, which is usually followed by death related to kidney and liver failure. In most cases [c.72% of those reported] however, victims survive (Halstead 1988). In cases of E. imbricata poisoning weakness, numbness and an inability to speak have also been reported. On Sapwuahfik Atoll, Micronesia, a form of E. imbricata implicated in poisonings is known as 'sirkitol', and is differentiated by its dark shell; the usual variety has a brightly-coloured and variegated shell, and is known as 'sapwake' (Buden 2000). Interestingly, on the n.w. coast of w. New Guinea, toxic turtles are reputedly differentiated by their long necks, black tongues and black marks under the chin, yet locals will still feed a sample of turtle meat to dogs or cats to test for toxicity. This might indicate that such visual clues have little bearing on toxicity (Halstead 1988). In TCM, shell of E. imbricata is used [3-8g] to treat febrile delirium, heat convulsions and blood poisoning (Keys 1976). Eggs, flesh and shell of Testudines spp. turtles are said to have aphrodisiac properties (Rätsch 1990).

Numerous other reptiles are reputed aphrodisiacs, such as the snakes Agkistrodon acutus ['sharp nosed pit viper', 'hundred pace pit viper', 'bai hua she' in TCM; taken in wine; has analgesic, sedative and vasodilatory effects], Boa sp. [boa constrictor], Bungarus multicinctus ['Chinese krait', 'Formosan banded krait'; in wine], Crotalus spp. [rattlesnakes and pit vipers] and Python sp. [a python], crocodile [Crocodylus spp.] eggs and tail flesh, iguana [Iguana iguana] flesh, 'monitor lizard' [Varanus salvator] scale exudate in wine, 'horned toad' [Phrynocephalus frontalis] and the 'skink' Lacerta scincus (Huang 1993; Rätsch 1990). In India, the 'sand lizard' Lacerta agilis [Agama agilis] is consumed in the form of ash [dose 0.3-0.5g] as a nerve tonic, stimulant and aphrodisiac; the flesh of the related L. vivipara is taken as a tonic stimulant, and its oil as an aphrodisiac. Oil from the 'Indian skink' Mabuia carinata is used as a restorative stimulant and aphrodisiac. In TCM, the tail of the 'red spotted lizard' Phrynosoma cornuta is used as a tonic stimulant, to treat asthma, neuraesthenia and pulmonary tuberculosis. The dose is one tail from a female and one from a male; they are considered mildly poisonous (Keys 1976; Nadkarni 1976). In Peru, a type of lizard known as 'cañanes' is consumed for its aphrodisiac properties, which are believed to derive from the immature fruits of **Prosopis** juliflora which it eats (Kennedy 1982). In Nepal, Kirati shamans say that geckoes of the genus Hemidactylus (Eublepharidae) have psychoactive properties, but they do not use them; many in Nepal believe that geckoes [and their bite] are poisonous, although nothing is known scientifically of toxicity from these reptiles. Some saddhus use the dried, pulverised tails for shamanic travel, either smoking them with **Cannabis** or drinking them in 'rakshi' [a local kind of schnapps] (Müller-Ebeling et al. 2002). Gekko gecko is taken dried, in wine, as an aphrodisiac (Rätsch 1990). Geckoes are used as a potent stimulant and stamina tonic by martial artists and athletes, and preparations are commercially available (Trout pers. comm.). However, I am forced to wonder how such an industry can be ethically or logistically viable.

See also *Methods of Ingestion* for uses of lizards in zombi potions.

OTHER FAUNA

Surprisingly, giraffes [Giraffa camelopardalis] have been reported to be psychoactive! The Humr Baggara of s.w. Kordofan in Sudan prepare a drink called 'umm nyolokh' from the liver and bone marrow of a giraffe, which is the main reason for hunting it. They say it makes them 'drunk', and hallucinations apparently occur both in a waking state and in sleep after drinking it. "It is said that a person, once he has drunk umm nyolokh, will return to giraffe again and again" (Rudgley 1998). Perhaps accumulation of alkaloids from the giraffe's **Acacia** diet plays a role (pers. obs.).

The Aztecs knew of a bird they called 'oconenetl', eating the flesh of which caused one to see visions. This bird is unidentified, and little is known of bird toxicology. Skin and feathers of S. American Pitohui spp. [P. dichrous, P. kirhocephalus and P. ferrugineus – decreasing in potency correspondingly] contain the steroidal alkaloid homobatrachotoxin [also found in some poison arrow frogs – see **Phyllomedusa**], which causes partial paralysis of hind limbs, locomotor difficulties and prostration (Dumbacher et al. 1992; Ott 1993). Batrachotoxins were also recently found in the feathers of some birds from New Guinea – Pitohui cristatus, P. dichrous, P. kirhocephalus, P. nigrescens, and Ifrita kowaldi. The highest levels were usually found in belly, breast, and leg contour feathers. They were not found in skin, and levels in feathers varied widely between different bird populations (Dumbacher et al. 2000). Thus, it is not unreasonable that birds could contain pharmacologically active compounds.

In Indian medicine, the flesh of the owl Athene brama indica ['ulooka'] is considered stimulant and useful in treating insanity; flesh of the 'house sparrow' Passer domesticus ['chataka'] is eaten as an aphrodisiac and cardiac stimulant; and flesh of the 'common Indian partridge' Perdix sylvatica ['krakara'] is eaten to improve memory and as a cardiac stimulant (Nadkarni 1976). Numerous birds reputedly have aphrodisiac properties, such as the chicken Gallus gallus [eggs, stomach, rooster genitals], the hummingbird Colibri sp. [unclear whether the dried bird is only used as a love charm, or consumed as well], the parrot Amazona farinosa, the 'petrels' Hydrobates spp. [bird's nest soup], the 'wryneck' Jynx torquilla, pheasants, quails and pigeons [see below] (Rätsch 1990).

The 'European quail' [Coturnix coturnix] is known to sometimes cause severe poisoning when eaten, and at one period in Roman history quails were believed to cause epilepsy. It has been hypothesised that quails are rendered toxic to other animals due to their diet. For example, quails are known to be able to consume hemlock seed [**Conium** maculatum] without coming to harm, yet are subsequently lethal to dogs who eat the quails. Ancient scholars claimed that quails fed on fruits of hemlock, henbane [**Hyoscyamus**] and hellebore [Helleborus spp.; see *Methods of Ingestion*, **Bufo**]. In Mauritius, 'pink pigeons' [Columba meyeri] feed on berries of 'fandamon' [an Aphloia sp. (Flacourtiaceae)], 'fangam' [a Styllingia sp. (Euphorbiaceae)] and a Lantana sp. [Verbenaceae], which have been claimed to be 'hallucinogenic'. After feeding, the birds become stupefied and incapacitated; their flesh is reputed to be 'hallucinogenic' when eaten, due to this diet. Ducks such as Anas diazi [a non-migratory Mexican duck] and A. platyrhynchos [a 'mallard'] have been observed to eat young **Bufo** toads without harm. It has been hypothesised that the Olmecs maintained their elaborate artificial lagunas at San Lorenzo in order to support duck populations which would eat **Bufo** marinus [remains of these toads were also found at the San Lorenzo site], transferring psychotropic properties to the ducks and perhaps removing the toxic properties. Duck masks of seemingly shamanic association are frequently found in Olmec archaeological remains, as are vessels and sculptures with depictions of ducks and shamans wearing duck masks. 'Cranes' have also been hypothesised as a psychotrope. The 'tsuru sennins' of Japanese lore "were 'crane-wizards' who are generally represented holding a half-gnawed crane leg and grimacing with bulging eyes and a manic ferocity". Tellingly, cranes were once the source of a valued meat even though it "did not taste good"; today it is a taboo food. Presumably, any pharmacologic effects from eating crane meat would be derived from the diet of the crane, as with other toxic birds. Cranes are generally held in rever-

ence, and in China they are associated with immortality (Kennedy 1982). The species eaten by the tsuru sennins was probably Grus japonensis, the 'Japanese crane' (pers. obs.). See also *Methods of Ingestion* for use of the 'secretary bird' Sagittarius serpentarius.

An interesting explanation has been offered for the religious veneration and magical/shamanic associations enjoyed by domestic cats in some cultures – the disease toxoplasmosis, caused by the parasite Toxoplasma gondii, which commonly infects cat intestines and is expelled in faeces. This parasite can also infect rodents, birds and humans; in rodents, the parasite so alters the behaviour of its hosts that they become attracted, rather than averse, to the smell of cat urine, and thus become easy prey for cats. In people, besides causing birth defects when pregnant women are exposed, the parasite can also affect consciousness in some people; those with weakened immune systems are more susceptible, with symptoms resembling those of schizophrenia. Incidentally, infections are common amongst schizophrenics, but can not account for all cases. The similarities of experience between 'schizophrenics' and shamans might point to a link between the mystical veneration of felines [including their supposed ubiquity as 'familiars' amongst witches] and the magical mindset, with cats – besides their other virtues – unwittingly contributing to the state of mind of their human companions, where domestic hygiene is less than ideal (Greener 2007).

Even the 'lowly' earthworm seems to have some psychoactive properties – in TCM, Pheretima aspergillam ['di-long'] is used as a sedative, hypotensive, anticonvulsant, diuretic, antipyretic and uterine stimulant (Hsu et al. 1986). Dried Lumbricus sp. earthworms and Hirudo sp. leeches, taken in wine, are reputedly aphrodisiac (Rätsch 1990). Earthworms have also been found to emit *nitrous oxide* into the soil (Matthies et al. 1998).

A USEFUL HERB TO HAVE AROUND

'Milk thistle' [Silybum marianum (Compositae)], also known as 'blessed milk thistle' or 'St. Mary's thistle', should be mentioned here not for its mental properties [even though it can treat depression], but for its useful properties as a liver tonic. The plant contains silymarin [a mixture of flavonolignans including silybin, silychristine and silydianin] concentrated mostly in the seeds, which acts as an effective agent in protecting the liver from the toxicity of 'death cap mushroom toxins' [see **Amanita**], alcohol and other drugs [including amitriptyline, nortriptyline, butyrophenone, cyclosporin, oestradiol, paracetamol, phenothiazine], hepatitis, cirrhosis, and cadmium poisoning. It is a free-radical scavenger, aids in liver regeneration, and may also have MAO-B inhibiting effects. Silymarin is not very water soluble, so the herb should be prepared as an alcohol tincture rather than as a tea. A daily dose of the seeds is 12-15g, or extracts equivalent to 200-400mg silymarin. The herb might possibly interact with warfarin, and further studies are needed to clarify this (Braun 2003; Bremness 1994; Chevallier 1996; Mazzio et al. 1998).

APPENDIX B: CHEMICAL INDEX

This appendix is intended as a guide to only some of the more interesting chemicals discussed in this book, which are distinguished in the main text by italic type. All are naturally-occurring, with the probable [but uncertain] exception of *amphetamine* and *methamphetamine*. The chemical information was obtained from The Merck Index 11th edition (Budavari et al. ed. 1989), the multi-volume Dictionary of Natural Products (Buckingham et al. ed. 1994) and The Sigma-Aldrich Library of Chemical Safety Data 2nd edition (Lenga 1988), except where other references are given. Pharmacological entries are referenced individually. The interested reader should regard this as a collection of preliminary data only. Human data for many chemicals is scarce, and much research is needed in this area.

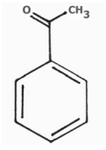
Although all practical efforts have been made to obtain complete information on chemical properties [such as melting points, solubilities etc.] with the time and resources available, this has unfortunately not been fruitful in all cases.

Abbreviations used

bp.	boiling point
dec.	decomposes
insol.	insoluble
mp.	melting point
sol.	soluble
soln.	solution

Acetophenone C_8H_8O

[1-phenylethanone; acetylbenzene; methyl phenyl ketone; hypnone]



Yellow-tinted liquid; forms laminar crystals at low temperatures; mp. 20.5°C; bp. 202°C; slightly sol. in water; freely sol. in alcohol, chloroform, ether, fatty oils, glycerol.

Soporific (Buckingham et al. ed. 1994), hypnotic. Used in perfumery to give an 'orange-blossom-like' odour [see **Citrus**] (Budavari et al. ed. 1989; Harborne & Baxter ed. 1993). Skin irritant. LD50 in rats [oral] – 815mg/kg. Keep away from flame (Lenga 1988).

In essential oils [Cistus ladaniferus, C. creticus, Stirlingia latifolia, Orthodon linalooliferum], in buds of Populus balsamifera (Harborne & Baxter ed. 1993).

Acetyl-carnitine $C_9H_{17}NO_4$

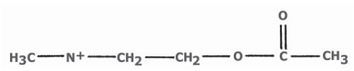
[carnitine acetyl-ester; vitamin BT acetate; 2-(acetyloxy)-3-carboxy-N,N,N-trimethyl-1-propanaminium hydroxide inner salt; (3-carboxy-2-hydroxypropyl)trimethylammonium hydroxide inner salt acetate]

Hygroscopic crystals; mp. 145°C [dec.]; very sol. in water and alcohol; practically insol. in ether.

Involved in the transport of fats into the mitochondria for energy. Long term administration [1-2g a day] can improve learning, memory and attention. Protects NMDA-receptors from degradation due to ageing (Dean & Morgenthaler 1990).

Acetylcholine $C_7H_{16}NO_2$

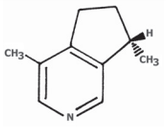
[2-acetyloxy-N,N,N-trimethylethanaminium]



The chloride form [$C_7H_{16}ClNO_2$] is a very deliquescent crystalline powder; mp. 149–152°C; normal form easily hydrolysed by alkalis.

Cholinergic and miotic agent, cardiac depressant, peripheral vasodilator. Human neurotransmitter (Buckingham et al. ed. 1994; Kruk & Pycock 1983). Can cause behavioural immobility, tranquillisation; large doses stimulate adrenal release of *epinephrine* and *norepinephrine* (Seiden & Dykstra 1977). See *Neurochemistry*.

(S)-Actinidine $C_{10}H_{13}N$

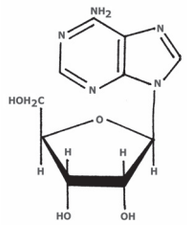


Oil; bp. 100–103°C; sol. in chloroform/methanol.

Powerful cat attractant – causes remarkable excitation in some felines (Buckingham et al. ed. 1994; Sakan et al. 1959a; Tucker & Tucker 1988). Not the same chemical as actinidin, an acidic protein also found in **Actinidia** (Harborne & Baxter ed. 1993).

Adenosine $C_{10}H_{13}N_5O_4$

[9-β-D-ribofuranosyl-9H-purin-6-amine; 9-β-D-ribofuranosyladenine; 6-amino-9-β-D-ribofuranosyl-9H-purine]

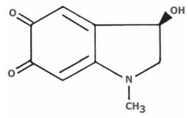


Crystals from water; mp. 234–235°C; practically insol. in alcohol.

One of the 4 principal nucleotides of nucleic acids [DNA, RNA]. Anti-arrhythmic (Budavari et al. ed. 1989), CNS- and locomotor-sedative, constricts bronchi, decreases cardiac output, dilates coronary blood vessels, modulates adenylate cyclase activity, inhibits platelet aggregation. Inhibits release of neurotransmitters, mostly acting presynaptically. Rapidly metabolised by *adenosine* deaminase; does not easily cross the blood-brain barrier (Kruk & Pycock 1983; Phillis et al. 1986; Snyder & Sklar 1984). Given to humans [i.v.], it increased blood pressure, heart rate and respiration (Biaggioni et al. 1991), the opposite of what would be expected. See *Neurochemistry*.

Adrenochrome $C_9H_9NO_3$

[2,3-dihydro-3-OH-1-methyl-1H-indole-5,6-dione; 3-OH-1-methyl-5,6-indolinedione]



Hemihydrate, brilliant red crystals from methanol and formic acid; dec. 115–120°C; freely sol. in water; fairly sol. in alcohol; almost insol. in benzene and ether. Solns. are unstable; optimum pH of water soln. 4.0. Well-formed and well-dried crystals can be kept in a vacuum dessicator for several weeks; easily oxidised to melanin. Very unstable.

Human *epinephrine* metabolite, formed by oxidation. Active sublingually 3–6mg or more; only forms from d- or dl-*epinephrine* appear to be active at these doses. Causes some LSD- or *mescaline*-like perceptual changes, and emotional depression. Visual alterations are minor at lower doses (Hoffer & Osmond 1960). Has also been found in the heart of the octopus Octopus vulgaris (Buckingham et al. ed. 1994). See *Neurochemistry*, *Influencing Endogenous Chemistry*.

Adrenocorticotropin $C_{207}H_{308}N_{56}O_{58}S$

[cotricotrophin; adrenocorticotrophin; ACTH; adrenomone]

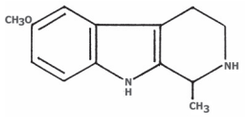
White powder; freely sol. in water; sol. in 60–70% alcohol or acetone; partly precipitates at pH 4.65–4.8; solutions are heat-stable, more stable

in acid soln.

Pituitary peptide hormone which stimulates adrenal secretions and growth of the adrenal cortex; improves learning, attention and memory. Hydrolysis products have the same activity. Used clinically for asthma and rheumatoid arthritis (Buckingham et al. ed. 1994; Budavari et al. ed. 1989; Kovacs & De Wied 1994; Kruk & Pycock 1983). See *Neurochemistry*.

Adrenoglomerulotropin $C_{13}H_{16}N_{20}$

[6-MeO-1,2,3,4-tetrahydroharman; 6-methoxytetrahydroharman; 6-MeO-THH; 1,2,3,4-tetrahydro-6-methoxy-1-methyl-β-carboline; 2,3,4,9-tetrahydro-6-methoxy-1-methyl-1H-pyrido[3,4-b]indole; 1-methylpinoline; McIsaac's compound]

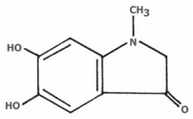


Crystals; mp. 150–151°C.

Mammalian pineal neurochemical. Some CNS activity at 100–150mg, studies lacking on higher doses; said by Claudio Naranjo to be 'hallucinogenic', though less potent than *6-methoxyharmalan* (Naranjo 1967; Shulgin & Shulgin 1997); binds to *serotonin* receptors (Glennon 1981); MAOI slightly less potent than *tetrahydroharman* in mouse brain and liver (Buckholtz & Boggan 1977). See *Neurochemistry*.

Adrenolutin $C_9H_9NO_3$

[1-methyl-1H-indole-3,5,6-triol;N-methyl-5,6-dihydroxyindoxyl; 3,5,6-trihydroxy-N-methylindole]

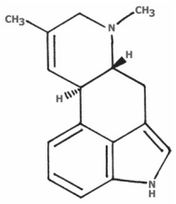


Monohydrate, bright yellow prisms from water; mp. 195/236°C [dec.]; anhydrous mp. 245°C.

Adrenochrome metabolite [along with leuco-*adrenochrome*]. Similar activity to *adrenochrome*; active sublingually 50mg (Hoffer & Osmond 1960). Potentiated by low doses of LSD or taraxein (Melander & Mårtens 1959). See *Neurochemistry*.

(-)-Agroclavine $C_{16}H_{18}N_2$

[8,9-didehydro-6,8-dimethylergoline]

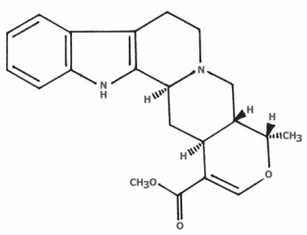


Rods from ether [dec. 198–203°C]; needles from acetone [dec. 205–206°C]; freely sol. in alcohol, chloroform, pyridine; sol. in benzene, ether; very slightly sol. in water. Mp. 208–209°C.

CNS excitant in animals, stimulating sympathetic nerves (Yui & Takeo 1958a, 1958b); hypotensive, brachycardiac, vasoconstrictor; potent *serotonin* antagonist (Takeo 1964); affects 5-HT2a receptors and α1-adrenoreceptors in the rat (Pertz 1996); also a *dopamine*-receptor agonist. Reduces uptake of *norepinephrine*, *dopamine* and *serotonin*, whilst reducing *dopamine* turnover and increasing *norepinephrine* turnover. Psychoactive in rats at 0.1-1mg/kg [s.c.] (Fuxe et al. 1978).

(-)-Ajmalicine $C_{21}H_{24}N_2O_3$

[δ-yohimbine; raubasine; vinceine; vincaine; tetrahydroserpentine; 16,17-didehydro-19-methyloxyohimban-16-carboxylic acid methyl ester]

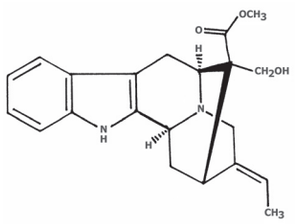


Prisms from methanol, dec. 257°C [mp. 259°C]; ajmalicine HCl – mp. 290°C [dec.], sparingly sol. in water or dilute HCl.

Vasodilator (Buckingham et al. ed. 1994), antihypertensive, tranquilliser, improves cerebral blood circulation (Budavari et al. ed. 1989; Harborne et al. ed. 1996). Blocks α1-adrenoreceptors; may also increase stimulation-induced neurotransmitter release (Creasey 1994).

Akuammidine $C_{21}H_{24}N_2O_3$

[rhazine; methyl 17-hydroxysarpagan-16-carboxylate]

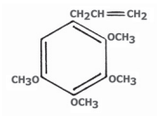


Mp. 234–236/265°C.

Hypotensive, skeletal muscle relaxant, local anaesthetic 3x more potent than *cocaine* (Harborne et al. ed. 1996).

1-Allyl-2,3,4,5-tetramethoxybenzene $C_{13}H_{18}O_4$

[1,2,3,4-tetramethoxy-5-(2-propenyl)benzene]

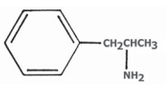


Tablets from ethanol aqueous soln.; mp. 25°C; bp. 145°C.

Non-amine precursor to TA [2,3,4,5-tetramethoxyamphetamine]; TA is psychoactive at 30-50mg or more, causing mild intoxication and mydriasis (Shulgin & Shulgin 1991; Shulgin et al. 1967).

Amphetamine $C_9H_{13}N$

[racemic desoxy-nor-ephedrine; β-aminopropylbenzene; (+-)-α-methylbenzene ethanamine; dl-α-methyl-phenethylamine; 1-phenyl-2-aminopropane; (phenylisopropyl)amine]



Mobile liquid with amine odour and burning, acrid taste; volatilises slowly at room temp.; bp. 82–85/200–203°C; slightly sol. in water; sol. in alcohol, ether; readily sol. in acids. Aqueous solns. are alkaline. *Amphetamine* sulphate is also known as benzedrine.

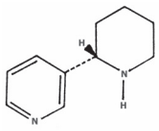
CNS stimulant and excitant, anorexic, antifatigue, sympathomimetic, bronchodilator, mydriatic. Excessive use may result in insomnia, headache, hyperirritability, anxiety, tachycardia, perspiration, fever, weakness, hypertension and/or hypotension, and even psychosis. The d-isomer is 3–4x as potent as the l-isomer in eliciting CNS effects; the l-isomer is slightly more potent than the d-isomer in affecting cardiovascular activity (Beckman 1961; Budavari et al. ed. 1989; Goodman & Gilman 1975; Julien 1995). Causes *norepinephrine* [most potently] and *dopamine* release, and blocks their re-uptake (Rothman et al. 2001; Julien 1995). Ligand of the trace amine [TA] receptor (Jacob & Presti 2005). Stimulates hydrox-

yindole-O-methyltransferase [HIOMT] activity in bovine pineal (Hartley & Smith 1973). Locomotor and psychostimulant activity may be at least partially mediated by endogenous CART peptides [see *Neurochemistry*] (Kimmel et al. 2000). Medicinal dose 5–10mg (Beckman 1961); moderate psychoactive dose 20–50mg [orally or snuffed], though some people experience 'severe reactions' from as little as 20–30mg; some i.v. users of the drug [with an established tolerance] may inject 100–500mg at a time (Julien 1995). Should not be taken within 2 weeks of taking MAOIs or tricyclic antidepressants; should not be taken by people with high blood pressure, heart disease, anorexia, hyperthyroidism, glaucoma, depression, schizophrenia or paranoid psychosis (Upfal 1995). LD50 in rats – 180mg/kg [s.c.]; LD50 of *amphetamine* sulphate in mice [oral] – 24.2mg/kg, and rats [oral] – 55mg/kg (Budavari et al. ed. 1989).

Widely used by soldiers from both sides in World War II (Julien 1995), and still used by some military personnel the world over. Controlled substance.

Anabasine $C_{10}H_{14}N_2$

[neo-nicotine; nicotimine; (S)-3-(2-piperidinyl)pyridine; 2-(3-pyridyl)piperidine]

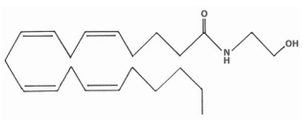


Liquid; mp. 25-30°C; bp. 104-105/145-147/270-272/276°C; sol. in water and most organic solvents.

Similar to *nicotine* in action, though less potent; binds to nicotinic *acetylcholine*-receptors (Sloan et al. 1988). Subacute and acute poisoning can cause vertigo, confusion, disturbed vision and hearing, photophobia, increased salivation, nausea, vomiting, cold extremities, diarrhoea, fainting and clonic spasms. Highly toxic, teratogenic, insecticidal. Also found in Anabasis aphylla (Buckingham et al. ed. 1994; Budavari et al. ed. 1989).

Anandamide $C_{22}H_{37}NO_2$

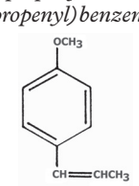
[arachidonylethanolamide; 5,8,11,14-eicosatetraenoic acid-(2-hydroxyethyl)amide]



Cannabinoid receptor ligand; produces effects similar, but not wholly identical to, those of *THC* (Wiley 1999); acts as a partial agonist, and antagonises binding of *THC* (Fride et al. 1995); also agonist of vanilloid VR1 capsaicin receptors (Szolcsányi 2000). Modulates pain (Piomelli et al. 2000; Walker et al. 1999); stimulates release of dynorphins A and B, as well as leu-*enkephalin*, in spinal cord (Houser et al. 2000). Ameliorates some symptoms of Multiple Sclerosis in experimental studies (Baker 2000; Di Marzo et al. 2000); inhibits binding to brain muscarinic *acetylcholine* receptors (Lagalwar et al. 1999); inhibits *glutamine* transmission (Piomelli et al. 2000); protects cortical neurons from ischaemic damage (Sinor et al. 2000). The structurally-related essential fatty acid (Z)-5,8,11,14-eicosatetraenoic acid is a constituent of many animal phospholipids, and also occurs in some ferns and mosses – it is potentially explosive (Buckingham et al. ed. 1994). See *Neurochemistry*.

Anethole $C_{10}H_{12}O$

[anise camphor; p-propenylanisole; 1-methoxy-4-(1-propenyl)benzene]

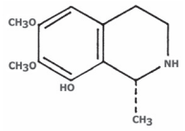


Leaflets with a sweet taste from ethanol at 20–21°C; mp. 21.4–22.5°C; bp. 235°C. Practically insol. in water; miscible with ether, chloroform; sol. in benzene, ethyl acetate, acetone, petroleum ether, alcohol.

Spasmolytic, carminative, may stimulate liver regeneration. Blocks neuromuscular transmission, may have some anticholinergic activity. Moderately toxic; LD50 in rats [i.p.] – 900mg/kg; the cis-isomer is more toxic, with an LD50 in rats [i.p.] of 93mg/kg (Albuquerque et al. 1995; Budavari et al. ed. 1989; Harborne et al. ed. 1996). Pheromone in some 'corn rootworms' [Diabrotica undecimpunctata, D. virgifera; see *estragole*] (Buckingham et al. ed. 1994). Non-amine precursor to 4-MA [PMA; 4-methoxyamphetamine], which is active at 50-80mg, causing an intoxicated state with mild psychedelic effects; raises blood pressure. Lasts c.5hrs (Shulgin 1973; Shulgin & Shulgin 1991). One underground chemist who synthesised a batch from 'essence of aniseed' described the drug: "It was totally disastrous because nobody liked it except us. It was sort of like psychedelic methedrine [*methamphetamine* HCl] [...] Very, very speedy [...] We took it ourselves and we got well crazy on it. It made you into a Viking berserker. We were roaming around mountains wild-eyed with sweat popping out [...] when you actually shot it up the rush made everything go black and white and the sky went like the set from a Wagner opera and you had this certainty that you were about to die but you didn't care. That didn't exactly endear it to the punters at Notting Hill Gate" (Ezra Pence [pseudonym], in Green ed. 1988)! 4-MA is a controlled substance, and higher doses [hundreds of mgs] have been fatal. It has often been encountered in the illicit drug trade, misrepresented as 'ecstasy' [3,4-methylenedioxy-*methamphetamine*] (pers. comms.).

Anhalonidine $C_{12}H_{17}NO_3$

[1,2,3,4-tetrahydro-8-hydroxy-6,7-dimethoxy-1-methylisoquinoline]



Small octahedra from benzene, mp. 160–161°C; freely sol. in water, alcohol, chloroform, hot benzene; sparingly sol. in ether; solutions acquire a reddish colour on standing.

Highly toxic; narcotic and curarising to frogs, but apparently not to mammals. Sedative in humans at 100–250mg, claimed by Lewin to be hallucinogenic (Kapadia & Fayez 1970; Kloesel 1958; Shulgin 1973).

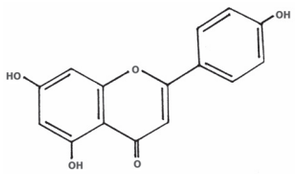
Apamin $C_{79}H_{13}N_{31}O_{24}S_4$

White powder with grey-tan cast.

Smallest neurotoxic polypeptide known. CNS excitant; interacts with spinal cord, causing spasms and convulsions; highly toxic (Buckingham et al. ed. 1994; Budavari et al. ed. 1989; Lenga 1988). Antagonises Ca2+-activated K+ ion channels (Kebadian & Neumeyer ed. 1994); blocks some 'high-affinity LSD-binding sites' (Lyttle 1993), presumably *serotonin* receptor subtypes (pers. obs.). Activity destroyed by oxidation with performic acid. LD50 in mice [i.v.] – 4mg/kg (Budavari et al. ed. 1989). In honey bee venom [see *Endnotes*] (Buckingham et al. ed. 1994).

Apigenin $C_{15}H_{10}O_5$

[4',5,7-trihydroxyflavone; 5,7-dihydroxy-2-(4-hydroxyphenyl)-4H-1-benzopyran-4-one; 2-(p-hydroxyphenyl)-5,7-dihydroxychromone]

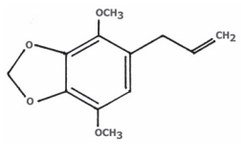


Yellow needles from aqueous pyridine; mp. 345–352°C; practically insol. in water; moderately sol. in hot alcohol; sol. in ethanol, methanol, dilute potassium hydroxide. Found free or as glycosides.

Anxiolytic and mild sedative agent. Binds to BZ receptors (Viola et al. 1995); inhibited MAO, type A more strongly than B (Han et al. 2007; Sloley et al. 2000).

Apiole $C_{12}H_{14}O_4$

[parsley camphor; 2,5-dimethoxy-3,4-methylenedioxy-1-allylbenzene]

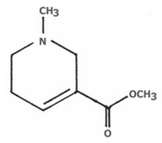


Crystals with faint parsley odour; mp. 29.5°C; bp. 294°C; insol. in water; sol. in alcohol, chloroform, benzene, ether, acetone, oils.

In high doses may cause short-lived intoxication. Insecticidal spasmolytic (Harborne et al. ed. 1996), abortifacient. Ingestion of 1g has caused death in a human. Symptoms of toxicity include strong abdominal pain, vomiting, diarrhoea, fever and vaginal bleeding. In essential oils (Battaglia 1995). Precursor to DMMDA [2,5-dimethoxy-3,4-methylenedioxy-*amphetamine*], which is mildly psychedelic at 75mg, lasting 6-8hrs (Shulgin 1973; Shulgin & Shulgin 1991), and is a controlled substance.

Arecoline $C_8H_{13}NO_2$

[arecaidine methyl ester; 1,2,5,6-tetrahydro-1-methyl-3-pyridinecarboxylic acid methyl ester; methyl 1,2,5,6-tetrahydro-1-methylnicotinate]

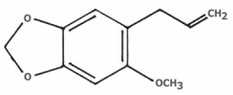


Oily liquid; bp. 92–94/105/209°C. Volatile with steam. Miscible with water, alcohol, ether; sol. in chloroform.

Cholinergic stimulant [muscarinic *acetylcholine* receptor agonist] in low doses, parasympathetic depressant in high doses, cathartic, brachycardiac, hypotensive, miotic, diaphoretic, vermifuge, increases tone of intestinal muscle (Bavappa et al. 1982; Marshall 1987); enhances serial learning (Sitaram et al. 1978). Toxic, possibly carcinogenic (Buckingham et al. ed. 1994). LD50 in mice and dogs – 100mg/kg, 5mg/kg s.c. (Budavari et al. ed. 1989).

Asaricin $C_{11}H_{12}O_3$

[5-methoxy-6-(2-propenyl)-1,3-benzodioxole; 1-allyl-2-methoxy-4,5-methylendioxybenzene; 2-allyl-4,5-methylenedioxyanisole ; has been called 'sarisan']

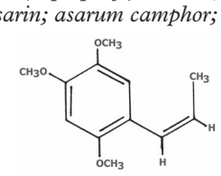


Oil; bp. 99°C. Virtually identical to *carpacin*.

Antifungal, insecticidal (Buckingham et al. ed. 1994). Non-amine precursor to MMDA-2 [2-methoxy-4,5-methylenedioxy-*amphetamine*], which is active at 25–50mg, lasting 8–12hrs – enhances awareness, similar to MDA [see *safrole*] (Shulgin 1973; Shulgin & Shulgin 1991), and is a controlled substance.

