ARCHAEOLOGICAL EVIDENCE FOR THE TRADITION OF PSYCHOACTIVE PLANT USE IN THE OLD WORLD

M. D. MERLIN
UNIVERSITY OF HAWAI'I AT MĀNOA, HONOLULU, HI 96822

We live in an age when a divine vision is dismissed as an hallucination, and desire to experience a direct communication with god is often interpreted as a sign of mental illness. Nevertheless, some scholars and scientists assert that such visions and communications are fundamentally derived from an ancient and ongoing cultural tradition. The hypothesis presented here suggests that humans have a very ancient tradition involving the use of mind-altering experiences to produce profound, more or less spiritual and cultural understanding.

A cross-cultural survey of ''relevant ethnographic literature'' involving 488 societies in the 1970s indicated that 90% (437) of these groups ''institutionalized, culturally patterned forms an altered state of consciousness.'' The highest rates (97%) were among the societies of ''aboriginal North America'' and the lowest (80%) in the ''Circum-Mediterranean region,'' which includes ''North Africa, the Near East, and southern and western Europe as well as overseas Europeans'' (Bourguignon 1973). A large percentage of these altered states are produced through consumption of psychoactive drug plant substances, supporting the idea that ''. . . the ubiquity of mind-altering agents in traditional societies cannot be doubted—just as the moods of industrial societies are set by a balance of caffeine, nicotine and alcohol, among many others'' (Sherratt 1995a; Fig. 1).

Traditionally, the use of the great majority of mind-altering drug plants has been strongly associated with ritual and/or religious activity; indeed, ritualized consumption in various forms, may be unequivocally religious, ''as in the Christian Eucharist or the complex wine-offerings to the ancestors in the elaborate bronze vessels of Shang and Zhou dynast China'' (Sherratt 1995b). Customary, or pre-industrial, motivations for ingestion of psychoactive organic materials have been predominantly dictated by spiritual and/or medicinal requirements. On the other hand, contemporary, modern use in various societies, especially in those areas affected by Western Civilization, is often inspired by personal ''recreational'' desires to experience euphoria, and frequently is impelled by peer group pressure.

An early relationship between humans and psychoactive plants, often within a highly ritualized, ceremonial context has been suggested by a number of authors (Allegro 1970; Emboden 1979; Furst 1972; Goodman et al. 1995; La Barre 1970, 1972, 1980; Schultes et al. 2002; Sherratt 1991, 1995b; Wasson 1968; Wilbert 1972; Wohlberg 1990). A number of these authors believe this kind of use of consciousness-altering plants provided the inspiration for initial human religious experiences, even perhaps three of the world's largest religions, Hinduism (Wasson 1968), Judaism (Dure 2001; Merkur 2000), and Christianity (Allegro 1970; Ruck et al. 2001). Although this hypothesis and some of the specific case studies (e.g., Allegro 1970) have been widely dismissed as erroneous, others continue to call attention to the importance of psychoactive drug plant use by humans and the origin of spiritual concepts (e.g., Smith 2000, also see Rudgley 1994, 1998, and Roberts 2001). For example, according to some classical scholars, Christianity evolved within the milieu of Judaic and Hellenistic healing cults, magic, and the Mystery initiations: ''All four of these inevitably imply a sacred ethnopharmacology, with traditions going back to earlier ages of the ancient world'' (see Ruck et al. 2001).

This relationship with mind-altering organisms is very old. It may have even originated before the evolution of our own genus, but more probably within the temporal span of our own species well back into the Pleistocene.

Economic Botany 57(3) pp. 295–323. 2003

Fig. 1. Semi-wild opium poppy, *Papaver somniferum.*

In a 1970 journal article in *Economic Botany* (24: 73–80), the ethnobotanist Richard Evans Schultes asked the anthropologist Weston La Barre a question concerning the known distribution of traditional psychoactive drug plant use in the Old and New Worlds. Schultes wanted to know why there are so few known psychoactive drug plants associated with traditional cultural use in the Old World. He pointed out that although there is much more ecological diversity and a much longer history of human occupation in the Old World, the New World has many more of these known culturally-associated ''plants of the gods.''

La Barre argued that there must have been numerous other species that were used in the Old World for such purposes, but the rise of civilization, and in particular monotheism eliminated most of these traditions in the Old World (and in those areas of the New World, where European religious influence has affected the precontact uses of such species). More fundamentally, La Barre argued that humans, at least in pre-industrial contexts, have been ''culturally programmed'' to find plants (or fungi) that allow them to communicate with the ancestors (or their spirit world). He suggested that this tradition goes back into the Paleolithic Era, long before the invention of agriculture when people were all hunters and gatherers. According to his thesis, as bands of humans spread out into new regions, including new ecological situations, they carried with them a culturally inspired motivation to find and use species of plants or fungi that would allow them to transcend their ''normal'' consciousness and enable them to communicate with their ancestors or gods—in essence, their spirit world.

The archaeological and paleobotanical records offer evidence for these assertions, albeit somewhat fragmentary now. However, with the powerful tools of modern science and human imagination, our understanding of our deep-rooted desire to experience *ecstasy* in the original sense of the word (to break the mind free from the body and communicate with the ''gods'' or the ancestors) will become clear with time. This review, utilizing archaeology and paleobotany, with its varying time depths in different regions, documents the antiquity of a very widespread tradition of human association with psychoactive species of plants and fungi in the Old World, particularly Eurasia.

In modern societies, psychoactive materials are used in a variety of ways. These include religious, medical, and secular applications, which in ancient times may or may not have been viewed as separate. For example, in the case of Neolithic Europe, Sherratt (1991) argued that psychoactive (''narcotic'') substances were consumed in a ritualistic context: ''Such 'religious' uses would no doubt have included 'medicinal' uses as well, since it would be artificial to separate physical healing from ritual observance.'' However, Sherratt (1995b) also suggested ''that evidence for the employment of substances such as opium or cannabis at various times in the past should not immediately be interpreted as an indication either of profound ritual significance or of widespread employment for largely hedonistic purposes: they may simply belong to the *material medica.*'' Under most conditions, in non-industrial societies, psychoactive substances were often, if not always used in ritualistic, religious contexts.

Mind-altering plant species, including the

ones discussed below, can produce a variable altered state of consciousness depending upon the quality and quantity of the psychoactive chemicals ingested, as well as the psychological set of the user and the social-environmental setting in which the substance is consumed (Julien 2001).

METHODOLOGY

Data used to support the hypothetical, widespread, ancient use of psychoactive drug species has been extracted from the literature of various disciplines such as anthropology, archaeology, ethnobotany, and palynology. Dating of evidence varies in technique and relative reliability. Most of the evidence has been dated using the radiocarbon method; some chronological documentation has relied on reference to the written record.

The archaeological evidence for psychoactive drug plant research has traditionally come in two forms, artifactual and paleoethnobotanical. The advantages and disadvantages of both forms of evidence must be considered. All artifactual evidence is subject to some type of interpretation and reconstruction. Disagreement may arise concerning the specific identification of the organism that the artifact is supposed to represent, as well as the interpretation of its artistic, religious, medicinal or other practical use or inspiration. The paleoethnobotanical record is much less subjective. However difficulties in assigning specimens to specific taxa may occur (Pearsall 1989), and confirmation of its putative use by humans is also sometimes difficult or even contentious. The most reliable information should be a combination of the two types of archaeological evidence. Although scholars ideally should identify the species ''symbolic meanings from depictions on artifacts and their [macrofossil or microfossil] presence in archaeological sediments'' (Popper and Hastorf 1988:2), the discovery of this kind of corroborative evidence has been rare.

Much of the evidence from Europe is paleobotanical, while in other areas such as the Near East the evidence is usually limited to artifacts and their interpretation. This reflects regional techniques, biases, and the amount of research undertaken by archaeologists working in these areas. A scarcity or lack of evidence from an area should not be assumed to represent the actual prehistoric preference or use of a plant.

Fig. 2. Ancient Greek depiction of opium poppy capsule or pomegranate fruit? (Courtesy of Mrs. Suzanne Labiner, Beverly Hills, California).

Artifact interpretation may vary between different schools of archaeological theory, or simply may differ in the identification of what species is represented. For example, an evolutionary theorist may be hard pressed to refer to a clay figurine as a religious object because it appears to have enormous breasts and hips; or artifacts depicting globular ''fruit'' may seem to some to be representations of opium poppy (*Papaver somniferum* L.) capsules, but to others they appear be depictions of pomegranate (*Punica granatum* L.) fruits (see Fig. 2, also see Merlin 1984). The most basic biological interpretations of an artifact may be the least controversial and most reliable. For example, a painting in an Egyptian tomb may depict a specific plant species, such as the Egyptian lotus or blue water lily (*Nymphaea nouchali* Burm. f. var. *caerulea* (Sav.) Verdc.–*N. caerulea* Savigny), which can be more clearly identified and referenced. However, any interpretation beyond identification without supplemental evidence such as references from papyri may be premature or inaccurate. Documentary evidence is usually not available. Therefore, a prudent interpretation of archaeological remains must take into account the context and associations of the artifact within the site.

Paleoethnobotany, as a subfield of ethnobotany, is ''concerned with elucidating human-plant relations in the past through study of archaeo-

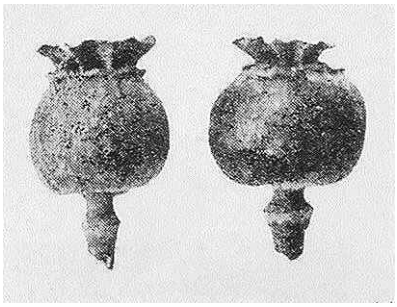

Fig. 3. Poppy capsules, circa 4,200 years old, recovered from small grass woven baskets found in a burial cave of Cueva de los Murciélagos near Albuñol in the southern Spanish province of Granada (from Neuwiler 1935).

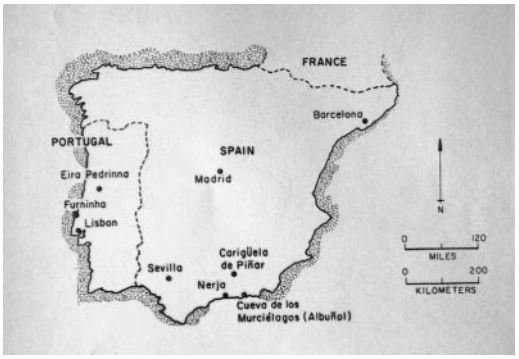

Fig. 4. Ancient evidence for *Papaver somniferum* in the Western Mediterranean, comes in the form of capsules recovered from small grass woven baskets found in a burial cave (Cueva de los Murciélagos) near Albuñol in the southern Spanish province of Granada.

logical plant remains'' (Pearsall 1989). These remains consist of three types: macrofossil remains, pollen grains, and phytoliths. Macrofossil remains may be desiccated, burned, or waterlogged wood, leaves, fruits or seeds that may be recovered in situ by screening techniques or flotation. Some paleoethnobotanical finds recovered from ancient sites in the early stages of archaeological research were not carefully extracted from non-disturbed contexts, for example, opium poppy capsules from southern Spain, (Gongora 1868; Fig. 3 and 4) and opium poppy seeds from various central European sites (Merlin 1984; Fig. 5 and 6). Although these fossils cannot be dated or placed in the most accurate contexts as possible, they are some the most direct ancient evidence of the presence and probable use of this species in the region.

Pollen consists of three layers: living cell, intine, and exine, and of these three layers only exine remains in fossilized pollen. Identification of fossil pollen is based upon identification of the structure, form and apertures of the exine. Phytoliths are opal silica bodies found in plants. They may provide important information from archaeological sites that are not conducive to the preservation of macrofossil remains or pollen. The ability to identify any paleoethnobotanical remains relies on comparative reference collections. Some pollen is especially difficult to identify, and may only be recognized as belonging to a particular family or genus rather than the exact species. The size and extent of paleoethnobotanical collections varies between different regions and areas, often based on the history and extent of archaeological research. When it is possible the archaeological finds and references will be analyzed for accuracy and reliability in the three areas of archaeological interest outlined above: artifact interpretation, paleoethnobotanical analysis and dating techniques.

RESULTS

Selected evidence is presented below for a limited number of psychoactive species or genera in the Old World, especially for those that have a relatively more extensive, ancient, archaeological record of association with humans. Within the discussion of each taxa, references will be examined, where appropriate and feasible, in an order based on antiquity of the evidence, and according to their cultural dispersal

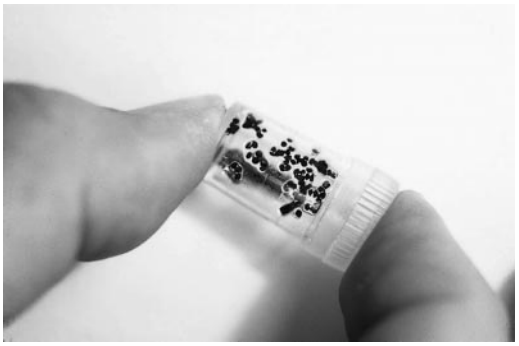

Fig. 5. The small vial holds 4,500 year old, Neolithic opium poppy seeds recovered from a Cortaillod settlement at Seeufersidlung Twann on the shores of Lake Bieler, Switzerland in 1975 (courtesy of Fritz H. Schweingruber, Swiss Federal Institute of Forestry Research).

