

PLANTS AND PLANT CONSTITUENTS AS MIND-ALTERING AGENTS THROUGHOUT HISTORY

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There appears to be no human society so simple in material culture as to lack some sort of mood-altering drug as an escape from the workaday world.

—La Barre

1

From his earliest gropings as a distinct animal, man undoubtedly experimented with his vegetal surroundings. He put into his stomach anything from the plant kingdom in his frantic search for nourishment. He early discovered that some plants served to assuage hunger and sustain him; others relieved symptoms of illness; still others were dangerous, making him ill or killing him outright; but a few, he found, transported him from this monotonous and not-too-pleasant mundane existence to realms of ethereal wonder and inexplicable separation from everyday existence. He had discovered the narcotics, especially the hallucinogenic plants, capable of much more than activity on the physical body but able, through their psychoactivity on the central nervous system, to alter in ways most extraordinary the psyche and its relationship to the natural affairs of man.

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Much of the experimentation that led man to his hallucinogens was very early. One of man's earliest cultigens, *Cannabis*, dates from well nigh the beginnings of agriculture in the Old World—10,000 years ago. Specimens of coca leaves have been found in mummy bundles in some of the very early graves of Peru, in sites too early even for maize. Peyote buttons have recently been recovered from dry caves in New Mexico, which have been dated at 4000 years of age.

Material evidence of the use of plant products as hallucinogens is certainly not lacking in archaeological sites. Yet from the importance of hallucinogens in aboriginal mythology and religion we know that they have played roles so ancient that they are basic concepts even in the origin myths of peoples in primitive societies around the world. There has been the suggestion that one of the oldest hallucinogens—*Amanita muscaria*—may go back as a narcotic so far in man's prehistory that it engendered the notion of divinity and the supernatural.

It requires only a glance at beliefs surrounding some of the hallucinogens to appreciate their basic nature and significance to aboriginal concepts concerning the origin of man and his cultures: hence their great age. The fact that hallucinogens in many aboriginal societies permeate all aspects of living is evidence of their antiquity fully as convincing as material remains.

They reach into prenatal life and influence life after death; they operate throughout earthly existence. They play roles not only in health and sickness but in the relationships between individuals, villages, and tribes, in peace and war, at home and in travel, in hunting and in agriculture—there is hardly any aspect of living or dying where hallucinogenic plants do not play a major role.

It is not at all difficult to understand why hallucinogens have penetrated so deeply into all aspects of primitive societies. Man in primitive societies had to explain why a few plants possessed unearthly powers that could transfer him temporarily from everyday existence to realms of ethereal wonder. His explanation maintained that these plants were the abode of a divinity or spiritual force, and they became sacred. This concept, actually, is not wholly confined to so-called primitive societies, since many of the religions of the more advanced cultures are based on similar beliefs: witness the widespread Christian thesis that a divinity could incarnate itself into the body of a man, Jesus. But in societies based on the belief that all of nature is controlled by the supernatural, that all of man's existence—even sickness and death—is ruled by powers in outer realms, what is more logical than to assume that these plants enable mortal man—or at least certain individuals in society—to communicate through hallucinogens of various kinds with the ruling forces? As La Barre (1970) maintains: "Sacred knowledge is commonly traceable, even by natives themselves, to an origin in revelation given to the ancestors or to some similarly charismatic individual, such as a shaman, visionary

prophet or other culture hero believed to have been able to 'tap' the unseen world of the 'supernatural.' "

There are many characteristics of hallucinations that can and do deeply influence primitive religion and ideas of the cosmos. Certain hallucinogenic plants—peyote, for example—induce indescribably deep and rich colors that are so unlike those normally experienced that only a supernatural origin seems possible; others produce only reds, oranges, or yellows; still others tend to be responsible for duller tones of blues, purples, or greys. The intoxication caused by some of these plants, especially those containing tryptamines, is characterized by macropsia and undoubtedly has played a role in mythology in connection with giants; others, however, have an opposite effect, micropsia, and have influenced belief—such as with the *oprita* of the Kofans—in the "little people." Other hallucinogens enable man to fly through the air by inducing the sense of levitation: shanshi of the Ecuadorian highlands; vinho de jurema in Brazil, the fly agaric in Siberia, the solanaceous species of medieval witches' brews of Europe.

Similarly, auditory hallucinations may enable medicine men and often others to speak with the controlling spirit forces: sinicuichi, gi-i-wa and gi-isa-wa, and thle-pela-kano in Mexico fall into this category. The peyote intoxication may, at certain phases, induce auditory aberrations and, like other hallucinogens such as *Cannabis*, may evoke peculiar response to chanting, singing, music, drumming, or natural sounds like that of rippling waters—an effect clearly suggesting in aboriginal thinking supernatural connections between the causative drug and man.

2

There are very definite classes of chemical constituents in plants that induce hallucinations of given kinds: visual, auditory, tactile, gustatory, and olfactory. They are, when known, of only a few types, which can be grouped into two broad categories: the nonnitrogenous and the nitrogenous.

The nonnitrogenous hallucinogens are, primarily, the dibenzopyrans—the cannabinolic constituents known only from the genus *Cannabis*—and the phenylpropanes present in essential oils found in certain spice plants.

