# Ethnopharmacologic Search for PSYCHOACTIVE DRUGS

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# The Place of Ethnobotany in the Ethnopharmacologic Search for Psychotomimetic Drugs

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## Introduction

The very descriptive word *ethnobotany* has been defined in sundry ways in the 70 years since it was created and first used by Harshberger (*23*). Although Harshberger indicated how ethnobotanical investigation could be integrated into overall research, he failed to offer a definition of his new term.

Years earlier, in 1874, Powers (*38*) had used the term *aboriginal botany* to refer to a study of "all the forms of the vegetable world which the aborigines used for medicine, food, textile, fabrics, ornaments, etc."

It was, apparently, not until 1916 that a truly broad concept emerged that went beyond mere identification and cataloguing of plants used by primitive peoples. This broad definition of the term *ethnobotany*, now rather widely held, was promulgated by Robbins, Harrington and Freire-Marreco (*42*), and, in effect, attributes to this discipline a study and evaluation of the knowledge of all phases of plant life amongst primitive societies, and of the effects of the vegetal environment upon the life, customs, beliefs and history of the peoples of such societies.

Jones (*27*) has offered the following precise definition: "the study of the interrelations of primitive man and plants." It is interesting to note that Jones and others (*9*) prefer to restrict *ethnobotany* to man in primitive states of culture. While this premise may and probably does almost always obtain, there is really no reason to circumscribe the term in this way. Vestal and Schultes (*62*) looked upon ethnobotany as a part of *economic botany*. Since I do not hold that ethnobotany need be limited exclusively to man in primitive society, my own definition (*46*) circumscribes *ethnobotany* as "a study of the relationships between man and his ambient vegetation."

# Ethnobotany and the Search for New Drugs

It is natural that an interdisciplinary field such as ethnobotany be replete with problems for investigation. These are and have been not only numerous but varied as well, and the burgeoning nomenclature bears witness to this variation. In recent years, such terms as *archaeoethnobotany*, *ethnomycology*, *ethnoecology* and *ethnopharmacology* have been proposed and have come into use.

Nowhere perhaps have the potentialities of ethnobotanical investigation been more scintillating than in the search for new psychotomimetic drugs (*57*). These potentialities have been realized in the case of a number of new and previously known hallucinogens that are now relatively well understood: the narcotic mushrooms and morning glories of Mexico; the ayahuasca-caapi-yajé complex of South America; the intoxicating snuffs of the Orinoco and Amazon basins. They remain to tantalise us, however, in the case of several narcotics known vaguely from common names or from sketchy reports of travellers and missionaries: several South American snuffs; the marari of lowland Bolivia; an intoxicating "tree-fungus" of the Yurimagua Indians of eastern Peru; the yurema root infusion of the Pankararú of Brazil; the magic woi of the Yekwana of southern Venezuela. Furthermore, they challenge us to find, through ethnobotanical avenues, new psychotropic plants that most certainly are still in use, but which have never been seen nor reported by the prying inquisitiveness of man outside of the culture that employs the narcotics.

I cannot help thinking that Linneaus himself must have had ethnobotany in mind, at least in part, when he in 1754 wrote in a museum catalogue the following philosophy: "Man, ever desirous of knowledge, has already explored many things; but more and greater still remain concealed; perhaps reserved for distant generations, who shall . . . make many discoveries for the pleasure and convenience of life. Prosperity shall see its increasing Musuems, and the knowledge of the Divine Wisdom, flourish together; and at the same time all the practical sciences . . . shall be enriched; for we cannot avoid thinking, that what we know of the Divine works are much fewer than those of which we are ignorant."

In the search for new hallucinogens, we have much to do and little time in which to do it. Peoples in primitive societies, because they live most intimately with their immediate vegetational environment, *do* possess a valuable understanding of the properties of plants, even though their knowledge of plants has sometimes been optimistically exaggerated by both lay enthusiasts and ethnopharmacological zealots. The aborigines' knowledge and understanding, furthermore, is probably everywhere far from complete. It, therefore, behooves all of us interested in a search for new psychotomimetic drugs to carry out our investigations along several avenues of approach, not following the ethnobotanical avenue to the exclusion of others (*52*). It is, however, the place of ethnobotany in this search that I shall here discuss, and I want merely, at the very start, to put it thus into proper perspective.