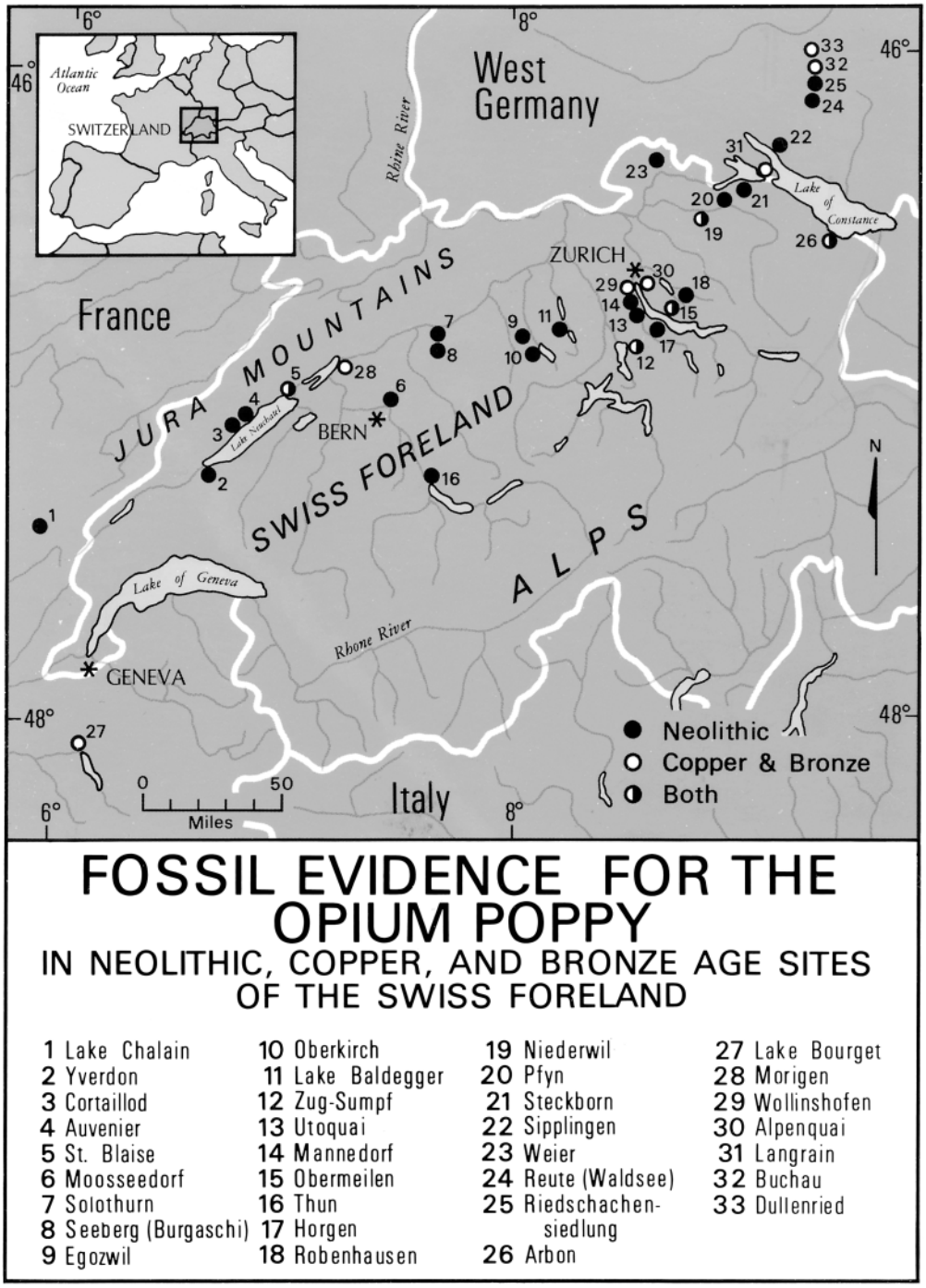

Fig. 6. Ancient fossil evidence for *Papaver somniferum* in the Swiss Foreland and surrounding areas.

or the geographical distribution of their known ancient use.

The ancient archaeological record is reviewed in detail for the following taxa: *Ephedra* L., *Perganum harmala* L., *Papaver somniferum* L., *Cannabis* L., *Nymphaea nouchali* Burm. f. var. *caerulea* (Sav.) Verdc., and *Mandragora officinarum* L. As noted above, some species that have been used for mind-altering purposes have also been employed for a variety of other reasons. These multi-purpose plants include, for example, *Cannabis* (true hemp) which has been grown for fiber production, seed food for humans and animals, as an oil source, and, of course, for its psychoactive resin. Therefore the need to verify the archaeological context which supports the argument that the species was present and used as a mind-altering substance is desirable, if not crucial. This also applies to *Papaver somniferum* (the opium poppy), whose seeds could come from field ''weeds'' or have been used as a food or oil plant, rather than as source of opiates. Furthermore, in the case of *Ephedra*, plants in this genus could have been burned for fuel. Nevertheless, there is strong reason to believe that all of the species featured in this survey were used, at least in part, for ritualistic, spiritual purposes reflecting the ancient relationships of humans and psychoactive plants for religious inspiration.

Ephedra

As a member of the Gymnosperm Division Gnetophyta, an enigmatic group of seed plants, the genus *Ephedra* includes 45 to 50 species. These perennial, dioecious, small shrubs (and one small, tree-like form) are a small, extraordinary group of plants adapted to arid conditions. They have photosynthetic stems with no leaves, and are found in cool, dry areas of Asia, Europe, Africa, North America and South America.

The oldest date for a potentially psychoactive plant in a cultural context is from the Neanderthal burial site at Shanidar Cave in northern Iraq where pollen of an *Ephedra* species (*E. altissima* Willk., cf. Leroi-Gourhan 1975; Solecki 1971) was dated to more than 50,000 B.C. (Solecki 1975). The Shanidar limestone cave, now located over 700 meters above sea level yielded soil samples extracted from around the male burial known as Shanidar IV. Two of the samples contained a large quantity of pollen grains representing a number of plant species. This evidence has been used to support the hypothesis that the hominid body was deliberately, and perhaps ritualistically buried on a bed of woody branches and flowers sometime between May and July, when the flowers of many of the species were in bloom.

Palynological analysis identified a number of species including *Achillea*-type, *Centaurea solstitialis*, *Senecio*-type, *Muscari*-type, *Althea*-type and *Ephedra altissima* (Leroi-Gourhan 1975); and a subsequent phytopharmacological evaluation of the therapeutic potential of these plants revealed their objective healing activity (Lietava 1992). This medical utility could have encouraged the intentional selection of these plant species by the Middle Paleolithic Shanidar Neanderthals. *Ephedra altissima* yields ephedrine, an alkaloid that produces sympatomimetic and amphetamine-like effects (Teuscher 1979), as well as euphoria (Wenke 1986:579). Therefore it may have served as an entheogen for ritualistic, spiritual purposes, and/or a medicinal.

However, not everyone has agreed with the hypothesis that the placement of the flowering plant offerings at the burial site was a conscious choice of the Neanderthals (e.g., see Sommer 1999). The original report described the existence of animal holes around the burial along with the fossil remains of the ''Persian jird'' (*Meriones persicus* Blanford). This rodent species lives in large colonies and is known to store large amount of seeds and flowers in its burrows. Indeed excavators identified numerous jird burrows near the burial, and 70% of all the rodent bone recovered from Shanidar Cave was from this jird species. Analysis of jird burrows has also revealed the remains of many of the same flowers that were found around Shanidar IV. Thus the presence of flower pollen around the skeleton may not have been the result of ritualistic activity, but simply the establishment of jird burrows following the burial (Sommer 1999).

Ephedra has sometimes been referred to as source of the active ingredient for the ancient *soma* (or *haoma*) beverage that was used for ritualistic and religious purposes over a wide region that included areas now referred to as India and Iran, and perhaps a much broader range (e.g., see Rudgley 1998). *Soma* has been closely identified with the Indo-Iranians, people whose ancient home land was located somewhere in

Central Asia. According to most archaeological interpretations, this early culture divided into two separate groups approximately 4,000 years ago. One group became the ancient Iranian peoples, the other, the Indo-Aryans, migrated south into what is now Afganistan and the Indus Valley. These two groups of people preserved extensive, religious oral traditions that were subsequently rendered in written form as the Rig Veda of the Indians and the Avesta of the Iranians. Central rituals in both of these ancient cultural traditions involved consumption of an entheogenic (spiritually stimulating) plant or fungus. This psychoactive species (or mixture of species) was called *soma* by the Indians and *haoma* by the Iranians. Similar rituals are performed by some of the descendants of these peoples who now use substitutes for *soma* that are not mind-altering; however, the identity of the original, sacred, mind-altering species has remained a mystery for many centuries. A large number of species were put forward as putative candidates for *soma* during 19th and 20th centuries (e.g., see Merlin 1972).

After many decades of debate about the identity of the psychoactive substance in the soma/haoma drink, R. Gordon Wasson's (1968) publication of *Soma: Divine Mushroom of Immortality,* argued very persuasively that the fly-agaric mushroom, *Amanita muscaria* (Fr. Ex L.) Quél. is the species in question. Wasson's argument was based mainly on ancient Indian sources. A majority of scholars accepted his thesis. However, a couple of decades later, Flattery and Schwartz (1989) argued effectively for Syrian rue (*Perganum harmala,* Zygophyllaceae), which was originally identified as the source of *soma* by Sir William Jones in 1794. Flattery and Schwartz relied primarily upon Iranian evidence to support their assertion that *soma* should be identified with *P. harmala* since this species is still well-known for its psychoactive effects in the home land region of the Indo-Iranians.

Evidence that human used *P. harmala* in the fifth millennium B.C. has been recovered from the Caucasus region (Lisitsyna and Prishcepenko 1977); and according to Miller (2003), *P. harmala* ''becomes more common in the third millennium [B.C.] archaeobotanical samples in the Near East, and is therefore likely to be associated with overgrazing.'' However, it may have been used for religious purposes, or, as it is employed today in some areas of this region, simply to ward off evil spirits or as a ''good luck charm.''

More recently, however, *Ephedra* has been reasserted as the source of the *soma* drug based on archaeological evidence recovered from Russian excavations at Gonur depe, the 4,000 year-old ''Zoroastrian capital'' in the Kara Kum desert of Turkmenistan, known in ancient times as Margiana. The Gonur depe complex is part of the previously unknown Bronze Age civilization in Bactria (North Afghanistan) and Margiana (Turkmenistan). Now referred to as the Bactria-Margiana Archaeological Complex (BMAC), it had two distinct cultural periods, the first between 1900 and 1700 B.C. and the second between 1700 and 1500 B.C. (Parpola 1994). At Gonur depe, archaeologists found monumental sites dated to the first half of the second millennium B.C. (Sarianidi 1994).

The Gonur South area of this site comprises a fortified compound of buildings. A large ''sacred fire temple'' shrine situated within this compound has two parts; one appears to have been used for public worship, but the other was a hidden ''inner sanctum of the priesthood'' which consists of private rooms (cf. Rudgley 1998). Analysis of the contents in ceramic bowls found in at least one of these private rooms by Professor Meier-Melikyan (1990) revealed the traces of both *Cannabis* and *Ephedra.* It has been suggested that both of these psychoactive substances had been used in conjunction in the making of psychoactive drinks. Ten ceramic pot-stands found in a room adjoining the ''inner sanctum'' seem to have been used in combination with strainers designed to separate the ''juices from the twigs, stems and leaves of the plants'' (Rudgley 1998; cf. Sarianidi 1994). A basin in another room at the other end of the shrine contained a large quantity of *Cannabis,* along with pottery stands and strainers that also appear to have used to make mind-altering, ritualistic beverages.

A pottery strainer, comparable to those found at shrine at Gonur South, that was also used apparently to concoct psychoactive beverages, was recovered from the shrine at the site of Togoluk 1 (mid-second millennium B.C.), although remains of mind-altering plants have not been discovered in this site. In addition, vessels found in shrine at a third settlement, Togoluk 21 (late second millennium B.C.) contained remains of *Ephedra* and the opium poppy (*P. somniferum*);

moreover, an engraved bone tube containing ''poppy pollen'' was also recovered from this same shrine (Sarianidi 1994).

The architecturally impressive temples in the Gonur depe complex of the BMAC are dated to the period of the early Mesopotamian civilization; and the discovery of ritual vessels dated between 2000–1000 B.C. with the remains of mind-altering drug plants in these temple shrines ''show that soma in its Iranian form *haoma* may be considered as a composite psychoactive substance comprising of *Ephedra* and *Cannabis* (see *Cannabis* section below) in one instance and *Ephedra* and opium (see *Papaver somniferum* section below) in another.'' (Rudgley 1998; cf. Parpola 1994).

According to Miller (2003), photographs of the *Ephedra*, *Cannabis*, and *Papaver*, and archaeological specimens presented in the Togolok-21 report by Meier-Melikyan (1990), appear to be consistent with the respective species; however, the determination of the *Papaver* species needs further study to confirm that it is *P. somniferum.* Indeed, Miller suggests that the poppy seeds could have come from field weeds or have been used as a food plant rather than as an opiate source for medicine or ritual. Miller also points out that in an arid climate, the wood of *Ephedra* could have been burned for fuel. Other scientists, who have critically reviewed the evidence for *Cannabis* in the Central Asian BMAC sites, concluded that the clay impressions from Gonur Temenos which are claimed to have been made with hemp (*Cannabis*) by Sarianidi (in Appendix I of 'Margiana and protozorastrism') ''are clearly of [Millet] *Panicum miliaceum*'' (Bakels 2003; Nesbitt 2002).