The nitrogenous hallucinogens—the active principles in by far the greater number of mind-altering plants—are alkaloids or related bases. They are conveniently arranged into nine groups: the isoxazoles (*Amanita*), tropanes (in many solanaceous narcotics: *Datura*, *Atropa*, *Mandragora*, *Hyoscyamus*, *Latua*, *Methysticodendron*), quinolizidines (*Cytisus*, *Sophora*, *Heimia*), phenylethylamines (known from a number of cactaceous species in *Lophophora*, *Trichocereus*, etc.), isoquinolines (*Lophophora*), tryptamines [*Justicia*(?)], certain mushrooms in *Conocybe*, *Panaeolus*, *Psilocybe*, *Stropharia*, and *Anadenanthera*, *Mimosa*, *Banisteropsis*, *Virola*, *Psychotria*], β -carboline [*Banisteriopsis*,

Tetrapteris(?), *Peganum*], ergolines (*Ipomoea*, *Rivea*, and the ascomycete genus *Claviceps*), iboga indoles (*Tabernanthe*). New types may, of course, turn up when phytochemical investigations on some of the still poorly understood hallucinogenic plants elucidate their composition.

While it is known that some of the active principles may induce characteristically visual or auditory hallucinations, there is no sound scientific evidence to support suggestions that definite kinds of visual hallucinations may tend to be produced by specific compounds. It has been, for example, intimated that the importance of huge serpents and felines in certain South American hallucinogenic ceremonies has "biochemical" explanations: that the great frequency of jaguars and other felines and snakes in descriptions of caapi intoxication might be due to an ability of the active chemical constituents to induce visions of definite kinds of subjects. There is, however, not a shred of scientifically sound evidence that such a degree of specificity exists. One is necessarily left with the near certainty that underlying the primacy of the jaguar in so many cultures are ancient, deeply ingrained, and highly positive experiences that are now part of the mind of aboriginal man. It is—to put it in really an oversimplified statement—that man, living in the South American jungle, has long since learned to respect and fear the stealth and power of gigantic snakes and cats and that, under conditions obtaining when his mind is altered by drugs, he sees and fears these overpowering animals—actually the only ones in his environment that he has experienced difficulty in overcoming.

3

One of the most ancient of the hallucinogens—although only very recently has it been deeply studied—is soma, the ancient god-narcotic of the early Aryan invaders of northern India. Whereas all other hallucinogens have been considered merely as sacred elements, soma was actually deified. It has long since died out of use in India, but scholars know of it in great detail through the hundreds of references to it in the rich Vedic literature.

Its sacred narcotic use among the Aryans goes back some 3500 years. Long an enigma that baffled botanists who tried to identify it, soma has only recently yielded to determination as *Amanita muscaria*, the widely recognized hallucinogenic fly agaric mushroom, which is still in ritualistic use in remote parts of northern Asia.

In modern times, this mushroom has been valued as a hallucinogen among isolated Finno-Ugrian tribesmen in eastern and western Siberia. Although first reported in the 18th century, the Siberian use of the fly agaric obviously is of great age, and it may be that the knowledge of these primitive peoples stems from the early days when the mushroom was undoubtedly more widely employed as a sacred narcotic than even 3500 years ago, the period of the Aryan invasion of India. The Chuckchis, for

example, believe that the mushrooms possess powerful spirits that delight in visiting places where the dead dwell; that, while it delights in playing practical jokes on a person under its influence, it may also guide him to other realms or guard him from harm in this world. The Koryaks maintain that the god Vahiynin (Existence) left the mushroom on earth to instruct man in the mysteries of nature. It is difficult to entertain any concept indicative of a more basic significance of a plant to the life of a people.

The most spectacular of the African hallucinogens, iboga (*Tabernanthe iboga*), now of ever increasing social importance in the Congo and Gabon, goes far back in prehistory to primitive Pygmy hunting societies. It is the basis of the Bwiti cult, and sorcerers take it to consult with the ancestors.

Tabernanthe iboga is, strangely enough, the only member of the extremely alkaloid-rich family Apocynaceae known to be employed as a hallucinogen. The part of the plant used is the yellowish root, which contains about 6% alkaloids: twelve indole alkaloids have been found in the plant. The most important is ibogaine—a cholinesterase inhibitor—which acts as a strong central nervous stimulant in addition to its effects as a hallucinogen.

Cannabis may well rank as our oldest hallucinogen. It is most certainly one of man's oldest cultivated plants, going back at least to the beginnings of agriculture in the Old World—some 10,000 years ago. Whether it was first valued for its mind-altering properties or for one of its several other economic uses cannot now be ascertained. Its psychoactive properties, however, are noted in the oldest recorded history in China and India, and obviously knowledge of them must predate the earliest records. An archaeological find in a Bronze Age urn in Germany, containing fragments of cannabis leaves and fruit, suggests that the plant material was valued for narcotic or medicinal purposes, not for fiber. In the 7th millennium B.C., the Chinese knew cannabis, but the Emperor Shen Nung in 2723 B.C. wrote about its "medicinal" properties. Ayurvedic medicine in India, which is rooted in great antiquity, employed cannabis early in the Christian era, even though its use in India goes back much earlier. In the 5th century B.C., Herodotus recorded the Scythian narcotic use of cannabis in sweat baths. Later, cannabis spread widely as a narcotic in many parts of Africa.

