12
Plants as Medicines

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Preparing a cultural history of medicinal plants is a challenging task, especially when attempting worldwide coverage. Each region has its own centuries-old, continuously changing, traditions. This is exemplified in Table 12.1, which shows the geographical origin of medicinal plants currently included in the European and the German pharmacopoeias. The latter includes a particularly large number of medicinal plants. It is of particular note in these pharmacopoeias that they still rely very heavily on European (including Mediterranean) plant resources, which are part of the tradition of Europe, and on the plants introduced by the various Arabic scholarly works.

How does one go about selecting plants to be included in this chapter? D. Moerman recorded at least one medicinal use for 8.2 percent, or 2,600 species, of a total of 31,600 North American species of higher plants (Moerman 1998), while in the case of Mexico, R. Bye has estimated that about 17 percent (5,000 species) of the total flora (30,000 species) are used medicinally (Bye 1993). From this overview it becomes obvious that the selection of just a few medicinal plants from any of the continents will have to highlight particularly interesting or typical examples and that such a selection has to be arbitrary. Consequently, we have selected six species from Africa, twenty from Europe (including the Mediterranean and the Near East), seven from northern Asia, fourteen from South and southeastern Asia, eleven from the Americas, and three from Australia/Oceania. Some species have been selected because they are of particular importance as medicinal plants and/or because they provide particularly interesting case studies that highlight exciting developments in the use of medicinal plants.

Africa

Very little information about plant use in Africa has been written down. In African thought, all living things are believed to be connected to each other, to the gods, and to ancestral spirits. If harmony exists between all of these, then good health is enjoyed, but if not, misfortune or ill health will result. Forces can be directed at humans by displeased gods, ancestors, and witches, resulting in disharmony which must be resolved before good health can be restored. Treatment may also involve much more than medicine. Practices such as divination and incantation may be carried out to help with diagnosis, and sacrifices may need to be made in order to placate the supernatural entity.

The traditional healer is also likely to be a religious leader, since health and spirituality are closely intertwined in Africa. Traditional healers have existed throughout Africa since prehistoric

Birthwort (*Aristolochia clematitis*). USDA-NRCS PLANTS Database/Britton, N.L., and A. Brown. 1913. *Illustrated flora of the northern states and Canada.* Vol. 1, p. 645.

times, for example, the *ifas* and *juju* men of West Africa or the *inyanga* (*sangoma* is the term used for diviners) of South Africa. Various methods have been used to identify "healing plants," such as trying to find a plant that possesses a stronger spirit than the one causing the disease, or by using the "law of signatures." This system existed in other parts of the world, including Europe in the Middle Ages (Grier 1937), and is based upon the concept that nature has provided a cure for every

TABLE 10.1 Geographical Origins of Medicinal Plants Contained in the European and the German Pharmacopoeia[§]

Geographical Region	EurPh 1997 & 98	DAB 1997 & 98	Total	DAB1926
Eurasia (incl. Mediterranean)	31	40(11)	71	76
· Central, Northern Europe	7	15(2)	22	19
· Central, Northern Europe and Mediterranean	3	3(2)	6	8
· Mediterranean only	8	7(3)	15	16
· Northern Asia and Near East	13	15(4)	28	33
Asia (Central, North, East)	3	2(2)	5	4
South and Southeast Asia	8	5(–)	13	24
Africa	5	1(–)	6	7
Australia	0	1(–)	1	1
North America	3	2	5	4
Mexico, Central and South America	9	3(3)	12	19
Oceans	1	0	1	1
Total	60	54	114	136

[§] If more than one species are accepted for a botanical drug, they are included only once.
· The data refer to the German Pharmacopoeia (DAB) only (i.e. botanical drugs not listed in the EurPh); the numbers in parentheses are the species which yield botanical drugs, which are included in the EurPh.

disease. Matching a plant to a disease for a cure involves finding a plant with a similar form to the diseased organ. For example, plants with a red flower would be used in blood disorders, and yellow-flowered plants in cases of jaundice.

The use of medicinal plants in Africa also provides the observer with timely reminders of how sustainable cultivation can protect a resource (*Aloe ferox*, Southern Africa), but a species may likewise move toward regional extinction through over-exploitation (*Prunus africana*, Cameroon). Modern treatises and texts of African *Materia Medica* include the following: for West African medicinal plants, Oliver-Bever (1986); the ethnobotanical studies of Neuwinger (1994, 2000); for North Africa, Bellakhdar (1997); and for South Africa and East Africa, Watt and Breyer-Brandwijk (1962); van Wyk et al. (1997).

African devil's claw, Grapple plant *Harpagophytum procumbens*
Pedaliaceae

Devil's claw or grapple plant derives its name from the formidable "claw," the dried hooked thorns of the fruit used in seed dispersal, which are a hazard to any passing cloven-hoofed animal or careless human. The plant is native to southern and eastern Africa and it is collected in regions bordering the Kalahari Desert. It thrives in clay or sandy soils and is often found in parts of the South African veldt. The tubers are traditionally used as a tonic, for "illnesses of the blood," fever, problems during pregnancy, and kidney and bladder ailments. Since the mid-1980s and with considerable research effort, African devil's claw has been developed into a very successful and relatively well-characterized phytomedicine for the treatment of pain relief in joint diseases, back pain, and headache. Most pharmacological and clinical research has been conducted on standardized extracts. The secondary storage tubers are collected and, while they are still fresh, they are cut into small pieces and dried. The main exporters are South Africa and Namibia. Attempts are currently under way to cultivate the species because over-harvesting has led to conservation concerns.

The dried and powdered root of the plant is now included in the *European Pharmacopoeia* (2002) and some national pharmacopoeias, such as that of Switzerland. Several constituents are known, including iridoids and phenylethanoids, but the active constituents have not been identified with certainty.

Aloe plant. Copyright Edward Parker, used with permission.

Aloe *Aloe vera*
Aloeceae

Aloe vera (also known as *A. barbadensis*) has long been used because of its medicinal properties and its mythical significance. Depictions of a plant similar to *A. vera* appear in wall carvings and paintings in ancient Egypt (2000 BC), but its use prior to the Roman period is speculative. Alexander the Great learned of aloe after conquering Egypt in 332 BC and, on Aristotle's advice, had his army capture the island of Socotra where *Aloe* grew, thus ensuring that his soldiers, rather than the opposition, would benefit from the healing powers of this plant. The first-century Greek herbal of Dioscorides gives a description of the healing powers of aloe and noted it was the sap, and not the gel, that was the healing agent. It should be clearly stated here that confusion does exist about which component of aloe is to be used. The gel, from the parenchyma cells in the inner leaf pulp, is the part that has been used medicinally for centuries and should be clearly distinguished from the exudates (or latex). This latex originates from the bundle sheath cells just beneath the outer skin of the leaves, is characterized by its yellow color and bitter taste, and is used as a strong purgative.

The plant is native to Africa. Its former scientific name, *A. barbadensis* (from the Caribbean island of Barbados), originates from the time Jesuit priests exported the plant from South America to Spanish territories in the Caribbean (Jamaica and Barbados) and subsequently imported it to England in the 17th century. *Aloe ferox*, or Cape aloe, is native to southern Africa and is widely applied in phytotherapeutic preparations. Aloe extracts incorporated into over-the-counter cosmetic and medicinal products are now widespread throughout the world. Aloe gel is used widely in many preparations including those for wound treatment, especially burn wounds and inflammation, as extensively reviewed by Reynolds and Dweck (1999) and Reynolds (2004). All *Aloe* species are protected by the Convention on International Trade in Endangered Species (CITES).

Cola nut, Sudan cola nut *Cola acuminata* and *C. nitida*
Sterculiaceae

These two taxa of evergreen trees are sometimes considered to be one species. They are endemic to the lowland forests of western Africa, especially Sierra Leone, Liberia, Ivory Coast, and Ghana, and have been introduced to Nigeria, Mali, and Guinea. *Cola nitida* is widely cultivated in the Caribbean. The medicinally used part of the plant is the cola nut (the tree's seed kernel) which is chewed to produce saliva. The seeds are rich in caffeine and related alkaloids and have consequently been used as a stimulant. However, cola's importance in African traditional societies goes beyond this: it is a

symbol of friendship, and guests receive a cola nut on arriving at a house. Also many ceremonies are ended by jointly eating cola nuts. The first drawing of a cola nut was published by Clusius in 1591, but it was only in the 19th century that the nut became more widely known in Europe and North America. Travelers' stories of using it to ease the hardship of expeditions and travel highlighted the stimulating effects of *C. nitida*, but it has no modern biomedical use.

See: Nuts, Seeds, and Pulses, p. 137; Caffeine, Alcohol, and Sweeteners, p. 179

Myrrh *Commiphora myrrha*
Burseraceae

Myrrh is indigenous to Northeast Africa, particularly Somalia and Ethiopia, and is one of the oldest and most highly esteemed botanical drugs. The drug used is the gum resin (an exudate), which is excreted by the trees through the bark. In present-day Morocco, for example, it is used as a balsam and for nervous disorders, and it is applied in cleansing ceremonies such as ritual fumigations (Bellakhdar 1997). *In vivo* anti-inflammatory effects have been reported for its extract (Duwiejua et al. 1992).

See: Fragrant Plants, p. 250

Red stinkwood *Prunus africana*
Rosaceae

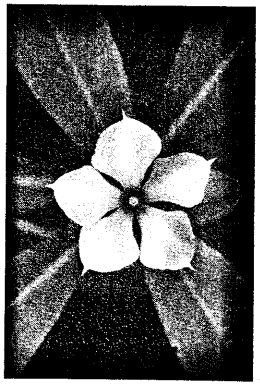
The bark of *Prunus africana* is obtained from a tree that grows in the high (at elevations of 1000–2500 m) mountain forests of Africa and Madagascar). It has been developed into a phytomedicine and used to treat benign prostate enlargement, with good clinical evidence pointing to the extract's efficacy. Within Africa, different decoctions of the plant are used to treat various conditions, including fevers, urinary tract infections, and inflammation (bark tea), and to prepare wound dressings (leaves), and the leaf sap is drunk for insanity. In the regions of origin a high-quality extract is produced from the botanical drug, which is mostly exported to Italy, France, and Spain. This extract could provide a sustainable and valuable income for many of the African countries, especially for Cameroon and Madagascar. However, the bark is currently harvested from this slow-growing tree in an unsustainable manner. Overharvesting has resulted in serious damage to plant populations and it is now CITES-listed. Consequently, there has been a drive to stop the collection of the bark or, alternatively, to increase efforts to cultivate the species. These have been hampered by shortage of seed stocks and the long unproductive period as the tree matures.

See: Ornamentals, pp. 265–6, 269, 270, 274, and 279–80; Wood, p. 321; Nuts, Seeds, and Pulses, p. 134

Rosy periwinkle *Catharanthus roseus*
Apocynaceae

A small, erect shrub, the rosy periwinkle (Madagascar periwinkle) is native to Madagascar but can now be found as a widely cultivated plant in warm climates around the world. The plant reaches a height of 3 feet (1 m) and has smooth oblong leaves; the pink or white flowers are borne all year round on the upper leaf axils. The plant is used in South Africa to treat diabetes and rheumatism, but its pervasive growth has now caused it to become a weed, especially in Kwa-Zulu Natal and Mpumalanga.