Ephedra species have, indeed, been used medicinally for hundreds, even thousands of years in the regions where they grow. *Ma huang* (*Ephedra sinica* Stapf.), also known as *Tsaopen-Ma Huang*, is a shrub, 30 to 50 cm in height, native to East Asia. An oral tradition in China dating back to approximately 2800 B.C., which is associated with the legendary first Chinese emperor and herbalist or shaman, Shen Nong (or Shen Nung), refers to the medicinal use of the dried stems of *Ma Huang* to cure multiple ailments such as the common cold, coughs, asthma, headaches, and hay fever. *Ephedra* (''ma-huang'') pollen has been recovered from the Banpo sites (dated to ca. 4800 to 4300 B.C.) of the Neolithic Yangshao culture in east Xi'an, in the Shaanxi Province of China (Manhong and Jianzhong 1990). The earliest written records of *Ma Huang* use can be found in a classic Chinese compilation of herbs called Shen Nong Ben Cao Jing (Flaws 1998), which dates back to the first century A.D. This early, studious treatise is a compilation of the greater part of all the knowledge about herbal medicine before the Han dynasty, discussing the uses of 365 ancient medicinal plants.''

PAPAVER SOMNIFERUM

The most ancient evidence for opium poppy use comes from sites in the Mediterranean region. Remarkable new evidence for a very old opium poppy association with humans was recently discovered in the underwater La Marmotta site in Lake Bracciano, Italy, northwest of Rome about 35 kilometers from the Tyrrhenian Sea. This site has been submerged by rising waters of the lake; however, approximately 7,700 years ago this small ''city'' was accessible from the sea by boat via the Arrone River. Italian archaeologists, sifting through the ruins of this Stone Age settlement, believe the La Marmotta site was occupied by an early European Neolithic farming community which lasted for about 500 years (Kunzig 2002). Many organic remains were well preserved underneath 3 meters of lime at the bottom of lake. Among the remarkable discoveries of preserved remains of plant and animal material are *P. somniferum* seeds which were presumably cultivated for food, oil, medicine, and possibly cult use (Fugazzola 2003). ''The bigger discovery concerns a 'great mother' [with] palaeolithic [features] in a room of this Neolithic settlement [and thus the] poppy seeds of La Marmotta have been found in association with [a] religious [cult] room'' (Samorini 2003). The fossil seeds from this Italian site are the oldest known seeds of *P. somniferum* found in association with humans, indicating that use and cultivation of the opium poppy dates back at least to the early Neolithic.

Although the archaeological evidence for *P. somniferum* presented above does not necessarily point toward mind-altering use, the following remark is insightful: ''The opium poppy has been cultivated since Neolithic times, perhaps in the first place for poppy-seed oil, but who can doubt that its narcotic property enhanced its value'' (Dimbleby 1967; also see Merlin 1984).

Cult use of the opium poppy approximately

2500 years ago (VIII–VI century B.C.) in southeast region of the Italian peninsula (Foggia Province) has been interpreted from the archaeological remains (steles) of the pre-Roman Dauni culture (Leone 1995, 1995-96; Nava 1988). Leone (1995) hypothesizes that the sphere-shaped ''pendants worn at the belt by the feminine Daunian Stelae represent opium plants, *Papaver Somniferum.*'' She believes that the significant ''spiritual role the plant played may have made it a monopoly of the priestly caste,'' and that these illustrated pillars bearing inscriptions ''assume a new significance in the light of this hypothesis.''

Archaeobotanical evidence for opium poppy use has also been found recently in an ancient Roman farmhouse (*villa rustica*) excavated in 1996 near Pompeii (at Villa Vesuvio, southern Italy). At the bottom of one of the storage vats (*dolia*) discovered in the cellar of this farmhouse (which is typical of other such structures of the same time of the great eruption, 79 A.D.) was a high percentage of seeds from plants associated with medicinal use, including *Papaver somniferum*; these seeds were recovered along with bones of reptiles and amphibians, suggesting that this assemblage is the residue of a ''medicinal'' preparation (Ciaraldi 2000). Remains of a ''poppy seed cake'' were also found in a ''ritual context from the city of Pompeii,'' in a ''typical atrium'' building known as the ''House of the Wedding of Hercules'' (Ciaraldi and Richardson 2000). These ''votive offerings'' probably honored the goddess ''Isis/Demeter.'' Although this evidence of opium poppy use was excavated ''from deposits dated to the end of the second century BC to AD 79, it is more likely that they were probably deposited in the 1st century A.D.'' (Ciaraldi 2003).

Ancient evidence for *P. somniferum* in the Western Mediterranean, comes in the form of capsules recovered from small grass woven baskets from a burial cave (Cueva de los Murciélagos) near Albuñol in the southern Spanish province of Granada (Gongora 1868; Neuwiler 1935; see Fig. 3). These capsules have been radiocarbon-dated to c. 4,200 years old (Giner 1980).

A relatively large amount of archaeological evidence and literary reference to the ancient use of the opium poppy from the Eastern Mediterranean region has been uncovered for its use as food, medicine, and cult activities. This evidence reaches as far back as the Late Bronze Age, and possibly earlier. In this region evidence for *P. somniferum* comes predominantly in the form of artifacts recovered from Late Bronze Age sites in Greece, Crete, Cyprus, Egypt, Palestine, and Syria (e.g., Emboden 1981, 1989; Gabra 1956; Kritikos and Papadaki 1967; Marinatos 1937; Merlin 1984; Merrillees 1968, 1999; Mylonas 1966; Quibell and Hayter 1927; Randall-MacIver and Wooley 1911; Sciaparelli 1927). The types of archaeological evidence and additional references can be found in Table 1. Some key examples of related artifacts and recent direct evidence are discussed below.

According to Merrillees (1999), ''Possibly the earliest representation of the poppy capsule in the Aegean world is a small limestone half-capital, about 5 inches high [12.5 cm], from the Palace of Knossos in Crete.'' This small artifact resembling a ''dried-out poppy capsule'' has a flat top representing the stigma, and spherical body similar to the poppy seed capsule and thalamus; it dates to the Late Minoan I (1600–1450 B.C.), and was no doubt made to fit on the upper part of a pillar to resemble a real poppy capsule fastened to its stem (see Evans 1928; Zervos 1956).

Most of the evidence for the presence and use of the opium poppy on mainland Greece in the Mycenaean period (ca. 1550–1100 B.C.) is in the form of artifacts with representations of the seed capsule. However, certitude of these representations has been debated as to whether they depict poppy capsules or pomegranate fruits; the latter also are spherically shaped and have crowns that are serrated (e.g., see Seeberg 1969, also see Fig. 2). Some of the artifacts in question definitely do represent opium poppy capsules, or at least resemble *P. somniferum* much more closely. Among these are two examples from the Peleponnesus that date to approximately 1500 B.C. (the transition period from Late Helladic I to Late Helladic II) which have ribbed bodies with serrated stigmas. One is a brooch-pine that has a gold head and a silver stem; the other is a gold pendant, from Mycenae. As Merrillees (1979) has pointed out, these artifacts with representations of opium poppy capsules are very similar to two gold pins from Anatolia, dating to about 1400–1200 B.C. (the pins are part of the Norbert Schimmel collection in the New York's Metropolitan Museum). Besides the exterior features of these pins that have heads resembling

TABLE 1. CHRONOLOGICAL TABLE OF SELECTED ARCHAEOLOGICAL EVIDENCE FOR THE PREHISTORIC USE OF PSYCHOACTIVE DRUG PLANTS IN THE OLD WORLD.

Date	Species	Location	Evidence	Reference
60 000 B.P.	*Ephedra*	Shanidar IV, N. Iraq, Burial Site IV outside of cave	Microfossils: *Ephedra* spp. pollen samples in grave	Solecki, 1975
10 000 B.P.	*Cannabis*	Taiwan	Artifacts: pottery shards w/ hemp rope imprints, similar to those used from stem	Chang, K 1968; Kung, C. T. 1959
5700 B.C.	*Papaver somniferum*	La Marmotta, Lake Bracciano, Italy	Macrofossil: Poppy seeds	Fugazzola 2003
5th Millennium B.C.	*Peganun harmala*	Caucasus	?	Lisitsyna and Prishcepenko 1977
4800–3200 B.C.	*P. somniferum*	Lac De Chalain Site, Switzerland, lakeside habitation	Macrofossils: Poppy seeds	Neuweiler 1935; Merlin 1984
4115–3535 B.C.	*Cannabis*	Pan Po Village, Weishui Valley, S. Shensi Prov., China. Temperate climate	Artifacts: weaving design on pottery jar, hemp cloth imprints on pottery jar.	Li 1974
4000–3000 B.C.	*P. somniferum*	Robenhausen Settlement, Lake Pfuffiker, Switz.	Macrofossils: seeds & one unripe capsule	Heer 1866; Merlin 1979
4000 B.C.	*P. somniferum*	Hornstaad-Hornle I, Lake Constance Germany	Macrofossil	Coles and Coles 1989
3600 B.C.	*P. somniferum*	Neolithic Settlement, Weier, Switz. Lake settlement site	Macrofossils: (layer 18) 619 poppy seeds, 48% of layer sample	Fredskild 1978; Merlin 1984
3300 B.C.	*P. somniferum*	Charavinces, Lake Paladru, France	Microfossil: Pollen	Coles and Coles 1989
3200–2600 B.C.	*P. somniferum*	Cortaillod Lakeshore Settlement, Seeberg, Switz.	Macrofossils: 3000 poppy seeds	Villaret-Von Rochow 1967; Merlin 1984
3200–2600 B.C.	*P. somniferum*	Niederwil Bog Site, Switz. Pfyn Culture	Micro/Macrofossils: *P. somniferum* indicating presence as important domesticated species	van Zeist and Casparie 1974; Merlin 1984
3000 B.C.	*P. somniferum*	Vavrovice, Czechoslovakia, settlement, end of Atlantean Period	Macrofossils: Poppy seeds w/ animal fossils in settlement	Sikulova and Opravil 1974; Merlin 1984
2900–2700 B.C.	*P. somniferum*	Lagozza, N. Italy	Macrofossils: opium poppy seeds, indicating domestication	Sordelli 1880; Hoops 1905; Merlin 1984
4th Dyn. 2720 2560 B.C.	*Nymphaea nouchali* (syn *N. caerulea*)	Egypt	Artifact: Fresco depicts water lily as offering to Osiris	Pleyte 1875; Emboden 1989
Neolithic (no date)	*P. somniferum*	Poland, Zeslawice, Radial Decorated Pottery Culture	Macrofossils: 12 opium poppy seed fossils	Gizbert 1961; Merlin 1984

TABLE 1. CONTINUED.

Date	Species	Location	Evidence	Reference
2500 B.C.	*P. somniferum*	Cueva de Los Murciélogos, Spain, cave burial site	Macrofossils: opium poppy capsules & seeds in esparta grass handbag	Gongora 1868; Merlin 1984
2000–1500 B.C.	*P. somniferum*	Hugelgraber (hill trench/grave) Mistelbach, N. Austria. grave site	Macrofossils: Poppy seed fossils	Werneck 1949; Merlin 1984
2100 B.C.?	*P. somniferum*	Nippur, Iran	Artifact: may contain reference to opium poppy as ingredient in prescription?	Univ. Penn. Artifact #CBS 14221; Merlin 1984
18th Dyn. 1550–1350 B.C.	*P. somniferum*	New Kingdom Tombs, Buhen, S. Egypt	Artifact: carnelian ''vasiform'' poppy capsule bead necklace	Randall-MacIver and Wooley 1911
18th Dyn. 1550–1350 B.C.	*P. somniferum*	Teti Pyramid, Saqqara, Egypt	Artifact: statue of small naked boy with disproportionate carnelian ''poppy capsule'' earrings, found in coffin	Quibbel and Hayter 1927
18th Dyn. 1550–1350 B.C.	*Mandragora officinarum*	Thebes, Egypt Tomb of Nakht	Artifact: Fresco depicts mandrake for purification of nostrils	Emboden 1989
Late Bronze Age (no date)	*P. somniferum*	Mari, Syria	Artifact: Late Bronze Age necklace w/ poppy capsule pendants	Merlin 1984
18th Dyn. 1550–1350 B.C. (New Kindgom)	*P. somniferum*	Tomb of King Siphtah & Queen Tauosrit, Thebes	Artifacts: blue faience copy of opium poppy capsule; two gold earrings with capsule representation; gold necklace with gold poppy capsule pendants	Merrillees 1968
16th or 15th century B.C.	*P. somniferum*	Egypt	Base-ring juglet once held liquid containing crude opium and oil that served as the solvent	Bisset, N. G. et al. 1996; Kaschel, K. 1996
15th century B.C.	*P. somniferum*	Palestine (probably) and Egypt (Tell el-Ajjul near Gaza)	Base-ring juglet once held liquid containing crude opium	Merrillees 1989
1500–1350 B.C.	*N. nouchali*	Egypt	Literature: Papyrus of Ani (Book of the Dead) explains & depicts shamanic transformations related w/ N. caerulea	Emboden 1981

TABLE 1. CONTINUED.