It is not only historical records and archaeological remains of cannabis that attest to its great antiquity in man's economy. The wide distribution and extreme polymorphism, especially of its principal species *Cannabis sativa*, indicate long manipulation by man in his agricultural history. Even though its value as a source of fiber, edible fruits, useful seed-oil, and medicine may have undoubtedly contributed to this manipulation and consequent variation as much as its employment as a narcotic, there is no room for doubt that selection for strains high in the intoxicating principles, especially in *C. sativa* and *C. indica*, has been carried on in some regions for millennia.

We know next to nothing about the use of hallucinogens in European prehistory. There has probably never been a part of the world, however, where the sinister use of hallucinogenic plants was more spectacular than

Europe of the Middle Ages, an area that with its Christian society was hostile to the use of mind-altering drugs. The role that the several solanaceous species—henbane (*Hyoscyamus niger*), belladonna or deadly nightshade (*Atropa belladonna*)—played in the preparation of witches' brews and the uncanny hold for so many centuries of the mandrake (*Mandragora officinarum*) in black magic are examples of this importance. The folk names of some of these plants attest their great age as narcotics: in German, *Hexenkraut* early related them to witchcraft; the English name *dwale* for the deadly nightshade stems from the ancient Scandinavian word for trance or stupor. The technical generic epithet *Atropa* goes back to the Greek for "unalterable" and the name of Atropos, one of the Fates, who cuts the thread of life; the generic name *Mandragora* is believed to be derived from a Sanskrit word signifying "sleep-drug."

Other members of this highly toxic family Solanaceae, however, are deeply and often anciently involved in cultural patterns in many diverse parts of the world. The genus *Datura* has enjoyed a major role in both New and Old World cultures and continues to do so.

Many if not most tribes north of Mexico were familiar with the psychoactive potency of several species of *Datura*, especially of *D. stramonium* in the eastern half of North America and *D. inoxia* (equivalent to *D. meteloides*) and *D. wrightii* in the Southwest and California. The Algonkians of the area of Virginia made a highly intoxicating medicine, called wyosocan and believed to contain *D. stramonium*. Young boys, to undergo initiation to manhood, were kept intoxicated for some twenty days in order to lose all memory of their former life. In the Southwest, toloache or *D. inoxia* also played important roles in initiation rites. The Yumas took it to acquire occult powers; the Luiseños gave it to youths, who danced screaming until they fell into a stupor in which they found their adult life. Among the Zuni, only rain priests, who own the plant, may collect the roots, which are powdered and put into the eyes that they may see at night, commune with the feathered animals, and contact the dead that they may intercede for rain. The Zuni have a myth ascribing direct divine origin to this *Datura*.

In Mexico, however, *Datura* attained an exalted place in the rich pharmacopoea of psychoactive drugs. Utilization goes far back in Mexican Indian life, and the hallucinogenic use of several species, especially *D. inoxia*, was widely and firmly established by the time of the Spanish Conquest. *Datura* is still highly esteemed in many Mexican tribes, such as the Tarahumares, who add it to tesguino, a fermented maize drink, and who use it ceremonially for the diagnosis of disease. A Mexican species of very special importance was *D. ceratocaula*, a fleshy plant with thick, forking stems that grows in swamps or in standing water. Known as "sister of ololiuqui" (a sacred convolvulaceous hallucinogen of Mexico), this unusual species played a major role among the Aztecs, who invoked the spirits of the plant in the treatment of certain diseases.

In South America, the native species of *Datura* (often considered to

represent a distinct genus, *Brugmansia*) are arborescent. All of the species are indigenous to high cool areas of the Andes, except *D. suaveolens* from the warmer lowland areas. They are handsome trees with large, showy flowers and have long been a favorite in horticulture, but they appear to be chromosomally aberrant cultigens no longer known in the wild state. Their narcotic use in aboriginal groups in South America varies from tribe to tribe, but in many areas their importance in ritual attests to great age as hallucinogenic agents. Always extremely dangerous as intoxicants, they are usually employed under the control of medicine men. The Jivaros, for example, administer *D. candida* to refractory children in the belief that ancestral spirits will correct their waywardness. In ancient Colombia, the Chibchas gave women and slaves of dead warriors and chieftains potions of *D. aurea* prior to their being buried alive to accompany their departed masters. The beautiful red-flowered *D. sanguinea*, valued throughout the Andes from Colombia south to Peru, was sacred to the Indians, who used the seeds in rites in the Temple of the Sun at Sogamozo in northern Colombia. In the mountain-girt Valle de Sibundoy in the highlands of southern Colombia, Ingano and Kamsá Indians have such a tradition of using *D. candida* and the closely related *Methysticodendron amesianum* that a number of morphologically atrophied and chemically distinct "races"—possibly representing virally affected strains—are kept by vegetative reproduction for employment for very specific hallucinogenic and medicinal purposes. This peculiar botanical phenomenon may well indicate great age of this culture trait in Sibundoy.