In Madagascar the plant is widespread, reflecting its multiple uses in herbal treatments. The striking floral display of the plant has promoted its spread around the world and has led to variations in its medicinal applications. By the early 20th century it was being used as an oral hypoglycemic agent (to lower blood sugar levels) in South Africa, southern Europe, and the Philippines; to treat diabetic ulcers in the West Indies; and to control hemorrhages and scurvy in Brazil. The role



Rosy periwinkle. Copyright Edward Parker, used with permission.

of the plant as an antidiabetic agent in the Caribbean led to the discovery of its effective anticancer activity. Diabetics in Madagascar were taking a periwinkle tea in preference to the more expensive insulin treatments. This prompted a small scientific study which found that rats given the tea had a significantly lowered white blood cell count. Although fatal to the rats, this finding prompted the researchers to investigate the effect of the Madagascar periwinkle against leukaemia, a disease caused by an abnormal increase in white blood cells. The active agent was identified as a new alkaloidal compound termed vinblastine which was licensed in the United States and approved for use in cancer treatments in 1961. A related alkaloid from the same plant, vincristine, was licensed as a drug two years later. Rosy periwinkle is now widely grown for extraction of these alkaloids.

Europe and the Mediterranean/Near East

Europe differs from the other regions under discussion, in that there the historical knowledge about medicinal plants is rarely a popular tradition or based on knowledge handed down from one generation to the next. Instead herbal traditions form part of mainstream pharmaceutical traditions and relatively well-researched botanical medicines are often available. Most of this information is now transmitted via the mass media, especially through popular books about herbal medicines and in countries such as Switzerland, Italy, France and Germany. Other countries, like the United Kingdom, consider many herbal medical products to be a form of alternative and complementary medicine. However, in both cases medicinal plants have become a commodity.

The Mediterranean and Near East region has been characterized by mutual influences among popular medical practices and schools of medicine. The oldest written information in the European-Arabic traditions originates from the Sumerians and Akkadians of Mesopotamia, and another region for which we have documents that have survived through the millennia is Egypt. There are many problems in translating ancient texts. Because medicinal plants are precious and used in small quantities, they are rarely found in the archaeological record. Translation of ancient names therefore relies on internal evidence—for example, descriptions of the plant concerned—and on philological techniques. Many plant names from ancient Mesopotamia and Egypt are of uncertain meaning or cannot be translated at all. The Egyptians documented their knowledge, including medico-pharmaceutical knowledge, on papyruses (e.g., the Papyrus Eber), using paper made from the sedge *Cyperus papyrus.*

Greek medicine has been the focus of pharmaceutical historical research for many decades. The Greek scholar Pedanius Dioscorides from Anarzabos (first century AD) is considered to be the father of (Western) pharmacy. The doctrine presented in his works governed pharmaceutical and medical practice for more than 1,500 years and has heavily influenced European pharmacy. He was an excellent pharmacognosist and described more than six hundred medicinal plants. A number of Greek and Roman scholars were influential in developing other fields of health care practice and the natural sciences, including the following:

- The Greek medical doctor Hippocrates (ca. 460 to 375 BC) who heavily influenced European medical traditions and was the first of a series (of otherwise largely unknown) authors which produced the so-called Corpus Hippocraticum (a collection of works on medical practice).
- The Graeco-Roman medical doctor Claudius Galen (Galenus) [130 to 201 (?) AD] who summarized the complex body of Graeco-Roman pharmacy and medicine and whose name survives in the pharmaceutical field of "galenics" or pharmaceutical technology.
- Pliny the Elder [23 or 24 AD to 79 AD (killed at Pompeii while observing the eruption of Vesuvius)], who was the first to give a "cosmography" (a detailed account) on natural history, which included cosmology, mineralogy, botany, zoology, and medicinal products derived from plants and animals.

After the conquest of the southern parts of the Roman Empire by Arab troops, the Greek medical texts were translated into Arabic and adapted to the needs of the Arabs. Many of the Greek texts survived only in Arab transcripts. *Ibn Sina* or Avicenna from Afshana (980–1037) wrote the monumental treatise *Canon of Medicine* (Qânûn fi'l tibb; ca. 1020), which was heavily influenced by Galen and which in turn influenced the scholastic traditions, especially of southern Europe. This five-volume book remained the most influential work in the fields of medicine and pharmacy for more than 500 years (together with direct interpretations of Dioscorides' work). While many Arab scholars worked in Eastern Arabia, the Arab-dominated parts of Spain became a second center of classical Arab medicine. An important early example is the "Umdat at-tabîb" (The medical references) by the "Unknown Sevillan botanist." Thanks to the tolerant policies of the Arab regimes, many of the most influential representatives of Arab scholarly traditions, such as Maimoides (1135–1204) and Averroes (1126–1198), were Jews.

In the Christian parts of Europe the texts of the classic Greeks and Romans were copied and annotated during the Middle Ages, especially in the versions that had been passed on by the Arabs. The Italian monastery of Monte Cassino is one of the earliest examples of such a tradition, and others developed around the monasteries of Chartres (France) and St. Gall (Switzerland). A common element of the monasteries was a medicinal plant garden, which was simulateneously used for growing medicinal (and aromatic) herbs required for treating patients and for teaching the knowledge about medicinal plants to the younger generation. The species included in these gardens were common to practically all monasteries, and many of the species are still important medicinal plants of today.

Of particular interest in this context is another text, the *Capitulare de villis* of Charles the Great (Charlemagne, 747–814), who ordered that medicinal and other plants were to be grown in the King's gardens and in the monasteries. He specifically listed twenty-four species of medicinal plants. Walahfried Strabo (808 or 809 to 849), abbot of the monastery of Reichenau (Lake Constance), deserves mention because of his *Liber de cultura hortum* (book on the growing of plants), the first textbook on (medical) botany, and the *Hortulus*, a Latin poem on the medical plants grown in the district (Vogellehner 1987). This poem is not only famous not only because of its poetry, but also because of its vivid and excellent descriptions of the appearance and virtues of medicinal plants.

The climax of the medieval medico-botanical literature was reached in the 11th century with *De viribus herbarum* [On the virtues of herbs] of "Macer Floridus," a Latin poem written in approximately AD 1070 and attributed to Odo of Meung. In this educational poem, 65 medicinal plants and spices are described. Another frequently cited source was *Physica, Causae et curae* by the Benedictine nun, early mystic, and abbess Hildegard of Bingen (1098–1179). She described the medical benefits of plants and included many remedies popularly used during the 12th century. On the one hand, it is an early botanical work, and on the other hand her writings focus on prophetic and mystical topics. The botanical works of both scholars are only available in later copies and in prints. Unfortunately these copies only give a rather distorted idea of the original documents and are heavily reinterpreted texts.

For over 1,500 years the classical and most influential medical book in Europe had been Dioscorides' five-volume *De materia medica* (published ca. 50–70 AD). Until the Europeans' (re)invention of printing in the mid-15th century, these texts were handwritten codices that were almost exclusively used by the clergy and scholars in monasteries. Information about medicinal plants in Europe became much more widely available following the writing of the early herbals which rapidly became very popular and which made information about medicinal plants accessible in the languages of the lay people. Important authors of herbals published during the 16th century include Otto Brunfels, Eucharius Rösslin/Adam Lonitzer, Leonhard Fuchs (German), Nicolás Monardes (Spanish), William Turner, John Gerard (English), Pietro A. Mattioli (Latin/Italian), Garcia ab Horto (Orto) (Portuguese), and Antoine Constantin (French). The early texts were still strongly influenced by Graeco-Roman concepts, but other influences from many sources became increasingly important during the 16th century. The herbals rapidly became available in the various European languages and many of the later authors copied, translated and reinterpreted the earlier books or manuscripts.

The use of medicinal plants has always been an important part of all medical systems, including those in Europe during the various historical periods. Little is known about the popular traditions of Medieval and early modern Europe, since these were generally not written down. Our knowledge starts with the availability of written (printed) records on medicinal plant use by common people (see the previous discussion). As pointed out by Barbara Griggs (1981) a woman in the 17th century was a "superwoman," capable of administering "any wholesome receipts or medicines for the good of the family's health." A typical example of such a remedy is foxglove (*Digitalis purpurea*), reportedly used by an English housewife to treat dropsy and then used more systematically by the physician William Withering (1741–1799). He transformed British herbalism from knowledge simply passed by word of mouth into a science used by medical doctors (see *Digitalis purpurea*, following).

In the 17th and 18th centuries, knowledge about plant-derived drugs expanded, but the attempts to "distillate" the active ingredients from plants were unsuccessful. The main developments during these centuries consisted of detailed observations on the clinical usefulness of the medicinal products recorded in previous centuries or of those brought over from non-European countries. The next main shift in emphasis came in the early 19th century when it became clear that the pharmaceutical usefulness of plants was due to specific molecules, which could be isolated and characterized. This led to the development of a field of research now called natural-product biology or—in the specific case of plants—phytochemistry. Pure chemical entities were isolated and their structure determined. Some of these were then developed into medicines or were chemically modified and then used as medicines. In the second half of the 20th century, micro-organisms became another important source of biologically active molecules and many of these have been developed into medicines. However, the following brief accounts are exclusively on plants that have been of considerable pharmaceutical importance in Europe during the last centuries.

North temperate Europe

Arnica *Arnica montana*

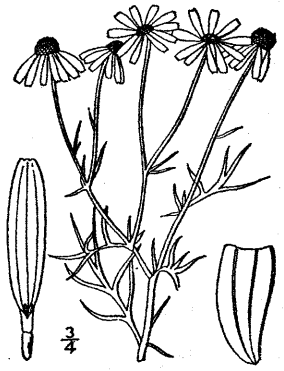
Asteraceae

It is well known that the German poet, philosopher, and natural historian J.W. Goethe (1749–1832) highly valued *Arnica montana*, and that he received a tea prepared with arnica after he had suffered a heart attack in 1823. Today, arnica is still an important medicinal plant, but pharmaceutical uses are exclusively external, for the treatment of bruises and sprains, and as a counterirritant. However, the task of establishing uses for the plant in the Middle Ages and the Renaissance has proven to be a difficult one. Arnica was hardly known in Greek, Roman, and Arabic medicine, and the first reliable evidence dates back to the 14th century (Matthaeus Silvaticus) and the 15th century. The situation was made even more complicated when this species was confused with water plantain, *Alisma plantago-aquatica*. In Jacobus Theodorus Tabernomontanus' *New vollkommentlich Kreuterbuch* (1588), there is a picture of *Arnica montana*. However, the text refers to water plantain (*Alisma plantago-aquatica*). Hence it comes as no surprise that the reported uses of these botanically completely different species are often very similar (especially during the 16th and 17th centuries). In the 16th century *Arnica montana* became an outstanding wound remedy.

Chamomile, German chamomile *Matricaria recutita* (syn. *M. chamomilla*)

Asteraceae

Chamomile is one of the most important medicinal plants of Europe, and has been in use for more than 2,000 years. It is used internally for gastrointestinal and respiratory complaints, as well as topically for inflammatory skin conditions (eczema, wounds, haemorrhoids). Hippocrates called it *euanthemos* (the real or good flower), Dioscorides called it *anthemis* and *anthyllis*, and Galen called it *anthemis* and *chamaimelon* (apple growing on the ground). It continues to be an important medicine in academic as well as popular medicine. The species has been exported to many areas and is today an essential element of medical systems all over the world. *Chamaemelum nobile*, or Roman chamomile, has very similar uses, especially as a (bitter) tonic and a gastrointestinal remedy, but it is chemically rather different. Historically it has been an important medicinal plant in England, France, and Italy.