Civilization is closing in on many, if not on most, parts of the world still sacred to the less advanced cultures. It has long been pressing in, but its pace is now accelerated as the result of geographically extensive wars, extended commercial interests, increased missionary activity, widening tourism. Modern methods of travel and penetration have given civilisation the tools for this accomplishment. Road-building programmes in Latin America provide us with but one example of how fast this penetration of the hinterlands is proceeding.

Our great concern lies in the progressive divorcement of man in primitive societies from dependence upon his immediate environment. I have often stated that perhaps the greatest enemy or, at least, competitor, of ethnopharmachological research is the arrival and cheap availability of the aspirin pill. More than once this has initiated an astonishingly rapid disintegration of native medical lore. I doubt that social scientists are fully aware of the rapidity of this disintegration, but the ethnobotanist cannot fail to see it. That the aspirin (meaning, of course, modern medicines in general) may be more beneficial than herbs and magic is not ours to consider here. What does interest us academically and practically is how to salvage some of the medicobotanical lore of primitive cultures before it shall have been forever entombed with the culture that gave it birth (*51*).

In considering the ethnobotanical approach in our search for new drugs we must constantly bear in mind the widespread exaggeration of the usefulness of ethnobotanical data. Although we cannot afford to pre-judge reports of aboriginal uses of plants simply because they seem to fall beyond the limits of credence, we must nevertheless ever keep in mind that there is no reason to presume that, because man in primitive living does have knowledge as yet unknown to us, he may possess anything more than a limited intuition into the properties of plants.

Although now at long last there is more agreement concerning the larger aims of ethnopharmacological investigations, the field has suffered—as has ethnobotany in general—from lack of orientation and integration. Ethnobotanical research has often, of necessity, been done as a sideline by botanists untrained in ethnology; by anthropologists lacking any knowledge of biology; or even by laymen, dedicated enough, but devoid of preparation in both biology and anthropology. And in more recent years, the training commensurate with thorough ethnobotanical investigations has enlarged its scope to include some familiarity with topics such as chemotaxonomy, which once would never have been considered germane. As a result of this checkered history, ethnobotanical research, its purposes and its potentialities has too often suffered from smug depreciation at the hands of specialists in disciplines that have been academically more clearly delimited.

The potentialities of ethnobotanical research into folk medicine are far too extensive for proper treatment in a short lecture, but certain salient points may and should be made, and these points may be supported by specific examples. In delving into the medicine of primitive societies, we must never lose sight of the vast difference between "medicine" in our sense and that in primitive societies. In almost all, if not all, primitive cultures, the concept

of sickness and even of death from natural causes is unknown or incomprehensible. Instead—and we must here over-simplify the problem for our purposes—supernatural spirits or forces of evil work in sundry ways to bring about the impairment of health or cessation of life. We should realize that hexing and witchcraft were widely accepted as recently as three centuries ago in what was, in many respects, the advanced culture of Europe. Amongst the members of primitive cultures to-day, treatment usually comprises various kinds of exorcism; and diagnosis, and often treatment itself, must be carried out through communication with the spirit or supernatural world. Many ways of communicating have been developed, but the employment of vision-producing narcotics or hallucinogens of plant origin seems to have been widespread in both time and space, and to have occurred in many wholly unrelated cultures.

We do not know exactly how many species of plants there are. There may be as many as 800,000. Estimates for the Angiosperms alone vary from the usually cited 200,000 to about half a million (*55*).

It is interesting to compare the number of species of plants that man has found valuable for nutrition with those that he has employed to induce hallucinations. Of this vast assemblage of Angiosperms, only about 3000 are known to have been used directly as human food. The number of species that actually feed mankind is, however, very small. Only about 150 Angiosperms are important enough as foods to enter the world's commerce. Of these, only 12 or 13 stand, in effect, between the world's population and starvation, and these dozen or so plants are all cultivated species (*55*).

We find, likewise, that the number of species providing man with narcotic agents is very small. Between four and five thousand species are now known to be alkaloidal,[1] and we must realise that constituents other than alkaloids—glycosides, resins, essential oils and others—may also be responsible for narcotic activity. Probably no more than 60 species, including Cryptogams and Phanerogams, are employed in primitive and advanced cultures for their intoxicating effects. Of these, only about 20 may be considered of major importance. What is even more significant is that so few—coca, opium poppy, hemp, tobacco—are numbered amongst the world's commercially important cultivated plants. Four of these five, if not all five, species are cultigens, unknown in the wild state. This bespeaks long association with man and his agricultural practices (*55*).