There is another solanaceous hallucinogen the use of which bespeaks antiquity. *Latua pubiflora*—the árbol de los brujos or latué of central Chile—is a very strict endemic. Its virulent poison can cause delirium, visual hallucinations, and often leads to permanent insanity. First reported in the middle of the 19th century, it was obviously of long tradition among the Mapuche Indians, whose medicine men employed it. The use of the drug has now apparently died out. It contains potent tropane alkaloids typical of so many members of the Solanaceae.

In ancient Mexico—and down to the present time—sacred, intoxicating mushrooms were, together with the peyote cactus and ololiuqui, the most important hallucinogenic agents.

Mushroom ikons—the so-called mushroom stones—have during the past century been excavated from highland Maya cultures of Guatemala, and archaeologists were at a loss to explain their significance. Now it is known that they represent idols connected with worship that employed intoxicating mushrooms as a sacrament. Some of these idols are dated from about 1000 B.C. and indicate that, at least 3000 years ago, there was a sophisticated ritual using these toxic plants as holy hallucinogenic sacraments.

Recent investigations have indicated that the hallucinogenic use of mushrooms—some 25 species in four genera (*Conocybe*, *Panaeolus*, *Psilocybe*, and *Stropharia*)—has survived in at least nine Indian groups in Oaxaca.

Detailed studies of the mushroom ritual have been made among the Mazatecs.

Frescoes from central Mexico dated at 300 A.D. have designs of the sacred mushrooms. There are numerous other indications of the great antiquity of mushrooms as hallucinogenic agents in Mexico. The Aztecs valued them greatly, and they are figured commonly on archaeological and other precolonial art objects.

Paintings at Tepantitla show mushrooms in close association with depictions of the Aztec god of rain. Furthermore, Xochipili—the so-called Aztec God of Flowers—has on his pedestal stylized engravings of *Psilocybe aztecorum*. The many references to hallucinogenic use of mushrooms by chroniclers reporting just after the Conquest indicate the extraordinary importance and antiquity of the use of these fungi. Several post-Conquest reports tell of the deep importance to Mexican religious life of mushrooms or teonanacatl (“flesh of the gods”), as they were then called in Nahuatl. They were served at the coronation feast of Montezuma in 1502. Hernández, in his great study of Mexican *materia medica*, wrote that three kinds of mushrooms were used hallucinogenically and that one—teyhuintli—caused “not death but a madness that on occasion is lasting . . . [and that] there are others again which, without inducing laughter, bring before the eyes all sorts of things, such as wars and the likeness of demons. Yet others . . . not less desired by princes for their festivals and banquets. . . .”

Due to intense Roman Catholic persecution of native religions, the rituals that employ these mushrooms were driven into the hinterlands and were not known until 1939. In 1916, an ethnobotanist, faced with the complete lack of knowledge of mushrooms so employed, suggested that the natives had misinformed the Spanish authorities and had pointed out mushrooms in an attempt to protect their true hallucinogen, peyote. He reasoned that dried peyote heads or “buttons” resembled dried mushrooms. Consequently, he misidentified teonanacatl, insisting that it was in reality the same as the peyote cactus. But research during the past forty years has shown not only that mushrooms were used but that they represented extremely important elements in the native cultures.

These mushrooms are biochemically significant because of the discovery that their active principles are curious indoles: psilocine and the structurally curious psilocybine. Psilocybine, a hydroxyindole alkylamine with a phosphorylated hydroxyl radical, represents a wholly new type of structure that not even the synthetic chemist had ever prepared: 4-phosphoryloxy-*N,N*-dimethyltryptamine. It is known only from these mushrooms.

Missionaries of the 18th century reported that the Yurimagua Indians in Amazonian Peru took an intoxicating beverage made from a “tree fungus.” Even though no field evidence has substantiated this use of a fungus in the Amazon, it has been suggested that the known hallucinogenic mushroom *Psilocybe yungensis* may have been the fungus to which reference was made.

The early Spanish chroniclers of Mexico likewise reported the use of ololiuqui and tlitiltzin among the natives as sacred intoxicants. Ololiuqui was described repeatedly as a vine and was at least twice illustrated as a morning glory. Again, however, as in the case of the mushrooms, morning glory seeds had never been seen employed in modern Mexico as intoxicants. Furthermore, no intoxicating principle was known in this family, the Convolvulaceae. Consequently, it was long presumed that the natives, to confound the Spanish ecclesiastical authorities, were pointing out morning glories to protect the sacred hallucinogen toloache, *D. inoxia*, of the Solanaceae, which has flowers superficially resembling those of the Convolvulaceae. This misidentification persisted in the literature until recently, when two species of morning glories employed to this day by Indians in Oaxaca were identified: *Rivea corymbosa*, the ololiuqui of the ancients, and *Ipomoea violacea*, the tlitiltzin. From the seeds of both species chemists eventually isolated a number of ergoline alkaloids related to the synthetic lysergic acid diethylamide (LSD). The total alkaloid content of *R. corymbosa* seeds is 0.012%, of *I. violacea* 0.06%, the reason why natives use smaller quantities of the latter than of the former.