Chamomile (Matricaria recutita). USDA-NRCS PLANTS Database/Britton, N.L., and A. Brown. 1913. *Illustrated flora of the northern states and Canada.* Vol. 3, p. 521.

European birthwort or snakeroot *Aristolochia clematitis*
Aristolochiaceae
Roots of the European snakeroot or birthwort, *Aristolochia clematitis*, and *A. rotunda* had long been used in medicine as an emmenagogue (to promote menstrual discharge), an abortifacient (to induce abortions), a diuretic, and for the treatment of arthritis. *A. serpentaria* (Virginia snakeroot) was similarly used in the United States, and was also used by Native Americans to treat snakebites. Until the early 1980s several phytomedicines from *A. clematitis* were widely sold in Europe. Its main active constituent, aristolochic acid, was also formerly used in Germany to treat abscesses, eczemas, and other long-lasting skin diseases and as a nonspecific stimulant of the immune system. However in 1981 both the extract and the pure compound were withdrawn due to serious carcinogenic and nephrotoxic (i.e., damaging to kidney cells) effects. A traditional Chinese medical herbal preparation which was used for its supposed weight-reducing effects, and which contained *Aristolochia fangchi* (Chinese Snake Root), known to possess large amounts of aristolochic acid, was used extensively in Belgium during the early 1990s. *A. fangchi* had inadvertently been substituted for another Chinese drug (*Stephania tetrandra*). Kidney failure owing to a progressive form of renal fibrosis due to the use of *A. fangchi* was observed eight to ten years later in many of the patients, and the import of this species is now widely banned.

Fennel *Foeniculum vulgare*
Apiaceae
Fennel and fennel seeds are a classic household remedy used as a cure for flatulence. It was important to Greeks and Romans and included in the *Capitulare de villis* as well as in the *Hortulus* of Walahfried Strabo (809 AD). It was reputed to ward off evil spirits. In his 16th century herbal, Leonhard Fuchs recommends the aerial parts and the seeds for stimulating lactation and as a diuretic. The seeds are also reported to be useful if one has a "weak·stomach." Another of Fuch's uses is for the macerated root: "if one puts it in honey it protects one against angry dogs" (sic) (Fuchs 2001).

See: Gathering Food from the Wild, p. 40; Herbs and Vegetables, p. 103

Feverfew *Tanacetum parthenium*
Asteraceae
Feverfew has been used as a bitter tonic and an antipyretic (i.e., to reduce fever) for many centuries; there was renewed interest in the plant in the 1990s as a potential treatment for migraines. *Tanacetum parthenium* is known in South America as Santa Maria and is an important species in

Feverfew (*Tanacetum parthenium*). J.S. Peterson @ USDA-NRCS PLANTS Database.

Foxglove. Copyright Dave Webb, used with permission.

many indigenous medical systems, especially in South and Central America, where it is used for menstrual disorders.

Foxglove *Digitalis purpurea* and *Digitalis* spp.
Scrophulariaceae
Foxglove, *Digitalis purpurea*, is one of the best-known examples of a remedy developed from close observation of the pharmacological effects of the species. Digitoxin from this and related species is still extracted from several members of the genus and is used today in the treatment of coronary disease. It was reportedly used by an English housewife to treat dropsy, and then used more systematically by the physician William Withering (1741–1799). Prior to William Withering, herbalism in Britain spread simply by word of mouth; his endeavors transformed it into a form of science used by medical professionals. Herbalism during this period was more of a clinical procedure concerned with the patient's welfare, than a systematic study of the virtues and chemical properties of medicinal plants.

Horse chestnut *Aesculus hippocastanum*
Hippocastanaceae
The seeds of the horse chestnut are used topically and orally for chronic varices (circulation problems in veins) and other inflammatory circulatory disorders. The active ingredient is a mixture of saponins collectively called aescin. The species originated in the Balkan peninsula or Anatolia, but is now cultivated in many regions of the world. In Europe the first trees were planted in Vienna in 1576 (Clusius), and the species was also introduced into North America. in the middle of the 19th century. The horse chesnut is commonly used in Continental Europe, and the German medical control agency published a "positive" (i.e., approved) monograph, or legally binding analysis of the accepted medical uses of the species, that was adopted by the health authorities (BFA 1994). However, the horse chesnut is of lesser importance in North America.

See: Wood, p. 323

Mint *Mentha* spp.
Lamiaceae
Peppermint, *Mentha* × *piperita*, is a very widely cultivated medicinal and aromatic plant, and is particularly important for the production of menthol, which is used as a flavouring agent. Its medical uses are to treat flatulence and gastrointestinal cramps. The species is also used to flavour chocolate

and in liqueurs. It is a hybrid of *M. aquatica* × *M. spicata*, which spontaneously originated in 1696 in an English garden. It can only be propagated via its runners. Today peppermint is one of the most important medicinal and aromatic plants, and is widely grown in some parts of Europe (southeastern Europe, Spain, Germany) and especially in the United States. It was reportedly first brought to the United States in the early 19th century and cultivated in the state of Massachusetts. From there the production spread to other East Coast states and to the northern Midwest (Michigan in 1835), and eventually to the West Coast (Oregon in 1919). In the 1940s production started in Wisconsin. Today the major production centers of the world are the Columbia River Basin, Washington, the Willamette Valley, Oregon, and the states of Indiana and Idaho. Another important representative of the genus, *M. spicata*, or spearmint, is menthol-free and commonly used to flavor toothpaste. The production of spearmint started later and its extension followed that of peppermint. It is mainly grown in the state of Washington.

Mentha arvensis, or corn mint, originally from Eurasia, is another prominent member of this genus used medically in numerous cultures of the world. The closely related *M. canadensis* is the Japanese peppermint used for a large variety of illnesses because of its high menthol content.

See: Fragrant Plants pp. 249–50; Herbs and Vegetables, pp. 106–7

Scotch marigold *Calendula officinalis*
Asteraceae

Scotch or pot marigold is used pharmaceutically, for example, to treat chilblains, chronic wounds (including ones which heal very slowly), and other inflammatory conditions of the skin. In some rural regions of Europe (e.g., Switzerland and the German Black Forest) the species is still widely used externally as a veterinary anti-inflammatory remedy. Normally the flower heads are mixed with lard or another animal fat, heated for a short period in order to extract the active lipophilic constituents, and the resulting product is stored for usage. The flower heads are also used to color butter and to thicken soups.

The species originated in southeastern Europe and is today widely cultivated (most commonly as a garden plant). It is uncertain whether the species was already used by the Greeks and Romans. The core problem is the lack of proper botanical identification of plants with names similar to the ones used for *Calendula* in much later periods. The first certain evidence is from the *Physica* (first printed 1533) of Hildegard of Bingen (1098–1179). According to Mayer and Czygan (2000b), this points to use in the popular (peasant) medicine of this period and later became a constant element of the various medieval texts (especially the later Circa Instans). This species is an example of the continuous usage of a medicinal plant for similar medical indications.

See: Ornamentals, p. 262

St. John's wort *Hypericum perforatum*
Hypericaceae

St. John's wort is a perennial which plays a primary role in modern evidence-based phytotherapy. The aerial parts of the plant have been used as an anti-inflammatory, healing application for wounds and as an antimelancholia remedy since the time of the ancient Greeks. In the Middle Ages many believed it to have magical powers to protect one from evil. Early Christian mystics named the plant after John the Baptist and it is traditionally collected on St. John's Day, June 24, and soaked in olive oil for several days in order to produce a red anointing oil to be used externally. This practice is still very common in many folk medicines of eastern and southern Europe, and some pharmacological evidence in support of the usage exists.

Several controlled studies have shown positive results when using standardized St. John's wort extract to treat patients with mild depression. Improvements were shown with no reported

St. John's wort (*Hypericum perforatum*). Jennifer Anderson @ USDA-NRCS PLANTS Database.

side effects. The active constituents in the plant (there are over fifty) include antraquinones (hypericin and pseudohypericin), prenylated phloroglucinol derivatives (hyperforin), and flavonoids.

However, the side effects of St. John's wort include stomach complaints, fatigue, and especially allergic reactions (photodermatitis). Most authorities warn strongly that *Hypericum* extracts should not be taken alongside other anti-depressants; doing so can result in a syndrome called serotonin syndrome.

See: Ornamentals, p. 282

Valerian (root) *Valeriana officinalis*
Valerianaceae

The combined root and rootstock of the (common) valerian with its characteristic "old socks" smell is used pharmaceutically to treat sleep disorders and other related conditions. It is a licensed medicine in many European countries and is currently grown commercially in Russia, Japan, the United States, Belgium, Holland, and Germany. The species has been used through the centuries in many European regions. L. Fuchs lists a variety of uses including as a diuretic and gynecological aid, but he does not include uses for sleep disorders.

White willow *Salix alba* and *Salix* spp.
Salicaceae

The genus *Salix* includes numerous trees and shrubs common in alpine ecosystems and along the margins of streams. The white willow, *Salix alba*, is a tree that commonly grows in areas periodically flooded along streams and lakes. Willow bark (known to pharmacists as *Salicis cortex*) is a European phytomedicine with a long tradition of use for treatment of chronic pain, rheumatoid diseases, fever, and headache, and one of its main compounds, salicine, served as a lead substance for aspirin (acetylsalicylic acid). Leonard Fuchs devotes a chapter in his *New Kreütterbuch* (1543), illustrated with three drawings of different species, to the various "classes" of willow. The leaves are reported to be good for treating some gastrointestinal complaints, and the bark to be useful for treating warts and corns. Acetylsalicylic acid is today used in a similar way. Fuchs's use of willow as a treatment for podagra (i.e., gout, especially of the big toe) mirrors modern uses in the treatment of a variety of chronic inflammatory conditions. A positive monograph for its use in fever-related diseases, rheumatic complaints, and headache was published by the German medical control agency (BFA). The drug is also monographed in the European Pharmacopoeia. Clinical evidence,

including two double-blind studies, points to the effectiveness of willow bark for the treatment of chronic pain and rheumatoid diseases. This potency as a treatment is the result of more than one substance (most of them so far unknown). The extract is effective at a dosage of salicylates (a group of compounds chemically related to salicylic acid) which is much lower than the one reported for aspirin. However, the mechanism of action of this complex mixture and the individual compounds responsible for this activity remain unknown.

See: Ornamentals, p. 284; Materials, p. 348

Wormwood *Artemisia absinthium*
Asteraceae
Wormwood or absinthe has been used for many centuries not only as a bitter tonic, stomachic (strengthener of the stomach), and stimulant, but also in the production of liqueurs (e.g., vermouth) and it remains a useful phytotherapeutic option for mild gastrointestinal disorders. It was known to Wallafried Strabo in the 9th century (Vogellehner 1987) and is the first species mentioned in Fuchs' *New Kreüterbuch* (1543). There it is recommended for a number of gastrointestinal problems, and for a large variety of other disorders. The species is an example of how systematic exploration of its clinical effectiveness and pharmacological effects over the last few centuries has helped to reduce the uses of wormwood to therapeutically validated ones. One of its constituents, the neurotoxic monoterpenoid (i.e., a terpenoid with ten carbons in the skeleton) thujone, is concentrated in vermouth wines, especially if they are distilled, but the use of such products has been outlawed in Europe since the 1920s. Consequently, thujone-free species and varieties are used in the production of such wines.