It may likewise be of significance that, whether because of cultural differences or floristic peculiarities or for some other as yet unappreciated reason, the New World is much richer in narcotic plants than the Old. These statistics, naturally, relate merely to those plants the narcotic properties of which man has discovered in his trial and error experimentation during the course of human history. The longer I consider this question, the more I am convinced that there may exist in the world's flora an appreciable number of such plants not yet uncovered by the experimenting natives and still to be found by the enquiring phytochemist. This is an aspect of the problem in which ethnobotanical approaches cannot help, but even though our ethno-

[1] R. F. Raffauf, personal communication.

botanical research into narcotic plants is still embryonic, we know enough to realise that both the Old and the New Worlds offer rich fields for potential discoveries.

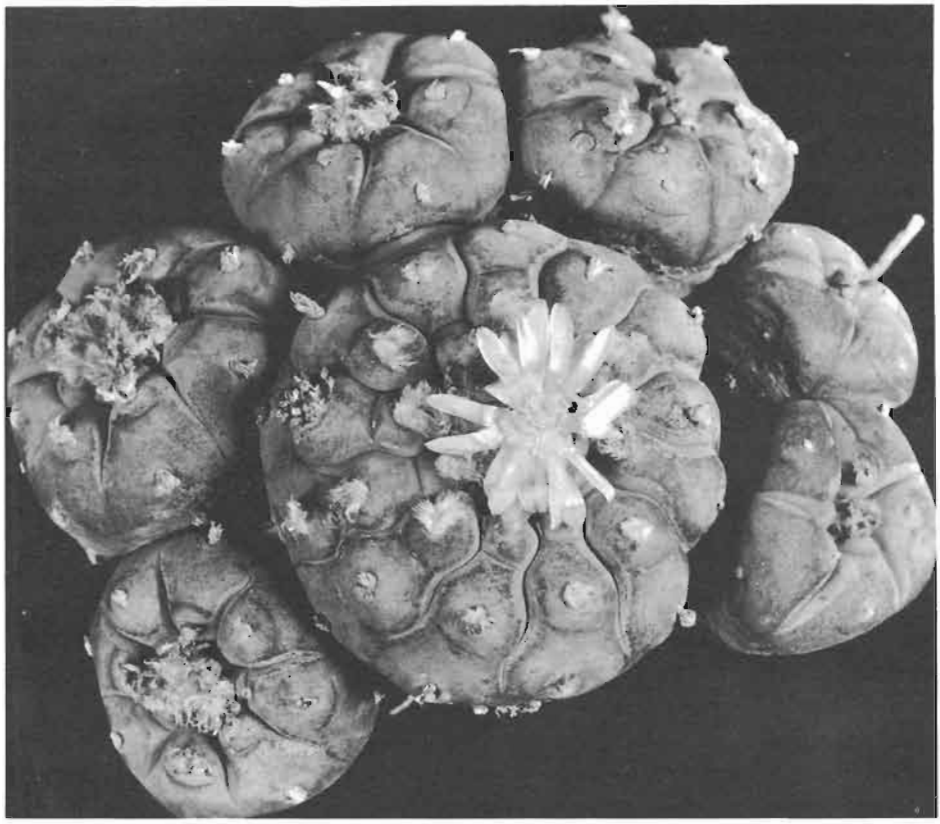
Where do some of the ethnopharmacological problems in connexion with our search for new and interesting psychotomimetic agents lie? Let us contemplate some of the hints that might guide such research in the future.

Geographically, the problems may be found almost throughout the globe, concentrated, to be sure, in areas where primitive societies still hold sway unmolested by the inroads of modern civilisation.