The chroniclers gave very detailed descriptions of ololiuqui and its effects. One wrote that "it is remarkable how much faith the natives have in the seed . . . which they consult as an oracle to learn many things . . . especially those beyond the power of the human mind to penetrate." Another reported how the "seeds are held in great veneration. . . . The Indians place offerings to the seeds in secret places . . . and put them amongst the idols of their ancestors" and that they do "all in their power so that the use of the plants does not come to the attention of the authorities."

Modern Indians in Oaxaca call the seeds of *R. corymbosa* "semilla de la Virgen." They grind the seeds to a powder on a metate, soak the powder in water, strain the liquor through a cloth. This liquid is then drunk. Unless the seed is crushed and soaked, it is not active. Contemporary use of these morning glory seeds concerns itself mainly with divination, prophecy, and diagnosis of disease.

In the same region of Oaxaca, the leaves of a mint, *Salvia divinorum*, known as hojas de la Pastora, are often employed as a hallucinogen. It has been suggested that *S. divinorum*, now used apparently only in Oaxaca, may have been the pipiltzintzintli of the ancient Aztecs. The plant is reproduced vegetatively, as it seems not to produce seeds—due possibly to great age of cultivation. Most Mazatec Indian families own a tiny plot of this mint hidden away in remote areas away from roads and trails. The intoxicating effects of these leaves are less marked than those induced by the mushrooms or morning glories and are of shorter duration. Although the psychoactivity has been experimentally established, no biodynamic constituent has as yet been isolated from *S. divinorum*.

It is probable, but not yet certain, that the leaves of two species of

Coleus—*C. blumei* and *C. pumilus*—are similarly employed in Oaxaca. Both are Old World plants introduced early into Mexico.

Undoubtedly the most important of the sacred Aztec hallucinogens and one the significance of which in native religions has grown is peyote, a small spineless cactus of central and northern Mexico and the Rio Grande area of Texas. Two species are recognized: *Lophophora williamsii*, the most widely distributed, and *L. diffusa*, restricted to Querétaro. There appear to be chemical as well as morphological differences between the two species.

Known to the Aztecs as peyotl, this cactus was a holy mediator between man and the divinities. Hernández, the King of Spain's personal physician who studied Aztec medicines, wrote in 1576 that "this root . . . conceals itself in the ground as though unwilling to harm those who may find and eat it." The early Spanish literature was fanatically and vituperatively condemnatory of peyote, and its use was equated with cannibalism. Attempts to extirpate the religious use of peyote resulted in its retreat into remote areas where it survived. The Tarahumares, Huichols, and other tribes of central Mexico still venerate this holy sacramental plant, and the Huichols practice an annual ceremonial pilgrimage to the areas where peyote grows to gather supplies. The purpose of this pilgrimage is to find their "life." To them, peyote is identical with the deer, their sacred animal, and with maize, their sacred food plant; all three are fused into a single symbol complex. Their "hunt" peyote, and their first peyote-hunting ceremony was led by Tatewari (Our Grandfather)—equivalent to Fire and the original Shaman—and the leader of the modern peyote quest becomes the embodiment of Tatewari.

The Tarahumares have perhaps the keenest appreciation of peyote. They assert that the severed heads of the cactus sing happily in the bags once they have been collected. The plant, they insist, prolongs life, protects hunters from wild animals, guards mourners from ghosts, and they assert that an individual who has not eaten peyote must never touch the plant, lest he become demented.

The extraordinary and complex peyote intoxication, as well as its reputation as a physical and psychic Indian medicine, led to its spread far to the north of its range in Mexico. During the last century, Indians from the United States encountered this native cactus-centered religion. Following 1880, it was accepted with great speed among many tribes in North America as the central sacrament of a new peyote cult—a blend of the ancient pagan and modern Christian elements—which was legally organized into the Native American Church, now claiming 250,000 members in the United States and Canada. These Indians, distant from the source of peyote, import legally the dried tops of the plant—peyote buttons—the form in which the cactus is usually ingested, even in Mexico.

The most outstanding characteristic of the peyote intoxication is the extraordinary series of visual hallucinations in indescribably brilliant colors in constant kaleidoscopic motion. This is often accompanied by auditory, tactile, gustatory, and olfactory hallucinations. It is consequently not difficult to

understand why natives would accord such a biodynamically potent plant a special place of honor and reverence in their thinking and living.

Lophophora williamsii contains some 33 alkaloids or related bases. Both phenylethylamines and isoquinolines are present. Mescaline, 3,4,5-trimethoxyphenylethylamine, is solely responsible for the characteristic visual hallucinations.

The Tarahumares and other Mexican Indians consider as "false peyotes" other cactus plants. Some of these have been investigated chemically and contain toxic principles. Among these false peyotes are species of *Ariocarpus*, *Pelecypora*, and *Astrophytum*. "All of these various species," reported the anthropologist Lumholtz, "are considered good, as coming from Tata Dios, and well disposed toward the people. But there are some kinds of hikuli [peyote] believed to come from the Devil. One of these, with long white spines, is called ocoyome. It is very rarely used, and only for evil purposes."