See: Caffeine, Alcohol, and Sweeteners, p. 180

Yarrow *Achillea millefolium*
Asteraceae
Yarrow has been used as a medicine for many centuries. The species is native both to temperate Europe and to North America. Particularly common in Europe were uses associated with inflammatory conditions (e.g., in the form of an externally applied poultice). Even though the species had been an important medicinal plant in many European countries and, for example, is mentioned by Fuchs as a useful treatment for a variety of inflammatory conditions such as wounds and abscesses, today it is of limited importance and is only used in some regions, as a popular medicine.

See: Ornamentals, p. 276; Herbs and Vegetables, p. 106

Mediterranean and the Near East

Alexandra senna *Senna alexandrina* and Tinnevelly senna *S. angustifolia*
Fabaceae
Both species are of desert origin: Tinnevelly senna, *Senna angustifolia*, is native to Arabia, West Africa and Asia, as far as Punjab, while Alexandra senna, *S. alexandrina*, grows naturally in northeastern Africa and it is harvested and cultivated in Sudan, China, and India.

About 1,000 years ago the Arabs introduced the use of dried leaves and especially fruits of senna into Western pharmacopoeias as a laxative. Senna was mentioned in detail by Ibn al-Baytar (1197–1248), one of the most important Arabian scholars of the Middle Ages and the author of the famous medical treatise *Jami' al-mufradat*. Over the centuries senna has proved its worth as an herbal drug and today represents one of the most widely used herbal drugs in the classical pharmacy.

Artichoke *Cynara cardunculus*
Asteraceae
Formerly known as *Cynara scolymus*, the artichoke is the best example of a food-medicine in the whole of European phytotherapy. Artichokes originated in the Mediterranean region and numerous diverse cultivars were subsequently developed. Many Mediterraneans used artichokes by soaking them in wine, then drinking the liquid as a digestive and a reconstituent for various illnesses. Today the culinary use of the fleshy flower receptacles and the base of the bracts is known worldwide. However, the utilization of the leaves in modern phytotherapy is quite recent and focuses on their cholekinetic (increasing the flow of bile acids), antihyperlipidemic (lowering the level of lipids in the blood), and hepatoprotector (liver-protecting) properties. Artichoke leaves are the main ingredients of the Italian bitter liqueur Cynar, which has contributed significantly to changes in Italian social habits. During the 1960s and 1970s Cynar was very popular and drinking it after a meal became a "must" in many urban milieus.

See: Herbs and Vegetables, pp. 119–20

Chaste tree *Vitex agnus-castus*
Lamiaceae
This shrub is native to the Mediterranean and northwestern India. Dried fruits of *Vitex agnus-castus* seem to be one of the oldest phytomedicines, dating back to the beginning of European civilization. The Greek name of this plant, "lygos" (pliable branch), hints at its usage in viticulture for staking vines and in livestock farming for pasture fences. The other Greek expression, "agonos,"meaning chaste and pure, distinguishes it as a feminine plant of goddesses like Hera, Demeter, and Artemis (Diana), a cult plant of womanliness. Agonos is the source of the medieval name "agnus-castus" (the chaste lamb). The ancient Greek physicians Hippocrates, Theophrastus, and Dioscorides all made reference to it, as did the Greek-Roman historian Pliny The Elder. Both Dioscorides and Pliny reported its use in suppressing the libido. The Greeks' use closely resembled modern practices: they recommended it as an aid in healing of external wounds and complaints of the spleen, and for use in child birth. The English believed it would suppress the libido, as did the Catholic church, which had it placed in the pockets of novice monks in order to help them in fulfilling their vow of chastity. Adam Lonicer (1679) wrote that the aerial parts of the species were macerated into wine and honey, and early American physicians used the fruits to stimulate lactation and as an emmenagogue.

In the Mediterranean the fruits are sometimes used as a diuretic, to induce production of milk, and as an antirheumatic treatment. Recent studies have confirmed the pharmacological validity of its use in relieving complaints associated with premenstrual syndrome. Specifically, it is effective in relieving insufficiency of the corpus luteum (luteal phase defect). These fruits, and also the aromatic leaves, have been occasionally used as a condiment and pepper substitute in southern Europe and northern Africa, and both are part of the legendary Moroccan spice mixture "ras el hanout."

Garlic *Allium sativum*
Alliaceae
Garlic represents one of the oldest medicinal plants in the Mediterranean. Garlic was first discovered in the wild, probably in the Iranian region, and is well documented by textual and archaeological records in Mesopotamia and Egypt from 3000 BC. The early Sumerian diet included garlic as a mainstay, and garlic is mentioned in the *Shih Ching* (The Book of Songs), a collection of ballads said to have been written by Confucius. Garlic was highly prized in ceremony and ritual, and it is said that lambs offered for sacrifice in China were seasoned with garlic to make them more pleasing to the gods. Herodotus wrote that the Egyptians fed it to slaves building the pyramids in order to increase their stamina. Workers deprived of their ration of garlic went on strike. An Egyptian

papyrus from 1500 BC recommended garlic for twenty-two ailments. It represented a kind of combination food–medicine.

In the fourth book of the Bible, it is reported that the Jews returning to Sinai had nostalgia for the eating of garlic, which they had known and appreciated in Egypt. In ancient Greece and Rome, it was claimed to have additional uses, such as repelling scorpions, treating dog bites and bladder infections, and curing leprosy and asthma. By 1000 AD garlic was grown in virtually the entire known Medieval world, and was universally recognized as a valuable plant. Many cultures elevated garlic beyond a dietary staple, and suggested that it had medicinal and even spiritual uses. Philosophers and scholars credited garlic with many virtues. Aristophanes suggested that athletes and those going into battle should eat garlic to enhance their courage. Pliny wrote about garlic's ability to cure consumption and numerous other ailments. Virgil commented that garlic enhanced and sustained the strength of farm workers. Celsius recommended garlic as a cure for fever. Hippocrates thought it was a good medicine for many health problems, and Mohammed, the prophet, claimed that if garlic was applied directly to a sting or a bite wound, it would ease the pain. For many centuries there was a widely held belief that garlic would keep evil at bay. Wreaths of garlic hung outside a door or dwelling were believed to ward off witches or vampires. Bull fighters may well wear cloves of garlic around their neck during a bullfight in order to protect themselves from the vicious horns. In the Middle Ages it was thought to prevent the plague.

In the Middle Ages the use of garlic as a medicine and food was spread to central Europe mainly by the Jews; the Jewish habit of frequently eating garlic became one of the characteristics reviled by the Nazi regime during the 1930s and 1940s. Later, in the 1960s, garlic was spread further by immigration of the southern Europeans. Louis Pasteur first documented that garlic had an anti-bacterial property. in 1858, and nowadays garlic preparations play a primary role in modern phytotherapy as a treatment for high blood pressure and to reduce high levels of lipids in the blood. Some clinical evidence points to garlic's effectiveness in treating these conditions.

See: Herbs and Vegetables, p. 104

Licorice *Glycyrrhiza glabra*
Fabaceae

This shrub originated in the semi-arid areas of the Eastern Mediterranean, Near East and Central Asia. The oldest report on the use of the roots of this species comes from a Sumer tablet of Mesopotamia (2000 BC), and shortly thereafter the use of *Glycyrrhiza uralensis* in China is documented. By then the sweet taste of the licorice root was already known (its botanical name, *Glycyrrhiza*, sweet root, comes from Greek). Alexander the Great, the Scythian armies, Julius Caesar, and even India's great prophet, Brahma, were known to have endorsed the benefits of licorice. Arab physicians used licorice to treat coughs and relieve side effects of laxatives.

Licorice began to be cultivated intensively in Syria, southern Italy, France, and Spain, particularly from medieval times onward. The tradition of licorice use then spread to reach central Europe, where St. Hildegard of Bingen first wrote about its use in the 12th century, and England, where the roots were used to aromatize beer in the 14th century. For over 3,000 years, licorice root has been used by Mediterranean and Near Eastern populations as a remedy for sore throats and coughs, and sometimes to heal ulcers. These two medical applications remain the basis on which *G. glabra* continues to be important in modern evidence-based phytotherapy. Licorice, which is now mainly cultivated in Turkey, the former Soviet Union, and China, is also used in the food industry. A decoction of its washed roots, filtered and concentrated, continues to be one of the favorite snacks for children and adults.

See: Spices, p. 165

Poppy *Papaver somniferum*
Papaveraceae

Papaver somniferum has long been popular in the Near East and in the Mediterranean as a remedy and source of pharmaceuticals. It is one of the prime examples of a medicinal plant. Illustrations of the Greek and Roman gods of sleep, Hypnos and Somnos, show them wearing or carrying poppies. Classical Greek physicians either ground the whole plant or used opium extract. Galen lists its medical properties, noting how opium "resists poison and venomous bites, cures chronic headache, vertigo, deafness, epilepsy, apoplexy, dimness of sight, loss of voice." Dioscorides described both the latex of the capsules (*opos*) and the extract of the whole plant (*mekonion*). By the 8th century AD, opium use had spread to Arabia, India, and China. The Arabs both used opium and organized its trade. Thomas Sydenham, 17th-century pioneer of English medicine, wrote, "among the remedies which it has pleased Almighty God to give to man to relieve his sufferings, none is so universal and so efficacious as opium." In 1874, English pharmacist Alder Wright had boiled morphine and acetic acid to produce diacetylmorphine, which was synthesised and marketed commercially by the German pharmaceutical giant Bayer. In 1898, Bayer launched the best-selling drug of all time, heroin.

Opium, the latex obtained by making a cut in the unripe capsules of this species, was imported into England from Iran as early as 1870. Today it still represents the industrial source used for isolating the opium alkaloids, which play a central role in the modern pharmaceutical chemistry as analgesics (morphine-derivates) and as a treatment for coughs (codeine-derivates). Today morphine is isolated from opium in large quantities—over 1,000 tons per year—although most commercial opium is converted into codeine by methylation (a simple chemical process which replaces an –OH group by an $-O-CH_3$ group). On the illicit market, opium gum is filtered into morphine base and then synthesized into heroin.

In the popular folk medicine of southern Europe and in the Near East, low doses of *P. somniferum* fruits, as well as the flowers of *P. rhoeas*, are still occasionally used as a tranquillizer.

See: Psychoactive Plants, pp. 199–200; Spices, pp. 167–8

Sage *Salvia officinalis*
Lamiaceae

Sage is native to the eastern Mediterranean region. The plant was already known in the medical practices of the Greek and Roman period, mainly as a digestive and cough remedy. At that time, its role as a culinary herb had yet to be discovered. In his recipe books, Apicuius refers to the seeds of sage, but not the leaves. Sage became an important medicinal plant for Mediterranean monks of the Middle Ages who dispersed it to central Europe. The medical treatises of the Tuscan physician Pietro Andrea Mattioli (16th century) and the German physician Adam Lonicer from Marburg describe the use of sage leaves as a mouth antiseptic, to heal bronchial diseases, as an appetizer and an emmenagogue (to promote menstrual discharge). The essential oil of sage contains thujon, the compound that makes the dried leaves of sage an important herbal drug today, to heal mild infections of the mouth and upper respiratory tract. It is widely used in over-the-counter phytotherapeuticals.