Asarone $C_{12}H_{16}O_3$

[1,2,4-trimethoxy-5-(1-propenyl)benzene; 2,4,5-trimethoxy-1-propenylbenzene; asarin; asarum camphor; asarabacca camphor]

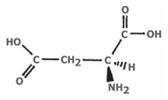


Occurs as a mixture of two isomeric forms [α-, the (E)- or trans-isomer, and β-, the (Z)- or cis-isomer (shown)]. α-Asarone – needles from light petroleum; mp. 62–62°C; bp. 296°C. Practically insol. in water; sol. in alcohol, ether, glacial acetic acid, chloroform, petroleum ether.

Sedative similar to *reserpine* (Sharma et al. 1961), spasmolytic, hypocholesterolaemic, anti-algal. Attractant, antifeedant and chemosterilant in insects. In animals, *asarone* prolongs the hypnotic activity of anaesthetics, acts as a cardiac depressant and hypotensive, and has some anticholinergic activity. The sedative action is apparently due to depression of the ergotropic division of the hypothalamus. Others observed it to cause excitation followed by sedation (Buckingham et al. ed. 1994; Hall 1973; Oswald et al. 1971b; Rastogi & Mehrotra ed. 1990-1993). In mice, β-*asarone* is more potent than α-*asarone* (Sharma et al. 1961); may be toxic, believed to be carcinogenic in high doses or with extended exposure (Harborne & Baxter ed. 1993; Lopez, M.L. et al. 1993). Non-amine precursor to TMA-2 [2,3,5-trimethoxy-*amphetamine*], which is active at 20-40mg or more, lasting 8-12hrs – similar to *mescaline*, but less colourful visually. Can cause nausea and brief periods of amnesia (Shulgin 1973, 1976; Shulgin & Shulgin 1991). TMA-2 is a controlled substance.

Aspartic acid $C_4H_7NO_4$

[aspartate; aminobutanedioic acid; aminosuccinic acid; asparagic acid; asparaginic acid]

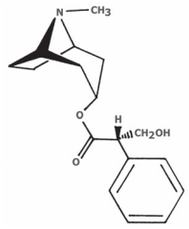


Leaflets from water; mp. 269–271°C.

Excitatory amino acid (Kruk & Pycock 1983). (S)-form found in proteins, peptides, sugar cane and sugar beet molasses; (R)-form in the red alga Chondria armata (Buckingham et al. ed. 1994). See *Neurochemistry*.

Atropine $C_{17}H_{23}NO_3$

[dl-tropine tropate; dl-hyoscyamine; 1-α-H,-5-α-H-tropan-3-α-ol-dl-tropate]

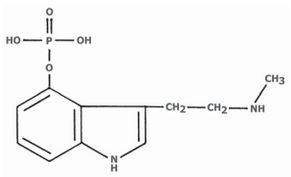


Long orthorhombic prisms from acetone, mp. 114–117°C. Slightly sol. in water; freely sol. in alcohol, glycerol, ether, chloroform; sol. in benzene and dilute acids.

Atropine is racemised during extraction from plant matter, to a mixture of equal parts d-*hyoscyamine* and l-*hyoscyamine*. Potent *acetylcholine*-inhibitor [blocks muscarinic receptors]; can reduce response to *histamine*, *norepinephrine* and *serotonin*. Causes excitement, agitation, delirium, blurred vision, difficulty in swallowing or speaking, suppressed salivation, dried mucous membranes, vasodilation, bronchodilation [large doses depress respiration], fever, muscular relaxation and mydriasis. Large doses lead to depression, tachycardia, coma, and death from paralysis of the medulla. Action is more prolonged than that of *hyoscine*, and comparitively has a stronger action on heart, intestine and bronchial muscle. Used in anaesthesia and anticholinesterase poisoning, as well as to treat some symptoms of Parkinson's Disease, and to produce mydriasis for optical examination. Hallucinogenic over 5-10mg; used therapeutically 0.2-1mg; lethal dose in humans uncertain – doses of 1000mg have been survived, yet 10mg has been lethal in a child. Can be absorbed through the skin (Beckman 1961; Buckingham et al. ed. 1994; Budavari et al. ed. 1989; Goodman & Gilman 1975; Henry 1939). Has been shown to weakly inhibit MAO and *5-hydroxytryptophan* decarboxylase (Rastogi & Mehrotra ed. 1990-1993).

Baeocystin $C_{11}H_{15}N_2O_4P$

[baeocystine; 4-phosphoryloxy-N-methyltryptamine]

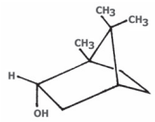


Sol. in methanol; mp. 245-248/254-258°C.

Precursor to *psilocybin*. Psychedelic. Gartz noted that 4mg "caused mild hallucinations for three hours", with 10mg "about as psychoactive as a similar amount of *psilocybin*" (Gartz 1989a, 1996).

D-Borneol $C_{10}H_{18}O$

[(+)-borneol; (+)-bornylalcohol; borneo camphor; (1S,2S)-2-bornanol]

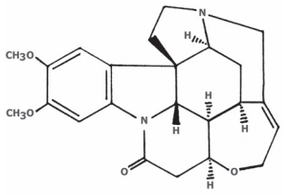


White hexagonal plates from petroleum ether; mp. 206–208°C; peculiar peppery odour and burning taste resembling that of mint; almost insol. in water; sol. in alcohol, ether, petroleum ether, benzene, toluene, acetone.

Can cause dizziness, mental confusion, nausea, vomiting, headaches, irritation and convulsions. LD50 in rabbits [oral] – 2g/kg (Budavari et al. ed. 1989; Lenga 1988).

Brucine $C_{23}H_{26}N_2O_4$

[10,11-dimethoxy-strychnine; 2,3-dimethoxystrychnidin-10-one]

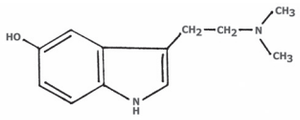


Needles from acetone/water, mp. 178°C; sol. in methanol, alcohol, chloroform, ethyl acetate, glycerol; slightly sol. in benzene, ether, boiling water. Handle in hood only.

CNS stimulant similar to *strychnine*; lethal dose to humans c.200mg (Harborne et al. ed. 1996).

Bufotenine $C_{12}H_{16}N_2O$

[5-hydroxy-N,N-dimethyltryptamine; 5-OH-DMT; N,N-dimethylserotonin; mappin; 3-[2-(dimethylamino)ethyl]-1H-indol-5-ol]

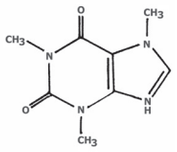


Prisms from ethyl acetate, mp. 146–147°C; methyliodide prisms from methanol, mp. 214–215°C; practically insol. in water; sol. in alcohol, dilute acids.

Psychoactive at 8-15mg i.v. or i.m. [not the preferred routes, as they are more likely to manifest excessive peripheral side-effects, which are typical symptoms of *serotonin* syndrome]. The oxalate was inactive nasally at up to 16mg, and the creatinine sulphate is also of questionable nasal activity, though the freebase was active from 6-10mg by this route. Effects from i.v. and/or i.m. administration include raised blood pressure, anxiety, apprehension, constriction or oppression of the chest, abdominal cramps, sweating, facial flushing [sometimes becoming purplish or cyan in some high-dose i.v. experiments] and vasoconstriction. Blobby, coloured or black and white visual effects ["pseudo-hallucinations of colour"], as well as mental overactivity and feelings of unreality were noted. An i.v. dose of 10mg over 50 seconds in a schizophrenic patient caused EEG readings to fall to 0.5-1Hz after 5 minutes. Death has occurred when taken with *reserpine* (Fabing & Hawkins 1956; McLeod & Sitaram 1985; Ott 2001a; Turner & Merlis 1959; Wassén & Holmstedt 1963). Recent bioassays conducted by Jonathan Ott [and in some cases, associates] indicate the freebase to be active intranasally from 5mg, with a visionary threshold at 40mg; similar observations were made for the sublingual route. Co-administration of very low doses of *harmine* and/or *harmaline* [eg. 7.5mg *harmine*] via these routes enabled equivalent activity from half the usual dose of *bufotenine*. [It should be noted that Ott is a low-MAO phenotype and thus these MAOI doses may be quite different for others.] Oral activity was observed above 100mg, though when taken with 40mg *harmaline*, Ott experienced a similar level of effect from only 20mg *bufotenine* freebase. Active from 2-8mg vapourised. Intrarectally, 30mg [with 250mg sodium bicarbonate and 1g cocoa butter] produced only physical effects; threshold psychoactivity was noted when the same dose was combined with 10mg *harmaline*. Onset and duration were similar to that observed with *5-methoxy-DMT* by the same routes. Effects of the freebase via these routes included euphoria [or dysphoria for some]; perception of a high-pitched tone [as with other entheogenic tryptamines such as *DMT*]; and subtle visionary effects from behind closed eyes, or overlaid onto the surroundings and best appreciated in dim light rather than darkness (Ott 2001a). Has shown MAOI activity in vitro, less potent than that of *DMT* or *5-methoxy-DMT* (Ho et al. 1970). Strong agonist of 5-HT1a, 5-HT1b, 5-HT1c & 5-HT2a receptors; less potent agonist of 5-HT1d & 5-HT2b receptors (McKenna et al. 1990; Peroutka 1986, 1993). More potent in the brain than *5-methoxy-DMT*, but less potent overall due to its increased difficulty in crossing the blood-brain barrier (McBride 2000). Mammalian neurochemical (Corbett et al. 1978; Cottrell et al. 1977; Tanimukai et al. 1970) – see *Neurochemistry*. Controlled substance in the US and Australia.

Caffeine $C_8H_{10}N_4O_2$

[theine; guaranine; methyltheobromine; 1,3,7-trimethylxanthine]



Hexagonal prisms by sublimation, mp. 238°C; sublimes 178°C. Aqueous solutions of caffeine salts dissociate quickly. Sol. in water, alcohol, acetone, chloroform, ether, benzene, ethyl acetate; slightly sol. in petroleum ether.

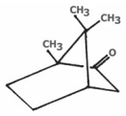
CNS, cardiac, and weak respiratory stimulant; diuretic; increases muscle irritability. Blocks *adenosine* receptors, removing their inhibition of *dopamine* release; weak phosphodiesterase inhibitor, increasing cAMP levels and potentiating β-adrenergic stimulation, though at levels much higher than those achieved naturally; BZ-receptor antagonist (Biaggioni et al. 1991; Budavari et al. ed. 1989; Garrett & Holtzman 1994; Goodman & Gilman 1975; Kruk & Pycock 1983; McManamy & Schube 1936; Saano & Airaksinen 1982; Snyder & Sklar 1984); antagonises respiratory depression induced by *codeine* or *morphine* (Bellville et al. 1962). Respiratory-stimulant effects are thought to be more closely linked to the type-4 phosphodiesterase-inhibition of *caffeine*, rather than *adenosine*-antagonism, as had previously been presumed; the CNS-stimulant effects are still believed to be mediated by antagonism at *adenosine* receptors (Howell 1993). Active in CNS as a stimulant at 100-200mg or more; excessive use may result in insomnia, agitation, anxiety, tremors, arrhythmia, vertigo, headache, muscle stiffness (Goodman & Gilman 1975; Julien 1995; McManamy & Schube 1936; Snyder & Sklar 1984), perspiration, nausea, abdominal cramps and indistinct hallucinations (pers. obs.). Heavy users experience less insomnia from *caffeine* taken before going to bed. Chronic consumption causes an up-regulation and/or sensitisation of platelet *adenosine* receptors. Addictive; withdrawal symptoms may include dysphoria, irritability, nervousness, difficulty in concentrating, lethargy and headache. Low doses can improve task performance, whilst higher doses impair it; however, performance enhancement is most noticeable only in people who were previously fatigued, rather than those who were well-rested (Biaggioni et al. 1991; Goldstein & Kaizer 1969; Snyder & Sklar 1984). Has been used as a *cocaine* substitute (Siegel 1980), and in the Philippines, has been smoked with *ephedrine*, the mixture being called 'shabu'; its use there today has been superceded by smokeable *methamphetamine*, sometimes known as 'ice' (Karch 1996) [and also known as shabu in Japan] (Julien 1995). *Caffeine* taken as strong, freshly-brewed coffee [see **Coffea**] after the onset of the peak of a *mescaline* or *psilocybin* experience, has been observed to "maximise both rushing sensations and perceptual disturbances"; this effect was most noted with *psilocybin* (Trout & Friends 1999). LD50 in mice [oral] – 127-137 mg/kg (Budavari et al. ed. 1989); human LD 192 mg/kg [oral] (Lenga 1988) or around 10g; symptoms of toxicity are expected at 1g and above (Goodman & Gilman 1975).

Paraxanthine [1,7-dimethylxanthine], the main metabolite of *caffeine*, is also an effective *adenosine* receptor antagonist, as is the main metabolite of paraxanthine, 1-methylxanthine (Biaggioni et al. 1991; Snyder & Sklar 1984).

Also found in Bidens pilosa [0.00025% in aerial parts], Cereus jamacaru [0.08–0.11% in seeds; may be in error], Combretum spp., Erodium cicutarium ['stork's bill'], Firmiana simplex ['wu tong'], Harrisia adscendens [0.12–0.2% in seeds; may be in error], Leocereus bahiensis [0.1-0.35% in seeds; may be in error], Neea therifera and Pilocereus gounellei [0.15–0.22% in seeds; may be in error] (Huang 1993; Rätsch 1998; Sarker et al. 2000; Suzuki et al. 1992; Trout ed. 1999).

Camphor $C_{10}H_{16}O$

[2-camphanone; 1,7,7-trimethylbicyclo[2.2.1]-heptan-2-one]

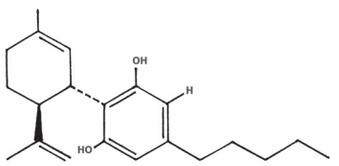


Translucent mass with crystalline fracture; rhombohedral crystals from alcohol; sublimes appreciably at room temp.; very steam volatile; mp. 179°C; bp. 204°C. Sparingly sol. in water; sol. in petroleum ether, fixed and volatile oils, alcohol, ether, chloroform, benzene, acetone, glacial acetic acid.

Can cause CNS-stimulation and euphoria, vertigo, mental confusion and delirium. Clonic convulsions, coma, respiratory failure and death may occur from doses of 730mg/kg or higher (Hall et al. 1978a; Karch 1996; Lenga 1988; McManamy & Schube 1936). Irritant, analeptic, respiratory stimulant, topical analgesic, antipruritic, antiinfective, antirheumatic. LD50 in mice [i.p.] – 3g/kg (Buckingham et al. ed. 1994; Budavari et al. ed. 1989; Lenga 1988).

Cannabidiol $C_{21}H_{30}O_2$

[CBD]

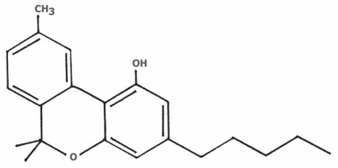


Pale yellow resin or crystals from petroleum ether; mp. 66–67°C; bp. 130/160–180/187–190°C. Practically insol. in water; sol. in alcohol, ether, benzene, chloroform, petroleum ether.

Sedative, analgesic, antibiotic, antiepileptic; seems to potentiate the depressant and antagonise the excitatory effects of Δ-9 *THC*; delays onset of high, prolongs duration and increases intensity (Hollister & Gillespie 1975; Karniol & Carlini 1973; Mechoulam 1970; Zuardi et al. 1982). Potent antioxidant; can protect against neuronal damage (Aesoph 1998; Hampson et al. 1998). Slightly suppresses MAO activity (Coper 1982).

Cannabinol $C_{21}H_{26}O_2$

[CBN; 6,6,9-trimethyl-3-pentyl-6H-dibenzo[b,d]pyran-1-ol]

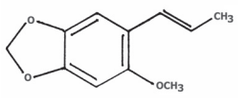


Faint orange resin or leaflets from petroleum ether; mp. 76–77°C; bp. 185°C. Sol. in alcohol, aqueous alkaline solutions.

The oxidative degradation product of *THC*. Has about 1/10 of its psychoactive potency [otherwise stated to be non-psychoactive]; seems to potentiate the disorientating qualities of *THC* whilst blocking its other effects (Hollister & Gillespie 1975; Karniol et al. 1975).

Carpacin $C_{11}H_{12}O_3$

[isosafrole methyl ether; 2-methoxy-4,5-methylenedioxy-1-propenylbenzene; 5-methoxy-6-(1-propenyl)-1,3-benzodioxole; 1-allyl-2-methoxy-4,5-methylenedioxybenzene; 2-allyl-4,5-methylenedioxyanisole; has been called 'sarisan' incorrectly]

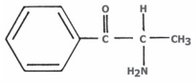


Crystals or oil from petroleum ether; mp. 47°C; bp. 119–124°C.

Non-amine precursor to MMDA-2 [see *asaricin*] (Shulgin & Shulgin 1991).

Cathinone $C_9H_{11}NO$

[α-aminopropiophenone; α-benzoylethylamine; 2-amino-1-phenyl-1-propanone]

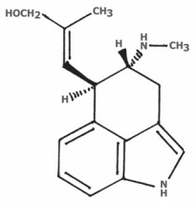


Sol. in methanol [with racemisation], methylene chloride; HCl mp. 189–190°C. Unstable except in dilute non-polar non-hydroxylic soln. Transformed in unfresh leaves of **Catha** edulis to *norpseudoephedrine* and norephedrine, with other minor breakdown byproducts [see **Catha**].

CNS stimulant similar to *amphetamine*, but more pleasurable; 8x more potent in causing *dopamine*-release than *norepinephrine*-release. Binds to *serotonin* receptors, though the dl-form is weaker in this regard; the d-form does not bind to these receptors. Also causes hyperthermia, respiratory stimulation, mydriasis, arrhythmia, hypertension and anorexia (Bruneton 1995; Crombie et al. 1990; Glennon & Liebowitz 1982; Kalix 1991).

Chanoclavine $C_{16}H_{20}N_2O$

[chanoclavine I; secaclavine]

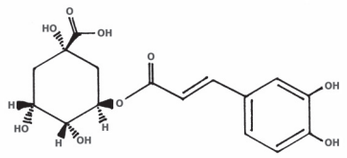


Thick prisms and polyhedra from acetone or methanol; mp. 220–222°C; sol. in boiling chloroform, boiling acetone, boiling ethyl acetate, boiling methanol; practically insol. in water.

Not thought to be active (Hofmann 1963), but has been claimed [perhaps in error] to be hallucinogenic (Harborne & Baxter ed. 1993). Found in various fungi and Convolvulaceae; mould fungi not mentioned elsewhere in this book yielding *chanoclavine* include Corticum caeruleum, Lenzites trabea and Pellicularia filamentosa (Abe et al. 1969).

Chlorogenic acid $C_{16}H_{18}O_9$

[caffetannic acid; caffeylquinic acid; helianthic acid; 3-O-caffeoylquinic acid; 3-(3,4-dihydroxycinnamoyl)quinic acid]

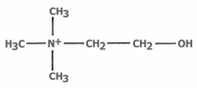


Hemihydrate, needles from water. Becomes anhydrous at 110°C; mp. 208°C. Freely sol. in alcohol, acetone; slightly sol. in water, much more so in hot water. Alkaline solns. turn orange. Forms caffeic acid on hydrolysis. First isolated from Liberian coffee [see **Coffea**]; found in many plants.

Antioxidant, anticarcinogenic, antimutagenic, inhibits cytochrome P450, inhibits glial MAO-B in rats (Mazzio et al. 1998; Shahrzad & Bitsch 1996; Yamada & Tomita 1996). Claimed to have "sexually stimulating effects" (Rätsch 1990). See also **Alstonia**.

Choline $C_5H_{14}NO+$

[bilineurine; sinkalin; amanitin; araquine; arachine; trimethylethanolamine; 2-hydroxy-N,N,N-trimethylethanaminium; (2-hydroxyethyl)-trimethylammonium]

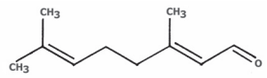


Hazy yellow substance; air and light sensitive; handle with care, as can cause burns. Destructive to tissue when inhaled (Lenga 1988).

Constituent of lecithin [phosphatidylcholine], which gives free *choline* on hydrolysis; lipotropic. Precursor to endogenous *acetylcholine*, with similar effects, but much less active; when not acting as a precursor to *acetylcholine*, probably stimulates *acetylcholine* release and acts as an agonist of muscarinic *acetylcholine* receptors. Poorly absorbed from the gastrointestinal tract, and is partly converted to trimethylamine and its oxide by

intestinal bacteria; converted to betaine, phosphorylcholine and lipids in the kidney. Thus, dietary *choline* rarely reaches the brain in quantity and has only weak peripheral activity due to its fairly rapid breakdown [this may be where *2-dimethylaminoethanol* comes in – see below]. When not obtained from dietary sources, can be biosynthesised endogenously from l-serine. Can act as a methyl-donor [eg. see *methionine*], such as in the biosynthesis of *methionine* from homocysteine; conversely, *methionine* from S-adenosylmethionine [SAM] acts as a methyl donor in the biosynthesis of *choline*. Reputed to improve memory and intelligence (Buckingham et al. ed. 1994; Dean & Morgenthaler 1990; Goodman & Gilman 1975; Haubrich et al. 1981; Sitaram et al. 1978; Tucek 1988). Pre-administration of phosphatidylcholine for several days prior to ingestion of "psychotropics including *mescaline* and especially *DMT*" has been observed to "enrich" the content of the experience (Trout & Friends 1999). LD50 in rats [oral] – 6640mg/kg (Lenga 1988). Estimated human LD50 [oral] – 200-400g. Oral doses of 10g produced no obvious effects (Goodman & Gilman 1975). See *Neurochemistry*.

Citral $C_{10}H_{16}O$

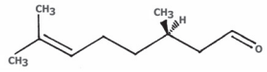


Natural citral is a mix of 2 geometric isomers, geranial [trans-citral, or citral A (shown)] and neral [cis-citral, or citral B]. Geranial is a light oily liquid with a strong lemon odour [see **Citrus**]; bp. 92–93°C; practically insol. in water; miscible with alcohol, ether, glycerol, mineral oil, essential oils. Neral is a light oily liquid with a lemon odour [less intense, but sweeter than geranial]; bp. 91-92°C. Solubility same as geranial. Not stable to alkalis or strong acids.

It is the sex pheromone of the parasitic wasp Itoplectis conquisitor (Buckingham et al. ed. 1994). When isolated from plants as the geometric isomer geranial, it may be condensed with olivetol to form Δ-9 *THC*; alternately, verbenol may be used in place of geranial, resulting in Δ-6 *THC* (Mechoulam et al. 1972).

Citronellal $C_{10}H_{18}O$

[rhodinal; 3,7-dimethyl-6-octenal]

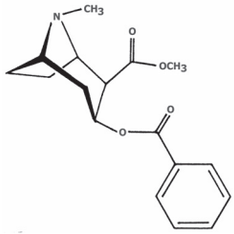


Colourless liquid; bp. 204–205°C. Sol. in alcohols; very slightly sol. in water.

Sedative, antiseptic, insect-repellant (Budavari et al. ed. 1989; Harborne et al. ed. 1996); may cause irritation (Lenga 1988).

Cocaine $C_{17}H_{21}NO_4$

[ecgonine methyl ester benzoate; benzoyl ecgonine methyl ester]

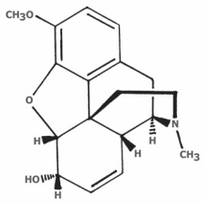


Monocline octahedra from alcohol, mp. 98°C. Volatile, esp. above 90°C; bp. 187–188°C. Slightly sol. in water; freely sol. in alcohol, ether, chloroform, petroleum, olive oil; sol. in acetone, ethyl acetate and carbon disulfide.

Potent CNS stimulant and euphoriant, adrenergic blocker, topical anaesthetic, vasoconstrictor, mydriatic. Inhibits *norepinephrine*, *dopamine* and *serotonin* re-uptake. Locomotor and psychostimulant activity may be at least partially mediated by endogenous CART peptides [see *Neurochemistry*]. Active 25-150mg; 20mg has been fatal or severely toxic, but only in very rare cases of individual sensitivity. Death may be due to respiratory depression, arrhythmia, seizures and/or severe hypertension (Buckingham et al. ed. 1994; Goodman & Gilman 1975; Julien 1995; Katzung & Trevor 1995; Kennedy 1985; Kimmel et al. 2000; Platt 1997). LD50 in rats [i.v.] – 17.5mg/kg (Budavari et al. ed. 1989). See **Erythroxylum** for further discussion of side effects. Controlled substance.

Codeine $C_{18}H_{21}NO_3$

[3-O-methyl-morphine; 7,8-didehydro-4,5-epoxy-3-methoxy-17-methylmorphinan-6-ol]

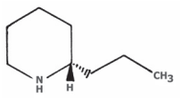


Orthorhombic sphenoidal rods or octahedra from water or dilute alcohol; mp. 154–156°C; slightly sol. in water, freely sol. in alcohol and dilute acids.

Narcotic, analgesic, antitussive, spasmolytic. Can cause nausea, dizziness, headache, CNS stimulation, convulsions, cyanosis, constipation, drowsiness and respiratory depression. Opiate receptor-agonist; c.0.1-0.25x as potent as *morphine*. Induces *histamine* release. Active 30-400mg. Can cause itching, flushing, dizziness, sedation, nausea and vomiting above 250mg. LD50 in rats – 427mg/kg [oral] (Buckingham et al. ed. 1994; Chahl 1991; Harborne et al. ed. 1996; Lenga 1988; Noyez et al. 1975; Preininger 1975; pers. comms.). Endogenous mammalian neurochemical (Cardinale et al. 1987; Noyes et al. 1975). Controlled substance.

Coniine $C_8H_{17}N$

[S-2-propylpiperidine; cicutine; conicine; N-methylconine; pseudoconhydrine]

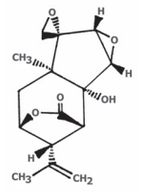


Colourless alkaline liquid, darkens and polymerises on exposure to light and air; mousy odour; mp. -2°C; bp. 65–66/166–166.5°C. Volatile with steam. Sol. in water [less so in hot water], alcohol, ether, acetone, benzene; slightly sol. in chloroform.

CNS excitant, then depressant. Causes weakness, drowsiness, nausea, vomiting, salivation, laboured respiration, increasing weakness, paralysis of CNS and skeletal muscle nerve endings, asphyxia, and eventually death. Estimated toxic dose 60mg; estimated lethal dose 100-300mg. LD50 in mice [oral] 100mg/kg. Also found in 'dog parsley', Aethusa cynapium (Budavari et al. ed. 1989; Wexter ed. 1998) and in Sarracenia flava (Mody et al. 1976).

Coriamyrtin $C_{15}H_{18}O_5$

[coriamyrtione]

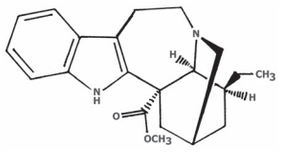


Bitter, monoclinic prisms; mp. 229-230°C. Slightly sol. in water, alcohol; freely sol. in ether, and hot alcohol.

Causes extreme CNS-excitation (Lenga 1988). LD50 in mice [i.p.] – 3mg/kg (Budavari et al. ed. 1989).

Coronaridine $C_{21}H_{26}N_2O_2$

[carbomethoxyibogamine]



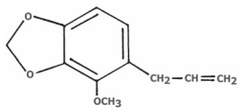
Amorphous crystals; mp. 235°C; sol. in methanol, ethanol, benzene.

CNS stimulant 25 times less potent than *ibogaine* (Bert et al. 1988). Analgesic, surface anaesthetic, hypothermic, diuretic, weakly oestrogenic, muscle relaxant, hypotensive; can cause brachycardia. Interacts with del-

ta-, kappa- and mu-opiate receptors; NMDA-receptor antagonist. Toxic to some cancers (Bisset 1985a; Creasey 1994; Deecher et al. 1992; Layer et al. 1996; Okuyama et al. 1992).

Croweacin $C_{11}H_{12}O_3$

[4-methoxy-5-(2-propenyl)-1,3-benzodioxole; 1-allyl-2-methoxy-3,4-methylenedioxybenzene]

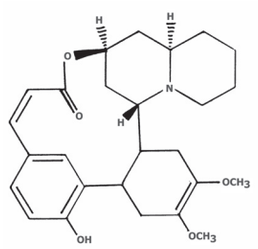


Oil; bp. 130–131/256–258°C.

Non-amine precursor to MMDA-3a [2-methoxy-3,4-methylenedioxy-*amphetamine*], which is active from 20-80mg, lasting 10-16hrs – increases visual awareness, causes CNS stimulation, mild psychedelic (Shulgin 1973; Shulgin & Shulgin 1991). MMDA-3a is a controlled substance.

Cryogenine $C_{26}H_{29}NO_5$

[vertine]

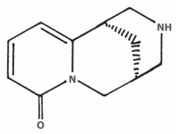


Crystals from methanol or chloroform; mp. 245–247/250–252°C.

Sedative, tranquilliser, hypotensive, hyperglycaemic, antiinflammatory, mydriatic. Antagonises binding to muscarinic *acetylcholine*-receptors, and acts as an antihistamine and non-specific *serotonin* antagonist (Kosersky & Malone 1971; Malone & Rother 1994; Nucifora & Malone 1971; Robichaud et al. 1965; Trottier & Malone 1969). As well as **Heimia** spp., found in Decodon verticillatus [see **Heimia**] and Lagerstroemia fauriei of the Lythraceae [see *Endnotes*]. This chemical is not the same as 1-carbamyl-2-phenylhydrazine, which is also known as cryogenine.

Cytisine $C_{11}H_{14}N_2O$

[baptitoxine; sophorine; ulexine]

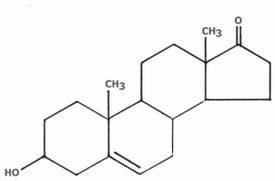


Orthorhombic prisms from acetone; mp. 152-155°C [sublimes]; bp. 218°C. Sol. in water, alcohol, benzene, chloroform, ethyl acetate, acetone, benzene; practically insol. in petroleum ether.

Nicotine-like activity peripherally; central effects are not *nicotine*-like, and have been little-studied, only manifesting in doses approaching the toxic; hypotensive, respiratory stimulant. Nicotinic *acetylcholine*-receptor agonist. Twice as toxic as *nicotine* orally, but active in smaller doses [¼ – ¾ that of *nicotine*] (Barlow & McLeod 1969; Kebadian & Neumeyer ed. 1994; Nucifora & Malone 1971; Reavill et al. 1990; Schmeller et al. 1994; Sloan et al. 1988). LD50 in mice [oral] – 101mg/kg; [i.p.] – 9.4-18mg/kg; [i.v.] – 1.73mg/kg (Buckingham et al. ed. 1994; Budavari et al. ed. 1989).

Dehydroepiandrosterone $C_{19}H_{28}O_2$

[DHEA; prasterone; dehydroisoandrosterone; transdehydroandros-terone; 3-hydroxyandrost-5-en-17-one; δ-5-androsten-3-β-ol-17-one; 17-hormoforin]

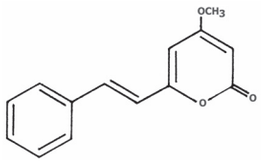


Dimorphous needles, mp. 140-141°C; or leaflets, mp. 152-153°C; sol. in benzene, alcohol, ether; sparingly sol. in chloroform, petroleum ether.

Anti-obesity, anti-aging, immune-stimulant and anti-tumour effects. Enhances cognitive functions, and improves neuron function and proliferation. Mediates limbic arousal. May be taken 50-2000mg a day; higher doses are less effective, as with many other cognitive-enhancers (Crenshaw & Goldberg 1996; Dean & Morgenthaler 1990); ligand for cannabinoid receptors, slightly more active than *anandamide* (Fride et al. 1995). Mammalian adrenal hormone, biosynthesised from cholesterol [via pregnenolone as an intermediate]; precursor to oestrogenic and androgenic steroidal hormones (Crenshaw & Goldberg 1996) – see *Neurochemistry*. Restricted or not approved in some countries.

5,6-Dehydrokawain $C_{14}H_{12}O_3$

[desmethoxyyangonin; 4-methoxy-6-(2-phenylethenyl)-2H-pyran-2-one; 4-methoxy-6-styryl-2H-pyran-2-one]



Mp. 138-140°C; sol. in alcohol, methanol/water, chloroform, oils.

Muscle relaxant, anaesthetic, potentiates barbiturate-induced sleep. CNS effects when given alone are minor [except when given i.v.]; however when combined with other 'kava-lactones' [see **Piper 2**] there is synergy (Keller & Klohs 1963; Klohs 1967; Meyer 1967). MAO-B inhibitor in human platelets; most potent in this regard of all kava-lactones tested (Uebelhack et al. 1998).

Also found in **Alpinia** [see **Kaempferia**, **Alpinia**], Aniba firmula, Didymocarpus pedicellata, and D. aurantiaca (Buckingham et al. ed. 1994).

Dermorphin

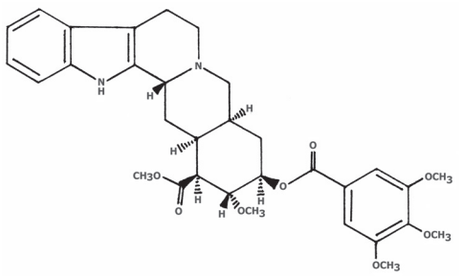
H-Tyr-D-Met-Phe-His-Leu-Met-Asp-NH_2

White powder; sol. in methanol.

Peptide with peripheral and central opiate-like activities; also has gastrointestinal effects, and effects on anterior pituitary functions. Agonist of mu-opiate receptors (Buckingham et al. ed. 1994; Lenga 1988; Melchiorri & Negri 1996).