## Consideration of Pressing Problems

Some of the most interesting enigmas lurk in the desert stretches of northern Mexico, where what we might term the "prototype" of the New World hallucinogens—peyote or *Lophophora Williamsii*—has long been the centre of religious and curative rites in the Tarahumare and Huichol country. Peyote, of course, is well known from many aspects, and 13 alkaloids have thus far been isolated from it (*33*). The explorer Carl Lumholtz (*32*) mentioned, however, other narcotic cactus plants, some of which are as yet not even botanically identified. "High mental qualities," he wrote, "are ascribed especially to all species of *Mammilaria* and *Echinocactus*, small cacti, for which a regular cult is instituted. The Tarahumares designate several as *hikuli*, though the name belongs properly only to the kind most commonly used by them . . . The principal kinds are . . . *Lophophora Williamsii*. The Tarahumares speak of them as the superior *hikuli* (hikuli wanamé) . . . Besides hikuli wanamé . . . , the Tarahumares know and worship the following varieties: 1. *Mulato* (*Mammilari micromeris*). This is believed to make the eyes large and clear to see sorcerers, to prolong life and to give speed to the runners. 2. *Rosapara*. This is only a more advanced vegetative stage of the preceding species—though it looks quite different, being white and spiny. 3. *Sunami*. (*Mammilari fissurata*). It is rare, but it is believed to be even more powerful than wanamé and is used in the same way as the latter; the drink produced from it is also strongly intoxicating. . . . 4. *Hikuli walula saeliami*. This is the greatest of all, and the name means 'hikuli great authority.' It is extremely rare among the Tahahumares, and I have not seen any specimen of it, but it was described to me as growing in clusters of from eight to twelve inches in diameter, resembling wanamé with many young ones around it. . . . All these various species are considered good, as coming from Tata Dios, and well disposed toward the people. But there are some kinds of hikuli 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."

Several of these narcotic hukuli plants are still unidentified. They are obviously all cactuses. Several species of *Mammilaria* have yielded alkaloids of undetermined identity, but the genus, which is not far removed from *Lophophora*, might be expected to contain active principles. The same may



Flowering head of the peyote cactus, *Lophophora Williamsii*, the "prototype" of the New World hallucinogens. Photograph by R. E. Schultes.

be said of *Echinocactus*. In this connexion, it is well known that in Mexico a number of species in seven other genera of the *Cactaceae*—*Ariocarpus*, *Astrophytum*, *Aztekium*, *Dolichothele*, *Obregonia*, *Pelecyphora* and *Solisia*—are popularly classed as peyote, perhaps because they bear some resemblance to the true peyote, *Lophophora*, or perhaps because they have similar toxic effects and may be employed with *Lophophora* or as a substitute for it (*45*). There is much, indeed, that needs ethnobotanical clarification in this whole picture; and it would seem to be a promising problem (*16*). All that we know is that, of these last seven genera mentioned, three—*Ariocarpus*, *Astrophytum* and *Dolichothele*—have yielded alkaloids (*65*).

Witch doctors in northern Peru (in Piura, Lambayeque and La Libertad) prepare an hallucinogenic drink called *cimora* from at least six plants (*13*). Several of the ingredients are said to be members of the *Cactaceae*. There is indirect evidence of great age for the use of this narcotic drink which is concerned with moon rites of the region. It is taken for therapeutic effects, for diagnosis and divination, and to make oneself owner of another's identity. This intoxicating brew must be potent if the plant ingredients, identified apparently without voucher specimens, are correctly indicated. The principal ingredient is said to be *San Pedro*, a cactus, *Trichocereus Pachanoi*, from

which the hallucinogenic alkaloid mescaline has been isolated (*21*). Other cactaceous ingredients—a member of the genus *Cactus* and *Neoraimondia macrostibas* (*Cereus macrostibas*)—likewise enter the preparation of the brew. A further addition is the campanulaceous *Isotoma longiflora*, known to contain the alkaloid lobeline. *Pedilanthus titimaloides* of the Euphorbiaceae is said also to be added. *Datura Stramonium* is furthermore cited as one of the plants in the formula, and this alone, of course, would provide a potent vision-producing base for the drink. With the apparent lack of voucher specimens, however, there is no way at present to verify the determination of these ingredients. An indication that there may be discrepancies in the determinations is that the chief ingredient was at first erroneously determined as *Opuntica cylindrica* (*12*). It has recently, however, been shown, on the basis of botanical collections, to represent *Trichocereus Pachanoi*, and has been ethnobotanically indicated as being a "magic and dangerous" plant (*18*). Whether or not the common name *San Pedro* applies to both *Opuntia cylindrica* and to *Trichocereus Pachanoi*, very dissimilar plants, has not been verified.