That peyote enjoys great antiquity as a sacred intoxicant is attested by the recent discovery of dried peyote buttons in archaeological sites in Texas of some 4000 years of age.

In prepeyote days in the American Southwest and Mexico, the toxic red seeds of the leguminous *Sophora secundiflora* were ingested in a vision-seeking ritual variously known as the Wichita Dance, Red Bean Dance, or Mescal Bean Dance. The bean, which contains the alkaloid cytisine, is dangerously toxic and can cause death through asphyxiation. When peyote, a relatively safe drug, came north, the Indians turned to its use and gave up ingestion of the mescal bean. It persists today, however, in the dress of the peyote leader as a necklace—a vestige of a once sacred plant.

Mexican Indians possess certain plants that characteristically induce auditory hallucinations. The most important of these is sinicuichi, *Heimia salicifolia*, with five quinolizidine alkaloids, the most important of which is cryogenine. Wilted leaves of sinicuichi are crushed in water, which is allowed slightly to ferment. The drink brings on drowsiness, a feeling that the surroundings are shrinking, auditory hallucinations, and a general isolation from reality. Another plant causing alteration of hearing is the composite *Calea zacatechichi*, which the Chontal Indians of Oaxaca, who call it thle-pelakano or "leaf of god," take in an infusion for divination through conversation with supernatural powers. Similarly, the Mixtecs of Oaxaca employ two species of puffball—*Lycoperdon marginatum* and *L. mixtecorum*—as auditory hallucinogens. Nothing is known of the active principles capable of altering auditory perception in the *Calea* or the *Lycoperdon*.

The value that Mexican Indians place on auditory hallucinogens is evident in the use of the sacred mushrooms, morning glories, and peyote, all of which, in addition to visual hallucinations, occasionally cause distortion of the hearing—a reaction that is considered of great significance among the indigenous users of these drugs.

In South America, perhaps the most renowned hallucinogen is the drink

variously called ayahuasca, caapi, natema, pinde, and yajé and prepared basically from the bark of several species of the malpighiaceae *Banisteriopsis*: especially *B. caapi* and *B. inebrians*. Either a boiled decoction or a cold-water infusion may be made. On occasion, other plant ingredients are added. This narcotic is widely used in the western Amazon and upper Orinoco and along the Pacific coast of Colombia and Ecuador.

The Kechwa term ayahuasca means "vine of the soul" and stems from the frequent experience that the soul separates from the body and wanders free during the intoxication. Many Indians insist that they even come to know death under the influence of the drug, and that those who take it "die," only to be reborn in a state of greater wisdom.

The effects of ayahuasca or caapi can be violent and with unpleasant after effects. Nausea and vomiting are almost always early characteristics of the effects of the drink. These are followed by a pleasant euphoria, then by visual hallucinations, initially of a bluish or purplish cast. Excessive doses cause nightmarish and frightening visions—often of jaguars and snakes.

Banisteriopsis caapi and *B. inebrians*, when used alone in the preparation of the intoxicant, possess hallucinogenic properties due to the presence in the bark of three β -carboline alkaloids: harmine, harmaline, and tetrahydroharmine. Recent research, however, has indicated many plants occasionally added to strengthen, lengthen, or alter the inebriating effects. Only a few have been chemically studied, but the results have been astonishing. Two of the additives—the leaves of the rubiaceae *Psychotria viridis* and the leaves of another species of *Banisteriopsis*, *B. rusbyana*—contain *N,N*-dimethyltryptamine. The tryptamines are ineffective when eaten, unless taken in the presence of a monoamine oxidase inhibitor. The β -carbolines act as this inhibitor, allowing the tryptamines to exert their hallucinogenic effect. Another occasional additive—*D. suaveolens*—contains highly hallucinogenic tropane alkaloids.

In the northwest Amazon of Brazil, the malpighiaceae vine *Tetrapteris methystica* is employed alone as the basis of a drink called caapi, which has effects identical with the drink prepared from *B. caapi*. In view of the close relationship of the two genera, it is probable that *T. methystica* contains the same or similar β -carboline alkaloids, but chemical investigation has not yet confirmed this suspicion.

Several other South American hallucinogenic preparations owe their activity to tryptamines: vinho de jurema, ebena or nyakwana, yopo, and huilca.

In Pernambuco, Brazil, the famous drink ajuca or vinho de jurema is made from the root of *Mimosa hostilis*, a small tree or large shrub of the Leguminosae. The ancient jurema cult was practiced formerly by five or six tribes: priests, young men, warriors, and old women took it with bowed heads before battle, and the warriors about to fight would see glorious visions of the spirit world, glimpses of the clashing rocks that destroy the souls of the dead journeying to their destination, and the mystical thunder bird with

lightning bolts flashing from a huge tuft on his head producing claps of thunder.

Reported in the literature as early as 1788 and 1843, jurema was definitely identified only in 1946. At that time, a new alkaloid named nigerine was reported from the roots, but it was later shown to be identical with *N,N*-dimethyltryptamine.