Date	Species	Location	Evidence	Reference
18th Dyn. 1550–1350 B.C.	*N. nouchali, M. officinarum, P. somniferum*	Tomb of Menna, Tomb of Nebamum & Ipuky, Thebes	Artifacts: Menna-Fresco shows *N. caerulea* offering to Horus. Nebamum-Fresco depicts funeral shafts of *N. caerulea, M. officinarum, P. somniferum*	Emboden 1981
18th Dyn. 1550–1350 B.C.	*P. somniferum*	Tomb of Cha, Egypt	Macrofossil: alabaster vessel containing opium	Sciaparelli 1927; Gabra 1956; Emboden 1981
1350 B.C.	*N. nouchali, M. officinarum*	Tomb of Semenkhara, Egypt	Artifact: limestone relief, his consort Meriathon offers mandrakes & lillies to Semenkhara	Emboden 1981
1350–1338 B.C.	*N. nouchali, M. officinarum*	Egypt: Tomb of Tutankhamen	Artifact: Unguent jar depicts Hathor with necklace of water lilies and mandrake	Emboden 1989
14th cent. B.C.	*N. nouchali, M. officinarum*	Tomb of Tutankhamen, Egypt	Artifacts: wall scene, Tut holds Nymphaea & two mandrakes, with ornamental collar bearing mandrake fruit. Coffer embellishment, wife ministers sick Tut with opium poppy, Nymphaea & mandrake fruit	Emboden 1981
16th or 15th cent. B.C.	*P. somniferum*	Cyprus, Egypt, Palestine, Egyptian Grave site	Artifacts: Cypriot juglets, Base-ring Ware vases in form of unripe poppy capsule; juglets containing crude opium	Merrillees 1962; Sjoquist 1940; Merlin 1984
16th or 15th cent. B.C.	*P. somniferum*	Egypt	Base-ring Ware vase in form of unripe poppy capsule, containing crude opium	Bisset et al. 1996; Kochel 1996)
15th cent. B.C.	*P. somniferum*	Palestine, Tell el-Ajjul near Gaza and another unknown site in Palestine	2 Base-ring Ware vases in form of unripe poppy capsule, containing crude opium	Bisset et al. 1996; Kochel 1996
1450–1100 B.C.	*P. somniferum*	Buried chamber at Gazi, Crete	Artifacts: 80 cm tall terracotta statue, with 3 pins representing poppy capsules in head	Blegen 1936; Merlin 1984
1350 B.C.	*P. somniferum*	Royal Tomb, Tell El-Amarna, Egypt	Artifact: necklace with gold ‘‘poppy capsule’’ beads	Merlin 1984

TABLE 1. CONTINUED.

Date	Species	Location	Evidence	Reference
1309–1224 B.C.	*N. nouchali*	Temple of Sethos I, Abydos, Egypt	Artifact: religious scene shows blue water-lily offering to Horus	James 1982
1230 B.C.	*Nymphaea alba sav.*	Tombs of Ramses II & Amenhotep I, Egypt	Macrofossils: *N. alba* petals in funeral wreaths about mummies	Emboden 1981; Schweinfurth 1884
1230 B.C.	*N. nouchali*	Egypt: Tombs of Ramses II and Amenhotep I	Macrofossil: funeral garlands	Pleyte 1875; Emboden 1989
1220 B.C.	*P. somniferum*	Burned Palace, Beyeesultan, Anatolia, Cyprus Temple #4	Artifact/Macrofossil: ''opium pipe,'' poppy seeds found in a footed bowl	Karageorghis 1976
20th Dyn. 1200 1085 B.C.	*N. nouchali*	Thebes, Egypt	Artifact: Fresco depicts water lily for purification of nostrils	Emboden 1989
1122–249 B.C.	*Cannabis.*	Burial site, China, Chou Dynasty	Arifact/Macrofossil: Cloth fragments made of hemp	Li 1974
1000 B.C.	*Cannabis*	Debris pile, Gordion, (near Anjara) Turkey	Artifact: pieces of hemp cloth	Belinger 1962
900 B.C.	*P. somniferum*	Iraq	Artifact: Bas relief, physician holding poppy plant (disputed interpretation)	Kilgour 1962
807–779 B.C.	*P. somniferum*	Auvernier-Nord, Lake Neuchatel, Switz.	Macrofossil: Suggests cultivation	Coles and Coles 1989
668–626 B.C.	*P. somniferum*	Iran	Artifact: Assyrian medical tablet may show knowledge of medicinal use of opium	Thomas 1949
500–300 B.C.	*P. somniferum*	The Agora, Athens, Greece Open Marketplace	Artifact: Statue of Demeter holding a shaft of wheat and poppy capsule	Kritikos and Papadaki 1967
(no date)	*P. somniferum*	The Sanctuary of Artemus Orthia, Sparta, Greece	Artifact: Symbolic ''poppy capsule'' bone pendants & lead figurine	Dawkins 1929; Kritikos and Papadaki 1967
200 B.C.	*Cannabis*	China	Literature: Chou-Li, mentions use of *Cannabis* as a fiber. Also evidence of use of *Cannabis* seeds as a domesticated grain crop	Touw 1981; Li 1975

TABLE 1. CONTINUED.

Date	Species	Location	Evidence	Reference
2nd and 1st centuries B.C.	*P. somniferum*	Levant	Ancient Jewish Coinage	Meshorer 1982
9th Cent. A.D.	*Cannabis*	Hokkaido, Japan	Macrofossil: Seeds suggest cultivation	Crawford and Takamiya 1990
1320 A.D.	*Cannabis*	Lalibela Cave, Begemeder Prov., Ethiopia	Macrofossil/Arifact: Two ceramic pipe bowls containing *Cannabis* traces	Dombrowski 1971; Van der Merwe 1975

Fig. 7. Tubular vase probably used to inhale opium vapors. It was recovered from a subterranean ''cult'' chamber in Gazi, Crete (near Knossos), dated to 1450–1100 B.C. (Courtesy of Vassos Karageorghis, former director, National Museum of Antiquities, Nicosia, Cyprus).

the poppy capsule, inside each of the hollow pinheads ''is a loose object that rattles when the object is shaken. This was clearly done to mimic the seeds in dried-out poppy capsules. The model for these pieces of jewelry was not the unripe, juice-laden bulb, but rather the desiccated capsule, which is often included in modern dried-flower arrangements'' (Merrillees 1999).

Certainly one of the prime examples of a connection of the opium poppy with ritual and/or spiritual use in the Eastern Mediterranean area is a large terracotta goddess figurine (ht. 80 cm) recovered from a subterranean ''cult'' chamber in Gazi, Crete (near Knossos). This ''Poppy Goddess'' statue has a half-length body with uplifted hands and a trance-like facial expression (Blegen 1936; Marinatos 1937, see Cover Illustration). The artifact has been dated to Late Minoan III (1450–1100 B.C.). It has three moveable, incised pins in the head which have been identified as representations of opium poppy capsules tapped for the alkaloid-rich sap; in addition, it was found in association with paraphernalia (including a tubular vase, Fig. 7) that indicate probable inhalation of opium vapors (Kritikos and Papadaki 1967; Merlin 1984). The ''Poppy Goddess'' may also represent ''a priest-

Fig. 8. Cylindrical, engraved, ivory ''pipe'' (13.5 cm long) with ''distinct traces of burning,'' probably showing the stains from inhaled opium smoke, found in ritualistic context (12th century B.C.) at Kition on Cyprus. (Courtesy of Vassos Karageorghis, former Director, National Museum of Antiquities, Nicosia, Cyprus).

ess hallucinating for the purpose of uttering prophecies'' (Merrillees 1999).

Similar, or associated, opium use paraphernalia (e.g., a comparable tubular vase) were also found in a roughly contemporaneous, ritualistic context (12th century B.C.) at Kition on Cyprus. One of the most remarkable artifacts from this Late Bronze Age site is a 13.5 cm long, cylindrical (slightly tapered), carefully engraved, ivory ''pipe'' with ''distinct traces of burning,'' probably showing the stains from inhaled opium smoke (Karageorghis 1976; Merlin 1984; see Fig. 8).

By the 12th century B.C. ''Cyprus already had a long-standing familiarity with [opium]'' (Merrillees 1999). An extensive late Bronze Age trade network for the production and export of opium latex, apparently centered in Cyprus, supplied a variety of ancient cultures in the eastern Mediterranean as a medicinal balm or a ritual substance. Late Bronze Age ceramic juglets (Base-ring ware, Fig. 9), most of them similar in shape and approximately 10–15 cm tall, have been found in tombs and settlements throughout much of the Middle East. Turned upside down, these thin-necked, pear-shaped, small vessels with their round bases resemble opium poppies pods. Further indication of what was contained inside is indicated by the swollen bodies that have white markings symbolizing knife incisions made on poppies capsules to allow opium latex to ooze out for collection (see Fig. 10).

Hundreds of the Late Bronze Age, Base-ring juglets have been found in sites in areas including Syria, Palestine, and Egypt. Some of them, analyzed with the gas chromatography procedure in the 1980s and 1990s, have turned up traces of opium (Bisset et al. 1996; Koschel 1996; Merrillees 1989). Since many of these Cypriot juglets were recovered from Late Bronze Age tombs in the Levant, we can surmise that these poppy capsule-shaped vessels were ''believed to be magically invested with the same therapeutic properties as its contents;

Fig. 9. Late Bronze Age ceramic juglets (Base-ring ware), most of them similar in shape and approximately 10–15 cm tall, have been found in tombs and settlements throughout much of the Middle East. Turned upside down, these thin-necked, pear-shaped, small vessels with their round bases resemble opium poppy pods (Courtesy of the Ashmolean Museum, Oxford, England).

Fig. 10. Incised, unripe opium poppy capsule with latex (opium) oozing out.

the juglet itself may have symbolized the eternal sleep of the dead'' (Merrillees 1999).

In Classical Greece, the opium poppy was a multipurpose plant that had secular and sacred uses, including mundane medicinal and food applications, as well as muiltifarious associations with divine aspects of the Greek culture (see Kritikos and Papadaki 1967; Merlin 1984; Merrillees 1999). Ancient Greeks associated fertility and abundance with the opium poppy, and therefore with the goddess Demeter. This deity in particular was connected with the opium poppy, and as such she was frequently depicted with stemmed grains of barley or wheat and opium poppy capsules in her hands or headdresses (e.g., Evans 1925; Kritikos and Papadaki 1967; Merrillees 1999, Fig. 11). In fact, *P. somniferum* was a weedy or cultivated plant intimately involved in the cultural ecology of ancient Greek, and probably many other agricultural societies of the ancient world (Merlin 1984). The divine, twin brothers, Hypnos and Thanatos, representing sleep and death, were also often showed with poppies in their crowns or their hands, manifesting the Greek awareness that sleep induced by opium brought rest and oblivion, but an overdose might be fatal.

The opium poppy, both in plant and in capsule form, appears on various coins of the ancient Greek and Roman periods, at least in some cases, testament to the use of the poppy as a symbol of various divinities (e.g., see Kritikos and Papadaki 1967; Merlin 1984). The capsule of the opium poppy is also shown on Jewish coinage dated to the 2nd and 1st centuries B.C. (Meshorer 1982). Recent North African evidence for opium poppy in association with people comes from a site in Tunisia that yielded *P. somniferum* materials from the Carthaginian, Iron Age, Punic, Roman, Medieval, and Byzantine periods (van Zeist et al. 2001).

Macrofossil and microfossil evidence from ancient Neolithic European sites north of the Mediterranean prior to 2000 B.C. for the opium poppy, *Papaver somniferum*, is relatively abundant, especially in the Swiss Foreland and other

Fig. 11. This terra cotta relief was recovered from Magna Graecia (ancient Greek colonies of South Italy). It depicts the Goddess of Spring (Persephon) emerging from the underworld with poppy capsules, sheaves of grain, and lilies in both hands (from Evans 1925:16, Fig. 18, Courtesy of the *Journal of Hellenic Studies*).

Fig. 12. *Cannabis* plant (courtesy of Robert Connell Clarke).

areas in Central Europe (Fig. 5 and 6). These remains, excluding the recent discovery at La Marmotta site (north of Rome) described above, (e.g., in Poland, Hungary, Czech Republic, Austria, Switzerland, Germany, northern Italy, France, Belgium, the Netherlands and the United Kingdom) date back variously to about 3000 B.C. based on radiocarbon dating and stratigraphic analysis (Merlin 1984; Coles and Coles 1989; for additional references see chronological table 1).

Many recent references for the opium poppy evidence in ancient Europe have been provided by Kroll (2003). For example, see the following: Gyulai (1996) for late Bronze Age and Iron Age sites (Urn field period) of the Hallstatt and Latène cultures in Hungary; Kroll (2001) for middle Neolithic Funnel Beaker, TRB culture, at Wangels, Eastern Holsatia, in Northwestern Germany; Castelletti and Rottoli (1999) for the Neolithic period in Italy; Heim and Hauzeur (2002) for the Neolithic period from the Rubané and Blicquy culture in Belgium; Heim and Jadin

Fig. 13. Hemp twine and rope made from *Cannabis*.

(1998) for the Neolithic period from the Hesbayan Linear Pottery culture in Belgium; and Monckton (2000) for Iron Age and Roman sites in the Arrow Valley, Great Britain. Many Medieval archaeological sites have also been shown to contain remains of *P. somniferum*; for example, Wiethold (1995) documented evidence from 14th century A.D. well/cesspits from Kiel, in Schleswig-Hostein, Germany.

Cannabis

Much evidence for the early use of *Cannabis* for fiber, food, medicine, ceremony and recreation can be gleaned from ancient written records (Fig. 12, 13, 14, and 15). However, the archae-

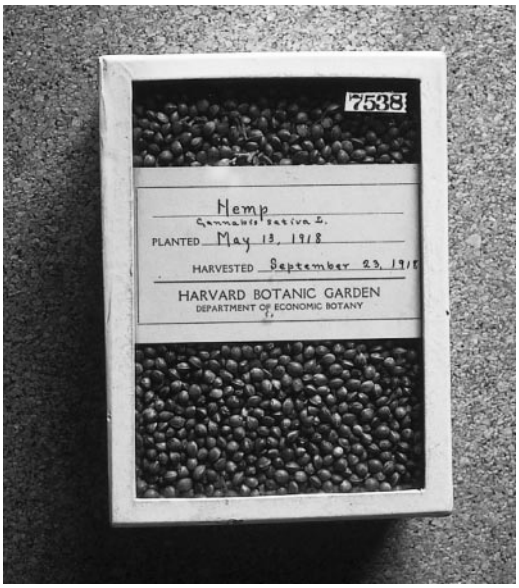

Fig. 14. Hemp seed from *Cannabis* (Courtesy of Richard Evans Schultes).