Deserpidine $C_{32}H_{38}N_2O_8$

[reserpidine; recanescine; raunormine; harmonyl; canescine; 11-demethoxy-reserpine]

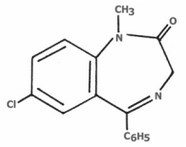


Three crystal forms from methanol – α [mp. 228-232°C], β [mp. 230-232°C] and γ [mp. 138/226-232°C with resolidification at 175°C].

Tranquilliser, antihypertensive, neuroleptic; may be toxic. Medicinal dose 0.25mg daily (Beckman 1961; Buckingham et al. ed. 1994; Harborne et al. ed. 1996).

Diazepam $C_{16}H_{13}ClN_2O$

[Valium™; diacepin; methyldiazepinone; 7-chloro-1,3-dihydro-1-methyl-5-phenyl-2H-1,4-benzodiazepin-2-one; 7-chloro-1-methyl-5-phenyl-3H-1,4-benzodiazepin-2(1H)-one]

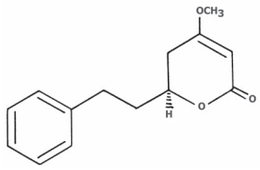


Plates from acetone and petroleum ether; mp. 125-126°C. Sol. in alcohol, acetone, chloroform, benzene; slightly sol. in water.

Depressant, anxiolytic, skeletal muscle relaxant (Budavari et al. ed. 1989); endogenous mammalian BZ-receptor agonist (Medina et al. 1989; Mousah et al. 1986; Müller 1987); potentiates effects of *adenosine* (Snyder & Sklar 1984). Active 5-10mg (Goodman & Gilman 1975). LD50 [oral] in rats – 710mg/kg (Budavari et al. ed. 1989). See *Neurochemistry*. This natural chemical was trademarked as the synthetic Valium before it was discovered in nature.

Dihydrokawain $C_{14}H_{16}O_3$

[marindinin]

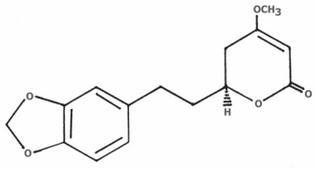


Crystals from ether; mp. 58-60°C. Sol. in alcohol, chloroform; moderately sol. in ether; practically insol. in water, petroleum ether.

Sedative, hypnotic, anaesthetic, anticonvulsant, potentiates barbiturate-induced sleep; causes ataxia in high doses (Keller & Klohs 1963; Klohs 1967; Meyer 1967). MAO-B inhibitor in human platelets, slightly less potent than *dihydromethysticin* in this regard, but weaker than *kawain* (Uebelhack et al. 1998). Also found in Aniba giganticola (Buckingham et al. ed. 1994).

7,8-Dihydromethysticin $C_{15}H_{16}O_5$

[dihydromethysticin; pseudomethysticin]

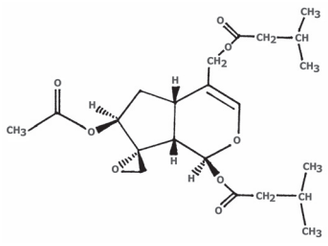


Prisms from methanol; mp. 117-118°C.

Causes "emotional and muscular relaxation, stabilisation of feelings and stimulation of the ability to think and act" (Lebot et al. 1999). Anticonvulsant, hypnotic, anaesthetic, potentiates barbiturate-induced sleep, protects against tissue damage from inadequate blood flow; can produce nausea and ataxia in high doses (Keller & Klohs 1967; Klohs 1967; Lebot et al. 1992; Meyer 1967; Singh & Blumenthal 1997). MAO-B inhibitor in human platelets, slightly less potent than *yangonin* in this regard (Uebelhack et al. 1998). Also found in Aniba gigantifolia (Buckingham et al. ed. 1994).

Dihydrovaltrate $C_{22}H_{32}O_8$

[didrovaltrate; didrovaltratum; dihydrovalepotriate]

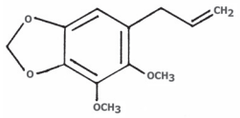


Mp. 63-64°C; sol. in chloroform, chloroform/methanol, alcohol/water, dichloromethane, oils or fats; insol. in water.

Sedative, tranquilliser, improves coordination (Buckingham et al. ed. 1994; Harborne & Baxter ed. 1993), spasmolytic, anticonvulsant (Hobbs 1993).

Dillapiole $C_{12}H_{14}O_4$

[1-ally-2,3-dimethoxy-4,5-methylenedioxybenzene; 4,5-dimethoxy-6-(2-propenyl)-1,3-benzodioxole]



Oil; mp. 29.5°C; bp. 285°C.

Insecticidal [also synergises with pyrethrins], molluscicidal (Buckingham et al. ed. 1994; Harborne & Baxter ed. 1993). Non-amine precursor to DMMDA-2 [2,3-dimethoxy-4,5-methylenedioxy-*amphetamine*]; DMMDA-2 is psychoactive at c.50mg, qualitatively said to be similar to MDA [see *safrole*] (Shulgin 1973; Shulgin & Shulgin 1991). DMMDA-2 is a controlled substance.

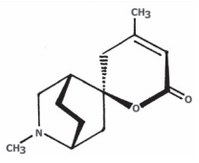
2-Dimethylaminoethanol $C_4H_{11}NO$

[DMAE; deanol; dimethyl-2-hydroxyethylamine; N-dimethylethanolamine]

Liquid; freezing point 40°C; bp. 135°C; miscible with water, alcohol, ether.

Often used as the p-acetamidobenzoate form [Deaner™]. CNS stimulant, antidepressant (Buckingham et al. ed. 1994; Budavari et al. ed. 1989), elevates mood, improves memory and learning, increases intelligence and physical energy, and can reputedly extend life-span. Some of these effects are controversial and may differ depending on dose, form of the drug taken, and length of administration. Treats symptoms of Huntington's chorea. Accelerates *choline* and *acetylcholine* synthesis, and increases *choline* and *acetylcholine* levels, though does not appear to act directly as a precursor as was once thought. One study (Zahniser et al. 1977) observed no noteworthy increases in these neurochemicals, though their treatment of test animals was not continued over an extended period [DMAE has a delayed effect – see below]. Precursor to phosphatidyl-*choline*, or may be broken down to phosphoryl-*choline*; enters the brain more efficiently than *choline*. Inhibits *choline* dehydrogenase. Has a delayed effect, and can be taken in gradually increasing doses up to 0.5-1g a day for at least three weeks, though some studies have observed some positive effects on concentration and sleep habits from as little as 10-20mg a day of the tartrate salt [which is poorly absorbed], and 'mild and pleasant' CNS stimulation from 10-20mg of the base [after 7-10 days of treatment]. After 3-4 weeks, a mild stimulation persists, but does not hinder sleep [though some studies found such higher doses to cause insomnia]; less sleep may be needed, and sleep may be sounder, with greater ease in morning functioning. After some 2 weeks of continuous use, however, the increase in *acetylcholine* reverses, and levels decline to normal (Dean & Morgenthaler 1990; Haubrich et al. 1981; Murphree et al. 1960; Osvaldo 1974; Pfeiffer et al. 1957). Can aid in induction of lucid-dreaming (Sergio 1988). Mammalian hormone, found in brain (Honegger & Honegger 1959). Flammable irritant (Lenga 1988). LD50 of the tartrate [oral] – c.3.1g/kg in mice, 2.6g/kg in rats; death due to respiratory depression and pulmonary oedema (Pfeiffer et al. 1957). Restricted or not approved in some countries. See *Neurochemistry*.

Dioscorine $C_{13}H_{19}NO_2$

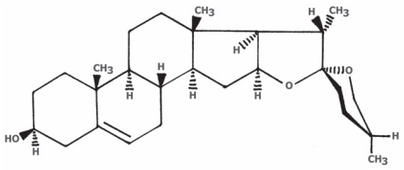


Greenish-yellow prisms from ether; mp. 43.5/54–55°C. Sol. in water, alcohol, acetone, chloroform; slightly sol. in ether, petroleum ether, benzene.

Analeptic, convulsant in large doses [up to 50mg/kg in mice]; mydriatic only at toxic doses. Similar effects to picrotoxin, but weaker. LD50 120mg/kg [i.p.] in mice. Dihydro-*dioscorine* appears to be inactive (Pinder 1953). Picrotoxin is a convulsant found in some plants used to poison fish; it is a *GABA*-antagonist (Goodman & Gilman 1975).

Diosgenin $C_{27}H_{42}O_3$

[nitogenin; dioscorea sapogenin; (3β,25R)-spirost-5-en-3-ol]

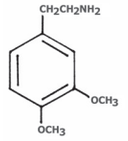


Crystals from acetone; mp. 204–207°C. Sol. in organic solvents and acetic acid.

Obtained by acid hydrolysis of many different saponins – eg. deltonin, deltoside or dioscin. Can be converted to pregnenolone, progesterone and other steroid hormones (Budavari et al. ed. 1989; Coppen 1980; Marker et al. 1940; Quigley 1978).

DMPEA $C_{10}H_{15}NO_2$

[3,4-dimethoxyphenethylamine; homoveratrylamine; 4-(β-aminoethyl)veratrole; 3,4-dimethoxybenzenethanamine]

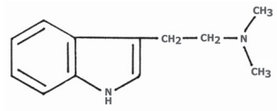


Crystals from benzene and petroleum ether; mp. 124°C; bp. 188°C.

Endogenous mammalian neurochemical, believed to be an abnormal metabolite or of dietary origin; so far not found to be psychoactive in humans [oral, 0.5-1g] (Kaplan & Sadock ed. 1989; Rosengarten & Friedhoff 1976; Shulgin 1973; Shulgin & Shulgin 1991), though 50-200mg/kg injected into rats resulted in 'hypokinesis'. N-Acetyl-*DMPEA*, a naturally-occurring metabolite of *DMPEA*, had similar activity at 1-5mg/kg, with quicker onset of effects. However in humans, it was not psychoactive in oral doses up to 1.2g (Johnson et al. 1970). It may be that these alkaloids do not easily enter the CNS (pers. obs.). *DMPEA* and its N-methylated homologues found in nature act as MAOIs, inhibiting deamination of *tyramine* and *tryptamine* by rat brain MAO – an action not observed with the β-hydroxylated derivatives (Keller & Ferguson 1976a, 1977). Despite this, *DMPEA* is oxidised by MAO (Goto et al. 1997). The related 4-MeO-*phenethylamine* and its N-methylated homologues inhibit the action of MAO on *tyramine*, but not *tryptamine* (Keller & Ferguson 1976b). This, and the MAOI activity of some isoquinolines [eg. see *salsolinol*] might contribute to the psychoactivity of normally orally-inactive *phenethylamine*s found in some 'peyotillos' and 'false peyotes' which are recorded as being psychoactive (pers. obs.). *DMPEA* has also shown neurotoxicity to dopaminergic neurons in vitro (Goto et al. 1997; Koshimura et al. 1997). Reduces hydroxyindole-O-methyltransferase [HIOMT] activity in bovine pineal (Hartley & Smith 1973). See *Neurochemistry*.

DMT $C_{12}H_{16}N_2$

[N,N-dimethyltryptamine; dimethyltryptamine; N,N-dimethyl-1H-indole-3-ethanamine; 3-[2-(dimethylamino)ethyl]indole]

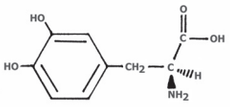


Crystals from ethanol; mp. 44.6–46.8°C; sol. in dilute acids, alcohols, acetone, chloroform, dichloromethane, ether, toluene, hexane, hot petroleum ether; slightly sol. in water; insol. in cold petroleum ether.

Psychedelic at 1mg/kg i.m., 0.2–0.4mg/kg i.v.; active by smoking at 25–100mg. Inactive orally at up to 350mg [without MAOI]. When smoked [preferably vapourised], as much as possible should be inhaled within 1 min. or so and held in for as long as practical – tolerance quickly sets in as the *DMT* is broken down by brain MAO, making extra inhalations capable of maintaining a peak but not increasing the strength of effect. With a fully effective dose, effects are felt after 20 seconds, and a rising tone vibration is sometimes both felt and heard [although some describe this merely as tinnitus, I do not agree that they are the same]. Blood pressure rises. From 30-60 seconds, the visual field is overwhelmed by intricate, rapidly metamorphosing visual effects; 1 minute to 5 minutes, perception of the body is not apparent, time dissolves and the mind exists in an extremely bizarre hyperspatial reality. After this time, visual phenomena subside, and the user is back to 'baseline' after c.30-60mins. Some people find it difficult to inhale a fully effective dose in the short time required before tolerance sets in. Lower doses are nowhere near as dramatic as high doses, and are best appreciated sitting or lying still with eyes closed. Oral doses combined with an MAOI take effect within 10–60mins, and last c.4hrs or less. A very powerful compound which should be approached with extreme respect. Agonist of postsynaptic 5-HT2a, and to a lesser extent 5-HT1a, 5-HT1d & 5-HT2c receptors [reducing *serotonin* levels]; also a ligand of the trace amine [TA] receptor, possibly leading to anxiolytic effects at small doses. Raises blood levels of β-*endorphin*, cortisol, *adrenocorticotropin* and prolactin. Peripheral vasopressor. Humans develop little tolerance with use several times a day, although at least 30 min. should be left between doses due to a short-term tolerance as mentioned above; produces little cross-tolerance with other indole psychedelics (Brimblecombe et al. 1964; Jacob & Presti 2005; McKenna et al. 1990; Shulgin 1976; Shulgin & Shulgin 1997; Smith, R.L. et al. 1998; Strassman 1992–1993, 1996; Strassman & Qualls 1994; Strassman et al. 1994, 1996; Szara 1961a; Turner & Merlis 1959; pers. obs.). Effects are enhanced by pre-administration of small amounts of LSD or *psilocybin* (Trout & Friends 1999). Endogenous mammalian neurochemical (Barker et al. 1981; Christian et al. 1977; Corbett et al. 1978; Gillin et al. 1976; Oon et al. 1977; Smythies et al. 1979; Tanimukai et al. 1970). MAOI in vitro, though not enough to be orally active, despite being the most potent MAOI of the tryptamines tested (Ho et al. 1970; McKenna et al. 1984b). Stimulates hydroxyindole-O-methyltransferase [HIOMT] activity in bovine pineal (Hartley & Smith 1973). Controlled substance. *DMT*-N-oxide, considered to be at least 10x less potent than *DMT* (McKenna et al. 1984b), is resistant to MAO metabolism in aerobic conditions (McKenna et al. 1984a), and is said to be active by smoking (Trout ed. 1997c). See *Neurochemistry*, *Influencing Endogenous Chemistry*.

L-DOPA $C_9H_{11}NO_4$

[3-hydroxy-tyrosine; 3,4-dihydroxy-phenylalanine; 2-amino-3-(3,4-dihydroxyphenyl) propanoic acid; levodopa]

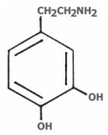


Colourless to white odourless and tasteless crystals; needles from water; mp. 276–278°C [dec.]/284–286°C. Sol. in dilute HCl and formic acid, water; practically insol. in ethanol, benzene, chloroform, ethyl acetate. In presence of moisture, readily oxidises and darkens.

Antidepressant, CNS stimulant; large doses induce locomotor stimulation, nausea, vomiting and 'involuntary chewing movements'; may exacerbate symptoms of schizophrenia, and induce psychotic symptoms in non-schizophrenics. Crosses blood-brain barrier easily, endogenous precursor to *dopamine* (Bell 1973; Boulton & Jiorio 1982; Malitz ed. 1972; Madras 1984; Moore 1978; Webster & Jordan ed. 1989). Sometimes taken with a decarboxylase inhibitor, to prevent it being transformed into *dopamine* before entering the brain. Sexual stimulant in low doses; inhibits this activity in high doses (Crenshaw & Goldberg 1996). Therapeutic dose 100-500mg (Goodman & Gilman 1975). LD50 in mice [oral] – 3650 mg/kg (Budavari et al. ed. 1989). Toxic to beetles and other insects (Harborne et al. ed. 1996). Restricted substance. See *Neurochemistry*.

Dopamine $C_8H_{11}NO_2$

[hydroxy-tyramine; 3,4-dihydroxy-phenethylamine; inotropin]



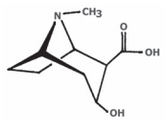
Stout prisms, highly sensitive to oxygen, discolours quickly [freebase] forming dopachrome [similar activity to *adrenochrome*]. HCl – rosettes of needles from water, mp. 240–241°C [dec.]; freely sol. in water; sol. in alcohol; practically insol. in ether, petroleum ether, chloroform, benzene and toluene.

Mammalian neurotransmitter, precursor to *norepinephrine*; does not easily cross blood-brain barrier; inactive orally without MAOI, though this combination presents a risk of hypertensive crisis. Adrenergic, sympathomimetic, vasopressor, cardiotonic, antihypotensive (Buckingham et al. ed. 1994; Budavari et al. ed. 1989; Cryer 1992; Goodman & Gilman 1975; Harborne et al. ed. 1996; Kaplan & Sadock ed. 1989; Madras 1984; Malitz ed. 1972; Moore 1978). Stimulates hydroxyindole-O-methyltransferase [HIOMT] activity in bovine pineal (Hartley & Smith 1973). CNS stimulant, euphoriant; causes feelings of pleasure, promotes orgasm (Crenshaw & Goldberg 1996; Malitz ed. 1972). Also found in the alga Monostroma fuscum. LD50 in rats [i.p.] – 163mg/kg (Buckingham et al.

ed. 1994). See *Neurochemistry*.

Ecgonine $C_9H_{15}NO_3$

[3-β-hydroxy-1-α-H,5-α-H-tropane-2-β-carboxylic acid]

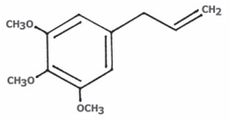


Triboluminescent monoclinic prisms from alcohol; mp. 198°C [dec. 205°C]. Sol. in water, alcohol, ethyl acetate; sparingly sol. in acetone, ether, benzene, chloroform, petroleum ether. Obtained by hydrolysis of *cocaine*.

Topical anaesthetic (Budavari et al. ed. 1989) weaker than *cocaine*, relieves hunger and fatigue, raises blood glucose levels. May have similar but much weaker cerebral effects to *cocaine* (Antonil 1978; Smith 1981). Toxic by inhalation, allergen (Buckingham et al. ed. 1994). Controlled substance; may be used to make *cocaine* (Clawson & Lee 1996; Smith 1981).

Elemicin $C_{12}H_{16}O_3$

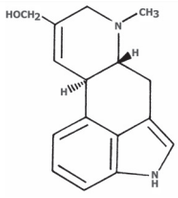
[1-allyl-3,4,5-trimethoxybenzene; 1,2,3-trimethoxy-5-(2-propenyl)benzene]



Oil; bp. 144–147/175°C; sol. in organic solvents.

Psychoactive in animals, causing excitation followed by sedation (Oswald et al. 1971b). Non-amine precursor to TMA [3,4,5-trimethoxy-*amphetamine*]; TMA is psychoactive at 100-250mg, lasting 6-8hrs – similar to *mescaline*, though less colourful visually (Shulgin 1973; Shulgin & Shulgin 1991; Shulgin et al. 1967), and similarly is a controlled substance.

Elymoclavine $C_{16}H_{18}N_2O$



Monoclinic prisms from methanol; mp. 248–252°C [dec.]. Fairly sol. in water with alkaline reaction; sol. in pyridine; very slightly sol. in organic solvents.

CNS excitant in animals; stimulates sympathetic nerves (Yui & Takeo 1958a, 1958b); hypotensive, brachycardiac, vasoconstrictor; *serotonin* antagonist (Takeo 1964); affects 5-HT2a receptors and α1-adrenoceptors in the rat (Pertz 1996), also stimulating *dopamine* receptors; stimulates pressor effects of *norepinephrine* and *nicotine*. In rats, 5mg/kg [i.p.] increased central *dopamine* levels in the hypothalamus and striatum, and increased its turnover in the striatum; increased levels and turnover of *norepinephrine* in the hypothalamus; and decreased *serotonin* levels and turnover in both these brain structures, whilst increasing *serotonin* levels in the cerebral cortex. LD50 over 24 hours was 228-535mg/kg in mice, and 81-258mg/kg in rats (Fuxe et al. 1978; Petkov & Konstantinova 1986; Petkov et al. 1984).

β-Endorphin H-Tyr-Gly-Gly-Phe-Met-Thr-Ser-Glu-Lys-Ser-Gln-Thr-Pro-Leu-Val-Thr-Leu-Phe-Lys-Asn-Ala-Ile-Ile-Lys-Asn-Ala-Tyr-Lys-Lys-Gly-Glu-OH

White powder.

Analgesic and behavioural activity like *morphine* and other opiates. Blocks inhibitory pathways in CNS. Mammalian neuropeptide (Kruk & Pycock 1983; Pomeranz 1977; Ree & de Wied 1983; Székely & Ronai 1982). See *Neurochemistry*.

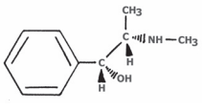
Enkephalins H-Tyr-Gly-Gly-Phe-X-OH [X=Met (*methionine*) or Leu (leucine)]

Met-*enkephalin* – needles from hot methanol; mp. 196–198°C. Leu-*enkephalin* – white crystalline solid; mp. 206°C [dec.].

Met-*enkephalin* and leu-*enkephalin* are opioid peptides with opiate-like effects; transient antinociceptive activity. Mammalian neuropeptides (Buckingham et al. ed. 1994; Herz 1980; Kruk & Pycock 1983; Ree & de Wied 1983; Székely & Ronai 1982; Székely et al. 1980). See *Neurochemistry*.

Ephedrine $C_{10}H_{15}NO$

[(1R,2S)-2-methylamino-1-phenyl-1-propanol]

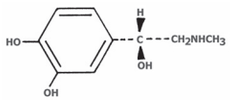


L-form – waxy solid, crystals or granules; gradually dec. on exposure to light; may contain up to 5.2% water; mp. 40°C; bp. 225°C; anhydrous material hygroscopic; mp. 34°C; sol. in water, alcohol, chloroform, ether, oils.

Indirect sympathomimetic agent, triggering release of catecholamines [*norepinephrine* most potently, as well as *dopamine*] and inhibiting their re-uptake; CNS stimulant similar to *amphetamine*; accelerates respiration and acts as a bronchodilator; decreases contractility of the bladder; vasoconstrictive. Agonist at α- and β-adrenergic receptors. Can cause tremors and insomnia (Bruneton 1995; Buckingham et al. ed. 1994; Goodman & Gilman 1975; Kalix 1991; Rothman et al. 2001). Potentiated by MAOIs (Iversen et al. ed. 1978), bringing the danger of hypertensive crisis. Japanese kamikaze pilots in WWII were reportedly given *ephedrine* injections ['philopon' – 'love of work']; after the war, there was an epidemic of injectable *ephedrine* abuse [by then called 'hirapon']. It has also been smoked with *caffeine* in the Philippines [see *caffeine*] (Karch 1996). Medicinal dose 15-50mg (Goodman & Gilman 1975); active as a CNS stimulant up to 200mg (pers. comms.; pers. obs.). Controlled substance [more than 20g]; otherwise restricted. Pseudoephedrine is less active as a CNS- and cardiac-stimulant, and the side-effects are more pronounced at psychoactive doses. Side effects of high doses include dry mouth, gagging, nausea and hypertension (Upfal 1995; pers. obs.).

Epinephrine $C_9H_{13}NO_3$

[adrenaline; 1-(3,4-dihydroxyphenyl)-2-methylaminoethanol]

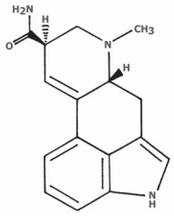


Off-white powder; mp. 211–216°C [dec. 215°C]; sparingly sol. in water; sol. in aqueous solutions of mineral acids, and of NaOH and KOH. Insol. in alcohol, ether, chloroform, acetone, oils.

Adrenergic, bronchodilator, mydriatic, antiglaucomic, vasoconstrictor, cardiac stimulant; may cause contact dermatitis. Used medicinally [i.m.] to relieve symptoms of anaphylaxis [severe allergic reaction]. Overdose and/or use outside of an appropriate medical context can be highly dangerous, resulting in cardiovascular disturbances and sometimes death. Active therapeutically around 0.5mg. High oral toxicity [antidote – guanine]. LD50 in mice [i.p.] – 4mg/kg. LD50 on the skin, in rats – 62mg/kg. Mammalian adrenal hormone and neurotransmitter. Does not cross the blood-brain barrier (Buckingham et al. ed. 1994; Budavari et al. ed. 1989; Cryer 1992; Goodman & Gilman 1975; Harborne et al. ed. 1996; Johnston et al. 2003; Marley & Stephenson 1972). Restricted substance. See *Neurochemistry*.

Ergine $C_{16}H_{17}N_3O$

[lysergic acid amide; lysergamide; LA-111; LSA; 9,10-didehydro-6-methylergonoline-8-β-carboxamide]

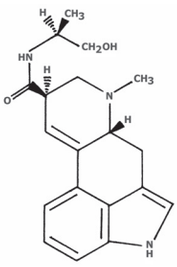


Prisms from methanol; mp. 242°C [dec.]; sol. in ethanol, methanol, chloroform; slightly sol. in water.

Psychoactive at 0.5–1mg; sedative, hypnagogic, causes sensitivity to sound-stimuli (Hofmann 1963). *Serotonin* antagonist (Cerletti & Doepfner 1958; Takeo 1964); slightly inhibits human plasma cholinesterase (Orgell 1963a). Stimulates hydroxyindole-O-methyltransferase [HIOMT] activity in bovine pineal (Hartley & Smith 1973). Controlled substance.

Ergonovine $C_{19}H_{23}N_3O_2$

[ergometrine; ergotrate; ergobasine; ergotocin; ergostetrine; d-lysergic acid-L-2-propanolamide; 9,10-didehydro-N-(2-hydroxy-1-methylethyl)-6-methylergoline-8-carboxamide]



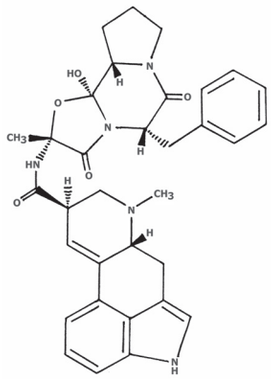
Tetrahedra from ethyl acetate; fine needles from benzene; mp. 162–163°C. Sol. in water, alcohol, ethyl acetate, acetone; slightly sol. in chloroform.

Mildly psychoactive and physiologically active from 0.65mg. Mild LSD-like psychedelic between 2–10mg, but with strong somatic side-effects [eg. leg cramps, physical sedation] increasing in intensity with increased dose; side effects were stated to overshadow the desirable effects, which were still relatively mild at the highest dose bioassayed and did not increase in intensity with the same magnitude as did these side effects; euphoria was minimal or absent [as *ergonovine* maleate] (Bigwood et al. 1979). Inhibits prolactin release; oxytocic; vasoconstrictor; uterotonic; used as a haemostatic to treat post-partum haemorrhage [0.2–0.4mg 2–4 times a day for several days]. Should not be used in the case of severe high blood pressure. *Serotonin* antagonist c.4x as potent as *ergine*; decreases *serotonin* levels and turnover; increases levels and turnover of *norepinephrine* and *dopamine*; binds to 5-HT2a receptors and α-1-adrenoceptors. Initially a D2 *dopamine*-receptor agonist, later becoming an antagonist. In rats, it caused "strong and long-lasting stimulation of locomotor activity" at 10mg/kg, due to activity at brain *dopamine* receptors. LD50 in rats 81–258mg/kg (Boissier 1978; Bruneton 1995; Cerletti & Doepfner 1958; Cools 1978; Pertz 1996; Petkov & Konstantinova 1986; Petkov et al. 1984; Rastogi & Mehrotra ed. 1990-1993; Upfal 1995).

Methylergonovine is c.3½ x as potent as a *serotonin* antagonist (Cerletti & Doepfner 1958), and is psychedelic at a dose of 2mg [similar in strength to a 10mg dose of *ergonovine*] (Ott & Neely 1980).

Ergotamine $C_{33}H_{35}N_5O_5$

[12'-hydroxy-2'-methyl-5'-(phenylmethyl)ergotaman-3',6',18-trione]

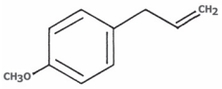


Elongated prisms from benzene; very hygroscopic, darkens on exposure to air, heat, light; mp. 213–214°C [dec.]; sol. in chloroform, pyridine, glacial acetic acid; moderately sol. in ethyl acetate; slightly sol. in benzene; almost insol. in water, petroleum ether.

Partial adrenergic agonist, later antagonist; *serotonin* antagonist; inhibits vasomotor centres; haemostatic; potent vasoconstrictor; oxytocic; hypertensive. Partly responsible for 'gangrenous ergotism' [see **Claviceps**]. Relieves migraine headaches, but does not prevent them. Sometimes available medicinally in combination with *caffeine*, which enhances the absorption of *ergotamine*. Can cause mental depression, confusion, drowsiness, weakness, headache and feeling of insects crawling under the skin. Active 2-4mg or more. High doses should be treated with caution and can result in impaired blood flow to legs, numbness in hands and feet, cold skin, gangrene, nausea, vomiting, diarrhoea, itching, strong thirst, seizures and unconsciousness. Should not be taken if suffering from severe infections, angina, severe high blood pressure, Raynaud's disease, impaired kidney or liver function, reduced blood flow to legs, arteriosclerosis or if pregnant or breast-feeding (Boissier 1978; Bruneton 1995; Buckingham et al. ed. 1994; Cerletti & Doepfner 1958; Goodman & Gilman 1975; Harborne & Baxter ed. 1993; Kruk & Pycock 1983; Upfal 1995). Restricted substance.

Estragole $C_{10}H_{12}O$

[methylchavicol; isoanethole; p-allylanisole; 1-methoxy-4-(2-propenyl)benzene; 1-allyl-4-methoxybenzene]

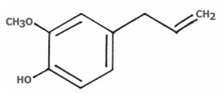


Liquid; bp. 95–96/108–114/216°C. Sol. in alcohol, chloroform; sparingly sol. in water.

Hypothermic, stimulates liver regeneration, binds to DNA (Harborne et al. 1996). Inhibits neuromuscular transmission, may have some anticholinergic activity (Albuquerque et al. 1995). A pheromone of the 'Southern' and 'Western corn rootworms' [Diabrotica undecimpunctata and D. virgifera] (Buckingham et al. ed. 1994). Carcinogenic in mice (Ames et al. 1987). LD50 in mice [oral] – 1250mg/kg (Budavari et al. ed. 1989). Non-amine precursor to 4-MA [see *anethole*] (Shulgin & Shulgin 1991; Shulgin et al. 1967).

Eugenol $C_{10}H_{12}O_2$

[5-allyl-guiacol; 2-methoxy-4-(2-propenyl)phenol; 1-allyl-4-hydroxy-3-methoxybenzene; 4-allyl-2-methoxyphenol]



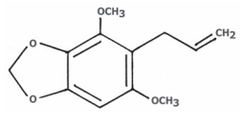
Colourless or pale yellow liquid with odour of cloves [see **Syzygium**] and spicy, pungent taste; bp. 248-255°C. Darkens and thickens on air exposure. Practically insol. in water; miscible with alcohol, chloroform, ether, oils; sol. in glacial acetic acid.

Psychoactive in animals, causing excitation followed by sedation (Oswald et al. 1971b); anticonvulsant, spasmolytic, hypothermic, antioxidant (Harborne & Baxter ed. 1993), insect attractant, analgesic [used in dentistry] (Buckingham et al. ed. 1994). LD50 in rats [oral] – 2680mg/kg (Budavari et al. ed. 1989). Non-amine precursor to 3,4-DMA [3,4-

dimethoxy-*amphetamine*], which is psychoactive from c.160mg and above, producing some *mescaline*-like symptoms (Shulgin 1973; Shulgin & Shulgin 1991; Shulgin et al. 1967); 3,4-DMA is a controlled substance.

Exalatacin $C_{12}H_{14}O_4$

[1-allyl-2,6-dimethoxy-3,4-methylenedioxybenzene; 2,6-dimethoxy-3,4-methylenedioxy-1-(2-propenyl)-benzene]

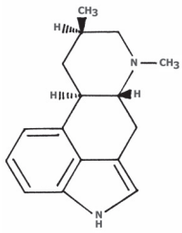


Oil; bp. 112–113°C; sol. in hexane, benzene, chloroform.

Non-amine precursor to 2,6-dimethoxy-3,4-methylenedioxy-*amphetamine* [DMMDA-3], of unknown human pharmacology (Torsten pers. comm. referring to comms. with A.T. Shulgin).

Festuclavine $C_{16}H_{14}N_2$

[dihydro-agroclavine]

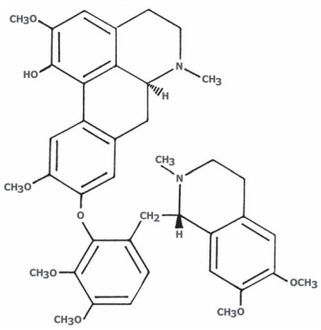


Long needles from methanol, mp. 238–242°C [dec. 239–240°C]; sol. in methanol, water/acetone, ether, chloroform.

Psychoactive in animals, causing CNS depression, drowsiness and slight mydriasis; reduced uptake of *norepinephrine* and *dopamine*, also reducing *dopamine* turnover (Fuxe et al. 1978; Yui & Takeo 1958a, 1958b). 5-HT2a-receptor and α1-adrenoceptor agonist in rats (Pertz 1996).

Foetidine $C_{40}H_{46}N_2O_8$

[fetidine]

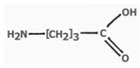


Crystals from ethyl acetate; mp. 132–135/125–126°C.

Nervous depressant, hypotensive, antiinflammatory (Buckingham et al. ed. 1994).