This problem is further complicated by a recent citation of the "magic and dangerous" *timora* of Huancabamba, Peru, as a species of *Iresine* of the *Amaranthaceae* (*18*). Is this *timora* perhaps the same word as *cimora*? We cannot tell at the present time. While several amaranthaceous genera contain alkaloids, no such constituents have been reported from *Iresine*. It is of interest to point out, however, that some of the Indians of southern Colombia are said to employ *Iresine* as an admixture in preparing their strongly hallucinogenic yajé drink (*Banisteriopsis* spp.) to increase its psychotomimetic potency (*49*). Here is one of the most challenging problems in the ethnobotany of hallucinogenic plants, and one which would not be difficult to investigate thoroughly.

In the late 17th and early 18th Centuries, Jesuit missionaries working amongst the Yurimagua Indians in the uppermost Amazon basin found the natives drinking a strongly intoxicating beverage prepared from a "tree fungus" ". . . the Yurimaguas mix mushrooms that grow on fallen trees with a kind of reddish film that is found usually attached to rotting trunks. This film is very hot to the taste. No person who drinks this brew fails to fall under its effects after three draughts of it, since it is so strong or, more correctly, so toxic" (*10*). Field work in the area has, up to the present time, not yet disclosed any practice of this kind, but it is a culture trait little likely to disappear spontaneously, at least without leaving traces, and the region is still inhabited by tribes in relatively primitive conditions of culture. It has been tentatively suggested that the tree fungus might be the known hallucinogenic *Psilocybe yungensis*,[2] but what might be the reddish film? Here certainly is a most challenging problem in ethnopharmacology.

The Mojo Indians, an Arawakan tribe living in eastern Bolivia, employ an unknown narcotic called *marari* (*34*). It has been reported that "whenever . . . the medicine-men had to interview the spirits, they drank a decoction prepared from a plant called marari, similar to our verbena, which caused

[2] R. G. Wasson, personal communication.

*Trichocereus Pachanoi* growing on the side of a cliff on the outskirts of Cuenca, Ecuador. Photograph by G. Rose. From Britton & Rose: *The Cactaceae* 2 (1920) fig. 196.

for 24 hours a general condition of excitement characterized by insomnia and pain" (*34*). According to reports, the medicine men try to avoid drinking marari whenever they "could operate without the narcotic." This may be interpreted as an indication of great potency or toxicity of the drug. By likening marari to "our verbena," the French ethnologist Métraux undoubtedly meant *Verbena officinalis*, a well known folk medicine of Europe. The marari might well represent one of the many South American verbenaceous species, but only direct field observation can clear up this enigma.

Oftentimes, no clear distinction has been made between stimulants and narcotics in the writings of early missionaries and other travellers. *Guayusa* is a case in point. Reports of a strongly stimulating plant of the westernmost Amazon, widely known as guayusa, place its use in the westernmost Amazon

of Colombia, Ecuador and Peru. The earliest report of guayusa dates from 1682 and comprises a missionary reference that pointed to a use surrounded by superstition in the region of the upper Marañon in Peru.[3] Amongst the several references to guayusa, perhaps the most important is that of Richard Spruce, who reported it to be a species of *Ilex* allied to *I. paraguariensis* "but with much larger leaves" and to be a tonic which, in strong infusions such as those prepared by the Jibaros, may be "positively emetic" (*59*).

The recent writings of Karsten (*28*) seem to indicate that guayusa may have narcotic properties as well, for he states that "just as the Jibaros take certain narcotic drinks when they are preparing for war, to see whether they will be lucky or not in the undertaking, so they also understand a kind of divination in regard to hunting. The drink then used is prepared of the guayusa (*Ilex* sp.), the leaves of which are boiled in water for the purpose. The guayusa is not a real narcotic but a tonic, to which the Indians ascribe magical purifying effects. The Jibaros, however, seem to believe that the drink produces dreams of divinatory significance or, more strictly speaking, what they call 'small dreams,' especially such as have reference to hunting." Other "supernatural virtues" or magical powers are ascribed to guayusa by the Jibaros.

Even though guayusa may not belong strictly to the category of psychotomimetic plants, it would be advantageous to know more concerning its curious effects—these "little dreams"—that the Jibaros ascribe to the infusion. Are these effects wholly imaginary, or may perhaps some other plant be occasionally boiled with the guayusa when the "little dreams" are experienced?