Fig. 15. Female inflorescence of *Cannabis.*

ological record for early use of *Cannabis* is much less extensive. Nevertheless, the macrofossil, pollen, and indirect material evidence from prehistory are substantial.

The earliest human use of Cannabis appears to have occurred in the steppe regions of Central Asia or in China (e.g., see Merlin 1972; Lu and Clarke 1995; Fleming and Clarke 1998). Hemp was certainly one of the earliest crop plants of China. Over hundreds, perhaps thousands of years, early inhabitants of Central and/or Eastern Asia domesticated *Cannabis* varieties from wild plants into artificially selected, cultivated crops. Chinese historical records and archeological data suggest that the history of hemp cultivation and use in Eastern Asia is approximately 5,000 to 6,000 years old. China therefore may have been the first region to cultivate, and even use hemp. ''From the time of the earliest primitive societies (about 4,000–5,000 years ago) to the Qin and Han dynasties (221 BC to 220 AD) ancient Chinese techniques of hemp sowing, cultivation, and processing developed rapidly and became fairly advanced'' (Lu and Clarke 1995). The earliest Neolithic farming communities along the Wei and Huang He (Yellow) rivers cultivated hemp as well as millet, wheat, beans, and rice. The oldest Chinese agricultural treatise is the Xia Xiao Zheng written around the 16th century B.C. It refers to hemp as one of the main crops grown in ancient China (Yu 1987). Remains of *Cannabis* fibers, along with probable fiber impressions and hemp seeds have been recovered from a variety of archeological sites, especially near the Huang He and Yangtze rivers.

Cord impressed pottery with possible fiber evidence of *Cannibis* use has been dated to approximately 10,000 B.C. in early post-glacial fishing sites on the south China coast, especially at the Yuan-Shun site in Taiwan (Chang 1968); and others dating from the fifth millennium B.C. up to the second century A.D. have been found in several regions on the mainland of China (Li 1974a,b). Sherratt (1997) noted ''that the early use of cord-impressed pottery in China—the so-called Sheng-wen horizon—was associated with an early use of hemp and an appreciation (explicit in the early historical records) of its narcotic properties.''

More recent evidence of actual hemp fiber comes from the Song Dynasty (c. 960–1280 A.D.) in the form of statuary fabricated with hemp cordage that was recovered from a site near Chin-Ch'eng in Shanxi Province, northeast China (Kuo 1978), and from a Shan Kingdom site (c. 1520–1030 B.C.) at Anyang in Henan Province, eastern China (Chang 1968). Even older *Cannabis* fiber material has been excavated from a Zhou Dynasty tomb in Shanxi Province; and complete hemp cloth specimens have been found in Han Dynasty tombs (ca. 100 B.C.–100 A.D.) in Gansu Province, northern China (Kansu Museum 1972; for additional ancient Chinese fiber and hemp paper artifact evidence, see e.g., Cheng 1959, 1963, 1966; Li 1974a,b; and Yin 1978). *Cannabis* seeds dated to the 9th century A.D. have been recovered from Hokkaido, Japan (Crawford and Takamiya 1990); *Cannabis* along with significant uses in ritual, clothing production, and early papermaking were introduced to Japan from China via Korea approximately 1400 years ago (Hunter 1943).

The use of *Cannabis* to the west of China has a very ancient history, perhaps older and somewhat different than that in China. Sherratt (1987, 1997) suggests that early inhabitants of the Eurasian steppes, members of the Sredni Stog culture that flourished about 4500–3500 B.C., used *Cannabis* to make a ''socially approved intoxicant,'' celebrating its significance ''by imprinting it on their pottery.'' The crucial relationship

between horse and human rider originated in the Sredni Stog culture which flourished in the Ukraine 6,000 years ago (Anthony et al. 1991). The origin of horse riding was the first significant innovation in human land transport predating the invention of the wheel, and hemp fibers may have played an important role in this crucial invention of horse riding.

One very notable historic reference supports the first ethnographic evidence of an early ''smoking culture'' in temperate Eurasia (Sherratt 1995). This indication concerning *Cannabis* comes from Herodotus (c. 446 B.C.), in which he describes the post-funeral purification ritual of Scythians on the Pontic steppes: ''On a framework of three sticks meeting at the top, they stretch pieces of woolen cloth, taking care to get the joins as perfect as they can, and inside this little tent they put a dish with red-hot stones on it. Then they take some hemp seed, creep into the tent, and throw the seeds on the hot stones. At once it began to smoke, giving off vapor unsurpassed by any vapor-bath one could find in Greece. The Scythians enjoy it so much that they would howl with pleasure'' (Herodotus, IV, 75).

The accuracy of this ancient account was established by archaeological excavations in 1947 of a series of burial mounds at Pazyryk in the Altai Mountains of Siberia dating to the fifth century B.C. In each burial a 1.2 m-high wooden frame tent was found; and each tent enclosed a bronze vessel with stones and hemp seeds, presumably left smoking in the grave (Fig. 16). ''A leather pouch with hemp seeds provided supplies, and scattered hemp, coriander and melilot seeds were also recovered'' (Sherratt 1995; cf. Rudenko 1970). New evidence for *Cannabis* use by the Scythian tribes during the early Iron Age has been uncovered in the Ukraine (Pashkevich 1999).

From two earlier cultures, one in Romania from a Kurgan Pit-grave at Gurbanesti near Bucharest dated to the ''later third millennium BC,'' and the other in a northern Caucasian Early Bronze Age site (more or less comparable third millennium age) from which similar ''pipe-cup'' vessels (polypod, i.e., footed bowls) containing hemp seeds were recovered (Ecsedy 1979). Based on the Herodotus quote and these seed discoveries in widely separated locations, Sherratt (1991) argues that ''the practice of burning cannabis as a narcotic is a tradition which goes back in this area some five or six thousand years and was the focus of the social and religious rituals of the pastoral peoples of central Eurasia in prehistoric and early historic times.''

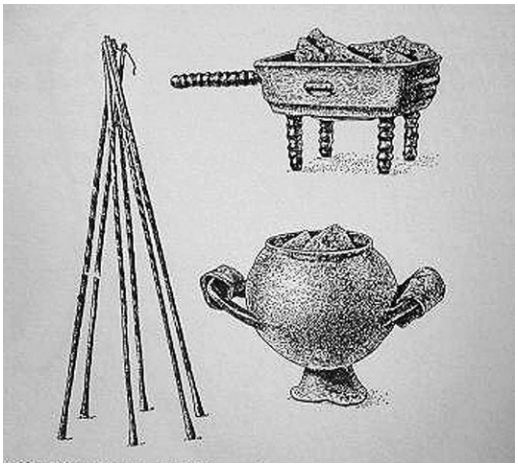

Fig. 16. Tent frame and bronze vessels with stones and *Cannabis* seeds found in a series of burial mounds at Pazyryk in the Altai Mountains of Siberia dating to the fifth century B.C. (Courtesy of Sir Harry Godwin and the Journal *Antiquity*).

According to Sherratt (1987) ''The first certain identification of hemp [fiber, or any form] in Europe is in the Hallstatt-period *Fürstengrab* [grave] of Hochdorf near Stuttgart, dated to c. 500 BC'' (cf. Körber-Grohne 1985; also see Merlin 1972 for an older, general review). Kroll (2003) asserts that the only definite Neolithic remains of *Cannabis* are from ''Russia, Ukraine or westernmost China.'' He refers to Larina (1999) for evidence of *Cannabis* from the Neolithic Linear Pottery Culture in the Russian area of the interfluve between the Prut and Dniester rivers, Pashkevich (1997) for early farmers utilizing hemp in the Ukraine (Neolithic and Bronze Age), and Rösch (1998, 1999) for reference to Neolithic use of hemp (*Hanf*) as a fiber plant (*Gespinstpflanzen*). According to Kroll (2003), *Cannabis* was certainly part of the Bronze Age southeastern European steppe environment ''even in late Neolithic settlements.'' However, he points out that similar to the nettle, *Urtica dioica*, ''feral forms of *Cannabis* may be ruderals, like nowadays in [all of] southeast Europe. The question is: feral forms from domestic ones? Or domestic forms from wild ones? There is no answer, one may use feral forms as well as domestic or true wild ones.''

Many other ancient sites, with evidence of *Cannabis* in Europe have been documented. For example, see the following: Gyulai (1996) for evidence from Bronze Age and Iron Age (Urn field period) Hallstatt and Latène cultures in Hungary; Robinson and Karg (2000) for Bronze or Iron Age remains at Vallensbæk in Denmark; König (2001) for Roman Iron Age evidence from Trier in Germany; Opravil (2000) for early Middle Age evidence from Mikulčice in the Czech Republic; and Lempiäinen (1999) for a review of the history of hemp (*Cannabis sativa* L.) in Finland including archaeobotanical evidence from 800–1600 A.D.

Archaeological evidence of *Cannabis* from Near Eastern sites is scarce, but an intriguing piece of hemp fabric was recovered from a Phyrgian Kingdom grave mound site at Gordion, near Ankara in Turkey which has been dated to the late 8th century B.C. (Bellinger 1962; Godwin 1967).

Remarkable evidence for *Cannabis* use in the Near East was found more recently in central Israel. In the town of Beit Shemesh, near Jerusalem, archaeologists uncovered the skeleton of a girl about 14 years old in a tomb from the late Roman period who died in childbirth; ''Three bronze coins found in the tomb dating to AD 315–392 indicate that the tomb was in use during the fourth century AD'' (Zias et al. 1993). A small amount (6.97 g) of a dark burnt substance was found in the abdominal area of the skeleton. Initially thought to have been incense, analysis by Israeli police and botanists at Hebrew University determined that the ancient material is a mixture of *Cannabis* resin (hashish), dried seeds, fruit and common reeds (*Phragmites*). Direct evidence of ancient drug substances themselves is rare because organic compounds decay rapidly; however, the substance found in this person's skeleton was preserved because it had been carbonized through burning. The archaeologists who uncovered this evidence believe the drug material was used as an aid in child birth, since it increases the strength and rate of recurring contractions in women giving birth; it was used in deliveries until the 19th century, after which it was replaced by newly developed drugs. However, others have disagreed with the strict medicinal use hypothesis (Prioreschi and Babin 1993), and argued that ritualistic use cannot yet be discounted. Unfortunately this short, young female probably died due to excessive bleeding.

Whether or not *Cannabis* was first used to make fiber, for food (seed of hemp), as a psychoactive resin for medicine, for ritual or spiritual purposes, or a combination of these motivations, the archaeological record provides evidence that it was a significant ethnobotanical source in antiquity. The ancient medical, psychoactive, and ritual uses of *Cannabis* are often difficult to separate, especially those mind-altering preparations used for medicine, psychological stimulation, and ritual use; and, of course, the interrelationships of traditional religious belief, ritualistic practice, and medicinal applications among psychoactive plants is not limited to *Cannabis.* In any case, the therapeutic use of *Cannabis* has a lengthy and ongoing history, with very diverse reports of its medicinal applications. It is well known, for example, that the ancient medicinal texts (*Materia medica*) of Greece and India, as well as China (see above) refer to specific uses for this plant. In should also be noted here that recent archeobotanical evidence for Cannabis dating between 400 B.C.–100 A.D. has been found in the Kali Gandaki Valley of Nepal which connects the Tibetan plateau with the plains of India (Knörzer 2000).

In Africa the archaeological evidence for ancient *Cannabis* is not substantial yet; but its first presence and use on the African continent may date back as much as 2,000 years ago. All of the historical references suggest dispersal from Central, South, or Southeast Asia into Africa prior to European contact. Indeed, the archeological, linguistic, and historical evidence from the 12th century A.D. to the present indicates that *Cannabis* was brought to Africa by Moslem sea traders from the Indian subcontinent, via Arabia, possibly as early as the 1st century A.D. (du Toit 1980; also see Emboden 1972 and LaBarre 1980). *Cannabis* appears to have spread down the eastern coast of Africa and then inland throughout the tropical sub-Saharan region. Dispersal across Africa was most likely slow, as only scattered sedentary farming cultures inhabited this region.

According to Emboden (1972), ''None of the more elaborate techniques of using *Cannabis* in the Mediterranean or the Near East accompanied the plant into Africa, and practices in the central part of the continent in the thirteenth century were very simple.'' Direct evidence of *Cannabis* use comes from ''two ceramic smoking-pipe bowls, excavated in Lalibela Cave, Begemeder

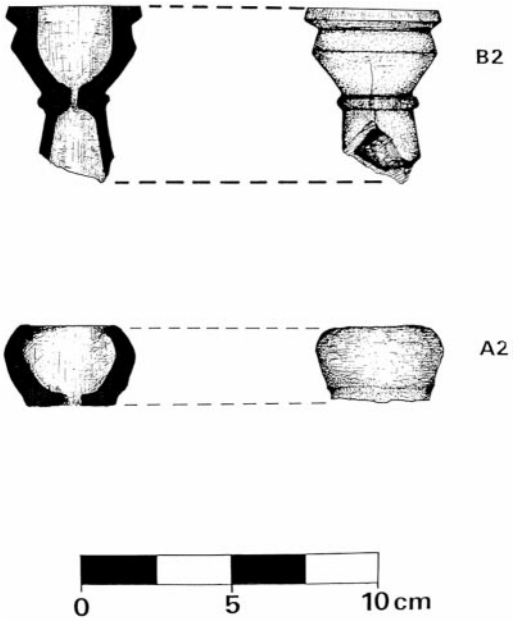

Fig. 17. Clay pipe bowls found in Lalibela Cave, Begemeder Province, Ethiopia, dated to 1320 ± 80 A.D. (Courtesy of Nikolaas van der Merwe).