GABA $C_4H_9NO_2$

[gamma-aminobutyric acid; γ-aminobutyric acid; 4-aminobutanoic acid; piperidinic acid]

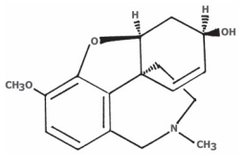


Leaflets from methanol and ether; needles from alcohol and water; mp. 202°C [dec. 203°C]. Freely sol. in water; insol. or poorly sol. in other solvents. On melting, it decomposes, forming water and pyrrolidone.

Antihypertensive, anticonvulsant; inhibitory effects in CNS. Can cause sedation, depression, muscle relaxation, analgesia. Mammalian neurotransmitter; does not cross the blood-brain barrier as well as its hydroxyl derivative, GABOB [gamma-amino-β-hydroxybutyric acid], which has similar activity to *GABA* and decreases brain *serotonin* [when given i.p.] (Buckingham et al. ed. 1994; Budavari et al. ed. 1989; De Maio & Pasquariello 1964; Kruk & Pycock 1983). *GABA* may antagonise *dopamine* activity (Kaplan & Sadock 1989). Reduces *vasopressin* levels; levels increase in male rats after orgasm (Crenshaw & Goldberg 1996). See *Neurochemistry*.

Galanthamine $C_{17}H_{21}NO_3$

[4a,5,9,10,11,12-hexahydro-3-methoxy-11-methyl-6H-benzofuro[3a,3,2-ef][2]benzazepin-6-ol; galantamine; galanthine; lycoremine]

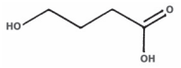


Crystals from benzene; mp. 126–129/133–134°C; sol. in hot water, alcohol, acetone, chloroform; less sol. in benzene, ether.

AChE inhibitor (Kametani et al. 1971; Vasilenko & Tonkopii 1975); powerful analgesic, inhibits traumatic shock, brachycardiac, restores non-depolarising neuromuscular blockage and restores synaptic transmission (Martin 1982). Doses of 5–10mg [3 times a day] have been safely given to Alzheimer's Disease patients, to relieve their symptoms; 15mg was noted to result in "central agitation and sleeplessness" (De Smet 1998). LD50 in mice [s.c.] – 11mg/kg. Found in a large number of plants from the Amaryllidaceae, such as Galanthus voronovii and **Narcissus** spp. (Buckingham et al. ed. 1994).

GHB $C_4H_8O_3$

[gamma-hydroxybutyric acid; gamma-hydroxybutyrate; γ-hydroxybutyrate; 4-hydroxybutanoic acid; 4-hydroxybutyrate; GBH; 'liquid ecstasy']

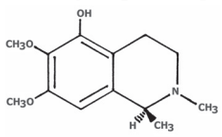


Often prepared as the sodium or potassium salts, which form white, hygroscopic crystals; sodium *GHB* – mp. 145–146°C; sol. in water.

Hypnotic, tranquilliser, weak analgesic; alcohol-like inebriant and euphoriant in low doses, though some people claim to experience mildly psychedelic effects. A low to moderate dose is considered to be 1-2g; coma, muscle spasms and vomiting may occur above 5g. Lasts 1-3 hours. Inhibits, then stimulates, *dopamine* release; large doses increase levels of *acetylcholine* and *serotonin*; increases cGMP levels; lowers glucose levels and utilisation. May be metabolite of *GABA*; found in relatively high levels in kidney, heart and skeletal muscle; unevenly distributed in brain. Highest concentrations in humans in foetal cerebellum and adult hypothalamus. LD50 [i.p., of sodium *GHB*] 2g/kg in male rats, 1.65g/kg in female rats. Toxicity greatly increased by alcohol (McCormick & Tunnicliff 1998; Tunnicliff 1992; pers. comms.). GBL [γ-hydroxybutyric acid lactone; γ-butyrolactone; 1,2-butanolide; 1,4-butanolide; dihydro-2(3H)-furanone] has similar effects to *GHB* in humans (Tunnicliff 1992; pers. comms.). See *Neurochemistry*.

Gigantine $C_{13}H_{19}NO_3$

[1,2,3,4-tetrahydro-5-hydroxy-6,7-dimethoxy-1,2-dimethylisoquinoline]

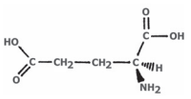


Crystals from ether; mp. 151-152°C.

Claimed to be "hallucinogenic" in cats and squirrel monkeys at 5mg/kg [i.p.]; lethal at 20mg/kg [i.p.] (Hodgkins et al. 1967).

Glutamic acid $C_5H_9NO_4$

[glutamate; 2-aminopentanedioic acid; 2-aminoglutaric acid]

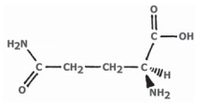


Rhombic crystals from dilute ethanol; mp. 211–213/224–225/247–249°C [dec.].

Excitatory amino acid and neurochemical (Kruk & Pycock 1983). From acid hydrolysis of proteins. Used as a seasoning additive in food [as Na, K and NH4 salts] (Buckingham et al. ed. 1994). See *Neurochemistry*.

Glutamine $C_5H_{10}N_2O_3$

[2,5-diamino-5-oxopentanoic acid]

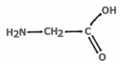


Needles from dilute ethanol; mp. 184–185°C; sol. in water; sparingly sol. in ethanol.

Psychotonic, alcohol antagonist. Widely distributed in plants, eg. in beetroot (Buckingham et al. ed. 1994). See *Neurochemistry*.

Glycine $C_2H_5NO_2$

[aminoacetic acid; glycocoll; glue sugar]

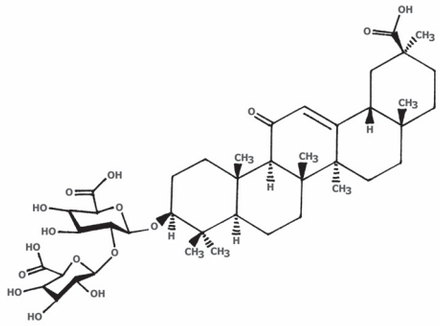


Crystals from dilute ethanol; mp. 262°C [dec.]; sol. in water; slightly sol. in alcohol.

Inhibitory amino acid (Kruk & Pycock 1983). Occurs widely in peptides and proteins (Buckingham et al. ed. 1994). See *Neurochemistry*.

Glycyrrhizin $C_{42}H_{62}O_{16}$

[glycyrrhitin; glycyrrhizic acid; glycyrrhizinic acid; glycyrrhetic acid 3-O-[β-D-glycopyranosyl(1→2)-α-D-glucopyranoside]

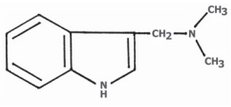


Crystals from glacial acetic acid, or hygroscopic powder; mp. c.220°C; freely sol. in hot water, alcohol; practically insol. in ether.

Adrenal tonic, antiinflammatory, expectorant, antihaemmorrhagic; has a protective action against saponin toxicity; MAOI. Can cause hypertension, sodium retention and heart enlargement if taken in excess (Buckingham et al. ed. 1994; Hall 1973; Hatano et al. 1991; Segal et al. 1977).

Gramine $C_{11}H_{14}N_2$

[3-(dimethylaminomethyl)indole; 3-(N,N-dimethylaminomethyl)indole; N,N-dimethyl-1H-indole; donaxine; doranine]

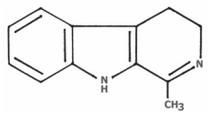


Shiny flat needles or plates from acetone; mp. 138–139°C; sol. in alcohol, ether, chloroform; slightly sol. in cold acetone; practically insol. in petroleum ether and water.

May have *ephedrine*-like actions; pharmacology unclear. In animals, first stimulates CNS [causing clonic convulsions and hyperpnoea], then depresses it – death may occur due to respiratory failure (Erspamer 1966). Behaviourally-active in rats, though 5-methoxy-*gramine* was much more effective (Gessner et al. 1961). Apparently psychotropic in sheep [10–30mg/kg i.v.], with effects noted after 10–15 seconds, and lasting 5–25min. [duration increasing with dose]; orally, *gramine* was quite toxic in large doses [400-600mg/kg], with effects beginning in 20min. to 1hr, death often resulting within a few hours (Bourke et al. 1988). Toxic to mammals, insects, plants, and bacteria (Corcuera 1993). In voles, it impaired kidney function and appeared to interfere with nutrient-utilisation; death often resulted with extended feeding [*gramine* was administered as a component of feed] (Goelz et al. 1980). In mammalian mitochondria [from rat liver and bovine heart], low doses slightly stimulated basal electron transport, and inhibited Ca2+-induced respiratory control; higher doses inhibited electron transport in the respiratory chain (Niemeyer & Roveri 1984). Inhibits human plasma cholinesterase (Orgell 1963a). MAOI activity has been demonstrated in vitro, but this is less potent than that of *DMT*, *5-methoxy-DMT* and *bufotenine*; 5-methoxy-*gramine* is also an MAOI, but less potent than *gramine* (Ho et al. 1970). Human toxicity was relatively unknown until recently, when *gramine* appeared as an obscure new health supplement. However, I have been unable to find reference to this outside of promotional literature. Suggested use is as a sedative and nerve tonic, to treat epilepsy, depression and *nicotine* withdrawal. Suggested doses are 100-200mg a day for children, 200-400mg for adults, with the only noted side effect from overdose being diarrhoea. Has been found to modulate blood pressure (Designed Nutritional Products undated).

Harmalan $C_{12}H_{12}N_2$

[3,4-dihydro-1-methyl-β-carboline; 4,9-dihydro-1-methyl-3H-pyrido[3,4-b]indole]

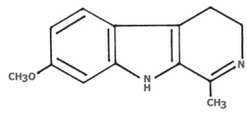


Cream needles from acetone; mp. 183–183°C [dec.].

MAOI in vitro (Buckholtz & Boggan 1977); endogenous neurochemical, sometimes formed as a result of alcohol consumption (Shulgin & Shulgin 1997). See *Neurochemistry*.

Harmaline $C_{13}H_{14}N_2O$

[dihydro-harmine; harmidine; 4,9-dihydro-7-methoxy-1-methyl-3H-pyrido[3,4-b]indole; 3,4-dihydro-7-methoxy-1-methyl-β-carboline]

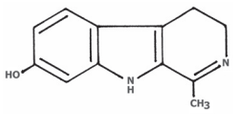


Orthorhombic bipyramidal prisms or tablets from methanol, rhombic octahedra from ethanol; mp. 227–231/250–251°C; solns. have blue fluorescence.

MAOI at 1.2–1.32mg/kg and above. Psychoactive at 150–500mg orally, lasting 5-8 hrs; causes sedation, intoxicated feeling, mild visual disturbances, often with lateral rippling effects and closed-eye eidetic imagery; mild psychedelic; causes nausea, dizziness, paraesthesia (Buckholtz & Boggan 1977; Kim et al. 1997; McKenna et al. 1984a; Naranjo 1967; Ott 1993, 1994; Shulgin 1977; Shulgin & Shulgin 1997; Udenfriend et al. 1958); antimalarial (Gröger 1959). Protects against oxidative neurotoxicity induced by *dopamine* or MPTP [1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine] (Lee, C.S. et al. 2000). Inhibits human plasma cholinesterase; inhibits Na+-dependent *choline* uptake, though more weakly than either *harmine* or *harmalol*; inhibits *GHB* synaptosomal transport; inhibits binding of leu-*enkephalin* to delta opiate-receptors; binds to *serotonin* receptors and I2 imidazoline receptors; weak NMDA-receptor antagonist; BZ-receptor antagonist; increasesc brain *serotonin*; inhibits adrenal *epinephrine* uptake, though less potent than *harmine*; has c.4x the tremorgenic potency of *ibogaine* in mice. Has a slower rate of uptake, and slower clearance rate, than *harmine*. Metabolised by O-demethylation to *harmalol* (Airaksinen et al. 1984; Carpéné et al. 1995; Du et al. 1997; Glennon 1981; Ho 1977; Layer et al. 1996; McCormick & Tunnicliff 1998; Mousah et al. 1986; Orgell 1963a; Saano & Airaksinen 1982; Smart 1981; Zetler et al. 1972). Lethal in rats at 120mg/kg [s.c.] (Mahmoudian et al. 2002). Controlled substance in some countries [Australia].

Harmalol $C_{12}H_{12}N_2O$

[4,9-dihydro-1-methyl-3H-pyrido[3,4-b]indol-7-ol; 3,4-dihydro-7-hydroxy-1-methyl-β-carboline]

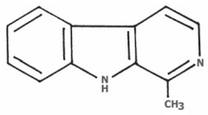


Fine orange or red needles from water; mp. 100–105°C; dec. 212°C [anhydrous]; aqueous solns. are yellow with green fluorescence; readily sol. in hot water, acetone, chloroform, alkali hydroxides, dilute acids, hot alcohol; slightly sol. in water, alcohol, ether; readily oxidised in air.

Weak MAOI in vitro in rat brain (Buckholtz & Boggan 1977); inhibits human plasma cholinesterase (Orgell 1963a); inhibits Na+-dependent *choline* uptake (Smart 1981); inhibits binding of leu-*enkephalin* to delta opiate-receptors (Airaksinen et al. 1984); binds to *serotonin* receptors (Glennon 1981); BZ-receptor antagonist (Mousah et al. 1986); protects against oxidative neurotoxicity induced by *dopamine* or MPTP [see *harmaline* above] (Lee, C.S. et al. 2000).

Harman $C_{12}H_{10}N_2$

[harmane; passiflorine; loturine; zygofabine; aribine; 1-methyl-9H-pyrido[3,4-b]indole; 1-methyl-β-carboline]

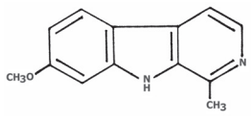


Bitter orthorhombic crystals from heptane and cyclohexane; mp. 237–238°C; exhibits bright blue fluorescence in UV light; practically insol. in water; sol. in dilute acids.

Plant growth inhibitor (Buckingham et al. ed. 1994). Is an MAOI experimentally, and binds to MAO (Buckholtz & Boggan 1977; Kim et al. 1997; May et al. 1994; McKenna et al. 1984a; Udenfriend et al. 1958), but in oral tests in humans of up to 250mg *harman* followed by 35mg *DMT*, no effects were noted (Ott 1994; Shulgin & Shulgin 1997), leading us to presume that *harman* is not an orally-active MAOI at this dose range. Inhibits plasma cholinesterase (Orgell 1963a); inhibits binding of leu-*enkephalin* to delta opiate-receptors (Airaksinen et al. 1984); BZ-receptor antagonist (Mousah et al. 1986; Saano & Airaksinen 1982); has c.½ the tremorgenic potency of *ibogaine* in mice (Zetler et al. 1972); also a free-radical scavenging antioxidant, a property shared by other β-carbolines (Tse et al. 1991). Inhibits AChE, and non-competitively inhibits muscarinic *acetylcholine* receptor binding, in rat brain (Skup et al. 1983). Catatonic motor-depressant in rats [10mg/kg]; higher doses [50mg/kg] were convulsive (Ho 1977). Mammalian neurochemical, possibly of dietary origin [eg. alcohol, cigarette smoke, soy sauce] or formed as a result of alcohol consumption (Callaway et al. 1995; Collins 1983; Shulgin & Shulgin 1997). LD50 in mice [i.p.] – 50mg/kg (Budavari et al. ed. 1989); lethal in rabbits at 200mg/kg [s.c.] (Mahmoudian et al. 2002). See *Neurochemistry*.

Harmine $C_{13}H_{12}N_2O$

[telepathine; yageine; banisterine; 7-methoxy-1-methyl-β-carboline; 7-methoxy-1-methyl-9H-pyrido[3,4-b]indole]

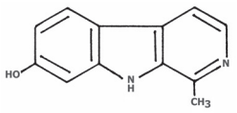


Slender orthorhombic prisms from methanol; mp. 257–259/261[dec., sublimes]/264–265°C; slightly sol. in water, alcohol, chloroform, ether.

MAOI at 140–190mg [or 1.5mg/kg] and above. Psychoactivity unclear in nature – widely differing responses to this chemical have been recorded at widely differing doses [40–900mg], some reporting no effects other than the physical, others reporting euphoria, mild CNS stimulation, sedation, and mild psychedelic effects; can cause hypotension, dizziness, nausea, ataxia, brachycardia (Buckholtz & Boggan 1977; Kim et al. 1997; McKenna et al. 1984a; Naranjo 1967; Ott 1994; Shulgin & Shulgin 1997; Udenfriend et al. 1958); can treat symptoms of Parkinson's Disease (Holmstedt 1982); antimalarial (Gröger 1959). Protects against oxidative neurotoxicity induced by *dopamine* or MPTP [see *harmaline* above] (Lee, C.S. et al. 2000). Inhibits Na+-dependent *choline* uptake, though more weakly than *harmalol* (Smart 1981); inhibits plasma cholinesterase (Orgell 1963a); binds to *serotonin* receptors (Glennon 1981); BZ-receptor antagonist (Mousah et al. 1986); has c.3x the tremorgenic potency of *ibogaine* in mice (Zetler et al. 1972). Slightly raises brain *dopamine* levels; inhibits adrenal *epinephrine* uptake. Metabolised by O-demethylation to *harmol* (Ho 1977). Apparently poorly absorbed through stomach; best taken sublingually or intranasally [in HCl form], or vapourised and inhaled [in base form] (pers. comms.; pers. obs.). LD50 in mice – 243mg/kg [s.c.] (Buckingham et al. ed. 1994), or 38mg/kg [i.v.] (Mahmoudian et al. 2002). Controlled substance in some countries [Australia].

Harmol $C_{12}H_{10}N_2O$

[7-hydroxy-harman; 7-hydroxy-1-methyl-β-carboline; 1-methyl-9H-pyrido[3,4-b]indol-7-ol]

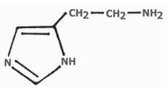


Mp. 304–307° C.

Weaker MAOI than *harmalol* in vitro, in mouse brain (Buckholtz & Boggan 1977), similarly potent to *harman* in rat liver (McKenna et al. 1984a); inhibits plasma cholinesterase (Orgell 1963a); inhibits binding of leu-*enkephalin* to delta opiate-receptors (Airaksinen et al. 1984); binds to *serotonin* receptors (Glennon 1981). CNS-depressant in rats; caused paralysis in higher doses (Ho 1977).

Histamine $C_5H_9N_3$

[ergamine; 1H-imidazole-4-ethanamine; 4-(2-aminoethyl)-1H-imidazole]

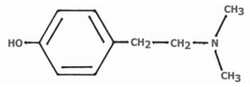


Deliquescent needles from chloroform; mp. 83–84/86°C; bp. 167/209–210°C; freely sol. in water, alcohol, hot chloroform; sparingly sol. in ether.

Potent vasodilator; gastric secretion stimulant; regulates body temperature; activates suppressor cells, reduces antibody secretion. Causes localised oedema response in mammalian tissues; can cause hypotension, tachycardia, increased heart rate and contractility. Involved in motion sickness; may aid in memory retention. Stimulates cAMP in brain, increases *norepinephrine* release, indirectly excitatory in neurons [potentiates excitatory signals]; may increase *vasopressin* secretion. Increases plasma levels of β-*endorphin*, *adrenocorticotropin*, corticosterone and β-lipotropin. Eating causes its release from gastric mucosa. Mammalian neurotransmitter. Does not cross the blood-brain barrier; is also mostly prevented from entering blood by an intestinal barrier. LD50 in mice [i.p.] – 2020mg/kg (Buckingham et al. ed. 1994; Budavari et al. ed. 1989; Levi et al. 1991; Maslinski & Fogel 1991; Schwartz 1991; Tasaka 1991; Watanabe et al. 1991; Yamatodani et al. 1991). *Histamine* antagonists can cause sedation, antidepression, analgesia and some degree of delirious intoxication at higher doses (pers. obs.; Schwartz 1991; Yamatodani et al. 1991). See *Neurochemistry*.

Hordenine $C_{10}H_{15}NO$

[peyocactine; cactine; anhaline; eremursine; N,N-dimethyltyramine; 4-hydroxy-N,N-dimethylphenethylamine; 4(2-dimethylaminoethyl)phenol]



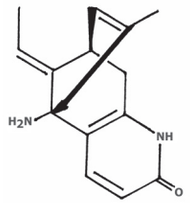
Orthorhombic prisms from alcohol or benzene/petroleum ether, needles from water; mp. 117–118°C; bp. 173–174°C; sublimes 140–150°C; very sol. in alcohol, chloroform, ether, water; sparingly sol. in benzene, toluene, xylene.

Hypertensive in large doses with *ephedrine*-like excitant action in animals; the methiodide has been reported to show *nicotine*-like activity in animals; diuretic, disinfectant, treats dysentery; grasshopper feeding deterrent (Buckingham et al. ed. 1994; Henry 1939). LD50 in mice – 113.5mg/kg (Budavari et al. ed. 1989). In voles, it appeared to be relatively non-toxic (Goelz et al. 1980) and antibiotic (McCleary et al. 1960). Appears to be mildly psychotropic in sheep [20–160mg/kg i.v.], with effects beginning in 10–15 seconds, and lasting 5–90min. [duration increasing with dose]; convulsions were noted in some sheep at the highest dose. Orally, doses of 200–400mg/kg were inactive; 800mg/kg was active with effects [milder, but similar in character to the 160mg/kg i.v. dose] begin-

ning in 30min. and lasting up to 1hr (Bourke et al. 1988).

Huperzine A $C_{15}H_{18}N_2O$

[selagine; 5-amino-11-ethylidene-5,8,9,10-tetrahydro-7-methyl-5,9-methanocycloocta[b]pyridin-2(1H)-one]

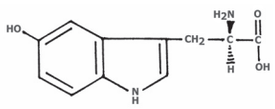


Crystals from acetone; amorphous base with odour of *coniine*; forms deliquescent salts; mp. 214–215/224–226/230°C; sol. in chloroform, methanol, water/tartaric acid.

Very strong AChE-inhibitor, and NMDA-receptor antagonist; markedly increases efficiency of learning and memory; the B-form has similar effects. Used to treat dementia from Alzheimer's Disease, myasthenia gravis (Liu et al. 1986; Tang et al. 1994; Zhang & Hu 2001; Zhou et al. 1993). See *Influencing Endogenous Chemistry*.

5-Hydroxytryptophan $C_{11}H_{12}N_2O_3$

[(S)- or (L)-form (natural form) – oxitriptan; levothym; serotonyl; triptene; 5-HTP]

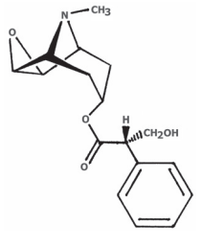


Pale pink needles or crystals; mp. 273°C [dec.]; dl-form sol. in water or 50% boiling alcohol; aqueous solns. stable at low pH.

Biogenic precursor to *serotonin*, increases *serotonin* levels (Bell 1973; Van Praag 1981; Webster 1989). Antidepressant and slight sedative at 50-500mg, sometimes euphoriant; more effective as an antidepressant in people with low endogenous *serotonin* levels. Takes effect within 1-3 weeks of daily use (Van Praag 1981), though one study noted beneficial effects within 3-5 days (Zmilacher et al. 1988). Further studies are needed to determine the spectrum of efficacy for *5-HTP* in treating different types of depression (Shaw et al. 2002). Side effects may include nausea, vomiting and diarrhoea, which Van Praag (1981) found could be largely eliminated by coating tablets with a pH buffer, so that the drug is not absorbed until it reaches the intestine (Van Praag 1981). Large doses cause mydriasis and excitation similar to that produced by LSD, in animals. Active at much lower doses with MAOI (Iversen et al. ed. 1978; Mantegazzini 1966) or a peripheral decarboxylase inhibitor [to prevent decarboxylation to *serotonin* before entering the brain] (Van Praag 1981). One study found no difference in efficacy of antidepressant action between *5-HTP* alone or with a decarboxylase inhibitor, but noted that patients using the latter combination were more likely to develop acute anxiety as a side effect (Zmilacher et al. 1988). Can suppress migraine headaches (Nicolodi & Sicuteri 1999). Weak MAOI in rat liver (McKenna et al. 1984b). Lowest LD50 in rodents 243mg/kg (Lewis 2000). Metabolite of Chromobacterium violaceum (Buckingham et al. ed. 1994). Some commercially-available *5-hydroxytryptophan* has caused symptoms similar to those of eosinophilia-myalgia syndrome, the same complication which resulted in the banning of *tryptophan*; such samples have been found to contain contaminants which have not been fully identified (Klarskov et al. 1999). Only available on prescription in some countries [such as Australia]. See *Neurochemistry*.

Hyoscine $C_{17}H_{21}NO_4$

[l-hyoscine; scopolamine; α-(hydroxymethyl)benzeneacetic acid 9-methyl-3-oxa-9-azabicyclo[3.3.1.02,4]non-7-yl-ester]



Viscous liquid, forms a crystalline monohydrate; mp. 59°C; freely sol. in hot water, alcohol, ether, chloroform, acetone; sparingly sol. in benzene, petroleum ether; easily hydrolysed by acids or alkalis; dec. on standing.

Anticholinergic hallucinogen [blocks muscarinic *acetylcholine*-receptors] similar to *atropine*. Mydriatic, antispasmodic, bronchodilator. Low doses cause drowsiness, euphoria, fatigue, amnesia, loss of concentration, and dry mouth; higher doses cause excitation, restlessness, motor incoordination, tachycardia, hallucinations and delirium, ending with brachycardia, inability to focus and mydriasis. The hallucinogenic effects are exacerbated by pain. Used in pre-operative medication. Psychoactive orally above 2mg; used therapeutically, 0.6mg as the hydrobromide. Can be absorbed through the skin. More toxic than *atropine*, though doses of 500mg have been survived. Reactions to this chemical in humans can be highly variable (Beckman 1961; Goodman & Gilman 1975; Moran 1993; Safer & Allen 1971; Terry et al. 1993). Has been shown to weakly inhibit MAO and *5-hydroxytryptophan* decarboxylase (Rastogi & Mehrotra ed. 1990-1993).

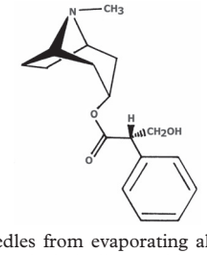
It has been used to control psychosis [often in combination with an opiate], and occasional intoxications have resulted when patients have overdosed on their medication. Accounts from some of these events are quite amusing to read. I could not resist giving some examples:

"A married man, aged 22 years, was brought into hospital after being found clad only in a pair of shorts, sitting in the middle of the road at about 8pm. He told the police he was flying an invisible aircraft by remote control [...] he said that he could hear bells ringing and he smoked imaginary cigarettes, tapping them out into plain glass ashtrays, described by the patient as decorated with nymphs and goddesses."

"A housewife, aged 25 years [...] had woken at midnight saying that the sitting-room was full of people [...] she plucked imaginary ice cream cones from the air and carried on a conversation with a non-existant girl friend, who she alleged was sitting on the kitchen stove" (Whitlock & Fama 1966).

Hyoscyamine $C_{17}H_{23}NO_3$

[(S)-tropine tropate; (S)-α-(hydroxymethyl)benzeneacetic acid 8-methyl-8-azabicyclo[3.2.1]oct-3-yl ester]

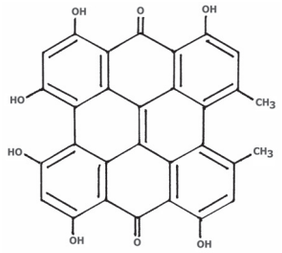


Silky tetragonal needles from evaporating alcohol; mp. 108–111°C; freely sol. in chloroform, alcohol, dilute acids; sol. in water, ether, benzene. Keep well closed and protected from light and heat; easily racemised to *atropine* – sometimes occurs naturally as a partial racemate.

Anticholinergic hallucinogen, acting at muscarinic receptors. Twice as potent as *atropine*; l-*hyoscyamine* is 8–50x as potent as d-*hyoscyamine* (Goodman & Gilman 1975). Similar activity to *atropine*, though more potent peripherally (Henry 1939). Also mydriatic, antispasmodic, antisecretory and antiemetic. Used in pre-operative medication, and to treat symptoms of Parkinson's Disease (Harborne & Baxter ed. 1993).

Hypericin $C_{30}H_{16}O_8$

[hypericum red; mycoporphyrin; 1,3,4,6,8,13-hexahydroxy-10,11-dimethylphenanthro[1,10,9,8-opqra]perylene-7,14-dione]

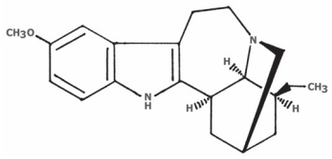


Solvated blue-black needles from pyridine and methanolic HCl; dec. 320°C; yields cherry red soln. with red fluorescence in organic bases; freely sol. in pyridine and other organic bases; almost insol. in most other organic solvents; sol. in alkaline aqueous soln.; below pH 11.5 solns. are red; above they are green with red fluorescence.

Tonic, tranquillising and antidepressant in very small quantities (Buckingham et al. ed. 1994; Budavari et al. ed. 1989); has shown weak MAOI activity in vitro, though inhibition for type A was stronger (Suzuki et al. 1984); binds to muscarinic *acetylcholine*-receptors and sigma-receptors (Raffa 1998). Inhibits HIV-replication in vivo (Eich et al. 1990).

Ibogaine $C_{20}H_{26}N_2O$

[12-methoxy-ibogamine]

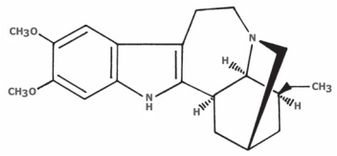


Prismatic needles from absolute ethanol; mp. 152–153°C [sublimes 150°C]; sol. in ethanol, ether, chloroform, acetone, benzene; practically insol. in water.

CNS stimulant, and psychedelic at higher doses, anticonvulsant, hypotensive, potentiates catecholamine-induced hypertension, tremorgenic [at 12.1 mg/kg (s.c.) in mice] (Bert et al. 1988; Buckingham et al. ed. 1994; Pope 1969; Popik et al. 1995; Zetler et al. 1972), can cause brachycardia; lowers body temperature. Inhibits AChE; inhibits MAO activity on *serotonin*, and catalyses it on catecholamines; reduces *glutamic acid*-induced neurotoxicity; NMDA-receptor antagonist; potentiates *morphine* analgesia and inhibits *morphine* withdrawal syndrome symptoms; partial agonist of kappa-opiate receptors; binds to sigma-receptors; blocks *dopamine* receptors for a long period, and alters their response to *morphine*, *cocaine*, *amphetamine*, alcohol and other addictive agents; increases extracellular levels of *serotonin* in the striatum and nucleus accumbens. Can be used to abolish addiction to heroin and other substances. Active 100mg-1g or more; psychedelic activity above 300mg, though unlike 'typical' serotonergic psychedelics. From 15–20mins after ingestion, an auditory oscillation and/or buzzing is heard/felt, and objects appear to vibrate intensely; skin is numb. From 1 hour after ingestion the unusual visionary phase begins – seems to be a kind of inward primal, regressive psychological state that takes the user to the root of their problems; 5–10hrs later, visions subside, and a stimulatory phase sets in, lasting 5–8hrs, with flashing lights experienced all around. There is usually insomnia after the experience, lasting up to 20 hours, from residual stimulation (Cappendijk et al. 1994; Deecher et al. 1992; De Rienzo et al. 1997; Layer et al. 1996; Popik & Skolnick 1999; Popik et al. 1995; Wei et al. 1998). LD50 in rats – 145mg/kg [i.p.]. Controlled substance in some countries. Animal studies demonstrated some neurotoxicity in large doses; however, this was not observed in therapeutic doses. After ingestion, *ibogaine* forms an active metabolite, nor-*ibogaine*, which is thought to mediate the long-lasting after-effects of *ibogaine*, especially in the case of drug-withdrawal therapy. Nor-*ibogaine*, like *ibogaine*, binds to kappa-opiate receptors [with a greater affinity than *ibogaine*] and NMDA receptors, decreases extracelleular *dopamine* levels in the striatum and nucleus acumbens, increases extracellular *serotonin* levels in the same brain areas, has an affinity [probably inhibitory] for *serotonin*-transport systems [much greater affinity than *ibogaine*], antagonises the motor-stimulant effects of *morphine*, and decreases alcohol, *cocaine*, and *morphine* self-administration in rats. Unlike *ibogaine*, it does not appear to be tremorgenic (Glick et al. 1996; Wei et al. 1998).

Ibogaline $C_{21}H_{28}N_2O_2$

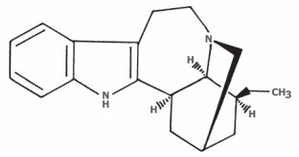
[10,11-dimethoxy-ibogamine; descarbomethoxy-conopharyngine]



Crystals from methanolic aqueous soln.; mp. 141–143°C.

CNS stimulant similar to *ibogaine*. Hypotensive and brachycardiac in anaesthetised cats. Tremorgenic at 2.6mg/kg [s.c.] in mice; LD50 in mice [i.v.] – 46mg/kg (Bert et al. 1988; Buckingham et al. ed. 1994; Van Beek et al. 1984; Zetler et al. 1972). Partial agonist of kappa-opiate receptors (Deecher et al. 1992).

Ibogamine $C_{19}H_{24}N_2$

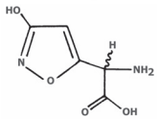


Crystals; mp. 162–164°C; sol. in ethanol, methanol, benzene, cyclohexane.

CNS-stimulant similar to *ibogaine*, hypotensive, tremorgenic, can cause brachycardia, shows some cytotoxic activity, weak antibacterial (Bisset 1985a; Buckingham et al. ed. 1994; Zetler et al. 1972). Partial agonist of kappa-opiate receptors (Deecher et al. 1992); NMDA-receptor antagonist (Layer et al. 1996).

Ibotenic acid $C_5H_6N_2O_4$

[pre-muscimol; α-amino-2,3-dihydro-3-oxo-5-isoxazoleacetic acid]

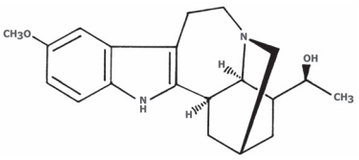


Crystals from water or methanol; mp. 151–152[anhydrous; dec.]/144-146°C [monohydrate].