Historically, one of the most famous South American hallucinogens is the snuff known in the Orinoco as yopo and prepared from beans of the leguminous *Anadenanthera peregrina*, known also as *Piptadenia peregrina*. Many early explorers of the region—including von Humboldt and Spruce—wrote about this strikingly powerful drug. Undoubtedly the earliest report—that of Pané—described the cohoba powder of the Taino Indians of Hispaniola in 1496. This description was first published in 1511, when the drug was detailed as being “so strong that those who take it lose consciousness . . . the arms and legs become loose and the head droops” and “almost immediately they believe they see the room upside down and men walking with their heads downwards.” It is probable that the tree—together with the custom of using the snuff prepared from its seeds—was taken to the Antilles by the Indians who invaded the islands from South America. The hallucinogenic use of *Anadenanthera* has, however, died out in the West Indies, and cohoba was not actually identified as the same drug as yopo until 1926.

The flat black beans are gently toasted, pulverized, and mixed usually with lime or alkaline ashes. Early explorers mistakenly felt that the biodynamic activity was due to the alkaline admixture. It is now known that the seeds contain several potent tryptamines, including relatively high concentrations of *N,N*-dimethyltryptamine and 5-methoxy-*N,N*-dimethyltryptamine, as well as bufotenine or 5-hydroxy-*N,N*-dimethyltryptamine.

The activity of yopo is rapid in onset but not of long duration, unless continued snuffing is practiced. Initial twitching of muscles and nervousness is quickly followed by a stage during which dancing, chanting, shouting, and violent physical action—such as gesticulating and fighting the hekula or enormous spirits—is characteristic. Eventually the Indian sinks down into a lethargic condition, during which visual hallucinations occur, and later into an almost comatose nightmarish sleep. Macropsia is very characteristic of the intoxication.

In the southern parts of South America—in Peru, Bolivia, and Argentina—the natives made intoxicating snuffs in preconquest times, but their use has long since died out. The term vilca in modern Peru refers often to *A. colubrina*, as does the term sébil in Argentina. An early report, dating from about 1571, stated that Inca sorcerers prophesied by contacting the devil through chicha (maize beer) and an herb called vilca. And in Argentina, the Comechingon Indians took something called sébil through the nose. However weak and circumstantial the evidence that vilca and sébil were prepared from *Anadenanthera*, there is no biochemical reason why this species could not have been the source of the snuff: the seeds contain tryptamines in

concentrations similar to those of the seeds of the morphologically related and more northerly species *A. peregrina*.

Another major South American snuff is prepared from the blood-red resin of the inner bark of several species of the myristicaceous *Virola*: *V. calophylla*, *V. calophylloidea*, *V. elongata*, and especially *V. theiodora*. This snuff is variously known as paricá, ebena, nyakwana, or yakee. The area of use of *Virola* comprises the northwest Amazon of Brazil and Colombia and the uppermost Orinoco of Venezuela, but its greatest use centers among the Waiká Indians of Brazil and Venezuela. Methods of preparing the snuff vary, but the end-product is a fine brownish powder, usually with the alkaline admixture of ashes and sometimes also with the powdered dried leaves of the acanthaceous *Justicia pectoralis* var. *stenophylla*.

Like yopo, ebena snuff causes initial excitement and nervousness, numbness of the limbs, twitching of facial muscles, often nausea, increased lacrimation and nasal discharge, macropsia, hallucinations, and finally a deep sleep. Macropsia enters into Waiká beliefs about the hekula or spirits resident in the drug.

That the effects of ebena snuff should be so similar to those of yopo is due undoubtedly to similarity in chemical composition of the two drugs. Although from a family unrelated to that of yopo, *Virola* snuffs are tryptaminic. A snuff prepared from *V. theiodora* contained up to 8% 5-methoxy-*N,N*-dimethyltryptamine. Tryptamine content of the snuff made from this species reaches 11%.

The Witotos, Boras, and Muinanes of Amazonian Colombia utilize the resin of *V. theiodora* and other species orally as a hallucinogen. Pellets of the boiled resin are rolled in a "salt" left upon evaporation of the filtrate of the bark ashes of *Gustavia poeppigiana* and ingested to bring on a rapid intoxication, during which the shamans see and speak with the "little people." In this oral use of *Virola*, the monoamine oxidase inhibitor activating the tryptamines is a minute concentration of a β -carboline alkaloid present in the resin.

In Peru, a tall columnar cactus known as San Pedro or aguacolla is the basic ingredient of a vision-inducing drink that *curanderos* administer to their patients or ingest themselves for diagnosis, divination, and confrontation with hostile spirits. The moon-oriented San Pedro cult is clearly of great age. The intoxicating drink prepared from this cactus, *Trichocereus pachanoi*, is called cimora. It may often contain additives, such as *Neoraimondia macrostibas*, another cactus, and the campanulaceous *Isotoma longiflora*, the euphorbiaceous *Pedilanthus tithymaloides*, and a species of *Datura*. While some of these additives may contain hallucinogenic principles, the active constituent of the *Trichocereus* is mescaline.

There are a number of minor intoxicants employed in sundry parts of the world. For the most part, their use is poorly understood, and in most cases, little if anything is known of ceremonies connected with their employ-

ment nor of their chemistry. Some may have narcotic effects, yet not be true hallucinogens.