See: Herbs and Vegetables, p. 109

Northern Asia

In the history of medicinal plant use in eastern Asia and Siberia, a very important school of medical practice, traditional Chinese medicine, links practices from a number of traditions that have been handed down by word of mouth (as in Siberia or northern China) and for which written historical sources are very rare and poorly investigated (e.g., Mongolian traditional medicine and the Tibetan school).

The Chinese *Materia Medica* has been growing throughout the last 2,000 years (Benski and Gamble 1993). This increase results from the integration of drugs into the official tradition from China's popular medicine as well as from other parts of the world. The first major *Materia Medica* after Tao Hong Jing was the *Xin xiu ben cao* 659 AD, also known as Tang Materia Medica, which was the official pharmacopoeia of the Tang dynasty. It contained 844 entries and was China's first illustrated *Materia Medica*. *Zheng lei ben cao*, 1108 AD, was the major medical treatise during the Song dynasty and contained 1,558 substances. However, China's most celebrated medical book is represented by Li Shi-Zhen's *Ben cao gang mu*, posthumously printed in 1596 AD, with 1,173 plant remedies, 444 animal-derived drugs and 275 minerals. This tradition has continued into the modern era with the publication in 1977 of the Jiangsu College of New Medicine's monumental 25-year project entitled *Encyclopedia of the Traditional Chinese Medicinal Substances* (*Zhong yao da cin dian*) containing 5,767 entries. Traditional Chinese medicine and Chinese plant remedies are nowadays used throughout Western countries, whereas other botanico-medical traditions remain largely restricted to their regions of origin.

Chinese foxglove *Rehmannia glutinosa*
Scrophulariaceae
Although it belongs to the same family as European foxglove and is sometimes known as Chinese foxglove, *Rehmannia glutinosa* has a completely different usage in traditional Chinese medicine.

R. glutinosa represents the most widely used drug of the Pharmacopoeia of China, where the plant, called *di huang*, is one of the most popular tonic herbs and is considered to be one of the fifty fundamental herbs. The drug is found in the root, which is used in different ways (raw, dried, charcoaled). Charcoaled *R. glutinosa* root is used to stop bleeding and to tonify (a form of balancing the body) the spleen and stomach. The fresh root is used to treat thirst, the rash from infectious diseases, and bleeding due to pathological heat. The dried root is used to treat bleeding due to blood deficiency and to nourish the vital essence, and the prepared root is used to treat chronic tidal fever, night sweats, and dizziness and palpitations due to anaemia or blood deficiency.

The root of Chinese foxglove is one of the ingredients of the "Four Things Soup," the most widely used woman's tonic in China, the other three ingredients being *Angelica sinensis*, *Ligusticum wallichii*, and *Paeonia lactiflora*. *Rehmannia* root is another example of a food–medicine and it is eaten after having been boiled "nine times."

Chinese rhubarb *Rheum officinale, R. palmatum*, and their hybrids
Polygonaceae
Chinese rhubarb originally grew wild in northwestern China, the best varieties coming from mountainous regions of Kansu Province, and in eastern Tibet. The dried roots of rhubarb have been used as a laxative for thousands of years, and it is known in the Chinese Pharmacopoeia by the name *dà huàng*.

Chinese rhubarb is mentioned in historical sources from 2700 BC and was cultivated for medicinal purposes. Wu, an emperor of the Liang dynasty (557–579), was advised to cure his fever, but only after being warned that rhubarb, being a most potent drug, had to be taken with great moderation. During the Yuan dynasty (1115–1234) a Christian sentenced to hard punishment was pardoned after using rhubarb to heal some soldiers. Marco Polo, who knew the Chinese rhubarb rhizome very well, talked about it at length in the accounts of his travels in China, while Chinese rhubarb was already widely used in European pharmacy, especially in the School of Salerno, possibly introduced through Arabic medicine. Later on, the Chinese emperor Guangzong (reigning from 1620 to 1621) was miraculously cured with rhubarb from a severe illness he contracted after having had a joyful time with four "beautiful women." In 1828 the Daoguang emperor sent out an edict stating no more tea and rhubarb could be sold to Western merchants. Rhubarb has played an important role in the historical Western Pharmacopoeias of the last centuries and it is still used today for its peculiar phytotherapeutical properties: it acts as an astringent at low doses (0.1–0.2 g of dried drugs) and laxative at high doses (1.0–2.0 g).

Ephedra, Ma huang *Ephedra sinica*
Ephedraceae
Ephedra sinica represents one of the oldest medicinal plants in China, where it is known by the name of *ma huang*. It is estimated that its use began 4,000 years ago, particularly in northern China and Mongolia. Ephedra was used in ethnomedicine as a stimulant, to increase perspiration, and as an anti-inflammatory. In the Chinese school of medicine, a preparation called *mimahuang*, containing roasted honey and chopped dried aerial parts of this species, is claimed to be an effective treatment for flu and respiratory tract inflammations. Ephedra, which contains ephedrine and similar alkaloids, has been used extensively in the ancient pharmacy as an antihistaminic in the treatment of asthma and as a natural decongestant. It has become a very popular ingredient in herbal combinations for allergies and hay fever. Since it is a central nervous system stimulant and increases the metabolism and increases body temperature, it has been used to control weight and to help prevent sleep, and by athletes in order to improve their performance. One of the side effects of increased metabolism is an increased pulse rate and a potentially dangerous rise in blood pressure. Occasionally, *ma huang* has been mixed with other stimulants or food supplements and used as a narcotic stimulant. Dangers stemming from lack of knowledge about the pharmacological effects of the drug caused several American states to ban ephedra in 2003, followed by a federal ban in 2004 on sales of products containing ephedra. It is currently on the doping lists of banned substances and ingredients of all the international sport associations. *E. equisetina* in China and *E. gerardiana*, *E. intermedia*, and *E. major* in Pakistan have also been used in a similar way.

Dried aerial parts of several Ephedra species, including *E. trifurca*, are known in the US as "Mormon tea," a very popular stimulant beverage made by Native Americans and the early settlers in the southwestern United States and Mexico.

See: Psychoactive Plants, p. 199

Ginkgo *Ginkgo biloba*
Ginkgoaceae
The name *ginkgo* is thought to come from the Chinese word *sankyo* or *yin-kuo*, meaning "hill apricot" or "silver fruit." This refers to the seeds, produced by female trees, which resemble apricots, but have a smell like rotting flesh or rancid butter (due to their content of butanoic and hexanoic acid). *Ginkgo biloba* was originally found in China and Japan, where it was cultivated as a temple tree. Fossilized leaf material from the Permian is remarkably similar to the modern *Ginkgo biloba*. Ginkgo had survived in China, where it was mainly found in monasteries in the mountains and in palace or temple gardens, where Buddhist monks cultivated the tree from about 1100 AD. It was spread by seed to Japan (around 1192 AD, linked with Buddhism) and Korea. Ginkgo is considered a sacred tree of the East and it is associated with longevity. In the 11th century (Sung dynasty) gingko is referred to in literature as a plant native to eastern China. Prince Li Wen-ho (first half of the 11th century), who came from the south, transplanted it to his residence, after which it became well known and was spread through propagation. Ginkgo has been depicted on Chinese paintings and appeared in poetry from that time onward. Scientists thought that it had become extinct, but in 1691 the German Engelbert Kaempfer discovered *G. biloba* trees in Japan, and it was brought to Europe (Utrecht) in 1730.

The earliest known medicinal use dates back to 2800 BC and is ascribed to the pseudofruits of *G. biloba*. They have been used as both food and medicine: the pseudofruit, prepared by fermentation

and cooking, have been considered a delicacy during weddings and feasts, while ginkgo seeds are used in traditional Chinese medicine as a kidney "yang" tonic, to increase sexual energy, halt bed-wetting, and soothe bladder irritation. The seeds are boiled as a tea used to treat lung weakness and congestion (especially asthma), wheezing, coughing, vaginal candidiasis, frequent urination, cloudy urine, and excess mucus in the urinary tract. In Malaya, the seeds are popularly used for making desserts and are recommended for their beneficial effect on the brain, circulation, and eyes. Interestingly, the leaves are much less frequently used in eastern Asia and include the treatment of chilblains (reddening, swelling, and itching of the skin due to frostbite), and as a throat spray for asthma. Today, ginkgo leaf extracts have enjoyed worldwide popularity and have stepped into the "herbal spotlight." This has been due to heavy media coverage and also to a number of very interesting clinical findings, recently supported by many pharmacological studies of its main constituents (diterpenes [ginkgolides], sesquiterpenes [bilobalide], and biflavonoids). *G. biloba* leaf derivatives have shown to be very effective in the treatment of intermittent limping due to chronic thickening of the arteries, senile dementia, vertigo, tinnitus, and hearing loss caused by severely reduced blood supply.

See: Nuts, Seeds, and Pulses p. 137

Qing hao *Artemisia annua*
Asteraceae

Artemisia annua has been used for hundreds of years in traditional medicine in China. The leaves were harvested in the summer, before the flowers appear, and dried for later use. The dried leaves are generally used in the treatment of fever, malaria, colds, diarrhea, as a digestive, and, externally, as a wound remedy. As recently as 1971 a Chinese research group isolated the active principle, the sesquiterpene lactone artemisinin, which proved to be very effective against the malarial parasite *Plasmodium falciparum*, and particularly towards chloroquine-resistant malaria.

In an attempt to overcome the frequent problem of many patients having a recurrence of the illness one month after the treatment, a number of derivatives of artemisinin have been developed (ethers, such as artemether and arteether, and esters, such as sodium artesunate and sodium artenlinate). Although artemisinin has been synthesized, this process is complex and not economically viable, and it is currently still extracted and isolated from the aerial parts of *A. annua*. Today artemisinin and its derivatives represent a promising group of antimalarial agents.

Korean ginseng *Panax ginseng*
Araliaceae

Korean ginseng is a small herbaceous plant growing wild in mountainous areas from Nepal to Manchuria, and from eastern Siberia to Korea. The earliest mention of it comes from a book of the Chien Han Era (33–48 BC), but by the 3rd century AD China's demand for ginseng created international trade of the root which allowed Korea to obtain Chinese silk and medicine in exchange for wild ginseng. Long before Vasco da Gama opened up a sea route to Cathay (China) in 1497, the "Three Kingdoms" (the Koreas and part of Manchuria) had a thriving trade selling ginseng to China. Soon after, word began to filter through to Europe about the northern woodland plant that had miraculous healing and restorative powers. The first reference to ginseng in Europe dates from 1643 and is a traveller's report published in Rome. In 1653, Hendrick Hamel of Holland and his fellow seamen were sailing from Formosa to Japan; during a lengthy storm they were blown off course and ran aground on Cheju Island, Korea. They were taken into custody by the Korean government and held on what was meant to be a permanent basis. In Hamel's diary, he noted that Korea paid "tribute" to China entirely in the form of ginseng. Three times a year an envoy would arrive from China to collect it. In 1709, a Jesuit named Father Jartous returned to Europe from an

assignment in China. In the Memoirs of the Royal Academy in Paris he wrote of the amazing medicinal ginseng root he had learned about. Later it was translated into English for the *Philosophical Transactions of the Royal Society of London.*

Although probably originally used as food, it quickly became revered for its strength-giving and rejuvenating powers, and its human shape became a powerful symbol of divine harmony on earth. Ginseng roots often resemble a human-like figure, which is why they are referred to as "human-root." The more human-like the root appears, the higher its value. The age of the root plays an important factor in assuming this human-like shape—thus, older roots are more valuable than younger ones. For customers in China, the shape of the root is very important: a 'skinny' root does not have the beauty that a larger one has and, hence, is not as valuable. Chinese herbalists have prescribed ginseng root for centuries to treat problems of the digestive and pulmonary systems, nervous disorders, diabetes, and a low sex drive in men. It is said to increase energy and improve memory. Ginseng is mainly used in modern evidence-based Western phytotherapy as an "adaptogen" (a substance which helps the body to deal with, or adapt to, stress or adverse external conditions): to stimulate the central nervous system, increase resistance to fatigue and stress, and to improve memory.