And then, what precisely is guayusa? Spruce noted that it was an *Ilex* and reported seeing a group of guayusa trees . . . over 300 years old . . . "that were not unlike old holly trees in England, except that the shining leaves were much larger, thinner and unarmed." A collection of *Ilex* from eastern Peru was described as *Ilex Guayusa* by Loessener, but it is sterile. Sterile material of a guayusa was gathered recently by one of my students in eastern Peru and represents undoubtedly an *Ilex*. It is not wholly improbable that this widely disseminated vernacular name may refer to a number of different plants with marked physiological action. The guayusa problem is certainly one that might occupy the attention of ethnobotanists interested in native narcotics and stimulants. It is rather disquieting that even the identity of such a plant should, after some three centuries, still be uncertain.

Another interesting reference concerning a plant with marked physiological activity which may or may not be narcotic in character reports the use by the Kakusi Indians of British Guiana of "peppers as a stimulant and excitant" (*43*). Even though the "peppers" were definitely identified as belonging to *Capsicum*, this report should be carefully checked by further field observations.

There is an interesting and very potent narcotic drink used in eastern Brazil that merits much more investigation. The Kariri (*30*) and Pankararú (*31*) Indians along the São Francisco River in Pernambuco have an ancient

[3] V. Patiño, personal communication.



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cult, still practiced, connected with a root known as *yurema*. Groups of warriors or strong young men are given a gourdful of the yurema root infusion by an elderly chieftain. With bowed heads, the celebrants see "glorious visions of the spirit land, with flowers and birds. They might catch a glimpse of the clashing rocks that destroy the souls of the dead journeying to their goal, or see the Thunderbird shooting lightning from a huge tuft on his head and producing claps of thunder by running about." The yurema rite was formerly much more widespread than at present, for it is known to have been practiced by at least three other tribes (the Guegue, Acroa and Pimenteira) of the general region. The ceremony exists also amongst the Tusha Indians, neighbours of the Pancararús.

There is reason to believe that the yurema-drink is the same narcotic as the intoxicating beverage of the Pankararús which has been reported under the Portuguese name *vinho de Jurema*. This drink is reportedly prepared from the roots of the leguminous tree *Mimosa hostilis* (*20*). Chemically, this plant is extremely interesting because of its close relationship to *Anadenanthera peregrina*, from the seeds of which the hallucinogenic yopo snuff of the Orinoco River basin is prepared. In 1946, an alkaloid was isolated from the bark of the roots of *Mimosa hostilis* (*20*) and was called nigerine, but recent chemical investigation has established the identity of nigerine and N, N-dimethyltryptamine, the same constituent found in yopo seeds from *Anadenanthera peregrina* (*36*).

In a remote tributary of the Apaporis River in Amazonian Colombia, the Peritomé-Tanimukas make use of an as yet unidentified plant to prepare a vision-producing drink employed in the adolescent initiation rites of boys (*57*). It is taken much as is the well known yajé or caapi of the same region prepared from *Banisteriopsis Caapi*, but the Tanimukas, who employ also this malpighiaceous vine, are quick to distinguish the two. The bark of the root of an extensive lacticiferous forest liana, without the admixture of any other plant material, is subjected to long boiling in order to prepare the drink. I was not able to see the vine nor to take the drug during my short stay amongst the Tanimukas, but all information pursuant to my questioning was constant. This liana, reported to be rich in latex, might represent an apocynaceous species, but the problem cannot be solved until extended field work is carried out with these isolated Indians.

There is evidence that natives of the New World have found psychotropic activity in plants introduced from the Old World. It has, for example, recently been reported that Yaquí medicine men from northern Mexico employ *Genista canariensis*, the genista of florists, for the purpose of inducing hallucinations (*17*), a property that has been experimentally substantiated. The genus *Genista* and the closely related *Cytisus*, in which *Genista canariensis* is sometimes included, are extremely rich in alkaloids. Cytisine, an alkaloid that formed the basis for the former hallucinogenic use amongst some North American Plains Indians of seeds of the leguminous *Sophora secundiflora* (*53*), has been isolated from leaves and beans of *Genista canariensis*.