One of the most interesting of these anomalous intoxicants is the mint *Lagochilus inebrians* of central Asia. For centuries, tribesmen living on the dry steppes of Turkestan have made a tea of the toasted leaves, stems, fruiting tops, and flowers. Sweetened with honey, it is drunk for inebriation. Recent studies have indicated the presence of a polyhydric alcohol that presumably is the psychoactive constituent.

Another enigmatic intoxicant is channa or kanna of the Hottentots of southern Africa. Some 225 years ago, it was reported that these people chewed a root, keeping the masticated material in the mouth for some time, and that shortly after the chewing, "their animal spirits were awakened, their eyes sparkled and their faces manifested laughter and gaiety," and that if taken to excess the drug caused them to lose consciousness and fall into a "terrible delirium." Since the use of this drug has apparently ceased, it has been impossible to identify it with certainty. The name kanna is, however, applied to several species of *Mesembryanthemum*: *M. expansum* and *M. tortuosum*, members of the Aizoaceae or carpet weed family that contain mesembrine, an alkaloid that produces torpor in man.

There are several unusual solanaceous species employed in South America as narcotics—in addition to the well known members of *Datura* and *Methysticodendron*. In the westernmost Amazon, a species of *Brunfelsia* is used alone as a hallucinogen by the Kofán Indians of Colombia and Ecuador and among the Jíbaros of Ecuador, it is valued as an additive of the ayahuasca drink. The identity of the intoxicating principle has not yet been established. It has recently been learned that a species of *Ichroma* is employed on occasion in the Andes of southern Colombia as an hallucinogen. The active constituent, probably alkaloidal, has not yet been determined. The genus *Petunia*, native of the Andes, has recently been reported as an intoxicant of highland peoples of Ecuador. Nothing is known of psychoactive principles in *Petunia*. It has similarly been reported that Ecuadorian Indians eat the highly toxic fruits of shanshi, *Coriaria thymifolia* of the Coriariaceae, for the sensation of flying. Although this plant has long been recognized as a potent cattle poison, the hallucinogenically active principle is not known. Several species of the ericaceous genus *Pernettya* are suspected as being used hallucinogenically in the Andes: taglli in Ecuador (*P. parvifolia*) and hierba loca or huedhued in Chile (*P. furians*). The toxic constituents andromedotoxine, a resinoid, and arbutine, a glycoside or hydroquinone, are common in this family and may be responsible for the activity of these species. In the southern Andes in Peru, *Lobelia tupa* of the Campanulaceae, locally called tupa or tabaco del diablo, is smoked for its intoxicating properties. It contains lobeline and related bases. In the same general area, the poorly understood *Desfontania spinosa*, belonging to the anomalous family Desfontaniaceae, is reputedly employed as a narcotic, but again phytochemical studies are

lacking. *Gomortega keule*, the only species in the family Gomortegaceae, may once have been employed as a narcotic in Chile, where it is called keule or hualhual. The fruits are said to be intoxicating, especially when fresh, due possibly to an essential oil. In the central Amazon of Brazil, the fruit of a large jungle tree, the moraceous *Maquira sclerophylla*, is reputedly used to prepare a snuff formerly employed by the Indians of the Pariana region. Nothing is known of its chemical constituents. There is suspicion that the beans of both *Erythrina* and *Rhynchosia* of the Leguminosae may once have been valued as narcotics in Mexico, but further studies are needed for verification. In northern Canada, the rootstock of flag root, the aroid *Acorus calamus*, which is known to induce visual hallucinations, may be employed for this purpose by local Indians. It contains asarones. The Old World *Cytisus canariensis* is reputedly employed as a minor hallucinogen by Yacuí medicine men in northwestern Mexico. Its active principle apparently is cytisine.

Several hallucinogens have been reported from southeast Asia but are not very well understood. Natives in Papua are said to eat leaves of ereiba, a species of the aroid *Homalomema*, together with the bark and leaves of agara, the himantandraceous *Galbulimima belgraveana*, as a narcotic preparation. It brings on a violent and crazed condition, leading to a deep sleep with dreams of men or animals that they are destined to kill. No hallucinogenic principle is known from *Homalomema*, but several isoquinoline alkaloids have been isolated from the *Galbulimima*. In New Guinea, *Kaempferia galanga*, known as galanga or maraba, is used as a hallucinogen. A member of the ginger family, Zingiberaceae, galanga is rich in essential oils. The rhizome is the part employed. The Bushmen of Botswana consider kwashi, the amaryllidaceous *Pancratium trianthum*, to be psychoactive. The bulb of this perennial is sliced and rubbed on incisions made in the skin of the head to induce visual hallucinations. The genus contains alkaloids, some of which are strong cardiac poisons.

4

It is clear that much still needs to be accomplished before we know most of the psychoactive plants used in primitive societies around the world. New ones are constantly turning up, and many are but imperfectly known. Furthermore, the study of plant additives is new and has already presented several fascinating problems. However, only an interdisciplinary study can lead to progress in this investigation—an investigation that boasts both academic and very practical aspects. The future—if we can keep ahead of the rapid disappearance of truly aboriginal life and customs—promises many amazing discoveries in the field of hallucinogens and plant narcotics.

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