Potent *GABA*-agonist, and *glutamic acid*-like excitant (Johnston et al. 1968). 'Entheogenic' at 1mg/kg (Ott 1993). A 20mg oral dose caused slight facial flushing, followed by lassitude and sleep, and later, persistent migraine, headache behind the eyes, and one-sided visual disturbance trailing off over 2 weeks[!]. LD50 in mice – 15mg/kg [i.v.], 25mg/kg [i.p.], 50mg/kg [p.o.] (Benedict 1972; Waser 1967), 38mg/kg [oral]; in rats – 42mg/kg [i.v.], 129mg/kg [oral] (Budavari et al. ed. 1989). Insecticidal (Buckingham et al. ed. 1994). Believed to be +- inactive until metabolised to *muscimol* (Ott 1993). Ibotenate, the racemate of *ibotenic acid*, caused initial excitation followed by prolonged depression of sensitivity of neurons to excitant amino acids and *acetylcholine* (Curtis et al. 1979; Puil 1981).

Iboxygaine $C_{20}H_{26}N_2O_2$

[descarbomethoxy-voacangarine; kimvuline]

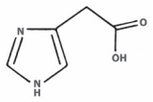


Mp. 235–236°C.

CNS stimulant similar to *ibogaine*; causes psychomotor effects; tremorgenic [at 26.2mg/kg (s.c.) in mice] (Bisset 1985a; Zetler et al. 1972); caused brachycardia and hypotension in anaesthetised cats, weak antibacterial. LD50 in mice [i.v.] – 42mg/kg (Buckingham et al. ed. 1994; Van Beek et al. 1984).

Imidazole-4-acetic acid $C_5H_6N_2O_2$

[imidazoleacetic acid; IMA]

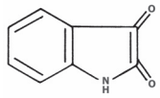


Crystals; mp. 222°C [dec.].

Endogenous metabolite in nervous system; has been found in brain, cerebrospinal fluid, and plasma. Hypnotic, can cause seizures. Potently displaces *GABA* from *GABA*a-receptors; antagonist at *GABA*c-receptor, possibly a weak partial agonist; binds to I1-imidazoline receptor. Enhances binding of benzodiazepines to *GABA*a-receptors. Blocks phencyclidine [PCP]-induced behavioural stimulation (Maslinski & Fogel 1991; Tunnicliff 1998). See *Neurochemistry*.

Isatin $C_8H_5NO_2$

[1H-indole-2,3-dione]



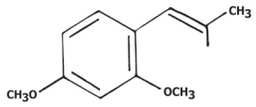
Orange crystals; mp. 203–205°C [dec., sublimes]. Sparingly sol. in water.

Component of endogenous *tribulin*, so far found in human urine, and in rat heart and brain. Used as an intermediate for indigoid dyes; also used as 0.2% methanol soln. for photometric detection of thiophene, proline and hydroxyproline.

MAO-B inhibitor, inhibits MAO-A much more weakly; increases *acetylcholine* and *dopamine* levels in rat brain, increases brain *serotonin*, but not in pineal; inhibits binding to BZ-receptors. Some studies have not duplicated MAOI activity. Early tests showed it to increase vigilance, reduce slow-wave sleep, and cause greater incidence of spontaneous rhythmic EEG activity (Glover 1998; Glover et al. 1988; Hucklebridge et al. 1998b; McIntyre & Norman 1990; Medvedev 1999; Minami et al. 1999; Yuwiler 1990). See *Neurochemistry*.

Isoosmorrhizole $C_{11}H_{14}O_2$

[isoosmorhizole; nothosmyrnol; 2,4-dimethoxy-1-(-1-propenyl)benzene]

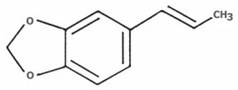


Bp. 75-77°C; sol. in hexane/benzene.

Non-amine precursor to 2,4-DMA [see entry for *osmorrhizole*] (Shulgin & Shulgin 1991).

Isosafrole $C_{10}H_{10}O_2$

[5-(1-propenyl)-1,3-benzodioxole; 1,2-(methylenedioxy)-4-(1-propenyl)benzene]

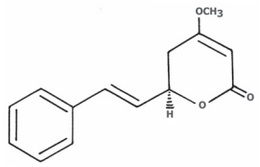


Liquid, odour of anise [see **Illicium**, **Pimpinella**]. Trans-form – mp. 8.2°C; bp. 85–86/135.6/179.5/253°C; miscible with alcohol, ether, benzene. Cis-form – mp. -21.5°C; bp. 77–79°C.

Psychoactive in animals, causing excitation followed by sedation (Oswald et al. 1971b). Non-amine precursor to MDA [see *safrole*] (Shulgin & Shulgin 1991).

Kawain $C_{14}H_{14}O_3$

[5,6-dihydro-4-MeO-6-(2-phenylethenyl)-2H-pyran-2-one; 5-OH-3-MeO-7-phenyl-2,6-heptadienoic acid δ-lactone; 4-MeO-6-(β-phenylvinyl)-5,6-dihydro-α-pyrone]



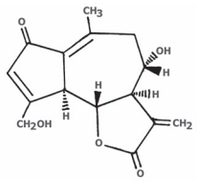
(+)-Form – rods from methanol and ether; mp. 105–106/110°C; bp. 195-197°C; practically insol. in water; sol. in acetone, ether, methanol; slightly sol. in hexane.

(+/-)-Form – needles from methanol; mp. 146–147°C.

Muscle relaxant, anticonvulsant, anaesthetic, sedative, causes ataxia in high doses, potentiates barbiturate-induced sleep (Buckley et al. 1967; Keller & Klohs 1963; Klohs 1967; Meyer 1967). Inhibits *norepinephrine*-uptake in rat brain (Seitz et al. 1997); MAO-B inhibitor in human platelets – in this regard, the least potent of the 'kava-lactones' tested [see **Piper 2**] (Uebelhack et al. 1998).

Lactucin $C_{15}H_{16}O_5$

[(5-α,6-α,8-α)-8,15-dihydroxy-2-oxo-1(10),3,11(13)-guaiatrien-12,6-olide]

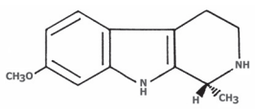


Crystals from methanol; mp. 224–233°C [sinters at 218°C]; sol. in water, ethanol, methanol, ethyl acetate, dioxane anisol.

A sesquiterpene lactone with CNS-sedative, cytotoxic, antitumour and bitter tonic properties; antagonises action of coffee [see **Coffea**] and tea [see **Camellia**]. LD50 in mice [oral] – 0.8–1.0mg/g (Forst 1941; Harborne & Baxter ed. 1993).

Leptaflorine $C_{13}H_{16}N_2O$

[tetrahydroharmine; THH; 2,3,4,9-tetrahydro-7-methoxy-1-methyl-1H-pyrido[3,4-b]indole; 1,2,3,4-tetrahydro-7-methoxy-1-methyl-β-carboline]

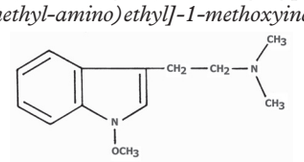


Mp. 198.4–199.8°C; sol. in chloroform, methanol. (+-)-Leptaflorine is synthetic; needles from methanol; mp. 199.4–199.8°C.

Roughly 1/3 the potency of *harmaline* as regards psychoactivity [active around 300mg orally], with similar effects; however, this is only from one human bioassay (Naranjo 1967; Shulgin & Shulgin 1997); also less potent than *harmaline* as an MAOI in vitro (Buckholtz & Boggan 1977; McKenna et al. 1984a; Udenfriend et al. 1958); weakly inhibits *serotonin*-uptake (Callaway et al. 1999). Vasodilator, tranquilliser (Trout ed. 1998, citing Raymond-Hamet 1941, C.R. Soc. Biol. 135:69-73 and Usdin & Efron 1979, Psychotropic Drugs and Related Compounds, respectively). Claimed to also be psychoactive when administered with MAO-inhibition from another agent, or when smoked (Trout ed. 1998, citing Callaway 1995, Eleusis 1:4–10); further details are lacking, and its oral MAOI capabilities remain to be demonstrated in humans (Trout ed. 1998).

Lespedamine $C_{13}H_{18}N_2O$

[1-MeO-DMT; 1-methoxy-N,N-dimethyltryptamine; 3-[2-(dimethyl-amino)ethyl]-1-methoxyindole]

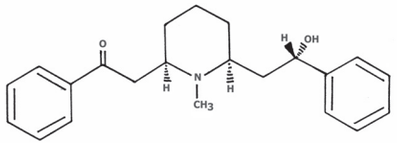


Colourless viscid oil; bp. 100–106/113–114°C; sol. in methanol.

Thought to probably be psychoactive by smoking; untested (Shulgin & Shulgin 1997).

Lobeline $C_{22}H_{27}NO_2$

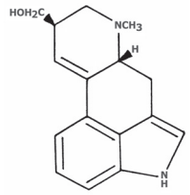
[8,10-diphenyllobelionol; 2-[6,2-hydroxy-2-phenylethyl)-1-methyl-2-piperidinyl-1-phenylethanone]



L-form [α-lobeline; inflatine] – needles from alcohol, ether, benzene; mp. 130–131°C; very slightly sol. in water or petroleum ether; sol. in hot alcohol, chloroform, benzene, ether; oxidation gives the symmetrical lobelanine [meso-*lobeline*].

Has action similar to *nicotine* in peripheral tissues, but *nicotine*-like central effects are yet to be demonstrated, possibly due to the fact that unlike *nicotine*, it does not cause *dopamine* release. Cognitive enhancer, emetic, hypotensive, respiratory stimulant, though depresses respiration in high doses; binds to nicotinic *acetylcholine* receptors; NMDA-receptor antagonist; inhibits plasma cholinesterase (Aizenman et al. 1991; Decker et al. 1993; Orgell 1963a; Reavill et al. 1990; Sloan et al. 1988); hyperalgesic when injected into rat brainstem, more potent than *morphine* (Hamann & Martin 1994). Also in seeds of Campanula medium (Buckingham et al. ed. 1994).

Lysergol $C_{16}H_{18}N_2O$

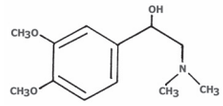


Crystals from ether; mp. 253-255°C.

Weakly psychedelic in limited human bioassays (Heimann 1965); shows CNS excitory effects in animals (Yui & Takeo 1958a, 1958b); partial agonist of 5-HT2a receptors, also affecting α1-adrenoceptors in the rat; strongly affects human 5-HT1dα- and 5-HT1dβ-receptors (Pertz 1996). Moderately resistant to heat degradation in bread-baking tests simulating **Ipomoea**-seed contaminated flour (Friedman & Dao 1990).

Macromerine $C_{12}H_{19}NO_3$

[α-[(dimethylamino)methyl]-3,4-dimethoxy-benzenemethanol; 1-(3,4-dimethoxyphenyl)-2-dimethylaminoethanol]

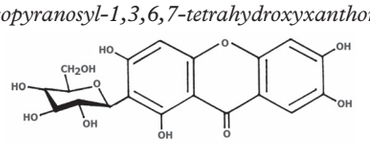


Crystals; mp. 66–67.5°C; sol. in ethanol, ether.

Claimed to be "hallucinogenic" in animals; 1/5 as potent as *mescaline*. Active 20mg/kg [i.p.] in cats and squirrel monkeys (Hodgkins et al. 1967). Using the conditioned avoidance response test on rats, *macromerine* was reported to be non-psychoactive [up to 100mg/kg of the hydrochloride, i.p.] (Vogel et al. 1973), though this needs further study [see *normacromerine*].

Mangiferin $C_{19}H_{18}O_{11}$

[euxanthogen; chinomine; alpizarin; 2-β-D-glucopyranosyl-1,3,6,7-tetrahydroxy-9H-xanthen-9-one; 2-C-β-D-glucopyranosyl-1,3,6,7-tetrahydroxyxanthone]

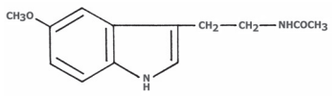


Pale yellow needles from ethanol aqueous soln.; mp. 270–272°C [dec.].

CNS stimulant in animals, weak MAOI, potentiates *morphine*-induced analgesia [mediated by *serotonin*] (Bhattacharya et al. 1972; Hostettmann & Wagner 1977); antiinflammatory, antiviral, antihepatotoxic (Harborne & Baxter ed. 1993). Widespread in angiosperms and ferns. Found in Mangifera indica, Gentiana spp., Iris spp., Salacia prenoides, Swertia spp., Aphloia madagascariensis, Athyrium mesosorum, Anemarrhena asphodeloides, Belamcanda chinensis, Hedysarum ussuriense, Hiptage madablota (Buckingham et al. ed. 1994; Harborne & Baxter ed. 1993; Hostettmann & Wagner 1977), Canscora decussata (Bhattacharya et al. 1972).

Melatonin $C_{13}H_{16}N_2O_2$

[N-acetyl-5-MeO-tryptamine; N-[2-(5-methoxy-1H-indol-3-yl)ethyl]acetamide]

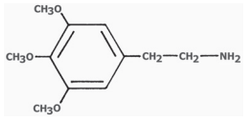


Pale yellow leaflets from benzene; mp. 116–118°C; sol. in ethanol/petroleum ether.

Hormone of pineal gland [also produced by other nerve tissues]. Antistress, immune-stimulant; synchronises brain electrical activity; regulates internal 'body-clock' and day/night rhythms [helping to alleviate symptoms of 'jet-lag']; helps induce sleep; powerful antioxidant; some weak MAOI-activity; modulates pituitary/adrenal axis, which modulate the other endocrines and organs of the body. Active in very small doses [0.5-3mg], though individual tolerances vary and some may need higher doses to benefit from *melatonin* supplementation. Orally-administered *melatonin* is rapidly absorbed from the gastrointestinal tract. Works best taken in evening or at night – morning or daytime doses may actually have the opposite effect, to the detriment of health. 50mg doses have been shown to increase REM sleep time, and increase intense colouration and vividness of dreams; has been known to cause visual imagery in the waking state. Can induce a feeling of well-being (Anton-Tay et al. 1971; Hagen & Cohen 1966; Hattori et al. 1995; Kveder & McIsaac 1961; Maurizi 1990; McKenna et al. 1984b; Pavel et al. 1980). Inhibits sexual activity (Crenshaw & Goldberg 1996). Stimulates hydroxyindole-O-methyltransferase [HIOMT] activity in bovine pineal (Hartley & Smith 1973). Potent skin-lightening agent. Can be converted to *6-methoxyharmalan* with removal of a molecule of water, though this remains to be demonstrated in vivo. Metabolised mostly to 6-OH-*melatonin*, as well as small amounts of 5-MeO-indoleacetic acid and an unidentified compound (McIsaac 1961). See *Neurochemistry*.

Mescaline $C_{11}H_{17}NO_3$

[TMPEA; 3,4,5-trimethoxyphenethylamine; 3,4,5-trimethoxybenzene-ethanamine]

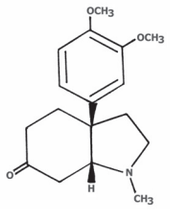


Crystals; mp. 35–36°C; bp. 180°C; moderately sol. in water; sol. in alcohol, chloroform, benzene; practically insol. in petroleum ether; takes up carbon dioxide from air and forms a crystalline carbonate.

Psychoactive at 100–200mg; fully psychedelic above 350mg; highest recorded human dose 1.5g. Minimum psychedelic dose 200–400mg with the sulphate salt, 180-260mg with the hydrochloride salt. Lasts 8–14hrs or more [depending on dose consumed] producing very colourful and vivid visions, accompanied by a usually-positive consciousness-expansion and mental clarity as well as strong stimulation. Psychedelic effects may take up to 2hrs or more to manifest, though strong doses are felt more rapidly. Initially causes nausea [usually], often with vomiting, after which the psychic phase of the experience comes to the fore (Fisher 1965; Kloesel 1958; Shulgin 1973; Shulgin & Shulgin 1991; pers. obs.). Stimulates hydroxyindole-O-methyltransferase [HIOMT] activity in bovine pineal (Hartley & Smith 1973). Lowers pulse and blood pressure; causes mydriasis. Agonist of postsynaptic 5-HT1a, 5-HT1b, 5-HT2a and 5-HT2c receptors [strongest at 5-HT2 types]; lowers *serotonin* levels; inhibits neuromuscular cholinergic transmission by blocking *acetylcholine* release; affects peripheral α-adrenergic receptors. LD50 in rats [i.p.] – 370mg/kg. Tolerance to the effects is rapidly developed, requiring at least several days between exposures to return normal response; cross-tolerance is also seen with *psilocybin* and LSD (Appel & Freedman 1968; Ghansah et al. 1993; Monte et al. 1997; Titeler et al. 1988; Trout & Friends 1999). Can be synthesised relatively easily [if you know what you're doing] from syringaldehyde, prepared by oxidation of lignin from Eucalyptus diversicolor ['karri'], E. obliqua ['messmate stringybark'] or E. regnans ['mountain ash'] (see Amos 1964). Controlled substance.

Mesembrine $C_{17}H_{23}NO_3$

[mesembranone; 3α-(3,4-dimethoxyphenyl)octahydro-1-methyl-6H-indol-6-one]

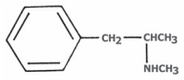


Pale yellow oil; bp. 186–190°C; freely sol. in alcohol, chloroform, acetone; slightly sol. in ether; practically insol. in benzene, petroleum ether, alkalis.

Psychological activity still unclear. For a long time said to be *cocaine*-like or *hyoscyamine*-like, based on assumptions, and some physiological effects noted from limited bioassays; structurally similar to crinane-class Amaryllidaceae alkaloids (Smith, M.T. et al. 1996). Recent bioassays of claimed pure *mesembrine* suggest its activity is the same as that of **Sceletium** tortuosum, in which it is found. Very potent; doses above 500mcg cause nausea, dizziness, and general discomfort (friendly pers. comm. 1999). Recently found to act as a *serotonin* re-uptake inhibitor [SRI]; *mesembrine* and its derivatives are claimed to be useful in treatment of depression, nervous anxiety, drug dependence, bulimia nervosa, and obsessive-compulsive disorders (Gericke & Van Wyk 1997).

Methamphetamine $C_{10}H_{15}N$

[N,α-dimethylbenzeneethanamine; d-N,α-dimethylphenethylamine; d-N-methylamphetamine; d-deoxy-ephedrine; d-desoxyephedrine; 1-phenyl-2-methylaminopropane; d-phenylisopr-opylmethylamine; methyl-β-phenylisopropylamine]

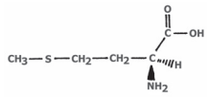


Methamphetamine HCl [$C_{10}H_{16}ClN$; speed; methedrine] – crystals, bitter taste; mp. 170–175°C; sol. in water, alcohol, chloroform; practically insol. in ether. A 1% aqueous soln. is neutral or slightly acid.

CNS stimulant, sympathomimetic. Can be prepared by reducing *ephedrine* or pseudoephedrine. More potent than *amphetamine* with similar pharmacology [see *amphetamine*], though at low to moderate doses the CNS effects are prominent and peripheral effects are not, unlike *amphetamine*. At higher doses, peripheral sympathomimetic effects are pronounced, including stimulation of cardiac output, increased blood pressure and vasoconstriction (Budavari et al. ed. 1989; Goodman & Gilman 1975; Julien 1995; Rothman et al. 2001). LD50 in mice [i.p.] – 70mg/kg (Budavari et al. ed. 1989). Controlled substance.

Methionine $C_5H_{11}NO_2S$

[2-amino-4-(methylthio)butanoic acid; 2-amino-4-(methylthio)butyric acid; γ-methylthio-α-aminobutyric acid]

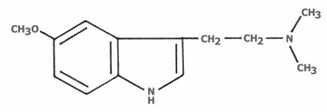


Minute hexagonal plates from dilute alcohol; mp. 280-283°C [dec., sealed capillary]; sol. in water, but crystals are water repellant at first; sol. in warm dilute alcohol; insol. in absolute alcohol, ether, petroleum ether, benzene, acetone.

Plays an important role in many biological methylations (Budavari et al. ed. 1989) [eg. *tryptamine* to *DMT*; see *Neurochemistry*, *Influencing Endogenous Chemistry*], particularly when metabolised with ATP to form SAM, an important methyl-donor (Cohen et al. 1974; Sprince 1970). Lipotropic, antiulcer, antidote (Buckingham et al. ed. 1994). May be toxic or poorly tolerated to people with liver diseases. 'Schizophrenics' given 20g a day for 1 week experienced behavioural changes and gastric distress; 'normal' people may tolerate large doses [10-20g a day] for short periods without incident (Harper 1973). Given with or without MAOI, *methionine* in varying doses "induced an acute florid psychotic reaction in 40% of schizophrenics tested". Caused behavioural changes and sleep disturbance when injected in mice and rats [250mg/kg a day for at least 21 days]; this was counteracted by co-administration of the amino acid l-serine. Metabolised to cysteine, homocysteine [convulsant] and/or cystathionine. Cysteine also apparently acts as a methyl-donor, producing urinary metabolites including N-methylated *serotonin*- and *tryptamine*-derivatives when given with an MAOI to schizophrenics, as well as exacerbating schizophrenic symptoms. Excess levels of dietary *methionine*, cysteine and/or homocysteine apparently encourage the metabolism of *tryptophan* to indoleacetic acid, rather than to N-methylated derivatives [*methionine* also competing with *tryptophan* for vitamin B6] – it seems that these amino acids may best be used for CNS effects by co-administration with an MAOI to ensure that any such desired derivatives are not immediately metabolised. dl-*Methionine* is less biologically-active than l-*methionine* (Beaton et al. 1975; Cohen et al. 1974; Sprince 1970). See *Neurochemistry*, *Influencing Endogenous Chemistry*.

5-Methoxy-DMT $C_{13}H_{18}N_2O$

[5-MeO-DMT; 5-methoxy-N,N-dimethyltryptamine; O-methylbufotenine; 3-[2-(dimethylamino)ethyl]-5-methoxyindole]



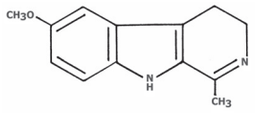
Prismatic crystals from hexane; mp. 66–68.5°C; sol. in ethanol, methanol, acetone, ether, dichloromethane, chloroform.

Active at 3.5–15mg smoked [vapourised], 10mg+ snuffed or sublingually, and 30mg+ orally. When vapourised, tremendous forceful 'rush' is felt almost immediately after inhalation, and the body becomes overwhelmingly sedated by the force; lateral vibrations in the visual field may be experienced at lower doses; visual effects not colourful or intricate as with *DMT*, though at doses around 10mg or more they are still very apparent, even to the extent that one may find one's-self in another physical place as real as 'normal' reality in every detail; some people are encompassed by a brilliant all-consuming white light; expansion of consciousness is usually experienced, though producing a more 'stoning' feeling at lower doses, or doses inefficiently administered. Despite the less vivid and colourful nature of the visual effects, this compound is much more powerful than *DMT*, with a good dose rocketing the subject beyond the realms of *DMT* to states of infinite submolecular cosmic conciousness, a full dose [ie. 10-20mg] vapourised and inhaled causing the user, as with *DMT*, to lose all contact with the physical world. Some find it comparable to 'near-death experience', and people sometimes think they have died or are dying while under the influence; rebirth from this state can be very pleasant. Doses above 10mg may produce nausea, vomiting, hypertension and unconsciousness accompanied by amnesia. Main effects last about 5 min. or less [longer when taken orally or sublingually], with return to 'baseline' after 1-2hrs. When combined with an MAOI such as *harmine* or *harmaline*, very unpleasant hypertensive and psychic effects have been experienced by some – it is advised that extreme care be taken with dosage via this route, and there might be a danger of *serotonin* syndrome with higher doses, due to the high affinity for 5-HT1a-receptors [see below, and *Influencing Endogenous Chemistry*]. Doses taken intranasally, sublingually or orally did not approach the full effects as experienced when vapourising the alkaloid, or when consuming it orally with an MAOI (Brush et al. 2004; Ott 2001b; Shulgin & Shulgin 1997; pers. obs.; pers. comms.). Effects are enhanced with pre-administration of small amounts of LSD (Trout & Friends 1999). Tolerance to the effects of repeated administrations does not seem to occur with *5-MeO-DMT* (Trout pers. comm.).

Potent agonist of 5-HT1a-receptors, and to a lesser extent 5-HT1b, 5-HT1c [5-HT2c], 5-HT2a [only slightly less potent binding than to 5-HT1a] & 5-HT2b receptors (McKenna et al. 1990; Peroutka 1986; Strassman et al. 1996; Winter et al. 1999b, 2000). Less potent in brain than *bufotenine*, though more potent overall due to its ease in crossing the blood-brain barrier (McBride 2000). Causes *norepinephrine*-release in in-vitro animal tests. Has MAO-A inhibiting activity in vitro, less potent than that of *DMT* (Ghosal 1972; Ho et al. 1970; McKenna et al. 1984b; Reimann & Schneider 1993). Stimulates hydroxyindole-O-methyltransferase [HIOMT] activity in bovine pineal (Hartley & Smith 1973). O-Demethylated by the P450 enzyme CYP2D6 (Yu et al. 2003). Endogenous mammalian neurochemical (Corbett et al. 1978; Guchhait 1976; Mandel & Walker 1974; Smythies et al. 1979; Tanimukai et al. 1970). Is orally-active in sheep at 40mg/kg; one sheep died 50 min. after being given a dose of 85mg/kg (Bourke et al. 1988). Controlled substance in some countries [Australia]. See *Neurochemistry*.

6-Methoxyharmalan $C_{13}H_{14}N_2O$

[6-methoxy-3,4-dihydro-1-methyl-β-carboline; 6-MeO-DHH; 10-methoxyharmalan]

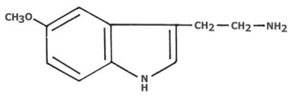


Crystals; mp. 208–209°C.

MAOI of similar potency to *leptaflorine* in rat liver (Buckholtz & Boggan 1977; Kim et al. 1997; McKenna et al. 1984a). Has been used in conjunction with *5-methoxy-DMT* to produce psychedelic effects (Leuner & Schlichting 1990). Appears to be psychoactive in rats [1mg or less] (McIsaac 1961; McIsaac et al. 1961). Caused mild psychotropic effects at 1.5mg/kg; said by Naranjo to be 'hallucinogenic'; slightly more active than *harmaline*. Powerful *serotonin* antagonist more potent than *harmaline*, slightly less potent than LSD (Glennon 1981; McIsaac et al. 1961; Naranjo 1967). Possibly a mammalian pineal neurochemical derived from cyclodehydration of *melatonin*. Shows skin-lightening activity the same as that of *melatonin* (McIsaac 1961). See *Neurochemistry*.

5-Methoxytryptamine $C_{11}H_{14}N_2O$

[5-methoxy-1H-indole-3-ethanamine; 3-(2-aminoethyl)-5-methoxyindole; meksamin; mexamine]

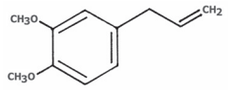


Crystals from ethanol; mp. 120–122°C; sol. in benzene, ethanol, chloroform.

Potentiates hypnotics and sedatives; more active than *serotonin* (Budavari et al. ed. 1989). Oxytocic. Reported to be 'psychotomimetic'; this probably is an extrapolation of the 'behavioural disturbance' observed in rats, which was in the same level of potency as *bufotenine*. Mammalian pineal neurochemical, also found in blood and urine; biological precursor to *melatonin*, *5-methoxy-DMT* (Banerjee & Snyder 1973; Beck & Jonsson 1981; Bosin & Beck 1979; Corbett et al. 1978; Gessner et al. 1961; Kveder & McIsaac 1961; Pevet 1983; Relkin 1983; Vogel 1969). Normally metabolised mainly to 5-MeO-indoleacetic acid (McIsaac 1961). May be O-demethylated by the P450 enzyme CYP2D6 (Yu et al. 2003). Agonist of 5-HT1a & 5-HT1d receptors; also affects 5-HT1b & 5-HT1c [5-HT2c] receptors (Peroutka 1986, 1993). MAOI in rat liver, of similar potency to *5-methoxy-DMT* (McKenna et al. 1984b). Protects against radiation (Shulgin & Shulgin 1997). See *Neurochemistry*.

Methyleugenol $C_{11}H_{14}O_2$

[O-methyleugenol; eugenol methyl ether; 4-allyl-veratrole; 4-allyl-1,2-dimethoxybenzene; 1,2-dimethoxy-4-(2-propenyl)benzene; 3,4-dihydroxyallylbenzene dimethyl ether]

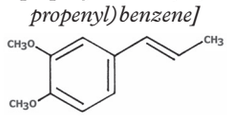


Oil; bp. 255°C; sol. in hexane, organic solvents.

CNS depressant, spasmolytic, skeletal muscle relaxant, hypothermic (Harborne & Baxter ed. 1993). Non-amine precursor to 3,4-DMA [see *eugenol*] (Shulgin et al. 1967).

Methylisoeugenol $C_{11}H_{14}O_2$

[3,4-dimethoxy-1-propenylbenzene; 1,2-dimethoxy-4-(1-propenyl)benzene]

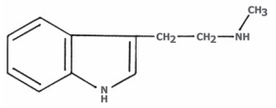


Normally isolated as a mix of E and Z isomers. Oil; mp. 16–17°C; bp. 138-140°C; sol. in hexane, organic solvents.

Non-amine precursor to 3,4-DMA [see *eugenol*] (Shulgin & Shulgin 1991).

N-Methyltryptamine $C_{11}H_{14}N_2$

[NMT; dipterine; N-methyl-1H-indole-3-ethanamine; 3-(2-methylaminoethyl)indole]

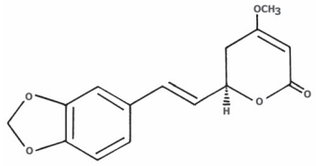


Prisms from petroleum ether; mp. 87–90°C; sol. in light petroleum, benzene, chloroform, ethanol/water.

Inactive at doses attempted orally; claimed to be active by smoking at 50-100mg, producing visual effects lasting only about 15 seconds, in one psychonaut. Mammalian neurochemical (Axelrod 1961; Corbett et al. 1978; Oon et al. 1977; Shulgin & Shulgin 1997); MAOI in rat liver, slightly more potent than *5-methoxy-DMT* (McKenna et al. 1984b). See *Neurochemistry*.

Methysticin $C_{15}H_{14}O_5$

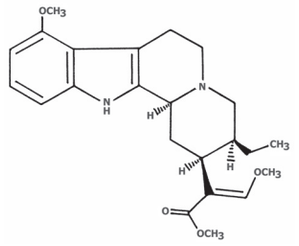
[6-[2-(1,3-benzodioxol-5-yl)ethenyl]-5,6-dihydro-4-methoxy-2H-pyran-2-one; 4-methoxy-6-(3,4-methylenedioxystyryl)-5,6-dihydropyran]



Crystals from methanol; mp. 132–134/139–140.5°C; practically insol. in water; sol. in alcohol, ether, acetone.

Muscle-relaxant, anticonvulsant, anaesthetic, sedative hypnotic; potentiates barbiturate-induced sleep. Causes ataxia in high doses (Buckley et al. 1967; Keller & Klohs 1963; Klohs 1967; Meyer 1967); protects against tissue damage from inadequate blood flow (Singh & Blumenthal 1997). Inhibits *norepinephrine*-uptake in rat brain (Seitz et al. 1997); MAO-B inhibitor in human platelets, slightly less potent than *5,6-dehydrokawain* in this regard (Uebelhack et al. 1998).

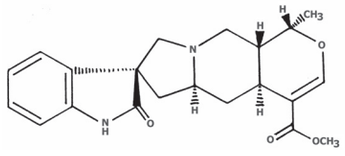
Mitragynine $C_{23}H_{30}N_2O_4$



White amorphous powder; mp. 102–106°C; bp. 230–240°C; sol. in alcohol, chloroform, acetic acid.

General depressant, analgesic, antitussive (Macko et al. 1972); affects μ- and δ-opioid receptors, and possibly also α2-adrenoceptors and 5-HT2a receptors (Matsumoto et al. 1997; Thongpradichote et al. 1998; Watanabe et al. 1997).

Mitraphylline $C_{21}H_{24}N_2O_4$

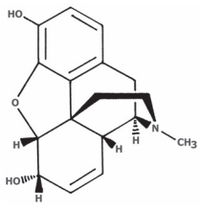


White needles from ethanol; mp. 265–266°C; sol. in methanol, ethyl acetate, ether.

Weak CNS depressant, hypotensive (Harborne & Baxter ed. 1993).

Morphine $C_{17}H_{19}NO_3$

[meconium; 7,8-didehydro-4,5-epoxy-17-methylmorphinan-3,6-diol]

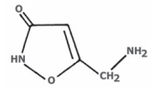


Short orthorhombic columnar prisms from anisole; mp. 254–256.4°C [dec. 254°C]; also, a metastable phase, mp. 197°C; high-melting form sublimes 190–200°C; the amorphous or freshly precipitated form is more sol.; sol. in ethyl acetate, alcohol, or mix of chloroform and alcohols; moderately sol. in boiling water, chloroform; slightly sol. in ether, ammonia, benzene; freely sol. in solns. of fixed alkali and alkaline earth hydroxides, in phenol, cresols, boiling methanol.