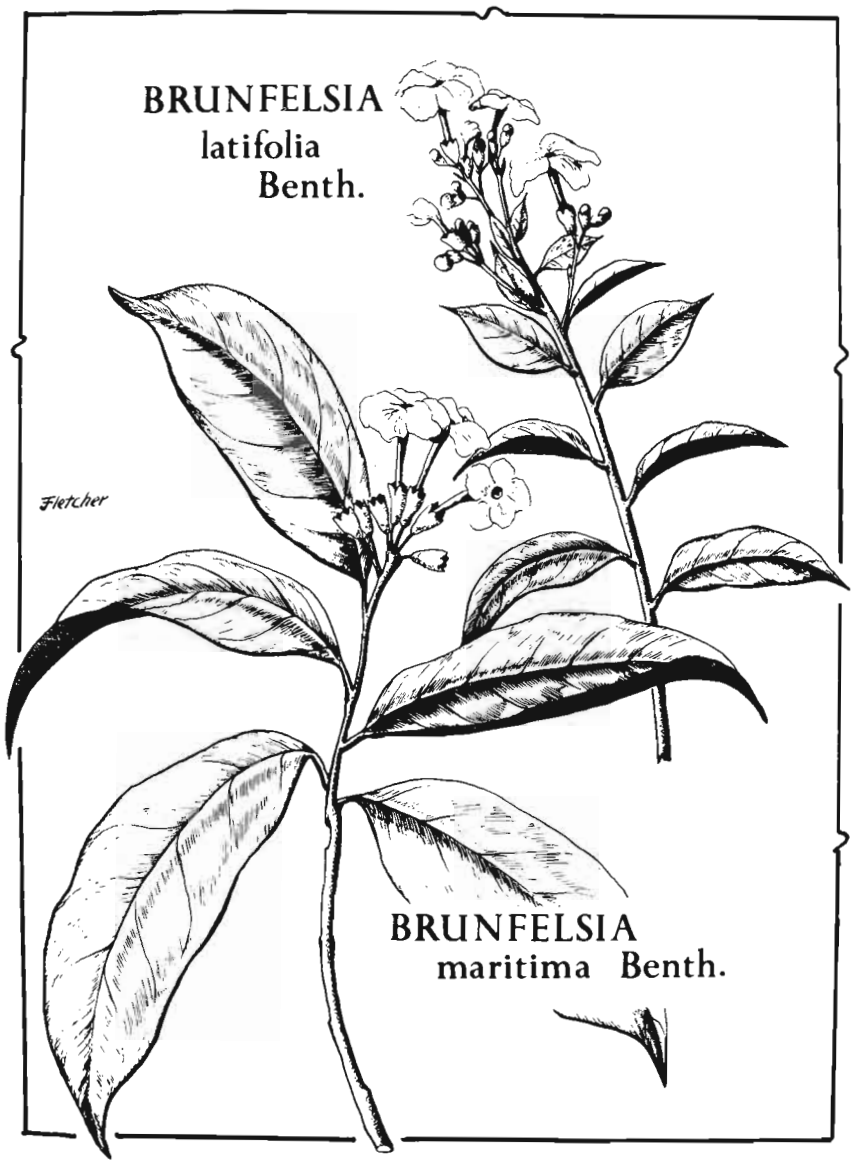
Other Old World plants that may have hallucinogenic uses amongst New World natives are several species of the labiate genus *Coleus*. Concurrent to the recent discovery by Wasson in the Mazatec Indian country of Oaxaca, Mexico, of the utilization of the leaves of *Salvia divinorum* as a narcotic (*63*), a similar employment of *Coleus pumila* and *C. Blumei*, both introductions from the Old World, was reported. The hallucinogenic effects of the *Salvia* have been experimentally substantiated, and it has been postulated that perhaps this plant, native to Mexico, might represent the ancient *pipiltzintzintli* of the Aztecs. Chemical examination of *Salvia divinorum* has not as yet disclosed a psychotropic constituent, and analysis of these two species of

*Coleus*, at least on the basis of the reputedly hallucinogenic material growing in southern Mexico, has apparently not been carried out. Other species of *Coleus* that are employed in the Old World as folk medicines have, however, been studied chemically, but no hallucinogenic substances have been reported from them. There is in Turkestan, nevertheless, another reputedly intoxicating mint—*Lagochilus inebrians* (*7*). The leaves are crushed and mixed with honey or sugar for ingestion. A physiologically active crystalline principle, lagochiline—a polyhydric alcohol—has been reported from this species (*1*, *61*).