Interestingly, in 1711, Father Joseph Francois Lafitau, a Jesuit, was sent from France to a mission near present-day Montreal, Canada. Jartous' writings eventually reached him in 1716. Realising that the local latitude was about the same as the area in China where ginseng grew, he wondered if some might grow in his vicinity. When he showed a drawing of the ginseng plant to the Indians, they immediately took him to a similar plant nearby, which was American ginseng, *Panax quinquefolium,* growing wild in the eastern half of North America. The Indians used it in ways somewhat different to those of the Chinese: as a tonic, for healing wounds, as a headache cure, to soothe eyes and muscular cramps, and to cure croup in children. Nowadays, American ginseng, together with other ginseng species (Japanese ginseng, *P. japonicus*; Himalayan ginseng, *P. pseudoginseng*; and San-chi ginseng, *P. notoginseng*) are sold widely in the United States and Europe, and are prescribed for similar medical conditions as the Korean ginseng.

Siberian ginseng *Eleutherococcus senticosus*
Araliaceae

Siberian ginseng is a thorny bush common in western Siberia, from the Amur to Sakhalin Island, and is commonly used in the popular medicine of Siberian populations. Russians in particular have used its roots as a cheaper substitute for the expensive Korean ginseng. Cosmonauts have relied on this nourishing herb to help them manage their rigorous training, while Olympic athletes have often used Siberian ginseng to maximize their potential. Siberian ginseng is considered by modern phytotherapy to be an "adaptogen" (a substance which helps the body to deal with, or adapt to, stress or adverse external conditions), as is Korean ginseng.

Southern and Southeastern Asia

India

The current practices within traditional Indian medicine reflect an ancient tradition that can be traced back to at least 900 BC, to written Ayurvedic records (Kapoor 1990; Mukherjee 2001). These practices, all holistic in nature, are divided into three principal systems: Ayurveda, Siddha, and Unani. The most ancient is Ayurveda, literally meaning the "science of life," and has a basis in the spiritual as well as the temporal. The practice of Ayurveda is aimed at the intrinsic whole of the patient and involves the administration of medicinal preparations of complex mixtures containing animal, plant, and mineral products. Siddha can be considered similar to Ayurveda and is governed by the understanding that everything, including the human body, is made up of the five basic

elements: earth, water, fire, air and space. In addition, 96 major elements are considered to constitute human beings and include the constituents of physiological, moral, and intellectual elements. An imbalance among any of these is believed to result in disease. Siddha medicine is based more on a psychosomatic system in which treatments are based on minerals, metals, and herbal products. The Unani medical system can be sourced to the writings of the Greek philosopher–physician Hippocrates (460–377 BC). The system was introduced by Arabic practitioners seeking refuge in India from the Mongol hordes invading Persia and central Asia. Unani medicine is based on the medical history of a patient and still includes a major element of plant drug administration that compliments dietary and physical regimes. However, in this case the drugs are usually single herbs administered for specific diseases, rather than the herbal mixtures commonly found in Ayurveda or Siddha.

Ginger *Zingiber officinale*
Zingiberaceae
Ginger is one of the world's most commonly used culinary spices. The medicinal use of ginger has an ancient history and can be traced back to Greek and Roman times. In Indian medicinal practice the plant has been mentioned in religious scriptures dating back to 2000 BC. The rhizome of the plant is used and is best recognized in Ayurvedic medicine as an aid to digestion and to treat rheumatism/inflammation. Trikatu ("three spice") is an example of an Ayurvedic remedy containing ginger, used to improve digestive and respiratory function, which also contains black pepper (*Piper nigrum*) and Indian long pepper (*Piper longum*). Across the world ginger is a popular food additive to aid digestion. Some of its more unusual uses are to promote hair growth (Japan), treat nerve disorders (India), and as an aphrodisiac (Cuba, Yemen). Ginger is acknowledged in Ayurveda to be effective against nausea and neurological dysfunction. Ginger consumption has also been reported to have a beneficial effect in alleviating the pain and frequency of migraine headaches.

Studies on the effectiveness of ginger in rheumatic conditions have shown a moderately beneficial effect, but falls short of proving ginger to be a positive, nontoxic remedy for such conditions.

See: Spices, pp. 163–4

Indian pennywort *Centella asiatica*
Apiaceae
Indian pennywort is a creeping herbaceous plant that prefers a moist habitat and is found near reservoirs and streams. This pantropical species is commonly found in India and throughout Sri Lanka, Madagascar, China, South Africa, the southeastern United States, Mexico, Venezuela, and Colombia. It is possible that *Centella asiatica* is identical with the medicinal plant called mandukpani in the Sanskrit text of Susruta (ca. 1200 BC), and today it is used not only in Ayurvedic medicine, but in a large number of medical systems, for a great variety of diseases, and throughout its native range. The major application of *C. asiatica* has been in the treatment of leprous lesions, first reported in 1887. The active triterpenoid principles were identified 70 years later, but in clinical trials have only been found to be effective in aiding wound healing, vein problems, and striae gravidarum (stretch marks of pregnancy). Standardized extracts of *C. asiatica* are today incorporated into various ointments and tablets. Other potential pharmaceutical uses are also currently being investigated.

Lemon Grass *Cymbopogon citratus*
Poaceae
Lemon grass, named after the prominent and relatively strong odor of the crushed leaves, can grow up to 3 feet (1 m) high, with long slender leaves. The base of the stalk is used extensively in oriental culinary dishes and as a tea. Its center of origin is unknown. Today it is widely cultivated throughout the tropics and is an important element of popular medicine in many countries. For example, in Cuba it was shown in a poll conducted in the 1980s to be one of the most widely used medicinal plants. The pharmaceutical uses are extremely diverse, but its use as a carminative (to treat flatulence) and for other gastrointestinal disorders seems to be most relevant, owing to the presence of essential oil.

See: Fragrant Plants, pp. 247–8

Makandi *Plectranthus barbatus*
Lamiaceae
Formerly known as *Coleus forskohlii*, this is an aromatic herb whose roots are the source of the drug used in medicinal preparations. The roots are a dull orange color and in India they are used to improve the appetite and in the treatment of anemia and inflammation. The roots are the only source of the important diterpene (a terpene with 20 carbon atoms) forskolin. Research was carried out on the possible use of forskolin to reduce high blood pressure and it was shown to be a potent inhibitor of the adenylate cyclase. Although this compound could have been developed into an antihypertensive drug, its development was halted and the compound is today mostly used as a model substance in experimental biochemistry as an inhibitor of adenylate cyclase.

Mishmi, Gold thread *Coptis teeta*
Ranunculaceae
Coptis teeta is a Ayurvedic herb found in the eastern Himalayan regions, particularly the Mishmi hill range of Arunachal Pradesh in northeast India. The rhizome of the plant is a prized medicinal commodity and is used to treat gastrointestinal complaints (WHO 1999) and malarial infections. However, the plant has been brought close to extinction by deforestation and overexploitation for its medicinal properties. Conservation schemes have recently been proposed and these may lead to the recovery of *C. teeta*. *Coptis* species found in other continents are also used medicinally by local populations and include *C. trifolia* (gold thread, North America) *C. chinensis* (China), and *C. japonica* (Southeast Asia). The principal active constituent of *Coptis* is the alkaloid berberine and it is known to display antidiarrheal and antimicrobial activity (WHO 1999).

Neem *Azadirachta indica*
Meliaceae
Azadirachta indica or neem is a principal species used in the Ayurvedic medicine of India and today is a tree grown throughout the (sub)tropics. The species is drought resistant and thrives in arid conditions with annual rainfall of between 15–46 inches (400–1200 mm). It can grow between 0–1500 m above sea level, but it is intolerant to freezing, extended periods of cold, and waterlogged soils. Neem trees can reach a height of 80–100 feet (25–30 m) and provide valuable shade with their dense canopy of pinnate leaves.

Neem is thought to have originated in the northeastern region of India (Assam) and in Myanmar (formerly Burma). The exact location of origin is uncertain and some attribute it to the whole of the Indian subcontinent, others to dry forest regions throughout South and Southeast Asia. Neem has also been established in China, Nepal, Australia, West Africa, central America, and the United States. The introduction of neem to East Africa is thought to have arisen during the construction of the Kenya–Uganda railways. Indian migrant workers are believed to have brought neem seed with them in order to cultivate this important medicinal plant. However, the tree is most widely used in India (Williamson 2002).

The neem tree possesses many medicinal uses derived from all parts of the plant. As part of Ayurvedic medicine, the leaves are chewed for 15 days in late winter in order to maintain a healthy

body. Tonics prepared by boiling the leaves, often with other herbal constituents such as ginger (*Zingiber officinale*), are useful against intestinal worms, fevers, and internal ulcers. Externally, the juice of the leaves is applied to the skin for the treatment of boils and eczema. The twigs are used extensively in dental hygiene to brush the teeth and are incorporated into pastes or mouth washes. The fruits of neem are used against leprosy, intestinal worms, and urinary diseases. Neem oil (Margosa) is a chemically diverse mixture that includes the isoprenoids azadirachtin and nimbidin, plus numerous fatty acids such as oleic and palmitic acids. The oil is used to treat chronic skin complaints, leprosy, and ulcers, and it is also sold as a natural botanical insecticide. Azadirachtin is the major insecticidal principle of neem.

Much controversy surrounds the development of this traditional insecticide and medicine. In 1992 the U.S. company W.R. Grace submitted a patent application in which a simple extraction procedure from the seeds of the neem tree was described. The plant material is extracted with a lipophilic solvent (e.g., ethyl ether), instead of with a watery one, as has been done for many centuries in India. This results in an increased stability. However, is this an innovation? American patent law does not recognize oral traditions like the Indian ones and approval of such a patent would have, for example, resulted in the exclusion of Indian companies from the U.S. market. This patent and some related ones have been revoked, but the conflict continues.

See: Materials, p. 342

Turmeric *Curcuma longa*
Zingiberaceae
Turmeric is endemic to peninsular India, especially the provinces of Tamil Nadu, West Bengal, and Maharashtra. The plant's growth habit is erect with large, pale green elongated/ribbed leaves; the flower develops a spike 4–6 inches (10–15 cm) with a cylindrical inflorescence of yellow flowers. *Curcuma longa* has a small, branched rhizome that is bright yellow on the interior.