Powerful narcotic, analgesic, euphoriant, tranquilliser, anxiolytic, respiratory depressant, antitussive, miotic. Horse stimulant. Hyperalgesic when injected into rat brainstem. Causes constipation. Can cause nausea and vomiting, and itching due to *histamine*-release. Opiate receptor agonist, particularly potently binding to mu-receptors; indirectly stimulates *dopamine* release. Lowers testosterone levels. Can be dangerously potentiated by alcohol, barbiturates, tricyclic antidepressants, MAOIs. Highly addictive; causes withdrawal symptoms, including runny nose, sweating, crying, goosebumps, muscle twitching, cramps, anorexia, insomnia, vomiting and diarrhoea. Does not cross the blood-brain barrier as easily as heroin [diacetylmorphine], due to its low lipid-solubility. Therapeutic dose is 5–30mg [oral tablets], 8–15mg [s.c.] or 10–20mg [i.m.]. Lethal oral dose in humans probably 120–250mg, though people have wide variation in tolerance. Addicts, people in pain, and those with hyperthyroidism can tolerate higher doses, and 20–300mg or more have been used 'recreationally' [some addicts take more than 1000mg daily]. If death occurs it is usually as a result of respiratory failure (Beckman 1961; Goodman & Gilman 1975; Gosselin et al. 1976; Hamann & Martin 1994; Julien 1995; Preininger 1975). Endogenous mammalian neurochemical (Brossi 1993; Cardinale et al. 1987), also found in human and cow milk (Hazum et al. 1981). Controlled substance. See *Neurochemistry*.

Muscimol $C_4H_6N_2O_2$

[pantherine; agarin; pyro-ibotenic acid; 5-(aminomethyl)-3(2H)-isoxazolone]

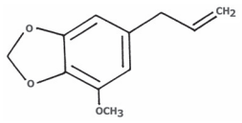


Crystals from ethanol; mp. 174–176°C [dec.]; in solid phase, exists as a betaine.

Active at 10–15mg, producing dizziness, ataxia, mood elevation, psychic stimulation [10mg dose], impaired concentration [15mg dose], visual and auditory distortions, "disorientation in situation and time", and muscle twitching, followed by brief sleep. Effects after this point were varied; with the 10mg dose, the subject felt "normal, rested and able to undertake anything", though with the 15mg dose he felt "dull and uncertain". An interesting effect from the pre-sleep phase was described – "Vision was altered by endlessly repetitioned echo-pictures of situations a few minutes before". Small doses [5mg] improved concentration (Waser 1967). Potent *GABA*-a receptor agonist, inhibits *GABA* binding; reduces neuronal excitability (Johnston et al. 1968; Mousah et al. 1986). Blocks phencyclidine [PCP]-induced behavioural stimulation (Tunnicliff 1998). Increased brain levels of *serotonin* and *dopamine* in rodents [i.p.]. May be metabolised by GABA transaminase (Michelot & Melendez-Howell 2003). LD50 in mice – 3.8mg/kg [s.c.], 2.5mg/kg [i.p.]; in rats – 4.5mg/kg [i.v.], 45mg/kg [oral] (Budavari et al. ed. 1989).

Myristicin $C_{11}H_{12}O_3$

[4-MeO-6-(2-propenyl)-1,3-benzodioxole; 1-MeO-2,3-methylenedioxy-5-(2-propenyl)benzene; 1-allyl-3-MeO-4,5-methylenedioxybenzene]

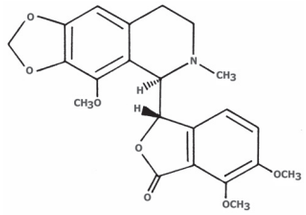


Colourless oil; bp. 95–97/149–149.5/173°C; sol. in hexane, organic solvents.

Psychoactive at 400mg in 6 out of 10 human bioassayists (Shulgin et al. 1967). May be an MAOI (Truitt et al. 1963). Narrow-spectrum insecticide (Buckingham et al. ed. 1994). Non-amine precursor to MMDA [3-methoxy-4,5-methylenedioxy-*amphetamine*], which is psychoactive at 100-250mg, and is a mild psychedelic similar in some ways to MDA, but gentler (Shulgin 1973; Shulgin et al. 1967; Shulgin & Shulgin 1991). Whether or not the presumed in vivo metabolism to amphetamines actually occurs has been under question. Rats were shown to metabolise it predominantly to 3-piperidyl-1-(3'-MeO-4',5'-methylenedioxyphenyl)-1-propanone; guinea pigs metabolised it predominantly to 3-pyrrolidinyl-1-(3'-MeO-4',5'-methylenedioxyphenyl)-1-propanone [these might also prove to be psychoactive] (Oswald et al. 1971b). However, in support of the hypothesis, a later study found rat liver to produce MMDA from *myristicin*, after a 5hr incubation; the reaction was enhanced under oxidative conditions (Braun & Kalbhen 1973). MMDA is a controlled substance.

Narcotine $C_{22}H_{23}NO_7$

[noscapine; opianine; 6,7-dimethoxy-3-(5,6,7,8-tetrahydro-4-methoxy-6-methyl-1,3-dioxolo[4,5-g]isoquinolin-5-yl)-1(3H)-isobenzofuranone]

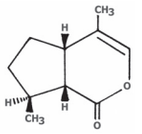


The (1R,9S)-form is the natural form [(-)-α-narcotine]. Stout needles from ethanol, or orthorhombic bisphenoidal prisms from diacetone; mp. 176°C; sublimes at 150–160°C under pressure; triboluminescent; slightly sol. in ammonium hydroxide, hot solns. of potassium hydroxide and sodium hydroxide, forming salts; salts formed with acids are dextrorotatory and unstable in water. *Narcotine* is a very weak base forming unstable salts with acids and strong bases. Readily epimerises to (-)-β-*narcotine*.

Analgesic, sedative, smooth muscle relaxant; antitussive, with similar potency to *codeine*. Active therapeutically at 25–50mg [as the HCl]; the β-isomer is more potent than the α-isomer (Buckingham et al. ed. 1994; Preininger 1975).

Nepetalactone $C_{10}H_{14}O_2$

[5,6,7,7a-tetrahydro-4,7-dimethyl-cyclopenta[c]pyran-1(4aH)-one]

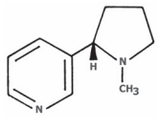


Oil; a mix of the cis-trans (shown) and trans-cis isomers [the cis-trans being 70–99% of the oil]; bp. 71–72°C; sol. in ether, carbon tetrachloride.

Cat attractant; sex attractant for aphids (Buckingham et al. ed. 1994; Tucker & Tucker 1988). Psychoactive constituent of catnip, **Nepeta** cataria (Harney et al. 1974, 1977).

Nicotine $C_{10}H_{14}N_2$

[3-(1-methyl-2-pyrrolidinyl)pyridine; 1-methyl-2-(3-pyridyl)pyrrolidine]



Colourless to pale yellow oily liquid, very hygroscopic, turns brown on exposure to air or light, acrid burning taste; bp. 123–125/246.1–247°C [partial dec.]; volatile with steam; miscible with water below 60°C; on mixing *nicotine* with water, the volume contracts; very sol. in alcohol, chloroform, ether, petroleum ether, kerosene, oils. Forms salts with almost any acid and double salts with many metals and acids. Base is readily absorbed through mucous membranes and intact skin; salts are not.

Tranquilliser, CNS-stimulant, memory and cognitive enhancer, anorexic. Activates nicotinic *acetylcholine*-receptors, and causes *acetylcholine* and catecholamine release [including *epinephrine* and *dopamine*], also stimulating muscarinic *acetylcholine*-receptors. After initial excitation, it

acts as a depolarising nicotinic-blocker; increases cortisol, *dehydroepiandrosterone* and progesterone levels, decreases *serotonin* levels. NMDA-receptor antagonist. Decreases blood flow to brain and penis; can cause impotence. Can cause nausea, vomiting, dizziness, sweating, salivation, headache, evacuation of bowel and bladder, weakness, mental confusion, twitching, convulsions, unconsciousness and respiratory paralysis in high doses. Highly toxic; treatment must be quick to be effective. Fatal human dose c.50–60mg. (+)-*Nicotine* is a more potent respiratory depressant than (-)-*nicotine*, and is much less potent than (-)-*nicotine* as a central stimulant; both are equipotent in their potential lethality. Orally, the base form is more toxic than the salt form. Addictive; can cause withdrawal symptoms including irritability, aggression, depression, impaired concentration, tremors (Aizenman et al. 1991; Barlow & McLeod 1969; Byrne 1988; Clarke 1990; Crenshaw & Goldberg 1996; Decker et al. 1993; Goodman & Gilman 1975; Julien 1995; Kruk & Pycock 1983; Reavill et al. 1990; Sabelli & Giardina 1972; Sloan et al. 1988; Terry et al. 1993; Watt & Breyer-Brandwijk 1962). Also found in Arum maculatum, Asclepias syriaca, Cyphomandra spp., Equisetum palustre (Rätsch 1998), Sempervivum arachnoideum (Paris & Frigot 1959), Sedum spp., Eclipta alba [see *Endnotes*] and Zinnia spp. (Pal & Narasimham 1943; Rimpler 1965).

Nitrous oxide N_2O

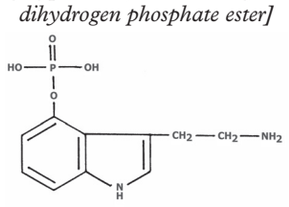
['nitrous'; laughing gas; dinitrogen oxide]

Colourless gas; mp. –91°C; bp. –88.5°C; dec. to N_2 and O_2 over 500°C. Can be detonated.

Mild and short-lasting anaesthetic when inhaled in small to moderate amounts [mixed with oxygen – preferably 40% nitrous oxide, 60% oxygen]; inhalation also reveals euphoric and dissociative/psychedelic activity with several lungfuls or more – this action is greatly potentiated by drugs such as *THC*, *mescaline*, *psilocin* and LSD. Strong dysphoric experiences are rare, but do occur; in any case, the effects are very short-lived after ceasing inhalation of the gas (pers. obs.; Atkinson et al. 1979). Higher doses act as a general depressant and anaesthetic/analgesic; when used for light surgical anaesthesia, 50–70% nitrous oxide is used. Concentrations higher than this can be dangerous to inhale. Sufficient oxygen must also be inhaled, mixed with the nitrous oxide, as well as breaths of air taken between lungfuls of nitrous oxide/oxygen (Atkinson et al. 1979; Goodman & Gilman 1975); deaths have occurred from hypoxaemia and asphyxiation, due to insufficient co-inhalation of oxygen (Temple et al. 1997; Winek et al. 1995). Other hazards of inhaling nitrous oxide from pressurised canisters or tanks include frostbite to skin exposed to the cold gas (Hwang et al. 1996); this is a further reason to mix the nitrous oxide with air in a balloon before inhaling, or at least to not inhale directly from the outlet of the tank. However, nitrous oxide is frequently inhaled through whipped-cream dispensers [without the cream] without frostbite. This is most likely because after being ejected under pressure from the whipped-cream bulb, the nitrous oxide is able to cool somewhat within the dispenser before it is inhaled (pers. obs.). Can be harmful to health with excessive and continued use, resulting in reduced white blood cells, reduced blood platelets and/or megaloblastic anaemia; generally, a syndrome of myelopathy or myeloneuropathy [a disease of the spinal cord] occurs, due to inactivation of vitamin B12 and dependent enzymes. Easily observable symptoms of chronic abuse may include weakness in lower limbs, ataxic gait, depression and memory loss. Neurological symptoms have been treated successfully by adminstration of *methionine* and vitamin B12, or hydroxocobalamin and folate supplements (Butzkueven & King 2000; Lai et al. 1997; Pema et al. 1998; Temple et al. 1997). Full mode of action unclear; appears to act as an NMDA-receptor antagonist, and inhibits ionic currents; also inhibits NMDA-mediated neurotoxicity, and has some neurotoxicity of its own, which is prevented by *GABA* activity (Jevtovic-Todorovic et al. 1998).

Norbaeocystin $C_{10}H_{13}N_2O_4P$

[norbaeocystine; bis-desmethylpsilocybin; 4-phosphoryloxytryptamine; 3-aminoethyl-1H-indol-4-ol dihydrogen phosphate ester]

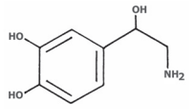


Crystals; mp. 188–192°C; sol. in water, methanol.

Thought to be psychoactive, possibly after dephosphorylation to 4-OH-*tryptamine* (Ott 1993).

Norepinephrine $C_8H_{11}NO_3$

[l-noradrenaline; NE; levarterenol; l-arterenol; 4-(2-amino-1-hydroxyethyl)-2-benzenediol; α-(aminomethyl)-3,4-dihydroxybenzyl alcohol; 2-amino-1-(3,4-dihydroxyphenyl)ethanol; 4-(β-amino-α-hydroxyethyl)catechol]

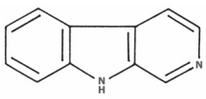


Microcrystals from water; mp. 216.5–218°C [dec.]; dl-form sparingly sol. in water; very slightly sol. in alcohol, ether; sol. in dilute acids; l-form HCl freely sol. in water.

Adrenergic, sympathomimetic, bronchodilator, antihypotensive, vasopressor (Buckingham et al. ed. 1994; Budavari et al. ed. 1989). Greater CNS stimulant activity than *epinephrine*, weaker PNS effects. Inhibits tyrosine hydroxylase. Human neurotransmitter (Goodman & Gilman 1975; Julien 1995; Kaplan & Sadock 1989; Kruk & Pycock 1983; Moore 1978); does not cross the blood-brain barrier (Marley & Stephenson 1972). May be metabolised to nor-*adrenochrome* (Hoffer & Osmond 1960). Also in Portulaca oleracea [c.0.2% w/w] and Phaseolus multiflorus (Lundstrom 1989). See *Neurochemistry*.

Norharman $C_{11}H_8N_2$

[β-carboline; 2-carboline; 9H-pyrido[3,4-b]indole]

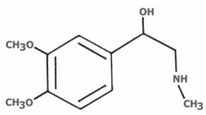


Crystals; mp. 198.5° C; sol. in hot water; sparingly sol. in petroleum ether.

MAOI more potent, or less potent [depending on which study you read] than *harman* in liver, and less so in brain (Buckholtz & Boggan 1977; Kim et al. 1997; McKenna et al. 1984a; Udenfriend et al. 1958); binds to MAO-B (May et al. 1994); inhibits plasma cholinesterase (Orgell 1963a); BZ-receptor antagonist, and initially a sedative [later potentiating convulsive activity] at 20mg/kg [i.p.] in rats (Morin 1984); partial agonist of muopiate receptors. Can inhibit symptoms of *morphine* withdrawal syndrome (Cappendijk et al. 1994). Inhibits AChE and non-competitively inhibits muscarinic *acetylcholine*-receptor binding in rat brain (Skup et al. 1983). Catatonic motor-depressant in rats [10mg/kg]; convulsant in higher doses [50mg/kg] (Ho 1977). Causes locomotor-effects in sheep (Harborne et al. ed. 1996); plant growth inhibitor; potentiates benzopyrene-induced mutagenesis. Mammalian neurochemical (Buckingham et al. ed. 1994; Collins 1983); may be metabolised by mice [given 0.5mmol/kg i.p., twice a day for 1 week] to the neurotoxin 2,9-N,N-dimethylnorharmanium cation, which is implicated in Parkinson's Disease (Matsubara et al. 1998). See *Neurochemistry*.

Normacromerine $C_{11}H_{17}NO_3$

[N-demethylmacromerine; N-methyl-3,4-dimethoxy-β-hydroxyphenethylamine; N-methyl-3,4-dimethoxyphenethanolamine]

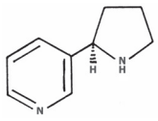


Needle-shaped slightly yellow crystals or brown gum; mp. 101-103°C; sol. in ethanol, chloroform.

Reported in an early study to be non-psychoactive, due to no observed effect on the conditioned avoidance response test in rats [up to 100mg/kg of the hydrochloride, i.p.] (Vogel et al. 1973); appears to be psychoactive in rats [up to 20mg/kg i.p.] using more complex testing methods, with comparisons made to *mescaline* and *psilocybin* (Bourn et al. 1978). Human pharmacology unknown.

Nornicotine $C_9H_{12}N_2$

[3-(2-pyrrolidinyl)pyridine; 2-(3-pyridyl)pyrrolidine]

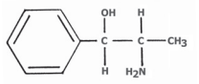


Viscous liquid, hygroscopic; develops a slight amine odour, less pungent than that of *nicotine*; bp. 105–107/117°C; miscible with water; very sol. in alcohol, chloroform, ether, petroleum ether, kerosene, oils. Less volatile and less easily oxidised than *nicotine*.

Roughly 1/3 as toxic as *nicotine*, with similar activity; can also cause faintness, muscular weakness, prostration, severe nausea, vomiting, diarrhoea, and collapse with or without convulsions (Budavari et al. ed. 1989). Also found in Salpiglossis sinuata, which contained over 0.01% alkaloids in roots and branches, including *nornicotine* (Schröder 1958).

Norpseudoephedrine $C_9H_{13}NO$

[cathine; norisoephedrine]

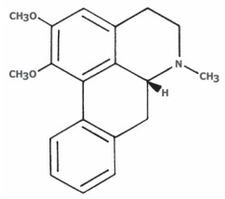


Plates from methanol; mp. 77.5–78°C; freebase strongly alkaline; sol. in alcohol, chloroform, ether, dilute acids.

CNS stimulant more potent than *ephedrine*; anorexic (Kalix 1991).

Nuciferine $C_{19}H_{21}NO_2$

[sanjoinine E; 1,2-dimethoxyaporphine]

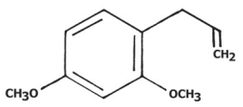


Crystals; mp. 165.5°C; sol. in methanol, chloroform, 2-propanol.

Strong sedative; inhibits adenylate cyclase (Buckingham et al. ed. 1994); neuroleptic activity similar to chlorpromazine in animals; potentiates *morphine* analgesia. Blockades *dopamine* receptors as an antagonist (Bhattacharya et al. 1978; Castedo & Tojo 1990); appears to have some anticholinergic activity (Zelenski 1977). Also found in Colubrina faralaotra [see also **Nelumbo**] (Buckingham et al. ed. 1994).

Osmorrhizole $C_{11}H_{14}O_2$

[osmorhizole; 2,4-dimethoxy-1-(2-propenyl)benzene; 2,4-dimethoxyphenylprop-2-ene; 1-allyl-2,4-dimethoxybenzene]



Bp. 71-73°C; sol. in hexane/benzene.

Non-amine precursor to 2,4-DMA [2,4-dimethoxy-*amphetamine*]; 2,4-DMA shows threshold psychoactivity at c.60mg, lasting c.3hrs, and qualitatively *amphetamine*-like with hints of dissociation. This alkaloid has not been explored much and caution is advised with higher doses (Shulgin & Shulgin 1991).

Oxytocin $C_{43}H_{66}N_{12}O_{12}S_2$

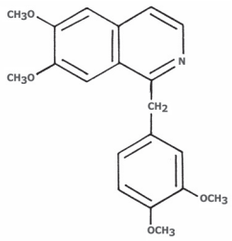
[L-cysteinyl-L-tyrosyl-L-isoleucyl-L-glutaminyl-L-asparaginyl-L-cysteinyl-L-prolyl-L-leucylglycinamide cyclic (1→6)disulfide]

White powder.

Oxytocic (Buckingham et al. ed. 1994); speeds uterine contractions in labour, and controls milk ejection (Kruk & Pycock 1983). Released in large amounts at orgasm; indirectly causes pleasure and sedation, enhances bonding through touch. May be involved in male post-coital inertia. Increases levels of *dopamine*, *vasopressin*, *epinephrine*, *serotonin*, prolactin, prostaglandin, VIP, LHRH, testosterone and oestrogen [in women]; stimulates α-adrenergic and cholinergic activity. Poorly absorbed orally; usually taken as a nasal spray or injected. Mammalian hormone (Crenshaw & Goldberg 1996).

Papaverine $C_{20}H_{21}NO_4$

[papaveroline tetramethyl ether; 6,7-dimethoxy-1-(3,4-dimethoxybenzyl)isoquinoline]

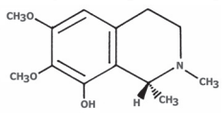


Triboluminescent orthorhombic prisms from alcohol and ether; mp. 147–148°C; sublimes 135–140°C under pressure; almost insol. in water; sol. in hot benzene, glacial acetic acid, acetone; slightly sol. in chloroform, petroleum ether. Stores best in soln. at pH 2–2.8.

Sedative; analgesic, weaker but longer-lasting than *morphine*; smooth muscle relaxant, cerebral vasodilator, antiasthmatic, antispasmodic. Phosphodiesterase-inhibitor, increasing cAMP levels; anticholinesterase. Initially stimulates respiration and increases blood pressure, later reversing these effects (Buckingham et al. ed. 1994; Budavari et al. ed. 1989; Goodman & Gilman 1975; Preininger 1975). Has shown neurotoxicity to dopaminergic neurons in vitro, as has tetrahydropapaverine to a lesser degree. Both have been tentatively proposed to be formed endogenously – tetrahydropapaverine from oxidation of the oxidative metabolite of *DMPEA* [dimethoxyphenylaldehyde], and *papaverine* from oxidation of tetrahydropapaverine – though this has not been demonstrated (Goto et al. 1997; Koshimura et al. 1997). Medicinal dose [oral] – 30–200mg (Goodman & Gilman 1975). LD50 in mice [i.v.] – 25mg/kg (Buckingham et al. ed. 1994).

Pellotine $C_{13}H_{19}NO_3$

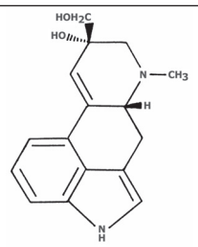
[peyotline; 1,2,3,4-tetrahydro-8-hydroxy-6,7-methoxy-1,2-dimethylisoquinoline; 1,2,3,4-tetrahydro-6,7-dimethoxy-1,2-dimethyl-8-isoquinolinol]



Crystals or plates from ethanol or petroleum ether; mp. 111–112°C.

Sedative at 15–30mg; soporific above 50mg (Bruhn & Holmstedt 1974; Shulgin 1973). 'Disorientation and hallucinations' have been experienced by a human with a dose of 300mg (Robles & Robleda 1931). Hypotensive and convulsant in animals (Kloesel 1958); 5–10mg caused convulsions in frogs, dogs and cats (Kapadia & Fayez 1970).

Penniclavine $C_{16}H_{18}N_2O_2$

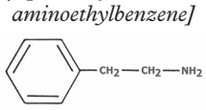


Crystals; mp. 222–225°C [dec.]; sol. in chloroform.

CNS excitory effects in animals (Yui & Takeo 1958a, 1958b).

Phenethylamine $C_8H_{11}N$

[2-phenylethylamine; β-phenethylamine; benzeneethanamine; β-aminoethylbenzene]

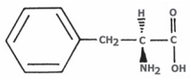


Liquid, fishy odour, strong base; bp. 194.5–195/197–198°C; sol. in water; freely sol. in alcohol and ether; absorbs carbon dioxide from air.

CNS stimulant like *amphetamine* when injected in high doses, or when given with an MAOI. Generally inactive orally (Boulton & Juorio 1982; Saavedra 1989; Sabelli et al. 1978; Squires 1978; Webster 1989). Skin irritant (Budavari et al. ed. 1989). Might cause tachycardia, anxiety, nausea and vomiting (Beck et al. 1998), but it has been given to humans to treat depression [10-60mg a day, with 10mg selegiline (l-deprenyl, an MAO-B inhibitor); successful in 60% of patients] with no side effects noted (Sabelli et al. 1996). Can cause severe migraine. Endogenous mammalian neurochemical, biosynthesised from l-*phenylalanine*. Readily crosses blood-brain barrier but is rapidly metabolised. If metabolised by *dopamine*-β-hydroxylase, phenylethanolamine is formed [a mild stimulant]; if metabolised by MAO-B [the preferred route], phenylacetaldehyde is formed [a sedative] (Boulton & Juorio 1982; Kruk & Pycock 1983; Sabelli & Giardina 1970; Sabelli et al. 1978). Brain content and/or turnover is increased by alcohol, **Cannabis**, opiates and *amphetamines* (Sabelli et al. 1978); behavioural effects are potentiated with *serotonin*-receptor blockade (Beck et al. 1998). See *Neurochemistry*.

Phenylalanine $C_9H_{11}NO_2$

[β-phenylalanine; α-aminobenzenepropanoic acid; 2-amino-3-phenylpropanoic acid]

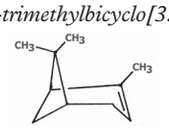


Natural L-form – monoclinic plates or leaflets from warm concentrated aqueous solns.; hydrated needles from dilute solns.; mp. 283–284°C [dec.]; sublimes in vacuo; sol. in water, more so as temp. increases; very slightly sol. in alcohol.

Biosynthetic precursor to tyrosine and/or *phenethylamine*; increases brain *phenethylamine* levels (Boulton & Juorio 1982). Antidepressant (Sabelli et al. 1978). Increases *tribulin* levels in rat brain (Bhattacharya et al. 1991a). Individuals with the disorder phenylketonuria [PKU] are unable to biosynthetically convert *phenylalanine* to tyrosine due to a defect in the function of the enzyme *phenylalanine* hydroxylase. This buildup of *phenylalanine* and metabolites such as *phenethylamine*, phenylpyruvic acid [interferes with *serotonin* metabolism] and phenylacetic acid often results in severe mental retardation (McIsaac 1961; Nyhan 1987; Sabelli et al. 1978). However, people without this disorder have consumed 20g a day [oral] with no adverse effects (Harper 1973). See *Neurochemistry*.

α-Pinene $C_{10}H_{16}$

[2-pinene; 2,6,6-trimethylbicyclo[3.3.1]-hept-2-ene]

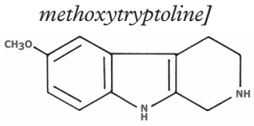


DL-form liquid, characteristic odour of turpentine; bp. 155–156°C; practically insol. in water; sol. in alcohol, chloroform, ether, glacial acetic acid. Oil of turpentine is 58–65% α-*pinene*, 30% β-*pinene*.

Flavouring ingredient, intermediate in manufacture of synthetic perfumes (Buckingham et al. ed. 1994). Irritates skin, mucous membranes; causes delirium, ataxia, kidney damage, coma. Inhalation causes nervous disturbances, dizziness, chest pain, palpitations, bronchitis and nephritis. Chronic contact can cause benign skin tumours. Absorbed through skin, lungs and intestine (Budavari et al. ed. 1989; Harborne & Baxter ed. 1993).

Pinoline $C_{12}H_{14}N_2O$

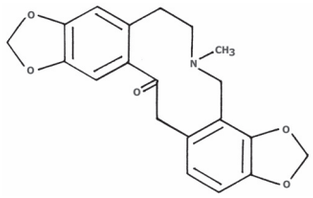
[6-methoxy-THβC; 1,2,3,4-tetrahydro-6-methoxy-β-carboline; methoxytryptoline]



Potent inhibitor of MAO-A in rat brain; elevates brain *serotonin*, and blocks its uptake (Buckholtz & Boggan 1977; Ho et al. 1968; McIsaac et al. 1972; Meller et al. 1977); inhibits binding of leu-*enkephalin* to delta opiate-receptors (Airaksinen et al. 1984). Potent antioxidant (Cheve et al. 2002). O-Demethylated by the P450 enzyme CYP2D6 (Yu et al. 2003). Endogenous mammalian neurochemical, found in high levels in human pineal gland (Langer et al. 1984; McIsaac et al. 1972). See *Neurochemistry*.

Protopine $C_{20}H_{19}NO_5$

[fumarine; corydinine; corydalis C; biflorine; macleyine; 4,6,7,14-tetrahydro-5-methylbis[1,3]benzodioxolo[4,5-c:5',6'-g]azecin-13(5H)-one]

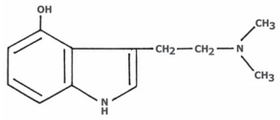


Monoclinic prisms from alcohol and chloroform; mp. 207–208°C; moderately sol. in ether; slightly sol. in ethyl acetate, benzene, petroleum ether; practically insol. in water.

Sedative, weak spasmolytic, lowers blood pressure and retards heart at low doses; excitant and convulsant in higher doses; smooth muscle stimulant or relaxant; weak antitumour activity, bactericidal (Buckingham et al. ed. 1994; Harborne & Baxter ed. 1993; Preininger 1975). Has anticholinergic activity (Capasso et al. 1997).

Psilocin $C_{12}H_{16}N_2O$

[psilocine; 3-(2-dimethylaminoethyl)-4-hydroxyindole; 3-(2-dimethylaminoethyl)-1H-indol-4-ol; 4-hydroxy-N,N-DMT; 4-OH-DMT]

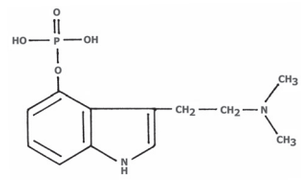


Plates from methanol; mp. 173–176°C [dec.]; very slightly sol. in water [more so in acidified water]; slightly sol. in methanol; seems to be most sol. in 75% aqueous ethanol. Unstable in soln., especially alkaline soln. Functions as an acid or a base; formed by metabolic dephosphorylation of *psilocybin*.

Active from 2-4mg; psychedelic above 6mg, lasting 4-8hrs; reportedly some 1.4x as potent as *psilocybin*. Lower doses produce physical sedation, restlessness, intense psychological introspection and mild visual distortions and enhancement, accompanied with mild intensification of colour perception; higher doses increase these symptoms and induce a powerful psychedelic state; higher doses still can induce a state similar to oral *DMT* activated by an MAOI (Hofmann et al. 1959; Ott 1993; pers. obs.). Potent agonist of 5-HT2a receptors, and to a lesser extent, 5-HT1a & 5-HT2b (McKenna et al. 1990). Weak MAOI in rat liver (McKenna et al. 1984b). Metabolite of *psilocybin*; rapidly absorbed from g.i. tract. Appears in blood plasma after 30 minutes. Most is excreted in the first 8hrs following consumption [c.25% excreted unchanged], with metabolites detected in urine even after 7 days. *Psilocin* is metabolised to 4-OH-indole-3-acetaldehyde and O-glucuronide; 4-OH-indole-3-acetaldehyde is then metabolised to 4-OH-indole-3-acetic acid and 4-OH-tryptophol. *Psilocin* oxidises to produce a blue pigment of unknown structure [see **Psilocybe** for discussion] (Hasler et al. 1997; Passie et al. 2002; Perkal 1981). Controlled substance.

Psilocybin $C_{12}H_{17}N_2O_4P$

[indocybin; psilocybine; psilocine O-phosphate; O-phosphoryl-4-OH-DMT; 3-(2-dimethylamino)ethyl-1H-indol-4-ol dihydrogen phosphate ester]



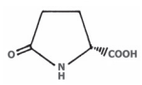
Crystals from boiling methanol or boiling water; mp. 185–195°C and 220–228°C, respectively; sol. in boiling water; moderately sol. in boiling methanol; slightly sol. in ethanol; practically insol. in chloroform, benzene.

Active from 2–4mg, psychedelic at 10–40mg; highest recorded human dose 120mg (Fisher 1965; Hofmann et al. 1959). Similar activity to *psilocin* – thought to be inactive until metabolised in the body by dephosphorylation to *psilocin* [4-OH-indoleacetic acid is also a metabolite from

this reaction in human plasma, and phosphoric acid is released]. This reaction does not seem to occur in alkaline [basic] solutions, but does in acidic and neutral solutions (Hasler et al. 1997; Horita & Weber 1961; Ott 1993; Perkal 1981). Agonist of 5-HT2a [mainly], 5-HT1a, 5-HT1d and 5-HT2c receptors. Reduces alpha and theta frequencies, and increases beta waves, in neocortex. Detectable in blood within 20-40 min. after consumption; only 50% of isotope-labelled *psilocybin* was absorbed after oral consumption; 3-10% is excreted unaltered. Given i.v., effects last only 15-30 minutes (Passie et al. 2002; Vollenweider et al. 1999). Small doses can improve visual acuity in humans (Fischer et al. 1992) and alleviate cluster headaches (Sewell et al. 2006). Weaker than *psilocin* as an MAOI in rat liver (McKenna et al. 1984b). Tolerance to the effects develops, but not as rapidly as with *mescaline*, requiring at least several days between exposures to return full response; cross-tolerance is also seen with *mescaline* and LSD (Appel & Freedman 1968). LD50 in mice [i.v.] – 285mg/kg; in rabbits [i.v.] – 12.5mg/kg (Budavari et al. ed. 1989). Best extracted from mushrooms by homogenisation with methanol [3ml per 100mg of dried mushrooms] for 2 min.; longer extraction times are apparently not needed (Perkal 1981). Later studies suggest that 75% methanol saturated with potassium nitrate is more effective than straight methanol (Wurst et al. 2002). Controlled substance.

Pyroglutamic acid $C_5H_7NO_3$

[pyroglutamate; glutamic acid lactam; α-aminoglutaric acid lactam; pidolic acid; glutimic acid; glutiminic acid; 5-oxoproline; 5-oxo-2-pyrrolidinecarboxylic acid; 2-pyrrolidone-5-carboxylic acid]

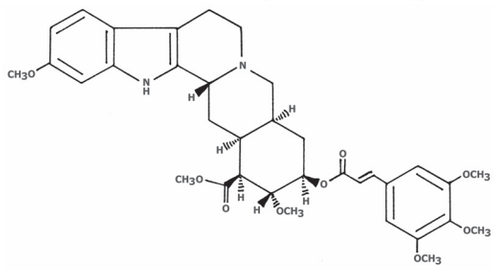


Crystals from water, mp. 156–157°C; or orthorhombic bisphenoidal crystals from alcohol and petroleum ether, mp. 162–163°C; sol. in water, alcohol, acetone. Easily prepared from L-*glutamic acid* by autoclaving with an equal weight of water at 135–140°C.

Present in large amounts in brain, blood and cerebrospinal fluid. Precursor to *glutamic acid*, catalysed by the enzyme 5-oxoprolinase. Improves memory, learning and attention, and has some anxiolytic effects (Moret & Briley 1988). Found in vegetables, fruits, grasses and molasses (Buckingham et al. ed. 1994). See *Neurochemistry*.