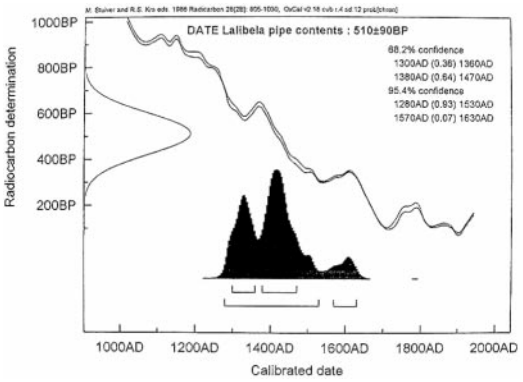

Fig. 18. Radiocarbon dating graph for ''cannabis-derived compounds'' found in ceramic smoking-pipe bowls excavated from Lalibela Cave, Begemeder Province, Ethiopia (Courtesy of Nikolaas van der Merwe).

Province, Ethiopia'' (van der Merwe 1975; cf. Dombrowski 1971; Fig. 17). Modified thin-layer chromatography indicated the pipe residues contained ''cannabis-derived compounds.'' The bowls were dated to 1320 ± 80 A.D. According to van der Merwe, this evidence suggests that ''some variety of *Cannabis sativa* was smoked around Lake Tana in the 13th–14th century, in much the same way as it is today.'' Subsequent related dates for charcoal at 630 ± 80 B.P. and residue in one of the pipes at 510 ± 90 (Fig. 18) have been reported (van der Merwe 2003). La Barre (1980) notes that ''the hypothesis of African pipe smoking in the fourteenth century must, however, run the gauntlet of Americanist opinion that the smoking of plant narcotics would be post-Columbian, after the pattern of Amerindian tobacco smoking.''

However smoking, as noted above, most probably took place in Africa, at least in some regions, well before European exploration. For example, *Leonotus leonurus* (wild ''*dagga*''), various species of *Salsola* (''*ganna*''), and most ubiquitously *Cannabis* were smoked as far back as the Iron Age in South Africa, predominantly among Bantu speakers (du Toit 1975).

According to Emboden (1972), in Sub-Saharan Africa, ''The simple but efficacious practice of throwing hemp plants on burning coals of a fire and staging what might today be called a ''breath in'' seems to have been popular initially. This was elaborated into a ritual in which members of a given tribal unit would prostrate themselves in a circle around the fire and each would extend a reed into the fumes in order to capture the volatized resins, without the accompanying irritation produced by standing over the vapors and inhaling. At a later date the fire was elevated to an altar, where humans could sit or stand while inhaling through a tube extending into the smoke.''

Excavations at the Iron Age site of Sebanzi Hill on the southern edge of the Central Kafue basin in the Southern Province of Zambia by Fagan and Phillipson (1965) uncovered four baked clay, non-Arab designed smoking pipes (Fig. 19 and 20). Radiocarbon dating, along with related pottery sequences, for the oldest two specimens indicates that these were in use about 1100–1300 A.D., and the others from the 13th–14th century (van der Merwe 2003). Although chemical tests of the these pipes from Zambia have not yet been possible, the excavators of the pipes argued that they were used for smoking *Cannabis* because tobacco could not have been known in Zambia at the time (Phillipson 1965).

An unusual find reported from the Kalahari Desert of Botswana provides a ''prehistoric'' record of pollen from about 130 km west of the Okavango River delta. In association with the calcite cave deposits (speleothem) that have pre-

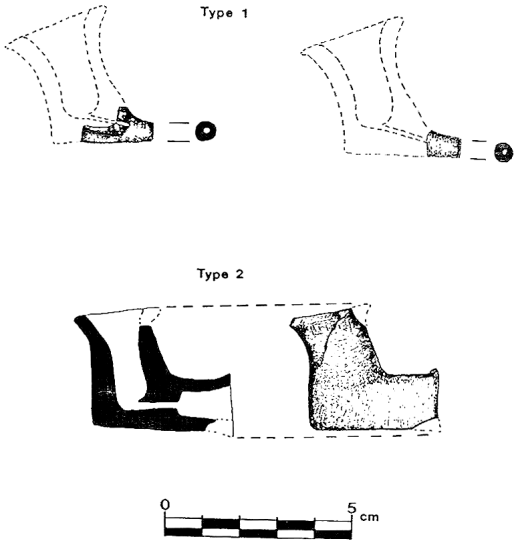

Fig. 19. Iron Age clay pipe bowl fragments from Sabanzi, Zambia (Courtesy of Nikolaas van der Merwe).

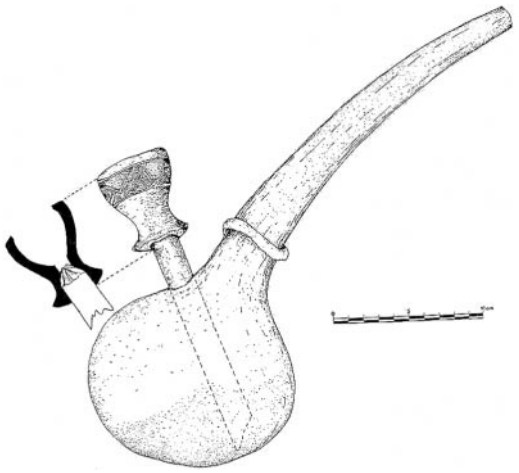

Fig. 20. A contemporary smoking pipe from Kariba, Zambia (Courtesy of Nikolaas van der Merwe).

cipitated from solution in a cave scientists have recovered a series of pollen fossils: ''Only one pollen type was identified that may directly indicate human activity, *Cannabis/Humulus* (Burney 1987a,b, 1988), which first appears in the sample dated to c. 3827 ± 298 BP'' (Burney et al. 1994). For a number of reasons Burney believes that this pollen fossil type can be best identified as *Cannabis* (Burney 2003).

Perhaps the most remarkable recent archaeological or paleobotanical evidence for *Cannabis* comes from Madagascar. The pollen record for *Cannabis* in lake sediment cores on this large island about 300 miles east of southern Africa are derived from several sites, with some dating back to approximately 2000 YBP. ''Pollen of the introduced hemp plant, *Cannabis sativa*, first appears at Lake Tritrivakely in the Central highlands about this time (Burney 1987a), and was present in a core from Lake Kavitaha about 200 km to the north from the beginning of the record at ca. 1500 years B.P.'' (Burney 1987b, also see Burney 1988).

This ancient evidence for the *Cannabis* in the Southern Hemisphere coincides roughly with the earliest human arrivals in Madagascar (Austronesians colonists or traders from elsewhere?) approximately 2,000 years ago. These early explorers or traders undoubtedly brought *Cannabis* along as part of their ''transported landscape'' (Anderson 1967) or ''portmanteau biota'' (Crosby 1973) that was consciously or inadvertently introduced into Madagascar. Burney believes the widespread wild (?) distribution of hemp plants is a ''regional-scale signal'' of human impact in Madagascar, and that *Cannabis* was an early human introduction by ancient seafarers who used the plant for various maritime uses to make rope, sails, water-resistant clothing, and hull caulking. ''Therefore hemp would, like goats, pigs, and rats, be among the first species introduced to new lands by Indian Ocean sailors coming ashore for provisioning and, eventually, longer stays (Burney 1997; cf. Vavilov 1949). *Cannabis* was not introduced to the New World until after 1492 A.D.

NYMPHAEA NOUCHALI AND *MANDRAGORA OFFICINARUM*

The genus Nymphaea included approximately 40 species found in tropical and temperate climates of both hemispheres. For a variety of reasons, much synonymy occurs. The blue water lily, *Nymphaea caerulea* Sav., is now lumped with *Nymphaea capensis* Thunb. into *Nymphaea nouchali* Burm. f. var. *caerulea* (Sav.) Verdc (Fig. 21).

Emboden (1978, 1981, 1989) combined artistic, papyri, and paleoethnobotanical sources as evidence for ancient Egyptian use of two taxa, the ''sacred blue water lily,'' *Nymphaea caerulea* (= *nouchali*) and the mandrake, *Mandragora officinarum* (Fig. 22) in shamanistic practices. Representations of the water lily in wall

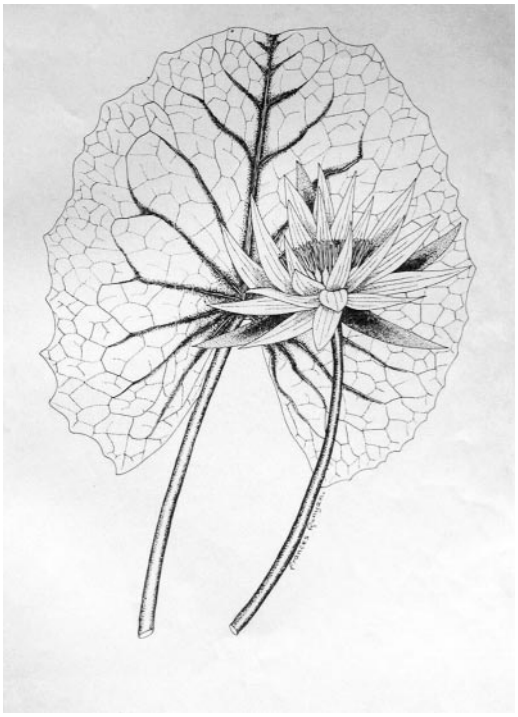

Fig. 21. The Blue Water Lily, *Nymphaea nouchali* var. *Caerulea* (Courtesy of William A. Emboden).

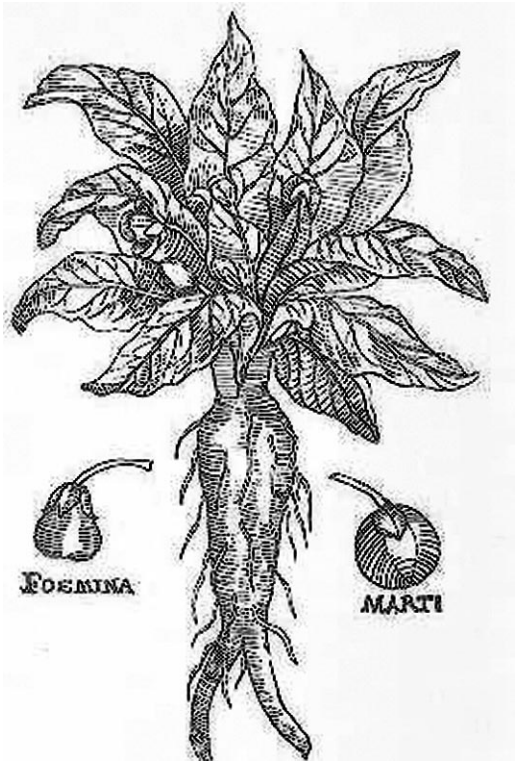

Fig. 22. *Mandragora officinarum* from Matthias de L'Obel 1581, Plantarum sev Stirpium Icones, Antwerp.

paintings began during the Fourth Dynasty in ancient Egypt and increased in frequency until the Eighteenth Dynasty when this lily was united with the ''golden'' (deep yellow when ripe) fruit of the mandrake (Fig. 23). Depictions of these mind-altering species in Egyptian frescos were originally interpreted as components of funeral scenes, with the plants as offerings. However, more recently this graphic evidence has been interpreted, with the help of various papyri, as portrayals of ritual healing: ''The abundant data indicate that the shamanistic priest, who was highly placed in the stratified society, guided the souls of the living and dead, provided for the transmutation of souls into other bodies and the personification of plants as possessed by human spirits, as well as performing other shamanistic activities'' (Emboden 1989).

The interpretation of ancient literary, artistic, or artifact interpretation without actual botanical evidence to support the identification of psychoactive drug plant use in antiquity limits a conclusive determination. In any case, the most significant forms of evidence that seem to link the sacred blue lily and mandrake, along with the opium poppy, *Papaver somniferum*, to the priestly caste are the papyri, ''. . . books of the dead, books of ritual magic, and related pictorial evidence—which were never meant to be seen by the public—present those same plants that are the vehicles to ecstasy'' (Emboden 1989). For more evidence for these three species from Egypt in the form of artifacts, papyri, and fresco scenes see James (1982), Randall-MacIver and Wooley (1911), Quibbel and Hayter (1927), Merrillees (1968), and Merlin (1984).

In a recent issue of Economic Botany, McDonald (2002) has attempted to determine the Middle Eastern Tree of Life, which he concludes is none other than ''the Egyptian lotus'' or ''Lily of the Nile'' (*Nymphaea nouchali*). Indeed, McDonald argues that we must ''identify the 'sacral tree' of Mesopotamia as a stylized lotus shoot rather than a palm tree,'' and that ''the classical lotus bud-and-blossom motif that we encounter in Egypt as early as 3000 BCE and in Mesopotamia by the second millennium BCE is

Fig. 23. In a scene depicting ritual healing, Semenkhkara, who is leaning on a crutch, is offered two mandrake fruits and a bud of *Nymphaea nouchali* by his consort, Meriton, who also holds more *N. nouchali* flowers in her left hand (colored limestone from the Staatliche Mussen, Berlin-Dahlem, Courtesy of William A. Emboden).

widely recognized as a symbol of rebirth and immortal life.'' McDonald further asserts that through a great depth of time there has been a loss of ''. . . our understanding of the mythic significance of the plant, and the ritualistic role it once played in the religious traditions of our distant forebears.''

Conclusion

The world-wide chronology, biological diversity, and geographical range of human use of psychoactive drug plants are neither complete nor unchangeable. Numerous psychoactive plants and regions are under-researched and require initial or additional research on this topic. Many scholars would believe it to be safe to assume that most psychoactive plants have a longer history of use than that recorded here. In any case, it is hoped that this paper provides a starting point from which other scholars may build upon. With a critical application of archaeology, paleobotany, anthropology, cultural geography, history, and other research disciplines the picture may become more complete. The evidence provided here should reveal the potential for such work in the future.