The rhizome is the source of turmeric, widely used in Indian cuisine, the dyeing of cloth, and traditional medicine. At the close of the 19th century, turmeric was used in laboratories in "turmeric paper" to test for alkalinity before litmus paper was produced. Medicinally, turmeric is considered to be a strong antiseptic and is used to heal wounds, infections, jaundice, urinary diseases, ulcers, and to reduce cholesterol levels. Turmeric, in the form of a paste, has been used to treat external conditions such as psoriasis (i.e., as an anti-inflammatory) and athlete's foot (i.e., as an antifungal). A major medicinal compound from *C. longa* is the phenolic constituent curcumin. This compound has been shown to be effective against some forms of cancer and has been intensively examined as a possible anti-inflammatory drug. In the United Kingdom an extract is currently being developed as a veterinary medicine for use in canine arthritis.

See: Spices, p. 170; Natural Fibers and Dyes, p. 312

Psyllium *Plantago* spp.
Plataginaceae
The seeds, which have a seed coat particularly rich in mucilage, are used medicinally for treating constipation, dysentery, irritable-bowel syndrome, and a variety of skin conditions. Certain types of mucilage are well known to have beneficial effects, on the gastrointestinal tract including antidiarrheal and anti-inflammatory effects. A number of species are used, including blond psyllium (*Plantago ovata*, Asia), black psyllium (*P. afra*, Asia), *P. asiatica* in Indochina, and great plantain (*P. major*, widespread throughout Asia).

Winter cherry *Withania somnifera*
Solanaceae
Winter cherry, also known as Indian ginseng, has similar alleged rejuvenating properties to that of ginseng in Chinese medicine. The plant is endemic to India, particularly in the sub-Himalayan (1000 m) tracts of Himachal Pradesh, Punjab, and the drier parts of India. Its use can be traced back to Assyrian sources, and the drug was already used in Mesopotamia as a narcotic. Ancient sacred writings of Hinduism from India praise the plant as a wonder drug, and it was used as a charm and as an aphrodisiac. In Europe it has been known since the 16th century and it is included in many herbals. In Ayurvedic medicine the roots are used to treat ulcers, fever, breathing difficulties, cough, tuberculosis, dropsy, and a variety of nervous disorders.

Southeast Asia

Java tea *Orthosiphon aristatus*
Lamiaceae
Java tea, or Indian kidney tea, is native to Southeast Asia and Australia and has a long tradition of use in India and neighbouring regions. It was introduced into European phytomedicine only toward the end of the 19th century, and today the leaves are widely used in Europe in the treatment of kidney and bladder problems, especially infections. Other uses include treatment of gout and rheumatism.

The Americas
This is the only geopolitical region which extends from the Arctic circle to the Antarctic circle. This, in combination with other geographic factors, results in an impressive biological diversity—more than 100,000 species of higher plants occur naturally on these continents. At the same time it is or was the home to numerous indigenous groups speaking a multitude of languages. It is estimated that about 1,200 ethnolinguistic groups existed in 1492, but today about 420 (i.e., only a third) remain. Most of these belong to the poorest sections of society in their respective countries. Recent attempts to strengthen indigenous traditions have been diverse and it is to be hoped that these attempts succeed in improving the generally appalling living conditions and strengthening the local traditions. The Amazon basin and the Central American region are particularly diverse botanically. Historically, some regions of the Americas have distinguished themselves for the development of dominant cultures that left impressive religious and civil monuments, like the Maya, Zapotecs/Mixtecs, and Aztecs (Nahua) in Mesoamerica, and the Inca in South America. In the case of the Aztecs, some written manuscripts or codices are available which record the use of plants for food, medicine, and many other purposes. The most important and oldest source is a herbal written in Nahuatl by Martin de la Cruz and translated into Latin by Juan Badiano. It was given to the King of Spain, Carlos V, in 1552. It was written rather hastily and has numerous color illustrations of medicinal plants. There have been several attempts to identify plants from this herbal and most of the identifications seem to be botanically sound. The major problem with this source is the European influence that being felt only 30 years after the conquest of México-Tenochtitlan. Also the Nahuatl author attempted to show "European sophistication."

Another important source is Fray Bernadino de Sahagún's work. It is certainly the best source available for the early historical period. This Franciscan missionary arrived in Mexico in 1529 and worked there until his death in 1590. The methods he used compare favorably with modern ethnographic techniques. He posed questions in Nahuatl to a group of ten to twelve elderly informants, and their answers were recorded in Nahuatl by trilingual (Nahuatl, Latin, Spanish) student scribes. The questions were then developed into a more extensive questionnaire used in communities around México-Tenochtitlan. He left several codices (among them the *Codex Florentino*, compiled ca. 1570)

and on the basis of these documents he wrote the *Historia General de las Cosas de Nueva España* (published 1793). From an ethnobotanical point of view, the source is somewhat more difficult to use than the Codex Cruz/Badianus because there are fewer botanical identifications and these are less certain. The strength lies more than anything in its description and analysis of medicinal concepts.

Let us now turn to North America. Most of our knowledge about medicinal plant traditions on the continent is due to anthropological and ethnobiological research conducted mostly since the second half of the 19th century. An excellent summary of these data is provided by Moerman (1998), who summarizes fieldwork by ethnographers who recorded such oral traditions in the late 19th and early 20th centuries.

America North of the Rio Grande

American mayapple and Podophyllotoxin *Podophyllum peltatum*
Berberidaceae

American mandrake or American mayapple is a poisonous weed which was commonly used in many regions of North America for many centuries. Its main use (e.g., by the Cherokee, Delaware, Iroquois) was as a laxative and the resin had been included in the American pharmacopoeia of 1820 for this purpose. Another use for the resin is the treatment of warts. It is one of the main sources of podophyllotoxin, a lignan which has resulted in semisynthetic derivatives essential in the chemotherapy, for example, of leukemia, especially teniposide, which was introduced into clinical use in 1967. It is well known that this substance revolutionized the chemotherapy of leukemia and has saved untold numbers of young lives.

Californian yew, Pacific yew *Taxus brevifolia*
Taxaceae

Taxus brevifolia or Californian yew has been used by a variety of West-American Indian groups in the United States and Canada as a medicine, and also for producing a variety of other useful products (canoes, brooms, combs). Very diverse pharmaceutical uses of the root and the bark are recorded and include several reports of the treatment of stomachache and, in the case of the Tsimshian (British Columbia, Canada), the treatment of cancer.

However, this ethnobotanical information was not the basis for the development of a pharmaceutical product. In 1962 several samples of *Taxus brevifolia* were collected at random for the

Scientists are trying to find alternative ways of producing taxol, one being from the yew needles rather than the bark of the Pacific yew tree. Source: Dr. Gorden Cragg. National Cancer Institute.

National Cancer Institute (NCI, United States) and the United States Department of Agriculture. These samples were included in a large screening program at the NCI. A potent cytotoxic effect was documented in one *in vitro* system. However, the *in vivo* effects (especially in cases of leukemia) were less promising and demonstrated a *general toxicity* of the samples. Bioassay-guided fractionation led to the isolation of 0.5 g of an active substance from a total of 12 kg of bark. The substance was named taxol. It took from 1961 until 1971 to establish the compound's structure. It is a diterpenoid with fifteen carbon atoms forming a complex ring system—a pentadecene ring system.

Clinical studies started 13 years later in 1984. Prior to this, studies on the compound's toxicology and the pharmacological mechanism of its action were conducted. It took a further ten years before taxol was approved in the treatment of anthracyclin-resistant metastasis-forming breast cancers. In the meantime the compound has been approved for a variety of other cancers, and semisynthetic derivatives are now also employed.

Some fascinating questions arise out of the use of this species and the compound isolated from it:

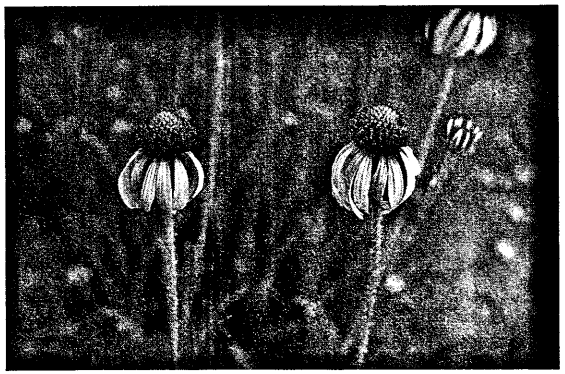
- *Taxus brevifolia* is a very slow-growing species and produces the relevant active ingredients only in very small amounts. Because taxol was isolated from the bark for many years, the trees had to be felled in order to obtain the botanical drug. The amount of taxol required to cover the annual therapy requirements of patients with ovarian cancer in the United States is estimated to be 15–20 kg. If other cancers common in the United States are to be treated with this compound, around 200 to 300 kg will be required per year. This amount can only be isolated from approximately 1.45 thousand tons of bark. Collecting such amounts would have been completely unsustainable and would have resulted in the extinction of the species within a few years. In the 1990s the semisynthetic production of taxol from natural products in other *Taxus* species (10-desacetylbaccatin II isolated from the European yew, *Taxus baccata*) enabled the production of large amounts of taxol. Up to this point an enormous conflict of interests between conservation and medicine/pharmacy was unavoidable. An alternative proposal is the production of taxol in *in vitro* plant cell cultures Goodman and Walsh (2001) have discussed the economic and political rise and fall of the Californian yew as a source of taxol in great detail.

This example again raises a series of important questions:

- Californian yew is native to a region in the main industrial power of the temperate zones. What sort of consequences would these studies have had if the species had been from a "developing" country? And specifically, what would have happened with respect to this conflict between conservation and medicine/pharmacy?
- Today the drug is produced from the needles of another species of *Taxus—T. baccata*—and more and more is produced biochemically in large-scale fermenting processes. The Californian yew is no longer needed for the production of the drug and this has also meant that the local economy no longer profits from this drug first developed from a native tree. What means are there to assure adequate benefit-sharing between the regions of origin and the industrial partners?

Echinacea *Echinacea angustifolia*
Asteraceae

Species of echinacea have been used widely in the indigenous medical systems of North America. Particularly common is the use of *E. augustifolia*—indigenous groups in North America frequently used it in the treatment of pain and, topically, of inflammatory skin conditions. The



Echinacea angustifolia. Clarence A. Rechenthin @ USDA-NRCS PLANTS Database.

following uses of *E. augustifolia* by the Winnibago tribe (modern Wisconsin, United States) were recorded.

- The juice serves as a remedy for pain and for treating burns (several reports).
- The species is used, in the form of incense, in the treatment of headache.
- It is an antidote for snakebites.
- Topical applications of a compress are used for treatment of enlarged lymph nodes (mumps).
- It is applied topically for treatment of toothache.
- It is used as a veterinary medicine for horses suffering from distemper.

According to Bauer (1998), the various species of this genus were used ethnopharmaceutically all over their natural area. In the second half of the 19th century, settlers of European origin started to use echinacea. The "medical doctor" H.G.F. Meyer is particularly well known, who widely advertised "Meyer's Blood Purifier" as a remedy for rheumatism, headache, digestive problems, tumors and boils, open wounds, vertigo, scrofula (tendency to get tuberculosis), bad eyes, intoxications resulting from plants or snakes. The plant used in this preparation was subsequently identified as *E. angustifolia*. Once larger amounts of echinacea were required, *E. pallida* with its larger rootstock became popular. In 1916 the rootstock of echinacea was included in the National Formulary of the United States. Both species were allowed for pharmaceutical use. At the beginning of the 20th century, echinacea became popular in Europe and has recently become an important immunostimulant, and an enormous number of (mostly ill-defined) herbal preparations are on the market both in Europe and in the United States. For some standardized extracts, sound clinical data are available that indicate that these extracts are clinically superior to placebo in the treatment of some common respiratory problems. However, the compounds responsible for the effect have not yet been identified.