Rescinnamine $C_{35}H_{42}N_2O_9$

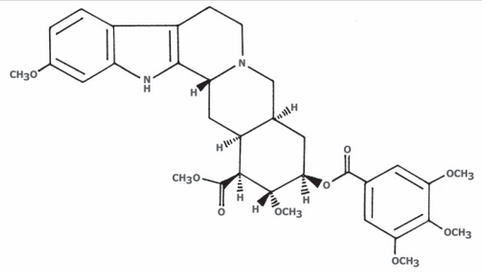
[reserpic acid O-(3,4,5-trimethoxycinnamoyl)methyl ester; sometimes called reserpinine incorrectly]



Fine needles from benzene; mp. 238–239°C [in vacuo]; practically insol. in water; moderately sol. in methanol, benzene, chloroform, and other organic solvents.

Antihypertensive, tranquilliser; similar pharmacology to *reserpine*, but less potent (Bruneton 1995; Buckingham et al. ed. 1994). Medicinal dose 0.5mg once or twice daily for 2 weeks, after which the dose is reduced to 0.25mg daily (Morton 1977).

Reserpine $C_{33}H_{40}N_2O_9$

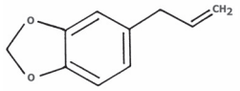


Long prisms from dilute acetone; mp. 262–266/284–285°C [dec. 264–265°C (277–277.5 in vacuo)]; very sparingly sol. in water; freely sol. in chloroform, methylene chloride, glacial acetic acid; sol. in benzene, ethyl acetate; slightly sol. in acetone, methanol, ethanol, ether, and in aqueous solns. of acetic and citric acids. Weak base. Upon standing most solns. acquire a yellow colour and pronounced fluorescence, especially after addition of acid or upon exposure to light.

Tranquilliser, antihypertensive (Buckingham et al. ed. 1994; Budavari et al. ed. 1989), sedative, hypnotic. Initially a brief sympathomimetic effect, followed by a slowly developing and prolonged fall in blood pressure, often with brachycardia and peripheral vasodilation. Depletes the brain of *serotonin* and catecholamines. Side effects of over-use may include depression, impotence in men, restlessness, nightmares and gastric ulceration. Overdose can cause death from respiratory depression. Can worsen asthma and bronchitis. Medicinal dose 0.05–2mg daily [orally or injected] (Beckman 1961; Bruneton 1995; Goodman & Gilman 1975; Morton 1977; Watt & Breyer-Brandwijk 1962). Given with an MAOI to animals, can cause central excitation and mydriasis similar to that induced by LSD (Squires 1978). In many Apocynaceous plants, particularly **Rauwolfia**; also in Tenduzia longifolia (Buckingham et al. ed. 1994).

Safrole $C_{10}H_{10}O_2$

[allylcatechol methylene ether; 3,4-methylene-dioxyallylbenzene; 5-(2-propenyl)-1,3-benzodioxole; 4-allyl-1,2-(methylenedioxy)benzene]

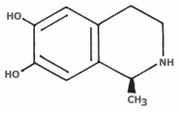


Colourless or slightly yellow liquid with **Sassafras** odour; bp. 231.5–234°C; insol. in water; very sol. in alcohol; miscible with chloroform, ether. Although sometimes spelled as 'safrol', this should not be confused with the drimane sesquiterpene also called safrol.

Psychoactive in animals, causing excitation followed by sedation (Oswald et al. 1971b); topical antiseptic, pediculicide, carminative. Intermediate in manufacture of perfume ingredients. Irritant, may be carcinogenic in very large doses or extended exposure (Ames et al. 1987; Buckingham et al. ed. 1994; Budavari et al. ed. 1989; Hall 1973; Segelman et al. 1976b). LD50 in rats [oral] – 1950mg/kg; in mice [oral] – 2350mg/kg (Budavari et al. ed. 1989). Non-amine precursor to MDA [3,4-methylenedioxy-*amphetamine*], which is active from 60-80mg, lasting 8-12hrs. MDA is euphoric, empathogenic, and a mild psychedelic stimulant (Shulgin & Shulgin 1991), and a controlled substance. The in vivo metabolism of *safrole* to MDA has not actually been demonstrated. Rats have been shown to metabolise it predominantly to 3-piperidyl-1-(3',4'-methylenedioxyphenyl)-1-propanone; guinea pigs have been shown to metabolise it predominantly to 3-N,N-dimethylamino-1-(3',4'-methylenedioxyphenyl)-1-propanone [these might also prove to be psychoactive]. Both compounds decompose to form 1-(3',4'-methylenedioxyphenyl)-3-propen-1-one (Oswald et al. 1971a).

Salsolinol $C_{10}H_{13}NO_2$

[1,2,3,4-tetrahydro-6,7-dihydroxy-1-methylisoquinoline; 1,2,3,4-tetrahydro-1-methyl-6,7-isoquinolinediol]



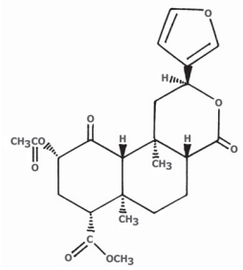
Crystals from ethanol/ether; mp. 174–175°C.

Occurs in humans as a mix of the (S)- and (R)-isomers; acts as an endogenous 'false neurotransmitter', formed from *dopamine* and acetaldehyde. Levels increase in humans when alcohol is consumed, though it

is present endogenously without alcohol intake (Buckingham et al. ed. 1994; Collins 1983; Deitrich & Erwin 1980; Haber et al. 1999). Inhibits MAO-A [the R-stereoisomer being c.10x as potent as the S-stereoisomer] (Bembenek et al. 1990; Feenstra et al. 1983); inhibits tyrosine hydroxylase; potent inhibitor of *dopamine*-uptake in rat brain; COMT inhibitor (Buckingham et al. ed. 1994; Deitrich & Erwin 1980); inhibits binding to mu opiate-receptors; weakly inhibits binding of leu-*enkephalin* to delta opiate-receptors (Airaksinen et al. 1984); inhibits release of pituitary *adrenocorticotropin* and β-*endorphin*; inhibits formation of cAMP; binds strongly to D2 and D3 *dopamine* receptors (Melziga et al. 2000). See *Neurochemistry*.

Salvinorin A $C_{23}H_{28}O_8$

[divinorin A; 15,16-epoxy-2-hydroxyl-1-oxo-13(16),14-clerodadien-17,12-olid-18-oic acid-2-Ac, methyl ester]

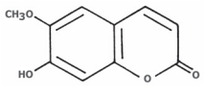


Crystals; mp. 242–244 °C; sol. in methanol, chloroform; miscible in corn oil/Tween-80/water; insol. in water.

Highly psychedelic; strongly active by smoking [preferably vapourising] at 200–1000mcg; sublingually at up to 2mg or more. When smoked, effects are +- instantaneous, with no noticeable transition period; the user usually experiences sensations of incredible force and motion, appearance of 2-dimensional membranes or surfaces, overlapping realities, loss of body-identity, hilarity [or terror], vivid time-travel to places from one's past, becoming static objects, and extremely bizarre and vivid visual hallucinations, often plant-based in nature. Main effects last several minutes, and return to 'baseline' occurs over several hours to several days, often with a pleasant afterglow and sense of awe-inspiring wonder. Sublingual effects are slower in onset and effect, and usually more manageable, lasting in the main about 20 minutes (Pendell 1995; Siebert 1994; Valdés 1994; pers. comms.; pers. obs.). Approach with extreme respect! Did not bind significantly to known receptor sites in preliminary tests (Siebert 1994), but a recent study found *salvinorin A* to be a potent selective agonist of kappa opioid-receptors (Roth et al. 2002). The main metabolite is probably salvinorin B (Schmidt et al. 2005). Recently made illegal in Australia [schedule 9 poison along with heroin, *cocaine*, etc.]; still legal almost everywhere else at time of printing [see **Salvia** for specifics], though it is under scutiny in the US.

Scopoletin $C_{10}H_8O_4$

[escopoletin; buxuletin; 7-hydroxy-6-methoxy-2H-1-benzopyran-2-one; 7-hydroxy-6-methoxy-coumarin; aesculetin 6-methyl ether; chrysatropic acid; gelseminic acid; β-methylaesculetin]

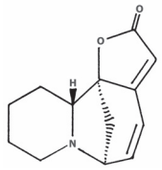


Needles or prisms from chloroform, ethanol or acetic acid; mp. 204°C; slightly sol. in water or cold alcohol; sol. in hot alcohol or hot glacial acetic acid; moderately sol. in chloroform; practically insol. in benzene. The alcoholic solution has a blue fluorescence.

Human psychopharmacology unknown. MAOI (Yun et al. 2001); hypotensive neuromuscular-blocker (Ojewole & Adesina 1983), hypnotic in animals in very large doses (MacRae & Towers 1984b). In many plants, including Cyphomandra betacea (Kala 1958).

Securinine $C_{13}H_{15}NO_2$

[securinan-11-one]

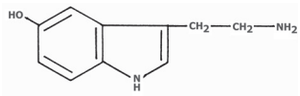


Yellow crystals from alcohol; mp. 142–143°C.

CNS stimulant with *strychnine*-like activity, but less than 10x as potent; affects autonomic nervous system, and acts primarily on spinal cord, enhancing reflex activity. *GABA*-a receptor agonist, inhibits cholinesterase, causes respiratory stimulation, hypotension and increased muscle tone. Toxic effects include tremors and rigid contractions, and death can result from orthotonic convulsions. It is poorly absorbed through the GI-tract; c.20% of an administered dose is absorbed into body fluids, where it is quickly broken down. LD50 in rats [oral] – >800mg/kg; in mice [oral] – 270mg/kg (Buckingham et al. ed. 1994; Huang 1993; Hui-Yung 1974).

Serotonin $C_{10}H_{12}N_2O$

[5-hydroxy-tryptamine; 5-HT; hippophaine; thrombocytin; thrombotonin; enteramine; anthemovister; 3-(2-aminoethyl)-1H-indol-5-ol; 3-(2-aminoethyl)-5-hydroxyindole]

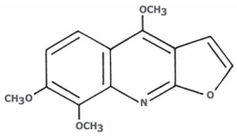


Small whitish crystals; mp. 167-168°C [HCl]; sol. in water [more so at greater temps.], glacial acetic acid; slightly sol. in methanol, 95% ethanol; insol. in absolute ethanol, acetone, chloroform, benzene. Very stable at low pH.

Behavioural sedative, causes 'behavioural disturbance' in rats; decreases anxiety and aggression, inhibits arousal and orgasm. Vasoconstrictor, smooth muscle contractant, antidiuretic, reduces gastric secretions. Involved in allergic reactions and pain [eg. see **Urtica** for an exogenously-produced example], as well as migraine and emesis. Increases *adrenocorticotropin* secretion. Human neurotransmitter biosynthesised from *5-hydroxytryptophan* or *tryptamine*; does not cross blood-brain barrier (Crenshaw & Goldberg 1996; Curtis & Davis 1961; Garattini & Valzelli 1965; Gessner et al. 1961; Kruk & Pycock 1983; Mantegazzini 1966; Sternbach 1991; Young 1983). For discussion on '*serotonin* syndrome' see *Influencing Endogenous Chemistry* and Sternbach (1991). See *Neurochemistry*.

Skimmianine $C_{14}H_{13}NO_4$

[β-fagarine; chloroxynonine; pentaphylline; 7,8-dimethoxydictamnine; 4,7,8-trimethoxyfuro[2,3-b]quinoline]

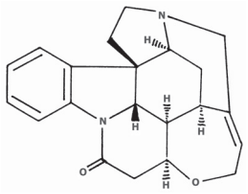


Pyramids or octahedral rods from alcohol; mp. 176-178°C; sol. in alcohol, chloroform; slightly sol. in ether, amyl alcohol, carbon disulfide; practically insol. in water and petroleum ether. Neutral pH.

Analgesic, anticonvulsant, antipyretic, potentiates the effects of barbiturates, CNS depressant (Harborne & Baxter ed. 1993); behavioural sedative in animals, and showed mild anti-*methamphetamine* activity (Cheng 1986). Claimed to have some *ephedrine*-like pharmacological activity (Buckingham et al. ed. 1994). Ligand of 5-HT2 receptors (Cheng et al. 1994). Has been found in a variety of Rutaceae, including Skimmia japonica (Buckingham et al. ed. 1994), Fagara spp., Glycosmis pentaphylla and Ruta graveolens (Budavari et al. ed. 1989).

Strychnine $C_{21}H_{22}N_2O_2$

[strychnidin-10-one]

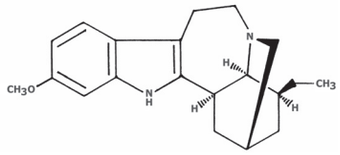


Very bitter orthorhombic sphenoidal prisms from alcohol; mp. 268–290°C [depending on speed of heating]; bp. 270°C; sol. in glycerol, amyl alcohol, methanol, toluene, benzene, ethanol; moderately sol. in boiling water; highly sol. in chloroform, boiling alcohol; very slightly sol. in ether, petroleum ether. Readily forms crystalline chloromethochloride artefacts when chloroform or methylene chloride is used in isolation.

CNS excitant, powerful convulsant (Goodman & Gilman 1975). Antagonises *glycine* at post-synaptic sites (Holmstedt 1995); antagonises *taurine* activity (Kruk & Pycock 1983); cholinesterase inhibitor (Orgell 1963a). An early sign of poisoning is stiffness of face and neck muscles, followed by increased reflex excitability which can lead to convulsions from over-response to sensory stimuli. Death can result from respiratory interference. Treatment should involve maintaining a clear airway, avoiding sensory stimulation, and administration of a muscle relaxant [such as *diazepam*, 10mg i.v.]. Fatal in humans 30-100mg; children may experience serious toxicity from 15mg (Goodman & Gilman 1975). Small doses sometimes used as a tonic. Sometimes used as a rat poison. LD50 in mice – 2mg/kg [oral] (Buckingham et al. ed. 1994).

Tabernanthine $C_{20}H_{26}N_2O$

[11-methoxy-ibogamine; 13-methoxy-ibogamine]



Needles or shiny leaflets from ethanol; mp. 209-212/213.5-215°C [subl. 160°C]; sol. in alcohol, benzene, ether, chloroform; practically insol. in water.

CNS-stimulant 17x less potent than *ibogaine* (Bert et al. 1988); hypotensive, brachycardiac (Buckingham et al. ed. 1994). Induces low frequency [4–6 Hz] rhythmic activity in the neocortex in rats. Binds at delta and kappa opiate-receptors; NMDA-receptor antagonist; BZ-receptor antagonist; increases turnover and synthesis of *dopamine* and *norepinephrine* in brain cortex. Induces fine-tremors; tremorgenic at 1.4mg/kg [s.c.] in mice. LD50 in mice [i.v.] – 38mg/kg (Deecher et al. 1992; Layer et al. 1996; Prioux-Guyonneau et al. 1984; Trouvin et al. 1987; Van Beek et al. 1984; Zetler et al. 1972).

Taurine $C_2H_7NO_3S$

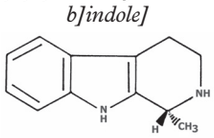
[2-aminoethanesulfuric acid; aminoethylsulfonic acid; ethylaminesulfonic acid]

Monoclinic prismatic rods; mp. 328°C [dec. 320-325°C]; sol. in water; insol. in alcohol. Emits toxic fumes on heating.

Depresses neuronal excitability, antiepileptic, antiarrhythmic (Kruk & Pycock 1983). Metabolic regulator; intermediate in metabolism of cysteine. Occurs in free form in animal tissues, bacteria, red algae, and some higher plants [eg. leguminous seedlings] (Buckingham et al. ed. 1994). See *Neurochemistry*.

Tetrahydroharman $C_{12}H_{14}N_2$

[eleagnine; calligonine; 1-methyl-THβC; 1,2,3,4-tetrahydro-1-methyl-β-carboline; 1,2,3,9-tetrahydro-1-methyl-1H-pyrido[3,4-b]indole]

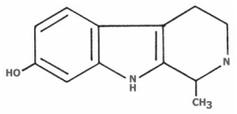


Mp. 144-148°C; (+-)-form [in **Leptactinia** densiflora] mp. 178-180°C; sol. in ethanol.

MAOI less potent than *harman* in mouse brain (Buckholtz & Boggan 1977); inhibits AChE, and non-competitively inhibits muscarinic *acetylcholine*-receptor binding, in rat brain, though less potent in this regard than *harman* or *norharman* (Skup et al. 1983); weakly inhibits binding of leu-*enkephalin* to delta opiate-receptors (Airaksinen et al. 1984). CNS depressant in rats; caused paralysis in higher doses (Ho 1977).

Tetrahydroharmol $C_{12}H_{14}N_2O$

[1,2,3,4-tetrahydro-7-hydroxy-1-methyl-β-carboline; 2,3,4,9-tetrahydro-1-methyl-1H-pyrido[3,4-b]indol-7-ol]

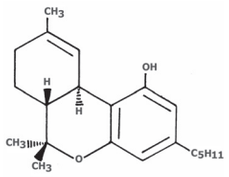


Mp. 254-255°C.

Normal component of human urine (Shulgin & Shulgin 1997). MAOI equipotent to *harmalol* in vitro in rat brain (Buckholtz & Boggan 1977). See *Neurochemistry*.

THC $C_{21}H_{30}O_2$

[Δ-1- or Δ-9-tetrahydrocannabinol; 6a,7,8,10a-tetrahydro-6,6,9-trimethyl-3-pentyl-6H-dibenzo[b,d]pyran-1-ol; marinol™; dronabinol]

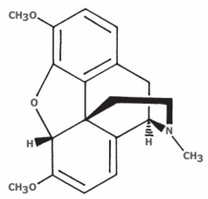


Resinous oil; bp. 200°C in vacuum; sol. in oils, fats, ethanol, methanol, butane, acetone; insol. in water. Oxidised to *cannabinol* in presence of air.

Psychoactive at 50-200μg/kg orally, 25-50μg/kg smoked, though partially destroyed in the burning of smoking (Mechoulam 1970); euphoric, mild psychedelic. Anti-asthmatic, analgesic, antiglaucomic, antihypertensive, anti-emetic (Cohen & Stillman ed. 1976; Grinspoon & Bakalar 1995; Noyes et al. 1975). Cannabinoid-receptor agonist (Piomelli et al. 2000). Has been found variously to either slightly suppress, or increase, MAO activity; inhibits amine uptake and *acetylcholine* release, as well as depressing presynaptic cholinergic neurotransmission. May suppress symptoms of *morphine* withdrawal (Coper 1982). Potent antioxidant (Hampson et al. 1998). Protects against ischemic neuronal damage in the striatum; this effect is only noted in the hippocampus in high doses (Louw et al. 2000). Ameliorates some symptoms of Multiple Sclerosis in experimental studies (Baker 2000; Di Marzo et al. 2000). Shows potential in destroying malignant gliomas in rat studies (Galve-Roperh et al. 2000; Piomelli 2000). Smoked *THC* [a single 1g cigarette laced with 1% Δ-9-*THC*] has been shown to cause massive increases in serum *melatonin* levels [greatest effect after 2hrs], except in one person who had high baseline *melatonin* levels, for whom the laced cigarette led to a reduction in serum *melatonin* (Lissori et al. 1986). Stimulates release of dynorphins A and B, as well as leu-*enkephalin*, in spinal cord (Houser et al. 2000; Welch & Eads 1999). In female rats, *THC*-mediated sexual receptivity [which is mediated through the CB1-receptor] has been shown to be modulated, at least partly, by *dopamine* D1 receptors and progesterone receptors (Mani et al. 2001). Controlled substance.

Thebaine $C_{19}H_{21}NO_3$

[paramorphine; codeinone methylenol ether; 6,7,8,14-tetradehydro-4,5-epoxy-3,6-dimethoxy-17-methylmorphinan]



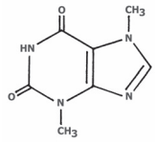
Orthorhombic, rectangular plates from ethanol; needles by sublimation; also obtained in cubes and prisms; mp. 193°C; sol. in ether; moder-

ately sol. in water; freely sol. in chloroform, benzene, pyridine, hot alcohol; practically insol. in petroleum ether.

Stronger narcotic but weaker analgesic than *morphine*; more toxic than *morphine*, can produce *strychnine*-like symptoms in higher doses. Increases the effects of *caffeine*. Causes *histamine* release from tissues; cholinesterase inhibitor. LD50 in mice [i.p.] – 20mg/kg (Buckingham et al. ed. 1994; Budavari et al. ed. 1989; Preininger 1975). Controlled substance. A synthetic *thebaine* transformation-product, named Cl 110,393, has LSD-like effects [see *mescaline* and *psilocin*, which have very similar effects to LSD in many regards] lasting more than 21hrs [in doses of 1mcg/kg (i.m.) and above] (Angrist & Gershon 1973).

Theobromine $C_7H_8N_4O_2$

[diurobromine; santheose; thesal; 3,7-dihydro-3,7-dimethyl-1H-purine-2,6-dione; 3,7-dimethylxanthine]

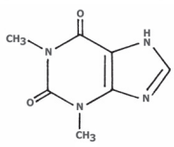


Monoclinic needles from water; mp. 351-357°C; sublimes 290-295°C; sol. in water, alcohol, fixed alkali hydroxides, concentrated acids; very sol. in boiling water; moderately sol. in ammonia; almost insol. in benzene, ether, chloroform. Forms salts which are dec. by water, and compounds with bases which are more stable.

Very weak CNS and respiratory stimulant; bronchodilator, diuretic, cardiac stimulant, smooth muscle relaxant, arterial dilator (Buckingham et al. ed. 1994; Goodman & Gilman 1975). About 1/10 the potency of *caffeine* or *theophylline* as a stimulant (Gilbert 1980). Highly toxic orally (Buckingham et al. ed. 1994), presumably only in very large doses (pers. obs.). *Adenosine* receptor antagonist, weaker than *caffeine* or *theophylline* (Snyder & Sklar 1984); weak phosphodiesterase inhibitor, increasing cAMP levels and potentiating effects of β-adrenergic stimulation, though at levels much higher than those achieved naturally (Goodman & Gilman 1975; Kruk & Pycock 1983).

Theophylline $C_7H_8N_4O_2$

[1,3-dimethylxanthine; theocin; 3,7-dihydro-1,3-dimethyl-1H-purine-2,6-dione]

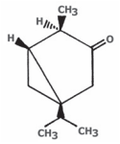


Monohydrate, thin monoclinic tablets from water, bitter; mp. 264-268/270-274°C; very sol. in water, alcohol, chloroform; sol. in alkali hydroxides, ammonia, dilute HCl; sparingly sol. in ether.

Weak CNS and respiratory stimulant (Goodman & Gilman 1975), bronchodilator (Budavari et al. ed. 1989); diuretic, cardiac stimulant and smooth muscle relaxant more potent than *caffeine* or *theobromine* (Buckingham et al. ed. 1994; Goodman & Gilman 1975). Highly toxic orally (Buckingham et al. ed. 1994; Goodman & Gilman 1975), can elicit convulsions at 50% higher than the therapeutic dose for asthma (Snyder & Sklar 1984). This might instead refer to known occasional toxicity of aminophylline [*theophylline* ethylenediamine], the form of the drug most commonly used in medicine (pers. obs.). *Adenosine*-receptor antagonist slightly more potent in vitro than *caffeine* (Biaggioni et al. 1991; Snyder & Sklar 1984); weak phosphodiesterase inhibitor, increasing cAMP levels and potentiating effects of β-adrenergic stimulation, though at levels much higher than those achieved naturally (Biaggioni et al. 1991; Goodman & Gilman 1975; Kruk & Pycock 1983).

Thujone $C_{10}H_{16}O$

[(-)-α-thujone:- l-thujone; (-)-3-isothujone; (1S,4R,5R)-3-thujanone] [(+)-α-thujone:- d-thujone; (+)-isothujone; (+)-3-thujone; (1S,4R,5R)-3-thujanone]



Equilibrium mixture contains 33% α- (shown) and 67% β-thujone. Colourless or almost colourless liquid; bp. 78-83.8°C [α], 85.7–86.2/201–202°C [β]; practically insol. in water; sol. in alcohol and many other organic solvents.

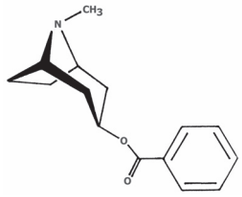
Psychotropic, anthelmintic, uterine-stimulant, antagonises narcotic-poisoning (Albert-Puleo 1978). Suggested to act on similar receptor systems to *THC*, based on some similarities in molecular structure, although this was not actually demonstrated (Del Castillo et al. 1975). α-*Thujone* is also analgesic, and modulates *GABA*-a receptors; β-*thujone* is less toxic. Metabolised by cytochrome P450 (Hölld et al. 2000). Ingestion may cause convulsions (Hall 1973). LD50 of the equilibrium mixture in mice [s.c.] – 134.2mg/kg; LD50 of α-*thujone* in mice [s.c.] – 87.5mg/kg; LD50 of β-*thujone* in mice [s.c.] – 442.2mg/kg (Budavari et al. ed. 1989).

Tribulin

Originally the name given to an endogenous MAOI detected in human urine [also inhibits binding to BZ-receptors, shows anxiogenic activity], now known to consist of at least 4 constituents, the makeup differing in different body tissues. These constituents of *tribulin* include *isatin*, 4-OH-phenylethanol, 4-OH-phenylacetate, ethyl indole-3-acetate [and/or methyl 3-indole-propionate] and methyl indole-3-acetate [all inhibiting MAO-A]. Women generally have higher levels of endogenous *tribulin* than men (Glover 1998; Glover et al. 1987; Hucklebridge et al. 1998b; Medvedev 1996, 1999; Medvedev et al. 1995a, 1995b). See *Neurochemistry*, *Influencing Endogenous Chemistry*.

Tropacocaine $C_{15}H_{19}NO_2$

[O-benzoyl-exo-3-hydroxytropane; O-benzoyl-exo-3-tropanol]

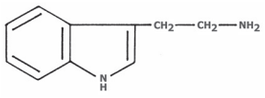


Plates or tablets; mp. 49°C; distills in vacuo without dec.; freely sol. in alcohol, ether, chloroform, benzene, petroleum ether, dilute acids; slightly sol. in water.

Said to be 'poisonous' (Buckingham et al. ed. 1994; Harborne & Baxter ed. 1993). Human pharmacology poorly known; causes local anaesthesia more rapidly than *cocaine*, though is scarcely mydriatic; otherwise "it resembles *cocaine* generally in action" (Henry 1939). Inhibits *choline* and *norepinephrine* uptake, and *acetylcholine* synthesis (Meyer et al. 1990). LD50 in rats [i.v.] – 15-20mg/kg (Budavari et al. ed. 1989).

Tryptamine $C_{10}H_{12}N_2$

[1H-indole-3-ethanamine; 3-(2-aminoethyl)indole; 2-(3-indolyl)ethylamine]

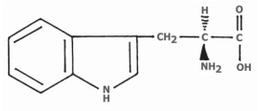


Needles from petroleum ether; mp. 118°C; bp. 137°C; sol. in ethanol, acetone; practically insol. in water, ether, benzene, chloroform.

Psychotropic. Increases blood pressure, causes mydriasis, nausea, bodily sedation, dizziness, sweating, mild increase of awareness, and mild, brief visual and auditory changes [infused i.v. over several minutes, 23-277mg] (Martin & Sloan 1970, 1986). Claimed by some to be mildly psychoactive by smoking (Shulgin & Shulgin 1997). Excitant in mice and cats [given i.v.] (Squires 1978). Can induce catatonia, possibly mediated by an indirect anticholinergic action, and antagonised by *serotonin*. Endogenous mammalian neurochemical, biological prescursor to *N-methyltryptamine*, *DMT* (Axelrod 1961; Barker et al. 1981; Corbett et al. 1978; Hanson 1966; Martin & Sloan 1986; Saavedra & Axelrod 1973; Tanimukai et al. 1970; Van Andel & Ernst 1961; Webster 1989). Weak MAOI in rat liver (McKenna et al. 1984b). In animals, it only appears to enter the brain in large doses (Martin & Sloan 1970), though it is apparently lipophilic enough to cross the blood-brain barrier (Young 1983). In any case, it is inactive orally (Shulgin & Shulgin 1997), presumably due to its rapid degradation by MAO. Co-administration with an MAOI, or instead ingestion of *tryptophan* with MAOI, may allow for its passage into the brain where it will most likely be metabolised to form other indoles (pers. obs.). See *Neurochemistry*.

Tryptophan $C_{11}H_{12}N_2O_2$

[2-amino-3-(3-indolyl)propanoic acid]

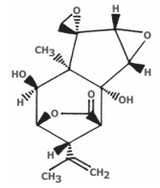


Leaflets or plates from dilute alcohol; mp. 252/278/289°C [dec. 289°C]; sol. in water, hot alcohol, alkali hydroxides; insol. in chloroform. Enzymatic hydrolysis product of most plant and animal proteins.

Antidepressant [4-6g a day], sedative; most effective in people with a dietary *tryptophan* deficiency. Further study is needed to determine its range of efficacy. Biological precursor to *tryptamine*, *serotonin* [via *5-hydroxytryptophan*] and *melatonin*, as well as other indoles. Best taken with 1–1.5g a day of nicotinamide [a form of vitamin B3] to enhance conversion to *serotonin*; nicotinamide inhibits the liver enzyme *tryptophan* pyrrolase, which would normally process much of the *tryptophan* ingested to vitamin B3. Increases slow-wave sleep. Can cause mild perceptual changes and heavy sedation [with some euphoria] in large doses [5-8g orally; one study used 30-90mg/kg (oral)], or in smaller doses with an MAOI and/or *methionine*. Some 'schizophrenics' may be more sensitive to these latter combinations. Side effects of large doses [c.9g and above] may include dry mouth, nausea, vomiting, headache, 'lightheadedness', blurred vision, tremors, diarrhoea and possibly bladder carcinoma [an indirect action observed in animal studies]; given with MAOI, side effects may include 'intoxication', tremor, hyperreflexia, flushing, low blood pressure when standing upright and nystagmus. As mentioned above, larger doses can prove counter-productive, as high levels induce activity of the enzyme *phenethylamine* pyrrolase, forming kynurenine [which reduces brain *serotonin* levels] as a product of vitamin B3 synthesis (Harper 1973; Kety 1961; Kruk & Pycock 1983; Mandell et al. 1969; Maurizi 1990; Shaw et al. 2002; Smith & Prockop 1962; Upfal 1995; Van Praag 1981; Wurtman 1987a). Increases *tribulin* levels in rat brain (Bhattacharya et al. 1991a). Amino acid present in small amounts in foods. Restricted substance. See *Neurochemistry*, *Influencing Endogenous Chemistry*.

Tutin $C_{15}H_{18}O_6$

[coriarin; 2-hydroxy-coriamyrtin]

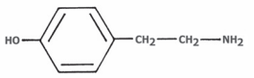


White, odourless crystals from ethanol or water; mp. 204-205/209-213°C ; sol. in water, alcohol, ether.

Poisonous (Buckingham et al. ed. 1994), CNS excitant, stimulates respiratory, vasomotor and cardioinhibitory brain centres (Harborne & Baxter ed. 1993). Causes giddiness, stupor, delirium, convulsions and coma (Budavari et al. ed. 1989). Reduces inhibitory action of *glycine*, has some *GABA*-antagonist activity (Curtis et al. 1973). LD50 in female mice – 3mg/kg [i.p.] (Budavari et al. 1989). Also found in Toxicodendron capense (Buckingham et al. ed. 1994).

Tyramine $C_8H_{11}NO$

[p-tyramine; 4-hydroxyphenethylamine; tyrosamine; 4-(2-aminoethyl)phenol; 2-(p-hydroxyphenyl)ethylamine]

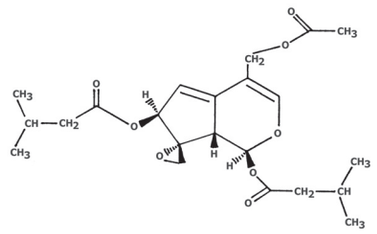


Crystals from benzene or alcohol; mp. 161/164-165°C; bp. 166/205-207°C; alkaline reaction; sol. in water, boiling alcohol; sparingly sol. in benzene, xylene.

Adrenergic (Budavari et al. ed. 1989); can cause release of brain *norepinephrine* and *dopamine* (Saavedra 1989); blocks *norepinephrine* and *dopamine* re-uptake, increases *norepinephrine* release (Kruk & Pycock 1983). Has indirect *norepinephrine*-like effects, though slower in onset and less marked; does not appear to have behavioural effects of its own (Webster 1989). Found in putrefied animal tissue, fermented foods, ripe cheese; should not be combined with an MAOI (Budavari et al. ed. 1989; Mashford et al. 1993). Endogenous mammalian neurochemical formed from tyrosine, *phenylalanine*, *l-DOPA*, *dopamine* and/or *phenethylamine*; prescursor to *dopamine*, octopamine (Boulton & Juorio 1982; Webster 1989). Also exists in other isomeric forms – o-*tyramine* [2-OH-*phenethylamine*] and m-*tyramine*. The former has been found in mammalian urine, but only in very low concentrations in brain; it has *amphetamine*-like effects (Boulton & Juorio 1982). Does not cross the blood-brain barrier (Marley & Stephenson 1972). See *Neurochemistry*. Also found in Aster linariifolius, Chlorophytum capense, Colocasia antiquorum, Cordyline terminalis, Crinum sp., Jacaranda acutifolia, Juglans nigra, Liriope spicata, Mariscus jamaicensis, Nandina domestica, Pyrostegia ignea, Sambucus canadensis and Schinus terebinthifolius (Wheaton & Stewart 1970).