Acknowledgments

I would like to thank the following people for kindly sharing relevant information: Corrie Bakels, David Burney, Robert C. Clarke, Marina Ciaraldi, Maria Fugazzola, Helmut Kroll, Naomi Miller, Mark Nesbitt, Forest Pitts, Timothy Rieth, Karl Reinhard, Giorgio Samorini, Don Ugent, Nikolaas van der Merwe, Joseph Zias, and especially the late Richard Evans Schultes for his inspiration and encouragement to keep tracking the ancient, traditional use of the ''Plants of the Gods.''

Literature Cited

Allegro, J. M. 1970. The sacred mushroom and the cross. Doubleday and Company, Inc., New York.

Anderson, E. 1967. Plants, man, and life. 2nd Edition. University of California, Berkeley.

Anthony, D. W., D. Y. Telegin, and D. Brown. 1991. The origins of horseback riding. Scientific American. 265(Dec.):94–100.

Bakels, C. 2003 Faculty of Archaeology. Universiteit Leiden, also see Bakels, C. 2003. forthcoming article in the Electronic Journal for Vedic Studies (EJVS) http://www1.shore.net/~india/ejvs/ with papers from the conference entitled ''The Soma/Haoma cult in early Vedism and Zoroastrism, edited by J. E. M. Houben.

Bellinger, L. 1962. Textiles from Gordian. Bulletin of the Needle and Bobbin Club 46:5–33.

Bisset, N. G. et al. 1996. The presence of opium in a 3,500 year old Cypriote base-ring juglet. Ägypten und Levante 6.

Blegen, E. P. 1936. Excavations at Gazi, Crete. American Journal of Archaeology 40:371–73.

Bourguignon, E., ed. 1973. Religion, altered states of consciousness, and social change. Ohio University Press, Columbus.

Burney, D. A. 1987a. Pre-settlement vegetation changes at Lake Tritrivakely, Madagascar. Palaeoecology of Africa 18:357–381.

———. 1987b. Late holocene vegetational change in central Madagascar. Quaternary Research 40:98–106.

———. 1988. Modern pollen spectra from Madagascar. Paleogeography, Palaeoclimatology, Palaeoecology 66:63–75.

———. 1997. Tropical islands as paleoecological laboratories: gauging the consequences of human arrival. Human Ecology 25(3):437–457.

———. 2003. personal communication.

Burney, D. A., G. A. Brook, and J. B. Cowart. 1994. A holocene pollen record for the Kalahari Desert of Botswana from a U-series dated speleothem. The Holocene 4:225–232.

Castelletti, L., and M. Rottoli. 1999. L'agricoltura neolitica italiana. Una sintesi conoscenze attuali. In A. Pessina and G. Muscia, eds., Settemila anni fa il primo pane. Ambienti e culture delle società neolitiche. University of Udine, Udine. Pages 15–24.

Chang, K. 1968. The archaeology of ancient China. Yale University Press, New Haven, CT.

Cheng, T.-K. 1959. Prehistoric China. Volume 1.—Prehistoric China. W. Heffer and Sons Ltd., Cambridge.

———. 1963. Chou China. Volume 3.—Chou China. W. Heffer and Sons Ltd., Cambridge.

———. 1966. Prehistoric China. Supplement to Volume 1. W. Heffer and Sons Ltd., Cambridge.

Ciaraldi, M. 2000. Drug preparation in evidence: an unusual plant and bone assemblage from the Pompeian countryside, Italy. Vegetation History and Archaeobotany 9:91–98.

———. 2003. Field Archaeology Unit, University of Birmingham, Personal Communication [1/16/03 & 1/19/03].

Ciaraldi, M., and J. Richardson. 2000. Food, ritual and rubbish in the making of Pompeii. TRAC 99, Proceedings of the Ninth Annual Theoretical Roman Archaeology Conference, Oxbow Books.

Coles, B., and J. Coles. 1989. People of the wetlands: bogs, bodies and lake-dwellers. Thames and Hudson Inc., New York.

Crosby, A. W. 1973. The Columbian exchange: biological and cultural consequences of 1492. Greenwood Press 1973. Westport, CT.

Crawford, G. W., and H. Takamiya. 1990. The origins and implications of late prehistoric plant husbandry in northern Japan. Antiquity 64(245):903.

Dimbleby, G. 1967. Plants and archaeology. London and New York.

Dombrowski, J. C. 1971. Excavations in Ethiopia: Lalibela and Natchabiet Caves, Begemeder Province. Boston University, Ph.D. thesis.

Dure, J. D. 2001. Manna: the magic mushroom of Moses. Sacred-Wine Press, Duncan, BC.

du Toit, B. M. 1975. Dagga: the history and ethnographic setting of *Cannabis sativa* in Southern Africa. Pages 81–116 in V. Rubin, ed., *Cannabis* and Culture. Mouton Publishers, The Hague.

———. 1980 *Cannabis* in Africa: a survey of its distribution in Africa and a study of *Cannabis* use in multi-ethnic South Africa. A.A. Balkema, Rotterdam.

Ecsedy, I. 1979. The people of the pit-grave kurgans in eastern Hungary. Akadémiai Kiadó, Budapest.

Emboden, W. A. 1972. Ritual use of *Cannabis sativa* L.: a historical-ethnographic survey. Pages 214–236 in P. T. Furst, ed., Flesh of the Gods: the ritual use of hallucinogens. Praeger, New York.

———. 1978. The sacred narcotic lily of the Nile: *Nymphaea caerulea.* Economic Botany 32:395–407.

———. 1979. Narcotic plants. Macmillan Publishing Co., Inc., New York.

———. 1981. Transcultural use of narcotic water lilies in ancient Egypt and Maya drug ritual. Journal of Ethnopharmacology 3:39–83.

———. 1989. The sacred journey in dynastic Egypt: shamanistic trance in the context of the narcotic water Lily and the mandrake. Journal of Psychoactive Drugs 21(1):61–75.

Evans, A. 1925. Ring of Nestor. Journal of Hellenic Studies 45(1):1–75.

———. 1928. The palace of Minos. Macmillan and Company, London.

Fagan, B. M., and D. W. Phillipson. 1965. Sebanzi: the Iron Age sequence at Lochinvar, and the Tonga. Journal of the Royal Anthropological Institute 95: 253–294.

Flattery, D. S., and M. Schwartz. 1989. Haoma and harmaline: the botanical identity of the Indo-Iranian sacred hallucinogen ''soma'' and its legacy in religion, language, and Middle-Eastern folklore. University of California Press, Berkeley.

Flaws, B., ed. 1998. The divine farmer's materia medica: a translation of the Shen. Nong Ben Cao Jing. Shou-Zhong, Y. (translator). Blue Poppy Press, Boulder.

Fleming, M. P., and R. C. Clarke. 1998. Physical evidence for the antiquity of *Cannabis sativa* L. Journal of the International Hemp Association 5(2): 80–95.

Fredskild, B. 1978. Seeds and fruits from the neolithic settlement Weier, Switzerland. Botanisk Tidsskrift 72:189–201.

Fugazzola, M. 2003. Museo Pigorini, Rome, personal communication. [1/9/2003]

Furst, P. T., ed. 1972. Flesh of the Gods: the ritual use of hallucinogens. Praeger, New York.

———. 1974. Archaeological evidence of snuffing in prehispanic Mexico. Botanical Museum Leaflets (Harvard University) 24:1–28.

Gabra, S. 1956. Papaver species and opium through the ages. Bulletin de l'Institut d'Egypte 37:39–56.

Giner, C. A. 1980. Estudio de los materials de cestria de la Cueva de los Murcielagos. Trabajos de Prehistoria 37:109–162.

Gizbert, W. 1961. Nowe stanowiska kipalne maku (*Papaver somniferum* L.) na ziemiach Polskich. Nouvelles stations fossils de pavot. Materialy Archeologiczne 2(1960):347–354; addendum 3(1961):266.

Godwin, H. 1967. Ancient cultivation of hemp. Antiquity 41(161):42–50, 137–138.

Gongora, M. 1868. Antiguedades prehistoricas de Andalucia. C. Moro, Madrid.

Goodman, J., P. E. Lovejoy, and A. Sherratt. 1995. Consuming habits: drugs in history and anthropology. Routledge, London and New York.

Gyulai, F. 1996. Umwelt und Pflanzenbau in Transdanubien während der Urnenfelder-, Hallstatt- und Latènekultur. Pages 127–136 in E. Jerem and A. Lippert, eds., Die Osthallstattkultur. Akten des Internationalen Symposiums, Sopron, 10.–14. Mai 1994. Budapest.

Hastort, C. A., and V. S. Popper. 1988. Current paleoethnobotany. The University of Chicago Press, Chicago.

Herodotus. Histories. Translated by A. de Sélincourt. Penguin, 1954, IV, 75. Harmondsworth.

Heer, O. 1866. Die Pflanzen der Pfahlbauten. Pages 1–54 in Neujahrsblatt der Naturforschunden Gesellschaft. Zürich.

Heim, J., and A. Hauzeur. 2002. Paysage paléobotanique des sites du Rubané et du groupe de Blicquy à Vaux-et-Borset ''Gibour'' (Hesbaye, Belgique). Culture du blé nu et récolte de pommes en contexte blicquien. Soc préhist française 99:289–305.

Heim, J., and I. Jadin. 1998. Sur les traces de l'orge et du pavot. L'agriculture danubienne de Hesbaye sous influence, entre Rhin et Bassin parisienne? Anthropol Préhist 109:187–205.

Hoops, J. 1905. Waldbäume und Kulturpflanzen im germanischen Altertum. K.J. Trübner, Strasbourg.

Hunter, D. 1943. Papermaking: the history and technique of an ancient craft. Alfred A. Knopf, New York.

James, T. G. H. 1982. Excavating in ancient Egypt. University of Chicago Press, Chicago.

Julien, R. M. 2001. A Primer of drug action. W. H. Freeman & Company, New York.

Karageorghis, V. 1976. A twelfth-century B.C. opium pipe from Kition. Antiquity 50:125–129.

Kilgour, F. G. 1960. Medicine in art: what's new. Journal of Medicine 216.

König, M. 2001. Die Grundlagen der Ernährung im römischen Trier. Pages 69–79 in H-P. Kühnen, ed., Das römische Trier. Führer archäol Denkmäler Deutschland 40. Schrr Rheinisches Landesmus Trier 20. Stuttgart.

Körber-Grohne, U. 1985. Die biologischen Reste aus dem hallstattzeitlichen Fürstengrab von Hochdorf, Gemeinde Eberdingen (Kreis Ludwigsbur). Pages 87–162 in Hochdorf 1, Forschungen und Berichte zur Vor- und Frühgeschichte in Baden-Württemberg 19.

Koschel, K. 1996. Opium alkaloids in a Cypriote base ring I vessel (bilbil) of the middle bronze age from Egypt. Ägypten und Levante 6:159–166.

Kritikos, P. G., and S. P. Papadaki. 1967. The history of the poppy and opium and their expansion in antiquity in the eastern Mediterranean area. Bulletin on Narcotics 19:3.

Kroll, H. 2001. Der Mohn, die Trichterbecherkultur und das südwestliche Ostseegebiet. Zu den Pflanzenfunden aus der mittelneolithischen Fundschicht von Wangels, Kr. Ostholstein. Pages 70–76 in R. Kelm, ed., Zurueck zur Steinzeitlandschaft. Archaeobiologische und oekologische Forschung zur jungsteinzeitlichen Kulturlandschaft und ihrer Nutzung in Nordwestdeutschland [3rd Albersdorf Coll.], Heide.

———. 2003. Institut fuer Ur- und Fruehgeschichte der Christian-Albrecht-Universitaet, Kiel, Germany, personal communication.

Knörzer, K-H. 2000. 3000 years of agriculture in a valley of the high Himalayas. Vegetation History and Archaeobotany 9:219–222.

Kunzig, R. 2002. La marmotta. Discover 23(11):34–40.

Kuo, Y. 1978. The Western Han wooden-chambered tomb of Lao-fu-shan, Nan-ch'ang, Kiangsi province KK 1965/66:268–272, 300, pl. II, III. In R. C. Rudolph, ed., Chinese Archeological Abstracts. UCLA Institute of Archeology, 252. Los Angeles.

La Barre, W. 1970. Old and New World narcotics: a statistical question and an ethnological reply. Economic Botany 24:73–80.

———. 1972. Hallucinogens and the shamanic origins of religion. Pages 261–278 in P. T. Furst, ed., Flesh of the Gods: the ritual use of hallucinogens. Praeger, New York.

———. 1980. Anthropological perspectives on hallucinoation, hallucinogens and the shamanic origins of religion. Pages 37–92 in W. La Barre, culture in context: selected writings of Weston La Barre. Duke University Press, Durham.

Larina, O. V. 1999. The linear pottery culture of the area between rivers Prut and Dniester. (In Russian). Stratum plus (Sankt Peterburg—Kishinev—Odessa) 2:10–140.

Lempiäinen, T. 1999. On the history of hemp (*Cannabis sativa* L.) in Finland and the archaeobotanical evidence. Pages 71–77 in L. Selsing and G. Lillehammer, ed., Museumslandskap. Artikkelsamling til Kerstin Griffin på 60-årsdagen. AmS-Rapport 12 A. Stavanger.

Leone, L. 1995. Oppio, ''*Papaver somniferum.*'' La pianta sacra ai Dauni delle stele, Bollettino Camuno Studi Preistorici 28:57–68.

———. 1995–96. Ancora sulle ''Stele daunie,'' La Capitanata, Foggia 32–33:141–170.

Leroi-Gourhan, A. 1975. The flowers found with Shanidar IV: a neanderthal burial in Iraq. Science 190:562–564.