Two aspects of the cultural history of these species deserve special mention:

- It is a phytomedicine, i.e., not a single compound but an extract, which hopefully is standardized to a series of lead compounds (in order to assure reproducible quality) as the active "drug."
- The modern phytomedicines with echinacea as an active ingredient were developed on the basis of the indigenous uses in North America. If such a product were to be developed based on modern ethnobotanical studies, appropriate steps would have to be taken in order to adequately compensate the traditional bearers of this knowledge.

Mesoamerica

Guava *Psidium guajava*
Myrtaceae
A brief mention has to be made of guyava or guava, a Mesoamerican tree which is now pantropically cultivated especially for its fruit. As is the case with many food plants, it is also used medicinally. The leaves and bark are commonly used in the treatment of diarrhea and some other gastrointestinal disorders. While it is not used biomedically, it is used in popular medicine and dates back to at least the Aztecs of the 16th century.

See: Fruits, p. 93

Passionflower *Passiflora incarnata*
Passifloraceae
In the days following their conquest of South America, the Europeans became interested in the passion flower. Its unique and very conspicuous flower reminded the conquistadors of the Passion of Christ, and they saw all the symbols of his suffering in the flower: the crown of thorns in the corona, the five wounds in the five anthers, the nails of crucification in the three stigma, the ten apostles (less Peter and Judas) in the five plus five lobes of the calyx and corolla, and the hands and whips of Christ's persecutors in the tendrils and lobed leaves. The aerial parts (*Passiflora herba*) are today used in the treatment of nervousness and unrest.

See: Fruits, p. 93

Quinine tree *Cinchona* spp.
Rubiaceae
Cinchona, the quinine tree, raises a series of fascinating questions about indigenous plant use and drug development. It is uncertain whether species of this genus were used pharmaceutically by the native populations of tropical South America prior to or during the 17th century. According to Schneider (1974) and Tschirsch (1910), the bark of this species was not used medically to a great extent, and it was known to specialists as a remedy in the treatment of "fever" (malaria) only in a very limited region. Since it is still doubtful whether malaria was endemic to the Americas prior to the conquest by the Europeans, it would seem unlikely that the bark would have been of any relevance. The bark and its use was popularized by the Jesuits ("Jesuits' powder"), and since 1687 it has been recorded in several lists of medicines (first in the "Arzneitaxe" of Frankfurt-on-the-Main, Germany). Its use as a remedy for malaria, and also for other forms of fever, spread very rapidly across Europe (Schneider 1974). In the mid-19th century the tree was introduced to Java and is now grown in many regions of the tropics. Quinine was isolated from the bark in the early 19th century and was obtained, for example, from the bark of *C. pubescens* and *C. officinalis* in relatively large amounts. The structure of quinine was not established until 1951.

However, the bark was used for various ill-defined forms of "fever" until in 1880 LaVeran identified the organism responsible for the illness—eukaryotes from the genus *Plasmodium*. In 1897–1898 Ronald Ross and Battista Grassi demonstrated the life cycle of the parasite and its dependency on the *Anopheles*-mosquito were. Only at this stage was it possible to understand the mechanism of action of Jesuits' powder, and this in turn allowed a rational phytotherapy using the isolated active ingredient, quinine. Since then a large number of quinine derivatives have been isolated. Another core ingredient is quinidine, a classic anti-arrhythmic drug.

This example demonstrates the long development process from initial observations (whether they were by the Jesuits or indigenous Americans) to several natural products used biomedically.

Wormwort, Epazote *Chenopodium ambrosioides*
Chenopodiaceae
The wormwort or wormseed is also known under its alternative Latin name, *Teloxys ambrosioides*, or its Aztec name, *epazotl* (modern mexican Spanish: *epazote*). It is another species with a long tradition of uses. Fascinatingly, it is used both as a spice for a variety of dishes, especially ones with Mexican black beans (frijoles), and as a medicine for gastrointestinal parasites. The name seems to be derived from the Nahua term for skunk, *epatl*, and relates to the rather unpleasant smell of the plant (some liken it to the urine of a skunk). As long ago as the 16th century, Fray Bernardino de Sahagún mentioned "epázotl" as a food. Today it is one of the most popular spices and is used medicinally as a vermifuge (to treat worms) as well as to reduce flatulence. It was included in many pharmacopoeias, including the ones of Mexico, the United States, and many European countries, but because of the toxic side effects (mostly of the essential oil) and a lack of evidence in support of its vermicidal effects, it has now been substituted by synthetic vermifuges. Once used worldwide as a medicine, it is today largely restricted to its region of origin, especially Mexico, where epazote is an essential part of the local cuisine and medical tradition, and also a powerful symbol for Mexican identity.

See: Herbs and Vegetables, pp. 118–9

Zoapatle *Montanoa tomentosa*
Asteraceae
Zoapatle or cihuapatli (*cihuatl*, woman and *patli*, medicine) is a classic example of a women's medicine and the main uses have been retained by the indigenous Mexican populations at least since the Aztec period. Sahagún described the use of its root for inducing labor ("which has the virtue to bring the new-born out") and in combination with the Mesoamerican sweatbath temazcal. It was so famous with the midwives of this period that it was rapidly accepted as a medicine for regulating "menstrual irregularities" by the Spanish conquistadors. However, the very nature of its use made it a very controversial remedy, and even though it is still commonly used in Mexico, it is not currently used in biomedicine.

Australia and Oceania

Australian aboriginal societies have for millennia been based on a migratory lifestyle, and at the time of the conquest in the 17th century about 250 languages were spoken among them. Many of these are under considerable threat or have already disappeared, and the cultures have been forced to change extremely rapidly. Until fairly recently many societies still had this migratory lifestyle, but increasingly the Australian Aborigines have settled especially in the central deserts and in the north of the continent. In the south of Australia much of the local indigenous knowledge has disappeared forever, but in the north communities are once again gaining autonomy through "native title" to their lands, and are eager to salvage what remains of their culture. Statistics show that Aboriginal and Torres Strait Island people are the most disadvantaged group in Australia, with high unemployment rates, poor housing conditions, low life expectancy, and high infant mortality and morbidity rates.

Surprisingly, few medicinal plants have been adopted by the white conquerors or have made their way to other continents. One of the most noteworthy exceptions is *Eucalyptus globulus*, which is now one of the most widely cultivated trees of the world.

Australian tea tree *Melaleuca alternifolia*
Myrtaceae
In Australia, Europe, and North America, tea tree oil (*Melaleuca aetheroleum*) from a tree native to subtropical coastal regions of New South Wales has become very popular in the last decades. Today it is obtained almost exclusively from cultivated material. The use of this species in biomedicine is based on the medical traditions of the Australian Aborigines and includes the treatment of infectious skin conditions (acne). It is also used in cosmetics.

See: Fragrant Plants, p. 245

Eucalyptus *Eucalyptus globulus*
Myrtaceae
Today, leaves from *E. globulus* (blue gum, fever tree) are used as a medicine and for the production of commercial oil of eucalyptus, which has 1, 8-cineole (= eucalyptol) as the main component (up to 85 percent in the case of *E. globulus*). However, several other species are used in the production of the essential oil, including *E. smithii* and *E. polybractea*. The oil and pure cineole have antiseptic effects and are mildly irritant to the mucosa and the skin. Inhalations to treat inflammatory infections of the upper respiratory tract (bronchitis) and creams/balsams to treat a variety of mild to moderate respiratory problems (including problems of the nose and throat) are the most common applications. Commercial material for the pharmaceutical industry is today produced in the Mediterranean (Spain, Morocco) and around the Black Sea (Ukraine).

See: Fragrant Plants, pp. 244–5; Wood, p. 328

Conclusions

Human cultures have for millennia found medicinally useful plants in their environment and the this knowledge has passed from generation to generation mainly by word of mouth. These practices began to be recorded in ancient scripts of India, China, Mesoamerica, and Arabia. This chapter provides an overview of medicinal plant usage around the world and although it highlights only some examples, it clearly shows the diversity in cultural history of human uses of medicinal plants. However, the sociocultural and industrial context within which these practices take place demands a closer analysis, for example, highlighting how overexploitation of medicinal plants has occurred in African countries through factors including the following:

1. Loss of natural habitat and dramatic reduction in the distribution and availability of medicinal plants due to competing uses of either the land (logging) or the medicinal plants themselves (timber logging; commercial harvest for export and extraction of pharmaceuticals; use for building materials and fuel; collections from the wild, e.g., *Prunus africana*).
2. A high rate of urbanization, in which a large proportion of the population seek traditional health practitioners to heal ailments that are often perceived to result from the action of individuals or ancestral spirits.
3. The change of traditional medical practices in the urban centers from a small-scale, specialist activity to one that is driven by wider economics. This produces a need to obtain as much medicinal plant material as possible without regard for the traditional conservation ethos found in rural communities.
4. Traditional practitioners moving to the urban centers where business is economically rewarding. In addition, the stresses and strains produced by urban living—such as finding

and maintaining employment, or nurturing and keeping a partner—all increase the demand for psychosomatic or symbolic symbols, all willingly provided by traditional practitioners using medicinal plants.

The opportunity to make money, whether from wild collected herbs sold from a market stall or a plant-derived drug marketed the multinational company, can skew the attitudes of the culture toward its plants to one of profit-making. Researchers studying the relationship between people and plants (ethnobotany) have much to contribute to our understanding of this change in order to highlight the need for cultural and botanical conservation. This requires a proper resolution of the intellectual property rights that local peoples have in respect to the sharing of their knowledge. Generally this is dealt with through legislative frameworks based on international treaties such as the Convention on Biological Diversity (CBD), but the implementation of such policies has proved difficult for financial, political, and social reasons.

A particular problem has been to ensure that benefits return to indigenous communities rather than governments. This is particularly true where medicinal plants are concerned. One current and successful case study deals with the small Samoan tree *Homalanthus nutans*—the source of the anti-HIV-1 drug prostratin (Cox 1997). The tree had long been a staple medicinal plant of local peoples in the treatment of hepatitis. Ethnobotanical studies and cooperation with local communities have been conducted for many years and the drug is now classified by the National Cancer Institute and the AIDS Research Alliance as a candidate anti-AIDS drug. A significant portion of the license income is to be returned to the Samoan communities.

In terms of conservation, new technologies can aid in the regeneration of medicinal plants through such techniques as plant tissue culture. Ongoing efforts include regeneration of a number of medicinal plants and production of biologically active compounds.

Many of the examples given in this chapter show the value of approaches with an interdisciplinary focus, integrating biological and social science. Medicinal plants are not just a commodity, but an integral element of cultures all over the world. Ethnopharmaceutical approaches may lead to improved primary healthcare in marginal societies, as well as the discovery of new drugs. Thus a core task for future research on medicinal plants is to integrate the cultural history of medicinal plants and our current biological knowledge of these resources, and to use this information for sustainable development of this exciting interaction between people and plants.

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