Valtrate $C_{22}H_{30}O_6$

[valtratum; valepotriate; valepotriatum; baldrisedon; halazuchrome B]



Oil; insol. in water.

Sedative (Buckingham et al. ed. 1994), tranquilliser, improves coordination, antagonises alcohol-induced hypotension (Harborne & Baxter ed. 1993), spasmolytic, anticonvulsant, increases *GABA* levels. Larger doses can be toxic (Hobbs 1993).

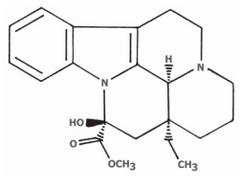
Vasopressin $C_{46}H_{65}N_{15}O_{12}S_2$

Human vasopressin is 8-L-arginine vasopressin [the formula given above]

Mammalian pituitary peptide hormone (Buckingham et al. ed. 1994; Budavari et al. ed. 1989). Improves attention, concentration and memory, modifies sleeping patterns, alters pain response, mediates some aspects of sexual arousal [dependent on presence of testosterone]. Has some *adrenocortocotropin*-releasing activity; potentiates cholinergic activity, and *glutamic acid* activity in some areas of brain; modulates α1-adrenergic activity. Stimulates thirst (Crenshaw & Goldberg 1996; Dean & Morgenthaler 1990; Kovacs & De Wied 1994; Kruk & Pycock 1983). Vasopressor, antidiuretic, haemostatic, reduces fever (Budavari et al. ed. 1989). Rapidly absorbed through nasal mucosa (Dean & Morgenthaler 1990). See *Neurochemistry*.

Vincamine $C_{21}H_{26}N_2O_3$

[vincamarine; minorine; perivincamine; methyl-14,15-dihydro-14-hydroxy-eburnamenine-14-carboxylate]

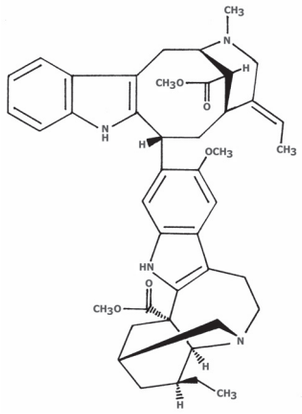


Occurs naturally as the D-form; yellow crystals from acetone or methanol; mp. 190-220/232-233[dec.]/274°C [dec.].

Antihypertensive (Buckingham et al. ed. 1994), cardiotonic, nöotropic. Induces low frequency [4-6Hz] rhythmic activity in the neocortex in rats; decreases alpha- and increases delta- and theta-wave activity. Sedative, depletes catecholamines. Causes cerebral vasodilation [increasing cerebral blood flow], and a biphasic fall in blood pressure. May stimulate neuronal metabolism, increasing utilisation of glucose and stimulating carbon dioxide production. Can improve memory, mood and concentration. Has a protective action in the brain; may cause enhanced cellular respiration. Oral therapeutic dose 30mg, twice daily (Bisset 1985a; Bruneton 1995; Dean & Morgenthaler 1990; Van Beek et al. 1984). LD50 in mice – 75mg/kg [i.v.]; >1000mg/kg [s.c.]; 1000mg/kg [oral] (Budavari et al. ed. 1989).

Voacamine $C_{43}H_{52}N_4O_5$

[voacanginine; 12-methoxy-13-[(3α)-17-methoxy-17-oxovobasan-3-yl]-ibogamine-18-carboxylic acid methyl ester]

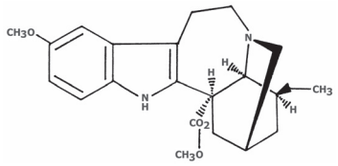


Prisms from acetone and methanol; mp. 224°C [dec. 223°C]; sol. in chloroform, acetone; slightly sol. in alcohol.

CNS stimulant or depressant 4.6x less potent than *ibogaine* (Bert et al. 1988); mild analgesic; cardiotonic of low toxicity; causes smooth-muscle contraction. In higher doses, causes hypertension due to peripheral vasoconstriction. LD50 – 360mg/kg [route of administration or species administered to not noted] (Bisset 1985a; Van Beek et al. 1984). Toxic to some cancers; some antibacterial action (Buckingham et al. ed. 1994).

Voacangine $C_{22}H_{28}N_2O_3$

[carbomethoxyibogaine; 12-methoxyibogamine-18-carboxylic acid methyl ether]

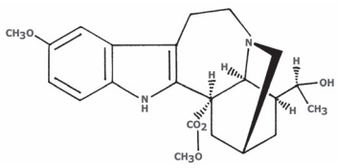


Prismatic needles from ethanol; mp. 136-138°C; sublimes 135°C; freely sol. in acetone, chloroform; slightly sol. in alcohol.

CNS stimulant 23x less potent than *ibogaine* (Bert et al. 1988); analgesic, hypothermic, surface anaesthetic, anticonvulsant, hypotensive; high doses cause convulsions, brachycardia and asphyxia; may cause some degree of catalepsy. Has some cytotoxic activity (Bisset 1985a; Buckingham et al. ed. 1994; Okuyama et al. 1992). LD50 in mice [i.v.] – 54mg/kg (Van Beek et al. 1984).

Voacristine $C_{22}H_{28}N_2O_4$

[voacangarine; 19-hydroxy-voacangine; 20-hydroxy-voacangine]

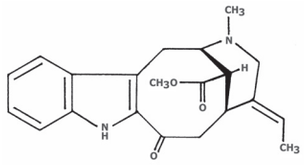


Crystals; mp. 112-114°C [dimorphous mp. 163-165°C].

CNS stimulant; hypotensive; can cause brachycardia. Weak cytotoxic activity against P-338 leukaemia cells. LD50 in mice – 77mg/kg [route of administration not noted] (Bisset 1985a; Buckingham et al. ed. 1994; Van Beek et al. 1984).

Vobasine $C_{21}H_{24}N_2O_3$

[N^4-methyl-perivine; methyl 3-oxovobasan-17-oate]

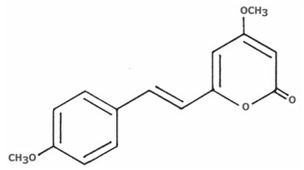


Crystals; mp. 111-113°C; sol. in ethyl acetate, acetone, chloroform, dichloromethane, methanol.

CNS stimulant [or depressant] 4.6x less potent than *ibogaine* (Bert et al. 1988), mild antipyretic and analgesic. Causes central and respiratory depression in large doses. LD50 in mice [i.v.] – 58mg/kg; however, cats have died from 10mg/kg [i.v.] (Bisset 1985a; Buckingham et al. ed. 1994; Van Beek et al. 1984).

Yangonin $C_{15}H_{14}O_4$

[4-methoxy-6-[2-(4-methoxyphenyl)ethenyl]-2H-pyran-2-one; 4-methoxy-6-(4-methoxystyryl)-α-pyrone]

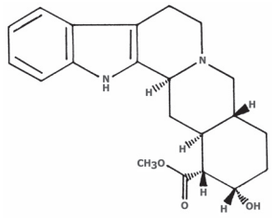


Greenish yellow crystals with blue fluorescence from methanol; mp. 153-157°C; practically insol. in water; sol. in hot alcohol, glacial acetic acid, ethyl acetate, acetone; slightly sol. in benzene, ether.

Muscle relaxant, anticonvulsant, sedative; strongly synergises with other 'kava-lactones' [see **Piper 2**] (Keller & Klohs 1963; Klohs 1967; Meyer 1967); MAO-B inhibitor in human platelets, slightly less potent than *methysticin* in this regard (Uebelhack et al. 1998). Nor-*yangonin* is found in Anaphalis adnata (Buckingham et al. ed. 1994).

Yohimbine $C_{21}H_{26}N_2O_3$

[yohimvetol; quebrachine; hydroergotocin; corynine; aphrodine; methyl(16-α,17-α)-17-OH-yohimban-16-carboxylate]



Orthorhombic needles from dilute ethanol; mp. 234-237/241°C; sparingly sol. in water; sol. in alcohol, chloroform, hot benzene; moderately sol. in ether.

Causes CNS excitation, increased blood pressure, heart rate and motor activity, sweating, nausea, local anaesthesia [similarly potent in this regard to *cocaine*] and mydriasis. Blockades α-2-adrenergic- and 5-HT2-receptors, and increases *serotonin* levels; releases stored *epinephrine* and *vasopressin*; increases *oxytocin*, *phenethylamine*, substance P, VIP, prolactin, cortisol and *acetylcholine* levels; decreases α-2 adrenergic, *GABA*, opioid and progesterone activity; inhibits plasma cholinesterase; increases *tribulin* levels in rat brain. Male aphrodisiac, though there is suppression of sexual activity at higher doses. Antidiuretic, antidepressant. Active around 15mg. Higher doses can cause nausea, arrhythmia, tremor, headache, dizziness, paraesthesia and anxiety. Has been used to treat angina pectoris and arteriosclerosis (Bhattacharya et al. 1991a; Bisset 1985a; Bruneton 1995; Buckingham et al. ed. 1994; Budavari et al. ed. 1989; Crenshaw & Goldberg 1996; Orgell 1963a). Should not be combined with tricyclic antidepressants (Fugh-Berman 2000). In combination with corynantheine, it has been sold as a *cocaine* substitute ['yocaine'] (Siegel 1980). Also found in Ladenbergia hexandra bark [traces] (Holker et al. 1964), Diplorhynchus spp., Lochnera spp., Pouteria spp. and Hunteria spp. (Meulen & Kerk 1964).

GLOSSARY

abortifacient — a substance used to procure abortion; or, referring to the property of causing abortion [ie. 'acting as an abortifacient']
AChEI — acetylcholinesterase inhibitor
achene — dry, one-seeded fruit which does not open [dehisce], formed from a superior mono-carpellate ovary
acidosis — medical condition involving high acidity in body fluids and tissues
acuminate — gradually tapering to a point
adaptogen — an agent that helps the body adapt to stress and novel situations
addiction — state of dependence related to habitual use of a substance or activity; usually correlated to physical dependence, wherin withdrawal symptoms are noted when the preferred substance or activity is not available
adrenergic — of or pertaining to neurons associated with ***epinephrine*** [adrenaline], or of an agent mimicking or promoting its effects; this relation also applies to the term ***noradrenergic***, with ***norepinephrine***, for example
adrenolytic — inhibits activity of ***epinephrine*** and/or adrenergic neurons
aghori — ascetic followers of Shiva, who believe that distinctions between opposites [such as concepts of 'good' and 'bad'] are illusory, and thus may sometimes be observed performing unusual acts outside the usual realms of social acceptability, such as performing rituals with human corpses, including eating the flesh
amenorrhoea — abnormal absence or stopping of menstrual periods
anaesthetic — any substance or procedure which reduces or abolishes sensation; general anaesthetics affect the whole body and produce unconsciousness; local anaesthetics only affect the region to which they are applied, and those closely surrounding it
analeptic — a CNS stimulant used to restore consciousness to a comatose person, or someone who has fainted
analgesic — any substance or procedure which relieves pain
anaphrodisiac — something which decreases sexual desire and/or ability
anodyne — something which soothes and/or eases pain
anthelmintic — eliminates intestinal parasites
anther — in a flower, the part of a stamen which produces pollen, usually divided into lobes by a band of tissue [the connective]
anticholinergic — a substance which blocks or reverses the activity of ***acetylcholine***; in the CNS this may result in delirium and hallucinations, amongst other effects [eg. see **Datura**]
antidiarrhoeic — acts against diarrhoea
antidipsogen — antagonises craving for alcohol
antifilarial — substance which kills filaria [parasitic nematode worms]
antinociceptive — antagonises nerve pathways involved in pain perception
antioxidant — neutralises damaging oxygen free-radicals
antiphlogistic — relieves inflammation or fever
antipyretic — reduces fever by lowering body temperature
antiseptic — destroys or inhibits growth of pathogenic bacteria
antispasmodic — reduces spasmodic activity in smooth muscle; often entails a nervine and general muscle-relaxant action
antitussive — suppresses coughing
anxiolytic — relieves anxiety and nervous tension
aphasia — also called dysphasia; a disease of the dominant hemisphere of the brain [eg. the left hemisphere for a right-handed person], affecting generation, content and understanding of language
aphrodisiac — incites sexual desire, or enhances sexual experience and/or ability
apiculate — terminating abruptly to a small point
arrhythmia — deviation from normal heart rhythm
arthralgia — joint pain without swelling or other arthritic symptoms
ascetic — person practising self-imposed hardship and denial of comforts, often including self-imposed physical and mental ordeals, usually in the pursuit of spiritual illumination
astringent — causes contraction of cells; observe the 'puckering' effect of black tea [see **Camellia**] in the mouth
ataxia — a state in which shaky and unsteady movement is observed
ayahuasca analogue — a combination of two or more plants or chemical substances, at least one containing an MAOI and the other/s containing ***DMT*** [or sometimes ***5-methoxy-DMT***], used to produce an effect analogous to that produced by ayahuasca containing **Banisteriopsis** and **Psychotria** or **Diplopterys**
ayahuasquero — shaman proficient in the use of ayahuasca [see **Banisteriopsis**]
ayurvedic medicine — therapeutic system based on ayurveda, 'the science of life', originating from India
bioassay — to determine the activity of a substance by ingestion, preferably self-ingestion — often referred to as the 'Heffter technique', after Arthur Heffter, who was the first person to bioassay a pure psychedelic compound on himself [***mescaline***, in 1897]
brachycardia — shortening of heart beat
bradycardia — slowed heart-rate to less than 50bpm
cannabinoid — any of a group of chemical substances structurally related to ***THC*** [including a tricyclic structure]; or, a substance which binds to cannabinoid receptors [such as ***anandamide***]
cardiotonic — tones and regulates heart activity
carminative — reduces intestinal gas
catalepsy — a symptom of catatonia involving abnormal maintenance of physical postures
catarrh — excess secretion of thick phlegm or mucus
catatonia — abnormal state of mute stupor, in which limbs can be moved by another person without resistance and will remain in the position they are left in for some time [see catalepsy]
catecholamine — chemical substance with two adjacent hydroxy groups on a benzene ring — eg. ***dopamine***
cathartic — laxative
caudate — excessively acuminate
cephalic — of or relating to the head
ch'i — also spelled 'qi' or 'ki'; Chinese word for vital energy of the universe or life force, paralleled by the Sanskrit 'prana'
cholinergic — of or relating to nerves which transmit and/or receive ***acetylcholine***; or a substance which mimics the actions of ***acetylcholine***, or stimulates its production and/or synaptic release
CNS — central nervous system
convolute — with one part wholly wrapped up in another
coriaceous — leathery
covalent linkage — a bond formed by sharing pairs of electrons between atoms
curandera — a female shamanic or medicinal healer
curandero — a male shamanic or medicinal healer
cyanogenic/cyanogenetic — of a plant or chemical compound which may generate cyanide or hydrocyanic acid [HCN] under certain conditions [see *Categories of Psychoactive Chemical Compounds*]
cytostatic — suppresses growth and multiplication of cells
cytotoxic — toxic to cells; sometimes this can be useful in treating cancer, if the cytotoxic activity is selective to tumorous growth
dehiscent — usually of a mature plant reproductive organ, referring to an ability to rupture or split to release seed or pollen
delirium — mental state characterised by disorientation, 'true' hallucinations, and sometimes excitation and delusional behaviour
demulcent — protects mucous membranes, keeping them moist and soothing irritation
diaphoretic — promotes sweating
dioecious — of plants which bear male and female flowers on separate plants
disinfectant — destroys or removes bacteria
dissociation — a state where thoughts and ideas seem to function separately, or removed from, consciousness or 'reality'
diuretic — promotes urine flow
drug — any substance which pharmacologically affects a living organism
d/w — dry weight
dysmenorrhoea — painful menstruation
dysphoria — opposite of euphoria
dyspnoea — difficult or laboured breathing
ecstasy — from the Greek 'ekstasis', roughly meaning 'flight of the soul from the body'; most people associate the word with less extreme sensations of rapture. Today it is commonly synonymous with 3,4-methylenedioxy-*methamphetamine* [MDMA] and its miscellaneous street substitutes or adulterants
emetic — causes vomiting
emmenagogue — promotes menstruation
emollient — soothes and softens skin tissue
empathogen — something which brings about a feeling of empathy with objects, places or other people
endogenous — from within the body
entheobotany — the study of entheogenic plants
entheogen — a substance which 'generates the god within'; sometimes interpreted as 'awakening the god within'. Originally proposed as a replacement term for ***psychedelic***. It is currently little-used; many people dislike the theological connotations of the word, which also is more descriptive of certain contexts of use and of a possible subjective effect out of many, rather than of a reliably replicable pharmacologic effect
enzyme — a complex protein which catalyses specific chemical reactions on the substrates with which it binds temporarily

ethnobotany — the study of the use of plants by humans
eupeptic — something which aids or maintains normal digestion
euphoria — 'bearing well'; generally associated with feelings of bliss, joy and good cheer in varying degrees
exogenous — from outside of, or alien to, the body; originating externally
expectorant — loosens phlegm or sputum, aiding in its removal
expert — a type of imaginary being invented by humans
febrifuge — reduces or prevents fever
filiform — slender and thread-like
fumigant — something smouldered or burned to treat a person or place with fumes or smoke, usually in a purifying context [spiritually or medicinally therapeutic]
galactagogue — promotes milk flow
GC — gas chromatography
glabrous — smooth
glaucous — covered with a fine waxy bloom
glucoside — a glycoside, in which the sugar constituent is glucose
glycoside — chemical compound derived from amino acids and containing one or more sugar moeities
habituation — psychological dependence on something that is used or done regularly
haemolytic — destroys red blood cells
haemoptysis — coughing up blood
haemostatic — prevents haemorrhage or bleeding
hakim — Muslim physician, judge or other authority
hallucination — a perception of any of the senses which can not be observed by others, and is thus deemed not to exist, or to be a delusion; in the case of psychoactive drugs, a hallucination is defined by the perceiver not recognising that the perception is a result of the effects of the drug and believe it to be physically real
hallucinogen — technically, a substance which causes hallucinations; often mis-applied to many psychedelic or visionary substances which do not usually cause 'true' hallucinations in most cases
hardhead — colloquial term referring to someone who is more resistant than most others to the effects of some psychoactive substances; such people are usually affected normally or even more strongly by at least some psychotropes
harv. — harvested
herb — botanically, a small tender plant; otherwise, any plant or plant part with medicinal or culinary virtues
HPLC — high performance liquid chromatography
hyperalgesia — increased perception of pain
hyperpnoea — increased rate of breathing, related and proportional to increased metabolism due to exertion
hypertension — high blood pressure
hypnagogic — of mental imagery experienced while going to sleep
hypnotic — a substance that causes sleep by depressing CNS function; I prefer to use the term to describe substances that induce a hypnotic state in the sense of trance, or detached but focused thought, which does not actually lead to sleep, unlike a narcotic or soporific, except in high doses
hypotension — low blood pressure
hypoxaemia — state of reduced oxygen content in arterial blood
icaro — magical chant or melody used by Amazonian shamans in healing or divinatory sessions; icaros are usually learned whilst under the influence of a psychotropic substance [such as ayahuasca], and different icaros have different effects, from calling on the healing power of a plant, to calling particular spirits, to simply calming a distressed patient
imbricate — overlapping at the margins in a parallel fashion
indigenous — originally native to a particular area
inebriation — an intoxication involving 'extravagant exhilaration' or ecstasy [see above]; often used to refer to alcohol intoxication
inflorescence — structure of flowering plants which bears the flower or flowers [the reproductive organs]
intoxication — referring to a state involving symptoms of 'toxicity' from ingestion of a drug; a very broad term which may refer to anything from nausea and vomiting, to varying states of desirable or undesirable inebriation, or psychotropic effect
in vitro — outside of a living organism [ie. in a test tube]
in vivo — inside of a living organism
involute — with edges inrolled spirally
ischaemia — insufficient blood flow resulting from blockage or constriction of blood vessels leading to a part of the body
lamina — blade of a leaf
ligand — in neurochemistry, something which has an affinity for a particular receptor type
lipid — fatty compound [including fats, steroids] that is soluble in organic solvents, but not in water
LSD — d-lysergic acid diethylamide or LSD-25 [also known as 'acid'], a synthetic psychedelic drug derived from ergot alkaloids [see **Claviceps**]
lyophilise — to dry by freezing in a high vacuum
macerate — process of soaking, usually to soften or break up tissues
MAOI — monoamine-oxidase inhibitor
medicine wo/man — a person proficient in healing, usually with herbs; not the same as a shaman, who has a broader function, though the two often overlap in practice
miotic — constricts the pupil of the eye
moeity — a chemical structure part of, or attached to, another; eg. ***tryptamine*** with an N-methyl moeity is also known as ***N-methyltryptamine***
MS — mass spectrometry
mucronate — abruptly terminating in a short, hard point
mutagenic — promotes cell mutation
mydriasis — dilation of the pupils
myosis — constriction of the pupils [also spelled miosis]
narcotic — a substance which diminishes consciousness and relieves pain; widely misapplied to all illegal drugs
nervine — has a tonic action on nerves
neuraesthenia — syndrome involving headache, dizziness, fatigue, irritability, anxiety and intolerance of noise
neuralgia — sharp burning or stabbing localised nerve pain
neuroleptic — antipsychotic, generally acting as a sedative tranquilliser
neurotoxic — harmful to nerve cells; many neurotoxins cause damage by causing excessive depolarisation or excitation of neurons
neurotrophic — relating to growth and nutrition of neural tissues
neurotropic — growing towards, or having an affinity for, neural tissues
nöotropic — a substance which enhances cognition, yet usually producing no marked psychotropic activity at normal doses; collectively, such substances are often called 'smart drugs'
nystagmus — rapid and involuntary eye movement
oedema — also known as dropsy; swelling of body tissues from excessive accumulation of fluids
oneirogen — stimulates dreaming, enriches dream content
ophthalmic — related to the eyes
ordeal poison — a toxic substance administered in some indigenous cultures [particularly in parts of central Africa] to determine guilt or innocence in important matters. Usually innocence is shown if the person under trial vomits up the substance [in the case of oral ordeal poisons]; otherwise, death may result, or at least violent gastric pain, signifying guilt
oxytocic — stimulates uterine contractions
paraesthesia — spontaneous tingling sensations, sometimes referred to as 'pins and needles'
paralytic — relating to paralysis; or, a substance which causes paralysis
PEA — phenethylamine, β-phenethylamine
pediculicide — a substance which kills lice
pers. comm. — personal communication [from another person], anonymous unless a name is given
pers. obs. — personal observation, whether it be a hypothesis, deduction, or derived from personal experience. This book is full of personal observations from the author, but the term is only used as a reference where necessary to avoid confusion with other referenced comments listed in close proximity
phenylpropane — chemical substance with a three-carbon side chain attached to a benzene ring
phenylpropanoid — chemical substance similar to, or synonymous with, phenylpropanes
phenylpropene — a kind of phenylpropanoid found in essential oils, which is lipid-soluble and aromatic
pheromone — a chemical which serves to signal messages between members of the same species, or sometimes between different species; pheromones are most famous for those which signal sexual interest or receptiveness, or which attract members of the opposite sex so that mating may occur
phytochemical — a chemical produced by a plant through natural processes; it is questionable whether this term can be applied to chemicals produced by plants purposely fed synthetic or exogenous precursors, which would otherwise not be found in the plant
precursor — in chemical terms, a chemical which is used to produce another chemical — eg. ***tryptophan*** is a precursor to ***tryptamine***
pruritis — itching
psychedelic — roughly meaning 'mind-manifesting', this word [coined as an alternative to the (usually) inaccurate term 'hallucinogen'] should correctly be spelled 'psychodelic' though this never caught on due to negative connotations of the prefix 'psycho'; generally referring to substances which elicit elaborate alterations in visual and thought processes, especially LSD, ***DMT***, ***psilocin*** and ***mescaline***; also used to refer to art or music evocative of a psychedelic state; currently disliked by some due to its mainstream association with 'hippies' and late 1960's 'psychedelic culture'
psychoactive — of something which alters consciousness or state of mind

psychonaut — a person who embarks on explorative journeys through the mind, through the use of psychoactive drugs, or by other effective means
psychoptic — a substance that has visionary properties; suggested by some as an alternative to 'psychedelic' and 'entheogen'
psychotrope — a substance that has psychotropic properties
psychotropic — a catchier way of saying psychoactive
purgative — a less embarrassing way of saying laxative
reality — many people devote their entire lives trying to figure out what it is, so I won't make any futile attempts to define such a bag of mystery and intrigue. Generally stated to be 'that which is real' [by consensus], but as reality seems to differ for everyone this is not a very acceptable definition
religion — secularised and dogmatised spirituality, its adherents often [but not always] lacking in true spiritual depth and understanding
revolute — with edges inrolled spirally, on the underside
rhizome — more or less horizontal creeping root, usually branching and sending up new growth away from the main plant
rubefacient — something which warms the skin and causes reddening
sacrament — a substance consumed, or act performed, ritually for the purpose of communion with god/s or 'higher realms'
saddhu — Hindu wandering 'saint' or spiritual seeker, generally a life occupation; many saddhus are also ascetics
sage — person renowned for being profoundly wise; also referring to **Salvia** spp. and some **Artemisia** spp.
schizophrenia — blanket term used to describe a variety of similar mental disorders, characterised by 'delusions', tenuous contact with consensus reality, and difficulty in functioning socially; sometimes hallucinations are present; is not the same as 'multiple-personality disorder' [a.k.a. 'split personalities']
serotonergic — of or pertaining to neurons associated with *serotonin*; or substances which mimic its effects
shaman — from the Siberian Tungusian word 'saman', referring to the 'medicine-men' or so-called 'witch-doctors' of the area, though now generally used to refer to similar practitioners worldwide; shamans use psychoactive plants and/or other methods to reach trance-like states or contact spirit realms for divination and healing
softhead — a person who is more easily affected by certain psychoactive substances, often with some exceptions [eg. a person may be a 'softhead' for **Cannabis** but not for alcohol, and vice versa]
somatic — relating to the body
soporific — produces sleep
sorcerer — practitioner of magic, usually used to harm or influence others, or for selfish means
spasmolytic — something which relieves spasms of smooth muscle
spirit — 'an ineffable vital quality that provides the link between the mundane and the divine' could be one way of attempting to capture it in words
spirituality — personal experience of the divine translated into one's daily life; non-secular, personalised religion
SSRI — selective *serotonin* re-uptake inhibitor
SRI — *serotonin* re-uptake inhibitor
stamen — of the male part of a flower consisting of a filament supporting an anther
stomachic — improves digestion and soothes stomach aches
stupefacient — a substance which causes one to become stupefied
sudorific — same as diaphoretic [see above]
sympatholytic — something which antagonises sympathetic nervous system activity
sympathomimetic — referring to symptoms of sympathetic nervous system stimulation, or something that causes them
synaesthesia — a merging of sensory perceptions, eg. seeing sound, tasting colour etc.
synergy — an action between two or more substances or things, which has an effect greater than the sum of the individual parts
tab. — tablespoon
tachycardia — increase of heart rate above the normal
TCM — Traditional Chinese Medicine
teratogen — causes birth defects
terete — not angular
THβC — 1,2,3,4-tetrahydro-β-carboline, also occasionally known as tryptoline
THIQ — 1,2,3,4-tetrahydroisoquinoline
TLC — thin-layer chromatography
tonic — a substance which improves and regulates the function of specific organs, or the body as a whole
topical — of something applied externally to the skin, usually to a specific area where an afflicition is located
torpor — state of sluggishness, decreased responsiveness
trachoma — an eye disorder which is a severe and contagious form of conjunctivitis
tranquilliser — [U.S. spelling - tranquilizer] a substance which produces calming effects
tremorgen — a substance which promotes fine-tremors
tripping — experiencing the effects of a psychedelic drug, whether one has been consumed or not
tsp. — teaspoon
urtication — burning or itching sensation, usually on the skin; can be due to hives or nettle sting [see **Urtica**]
vasoconstrictor — causes constriction of blood vessels
vasodilator — causes dilation of blood vessels
vasopressor — something which stimulates contraction of blood vessels, resulting in increased blood pressure
vegetalista — Amazonian shaman or curandero/curandera who utilises plants
vermifuge — something used to expel intestinal worms
visionary — a substance which can induce visions; also used to describe art or people that communicate visionary states or 'out-there' concepts
vulnerary — wound-healing
War on Drugs — a misguided exercise in futility, which serves only to alienate, incarcerate, and otherwise destroy the lives of large sections of the community, without decreasing the prevalence of drug use, as well as increasing the risks of non-prescribed drug use and producing flow-on social problems which would otherwise be trivial or non-existent
w/w — wet weight, fresh weight

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Abbreviations used here for some commonly referenced journals:

Aust. J. Chem.	Australian Journal of Chemistry
Aust. Vet. J.	Australian Veterinary Journal
Biochem. Pharm.	Biochemical Pharmacology
Biochem. Syst. Ecol.	Biochemical Systematics & Ecology
CA	Chemical Abstracts
Chem. Pharm. Bull.	Chemical & Pharmaceutical Bulletin
Ec. Bot.	Economic Botany
Harv. Bot. Mus. Leaf.	Harvard Botanical Museum Leaflets
J. Agric. & Food Chem.	Journal of Agricultural & Food Chemistry
JACS	Journal of the American Chemical Society
JAMA	Journal of the American Medical Association
J. Am. Pharm. Ass.	Journal of the American Pharmaceutical Association
J. Chem. Soc.	Journal of the Chemical Society
J. Ethnopharm.	Journal of Ethnopharmacology
JNP	Journal of Natural Products
JOC	Journal of Organic Chemistry
J. Pharm. Exp. Ther.	Journal of Pharmacology & Experimental Therapeutics
J. Pharm. Sci.	Journal of Pharmaceutical Sciences
Pharmacol. Biochem. Beh.	Pharmacology, Biochemistry & Behaviour
Phytochem.	Phytochemistry
Pl. Med.	Planta Medica
PNAS	Proceedings of the National Academy of Sciences, USA
Tetr. Lett.	Tetrahedron Letters
Yakugaku Zasshi	Journal of the Pharmaceutical Society of Japan

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Brush, D.E. et al. 2004. "Monoamine oxidase inhibitor poisoning resulting from internet misinformation on illicit substances." J. Toxicol. Clin. Toxicol. 42(2):191-195. [Note: this article is rather hysterically anti-drug, and seems to consider all "partisan" [as opposed to anti-drug] drug-related websites as sources of "internet misinformation", and all 'underground' scientists such as Jonathan Ott as suspect sources of information - where often the real problem is of young psychonauts failing to do their research properly and experiment with caution. The supposed peer-rated drug-knowledge credentials of emergency-room admittees are used to further encourage a fear of all psychedelic substances (implying that there is no safe self-experimentation), ignoring the fact that a lot of young psychonauts (and some older ones) are simply far less knowledgeable of the subject than they or their friends think they are, and hence tend to take stupid risks more frequently. In my opinion this just strengthens the need for books like this one you are now reading!]
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ILLUSTRATION CREDITS

All illustrations have been executed by the author. Many are closely based on original artworks or photographs by others, as listed below. The prime criterion for including illustrations was accurate detailing to aid identification [along with the written descriptions]. Use of creative license by an illustrator can distort the accurate representation of a biological entity. Many of the species illustrated within were not available in a living state for first-hand study by the author [not including those investigated in a dry state], lacking the time and funding required for the extensive travelling such an undertaking would involve. Use of high definition colour photographs taken by the author and donated by others would of course have been preferable, but such an option was not available within the cost restrictions involved in producing this self-funded work. Black and white photographs often do not reproduce clearly enough to be useful for any but a cursory impression. A planned future revised edition of this work is hoped to include a large array of original colour photographs.

It is for these reasons the author reluctantly decided that attempting re-worked versions of the art of others was the best viable option for this current edition. I did not wish to directly reprint them, lacking the time and resources to secure copyright permission from all relevant sources, and also recognising that some of the original artworks could do with some improvement. Previously published originals were enlarged, traced for the general outlines, then painstakingly hand-detailed taking care to give the illustration dimension and to attempt to correct artistic embellishments, errors or unclear areas of the originals, based on comparison with botanical or zoological descriptions, as well as other illustrations or photographs when available. Some of these originals were so good they could not really be improved upon, though the reproductions of these are still different from the originals. Original artists are listed below, where their names could be located, followed by reference to the publication in which original artworks were printed. Some publications failed to specify the artists responsible for particular artworks, or failed to name any of the artists used; in such cases, only the publication in which the illustration appeared has been given as a reference.

List of Illustrations

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Voacanga africana	after 'J.W.', in Exell et al. ed. 1960-1993.

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SEARCH FOR ULTIMATE TRUTH

many things in one
the way things are
the way things seem to be, and the way things could be
the inexplicable beauty of the evening sun
and the cool luminescence of its sister the moon
the balance of everything
the knowing that every action affects all others
the infinite connection of all parts
each part bearing the signature of the whole
the many faces of every fraction
the delightful order in the divine chaos
as above so below
the acceptance of every occurrence
as part of the game
as another valuable lesson
the knowing of your respective place in the greater whole
and further, of your equality with everything
of returning to the whole
and seeing it was there all along
not separate
not lost in time
bringing knowledge of the untapped strength inherent in all
to affect their destinies, and in course,
the destiny of all
not to overcome or destroy out of hatred
but rather to transform, share
and strengthen all with the virtues
of quiet wisdom, resilience, acceptance and kindness,
the wonders of joy and laughter
admiration for the unsurpassed brilliance
of creation in all its glory and diversity,
knowing of the presence and overlapping proximity
of dimensions and realities
other than the 'regular'
whatever that is
to recall that all
is of one and the same
a single organism beyond ordinary comprehension
constructed of mystery
made cohesive by an elusive truth
divided by confusion and fear
a true paradox
the simplicity and complexity of it all -
the futility of searching for a single phrase
to sum up or define 'the meaning' -
it's right in front of your eyes
reality is yours to explore, shape and create
why, why not?