Li, H. 1974a. The origin and use of *Cannabis* in eastern Asia—Linguistic-Cultural Implications. Economic Botany 28:293–301.

———. 1974b. An archaeological and historical account of *Cannabis* in China. Economic Botany 28: 437–448.

Lietava. J. 1992. Medicinal plants in a middle paleolithic grave Shanidar IV? Journal of Ethnopharmacology 35(3):263–266.

Lisitsyna, G. N., and L. V. Prishcepenko. 1977. Paleoethnobotanischeskie. Nakhodki Kavkaza I Blizhnego Vostoka. Nauka, pp. 64, 71, 85. Moscow.

Lu, X., and R. Clarke. 1995. The cultivation and use of hemp (*Cannabis sativa* L.) in ancient China.

Journal of the International Hemp Association 2(1): 26–30.

Marinatos, S. 1937. The Minoan Goddess of Gazi. Archaeologiki Ephemeris 1:278–291.

Manhong, R. E., and S. Jianzhong. 1990. Paleobotanical and paleoclimatological study of the Banpo site. Translated by B. Gordon, edited by B. Gordon & Raymond Chau. Kaogu (Archaeology) 1:87–93. (see: http://www.carleton.ca/~bgordon/Rice/papers/re-90.htm)

McDonald, J. A. 2002. Botanical Determination of the Middle Eastern Tree of Life. Economic Botany 56(2):113–129.

McGovern, P. E., S. J. Fleming, and S. H. Katz, eds. 1995. The origins and ancient history of wine. Gordon and Breach, New York.

McGovern, P. E., M. M. Voight, D. L. Glusker, and L. J. Exner. 1996. Neolithic resinated wine. Nature 381(June 6):480–481.

McGovern, P. E., U. Hartung, V. R. Badler, D. L. Glusker, and L. J. Exner. 1997. The beginnings of winemaking and viniculture in the ancient Near East and Egypt. Expedition 39:3–21.

Meier-Melikyan, N. R. 1990. Analysis of Plant Remains from Togolok-21 [in Russian, ''Opredelenie Rastitel'nix Ostatkov iz Togolok-21'']. Drevnosti Strani Margush, by V. I. Sarianidi, pp. 203–205 and figs. 55–58. Ilim, Ashkabad. Turkmenistan/Togolok 21.

Merkur, D. 2000. The mystery of manna: the psychedelic sacrament of the Bible. Park Street Press, Canada.

Merlin, M. D. 1972. Man and marijuana: some aspects of their ancient relationship. Farleigh Dickinson University Press, Rutherford, NJ.

———. 1984. On the trail of the ancient opium poppy. Fairleigh Dickinson University Press, Rutherford, NJ.

Merrillees, R. S. 1962. Opium trade in the Bronze Age Levant. Antiquity 36:287–292.

———. 1968. Cypriotic Bronze Age pottery found in Egypt. Studies in Mediterranean. Archeology XXVIII. P. Astrora, Lund, Sweden.

———. 1979. Opium again in antiquity. Levant 11: 167–171.

———. 1989. Highs and lows in the Holy Land. Eretz-Israel 20:148–154.

———. 1999. Opium for the masses: how the ancients got high. Odyssey, Winter.

Meshorer, Y. 1982. Ancient Jewish coinage, Volume 2. Amphora Books, Dix Hills, NY.

Miller, N. 2003. University of Pennsylvania. Personal Communication. [1/2/03].

Monckton, A. 2000. Waterlogged plant macrofossils. Pages 171–175 in S. C. Palmer, ed., Archaeological excavations in the Arrow valley, Warwickshire. Warwickshire Archaeol Soc Transact 103. Birmingham.

Museo Pigorini. 2002. Website for Il Museo Nazionale Preistorico Etnografico di Roma: (http://www.pigorini.arti.beniculturali.it/Museo/Preistoria/Marmotta/marmotta.html).

Mylonas, G. E. 1966. Ancient Mycenae. Princeton University Press, Princeton, NJ.

Nava, M. L. 1988. Le Stele della Daunia, Electa, Milano.

Nesbitt, M. 2002. Royal Botanical Gardens at Kew, Personal Communication, citing corroborative agreement from Corrie Bakels, Archaeology Department, Leiden Unversity.

Neuwiler, E. 1935. Nachträge urgeschichtlicher Pflanzen. Vierteljahrsschrift der Naturforschenden Gesellschaft in Zürich, 80:98–122.

Ott, J. 1993. Pharmacotheon: entheogenic drugs, their plant sources and history. Natural Products Co., Kennewick, WA.

Opravil, E. 2000. Zur Umwelt des Burgwalls von Mikulčice und zur pflanzlichen Ernährung seiner Bewohner (mit einem Exkurs zum Burgwall Pohansko bei Břeclav). Pages 9–169 in L. Poláček, ed., Studien zum Burgwall von Mikulčice. Band 4. Spisy Archeologický ústav Akad věd Česke Republic Brno 18.

Parpola, Asko. 1994. Deciphering the Indus script. Cambridge University Press, New York.

Pashkevich, G. A. 1997. Early farming in the Ukraine. Pages 263–273 in J. C. Chapman and P. M. Dulokhanov, eds., Landscapes in flux. Central and eastern Europe in antiquity. Colloquia Pontica 3. Oxford University Press.

Pashkevich, G. 1999. New evidence for plant exploitation by the Scythian tribes during the early Iron Age in the Ukraine. Acta Palaeobot. Suppl. 2 [Proc 5th EPPC], Krákow, pp 597–601.

Pearsall, D. M. 1989. Palaoethnobotany: a handbook of procedures. Academic Press, Inc., New York.

Phillipson, D. W. 1965. Early smoking pipes from Sebanzi, Zambia. Arnoldia (Rhodesia) I, No. 40.

Pleyte, W. 1875. Dc Egyptischelotus. Nederlandische Kruidkundig Archief: Versiogen en Mededellingen der Nederlandische Botanische Vereeniging. Amsterdam.

Prioreschi, P., and D. Babin. 1993. ''Ancient use of *Cannabis.*'' Nature 364:680.

Quibell, J. E., and A. G. K. Hayter. 1927. Excavations at Saqqara: Teti Pyramid, north side. Cairo: Imprimerie de L'Institut français d'archeologie orientale.

Randall-MacIver, O., and C. L. Wooley. 1911. Buberi (Eckley B. Cox, Jr. Expedition to Nubia). Vol. 7–8. University of Pennsylvania, Philadelphia.

Roberts, N. 1998. The holocene, an environmental history. Basil Blackwell, Oxford.

Roberts, T., ed. 2001. Psychoactive sacramentals: essays on entheogens and religion. Council on Spiritual Practices, San Francisco.

Robinson, D. E., and S. Karg. 2000. Arkæobotaniske analyser. Nationalmuseet 2000. Arkæol udgravninger Danmark, pp. 369–380.

Rösch, M. 1998. Gespinstpflanzen. Pages 557–558 in H. Beck et al., eds., Reallexikon der Germanischen Altertumskunde, 11.

———. 1999. Hanf. Pages 630–631 in H. Beck, D. Geuenich, H. Steuer, and D. Timpe, eds., Reallexikon der Germanischen Altertumskunde, 13.

Ruck, C. A. P., B. D. Staples, and C. Heinrich. 2001. The apples of Apollo: Pagan and Christian mysteries of the Eucharist. Carolina Academic Press, Durham, NC.

Rudenko, S. I. 1970. Frozen tombs of Siberia. Dent, London.

Rudgley, R. 1994. Essential substances. A cultural history of intoxicants in society. Kodansha International, New York.

———. 1998. The encyclopedia of psychoactive substances. Little, Brown and Company, London.

Samorini, G. 2003. Personal Communication, March.

Sarianidi, V. 1994. Temples of Bronze Age Margiana: traditions of ritual architecture. Antiquity 68:388–397.

———. 1998. Margiana and protozoroastrism. Kapon, Athens.

Schiaparelli, E. 1927. La tomba intatta dell'architetto Cha nella Necropoli di Tebe. Musei Egiziani, Turin.

Schultes, R. E. 1995. Antiquity of the use of New World hallucinogens. Integration 5:9–18.

Schultes, R. E., A. Hofmann, and C. Rätsch. 2002. Plants of the Gods: their sacred, healing and hallucinogenic powers. 2nd revised edition. Healing Arts Press, Vermont.

Seeberg, A. 1969. Poppies, not pomegranates. Acta ad Archaeologiam et Artium Historiam Pertinentia 4: 7–11.

Sherratt, A. G. 1987. Cups that cheered. Pages 81–114 in W. H. Waldren and R. C. Kennard, eds., Bell Beakers of the Western Mediterranean. BAR Int. Ser. 331, vol. 1. British Archaeological Reports, Oxford.

———. 1991. Sacred and profane substances: the ritual use of narcotics in later Neolithic Europe. Pages 50–64 in P. Garwood, D. Jennings, R. Skeates, and J. Toms, eds., Sacred and profane: proceedings of a conference on archaeology, ritual and religion. Oxford University Committee for Archaeology Monographs. 32.

———. 1995a. Introduction: peculiar substances. Pages 1–10 in J. Goodman, P. E. Lovejoy, and A. Sherratt. 1995. Consuming habits: drugs in history and anthropology. Routledge, London and New York.

———. 1995b. Alcohol and its alternatives: symbol and substance in pre-industrial cultures. Pages 11–46 in J. Goodman, P. E. Lovejoy, and A. Sherratt. 1995. Consuming habits: drugs in history and anthropology. Routledge, London and New York.

———. 1997. Economy and society in prehistoric Europe: changing perspectives. Princeton University Press, Princeton.

Sikulová, V., and E. Opravil. 1974. Nález zvírechích kostí a rostlinných zbytků ve Vávrovichíc (okr. Opava). Fund von Tierknochen und Pflanzenüberresten in Vávrovice (Bex. Opava). Přěheld Výzkumu, pp. 124–125.

Smith, H. 2000. Cleansing the doors of perception: the religious significance of entheogenic plants and chemicals. Jeremy P. Tarcher/Putnam, New York.

Solecki, R. S. 1971. Shanidar, the first flower people. Knopf, New York.

———. 1975. Shanidar IV, a neanderthal flower burial in northern Iraq. Science 190:880–881.

Sommer, J. D. 1999 The Shanidar IV ''flower burial'': a re-evaluation of neanderthal burial ritual. Cambridge Archaeological Journal 9(1):127–129.

Sordelli, F. 1880. Sulle piante della torbiera e della stazione prestorica della Lagozza. Atti della Società Italiana di Scienzas Naturales Milano 23.

Teuscher, E. 1979. Pharmakognosie. Akademie-Verlag, Berlin.

Touw, M. 1981. The religious and medicinal uses of *Cannabis* in China, India and Tibet. Journal of Psychoactive Drugs 13(1), Jan–Mar.

van der Merwe, N. J. 1975. *Cannabis* smoking in 13th–14th century Ethiopia: chemical evidence. Pages 77–80 in V. Rubin, ed., *Cannabis* and Culture. Mouton, The Hague.

———. 2003. Department of Archaeology, University of Cape Town, Personal Communication.

van Zeist, W., and W. A. Casparie. 1974. Niederwil, a palaeobotanical study of a Swiss neolithic lakeshore settlement. Geologie en Mijnbouw 53(6): 415–428.

van Zeist, W., S. Bottema, and M. van der Veen. 2001. Diet and vegetation at ancient Carthage: the Archaeobotanical evidence. Groningen [Inst Archaeol Univ], 104 pp.

Vavilov, N. I. 1949. The origin, variation, immunity and breeding of cultivated plants. Chronica Botanica 13:1–6.

Villaret-von Rochow, M. 1967. Frucht- und Samenreste aus der neolithischen Station Seeberg, Burgäschisee-Sud. Acta Bernensia 2:21–64.

Wasson, R. G. 1968. Soma: divine mushroom of immortality. Harcourt, Brace, Jovanovich, New York.

Wenke, M., ed. 1986. Farmakologie. Avicenum, Praha.

Werneck, H. L. 1949. Ur- und frühgeschichtliche Kultur- un Nutz-pflanzen in den Ostalpen und am Ostrande des Böhmerwaldes. Schriftenreihe der Landesbaudirektion, 6:1–288.

Wiethold, J. 1995. Plant remains from town-moats and cesspits of Medieval and Post-Medieval Kiel (Schleswig-Holstein, Germany). In H. Kroll and R.

Pasternak, eds., Res archaeobotanicae—9th Symposium. IWGP.

Wilbert, J. 1972. Tobacco and shamanistic ecstasy among the Warao Indians of Venezuela. Pages 55–83 in P. T. Furst, ed., Flesh of the Gods: the ritual use of hallucinogens. Praeger, New York.

Wohlberg, J. 1990. Haoma-soma in the world of ancient Greece. Journal of Psychoactive Drugs 22(3): 333–342.

Yin, T. 1978. The bronzes unearthed at Shu-ch'eng, Anhwei. KK 1964/10:490–503, pl. I, VI. In R. C. Rudolph, ed., Chinese Archeological Abstracts. UCLA Institute of Archeology, 252, Los Angeles.

Yu, Y. 1987. Agricultural history over seven thousand years in China. Pages 19–33 in S. Wittwer, Y. Youtai, S. Han, and L. Wang, eds., Feeding a billion: frontiers of Chinese agriculture. Michigan State University Press, East Lansing.

Zervos, C. 1956. L'art de la Créte néolithique et minoenne. Editions ''Cahiers d'art,'' fig. 619, Paris.

Zias, J., Stark, H. Seligman, J. Levy, E. Walker, A. Breuer, and R. Mechoulam. 1993. Early medical use of *Cannabis.* Nature 363(6426):215.