Without any doubt, one of the most fascinating and promising possibilities of adding to our list of hallucinogens has recently been brought to my attention by one of my former students, Prof. Melvin L. Bristol of the University of Hawaii, who spent more than a year in ethnobotanical field work in southern Colombia. It concerns the solanaceous genus *Brunfelsia* in South America (*57*). A tropical New World genus of about 25 species, *Brunfelsia* plays an important role in aboriginal folk medicine in equatorial America. The fluid extract of one species—*Brunfelsia Hopeana*—is employed pharmaceutically in Brazil as an antidiuretic and antirheumatic. Although atropine-type alkaloids—brunfelsine, manacine and mandragorine—have been reported for *Brunfelsia Hopeana*, little if anything is known of the chemistry of other species (*65*). The aglycone scopoletine, a coumarine derivative found in a number of plant families, has also been isolated from *Brunfelsia*. Consequently, we know that this genus does possess active constituents of very definite physiological activity.

Evidence for the narcotic use of *Brunfelsia* is quite real, but it is not yet corroborated by a good body of field observation. Herbarium records are very helpful in this instance. There are two collections that indicate the use of *Brunfelsia* as a narcotic. One—*Tessmann 3243* from eastern Peru—reports simply that the plant is "a narcotic." The other—*Bristol 1364* from the Colombia Putumayo—states that the plant is a narcotic and medicinal cultivated in Kofán Indian houseyards. Other collections of this genus from Bolivia, Brazil, Colombia, Eucador and Peru indicate a broad spectrum of therapeutic uses ranging from treatment of "yellow fever" to snake bite. Its commonest use in folk medicine seems to be to relieve "rheumatism." Several collections indicate that *Brunfelsia* is toxic. In fact, in the vicinity of Leticia, a Colombian town on the Amazon River, *Brunfelsia maritima* (*Schultes, Raffauf & Soejarto 24108*), escaped from cultivation at an abandoned Indian site on the upper Amazon in Colombia, has been responsible for serious cattle poisoning. The plant is here referred to as *sanango*, which seems to be a somewhat general term applied in the upper Amazon to several plants with medicinal or toxic properties.

The Kofán Indians of the westernmost part of the Amazon of Colombia and Ecuador grow *Brunfelsia* extensively as an ornamental. They know the plant as *borrachera*, a vernacular term in Spanish applied to almost any kind of intoxicating plant, especially to the species of tree-Daturas, in Colombia. The Kofán indicate that they become very cold after taking an infusion of the scraped bark of *Brunfelsia*. This characteristic of the in-




toxication has been reported on herbarium labels of collections from Peru, and may well explain the wide use of the plant as a supposed febrifuge. One of my graduate students, Mr. Homer V. Pinkley, who has spent a year living with the Kofán, reports these medicinal applications of *Brunfelsia*, but found no direct evidence that could be interpreted as indicative of its use as an hallucinogen.

Intensive field work may still uncover a former use of *Brunfelsia* as an hallucinogenic agent in the western Amazon or on the eastern slopes of the Andes of Colombia, Eucador or Peru. But *Brunfelsia* is a genus that needs botanical revision and phytochemical investigation. A thorough study could

Flowering branch of *Brunfelsia maritima*, a medicinal and ornamental plant common in the western Amazon of Colombia and Ecuador. Río Aguarico, Ecuador. Photograph by H. V. Pinkley.

reward us with a clearer picture of this possible aboriginal American hallucinogen. Might its use as an hallucinogen have disappeared? We should realise that the disappearance of the use of a plant in a given area is not unknown. A century ago, for example, the sapindaceous caffeine-stimulant guaraná, *Paullinia Cupana*, was reported by Spruce as cultivated all the way up the Rio Negro of Amazonian Brazil and into southern Venezuela (*59*). I found that it has now almost completely vanished from cultivation in this region, and the use of the vine as the source of a stimulant is unknown along the Rio Negro at the present time. Might not the same fate have happened to the solanaceous genus *Brunfelsia?*

One of the most interesting enigmas in South America concerns the question of whether or not the apocynaceous genus *Prestonia* is or has ever been used narcotically. The literature is rich in reports, most of them uncritical and unfounded in field work, that *Prestonia amazonica* (*Haemadictyon amazonicum*) is the source of the hallucinogen known as *yajé*. All manner of confusion has attended this information. Although we believe that we

are warranted in asserting that *Prestonia* is not employed as a narcotic, there remains enough doubt to justify further field investigation (*58*). What, precisely, is the problem?

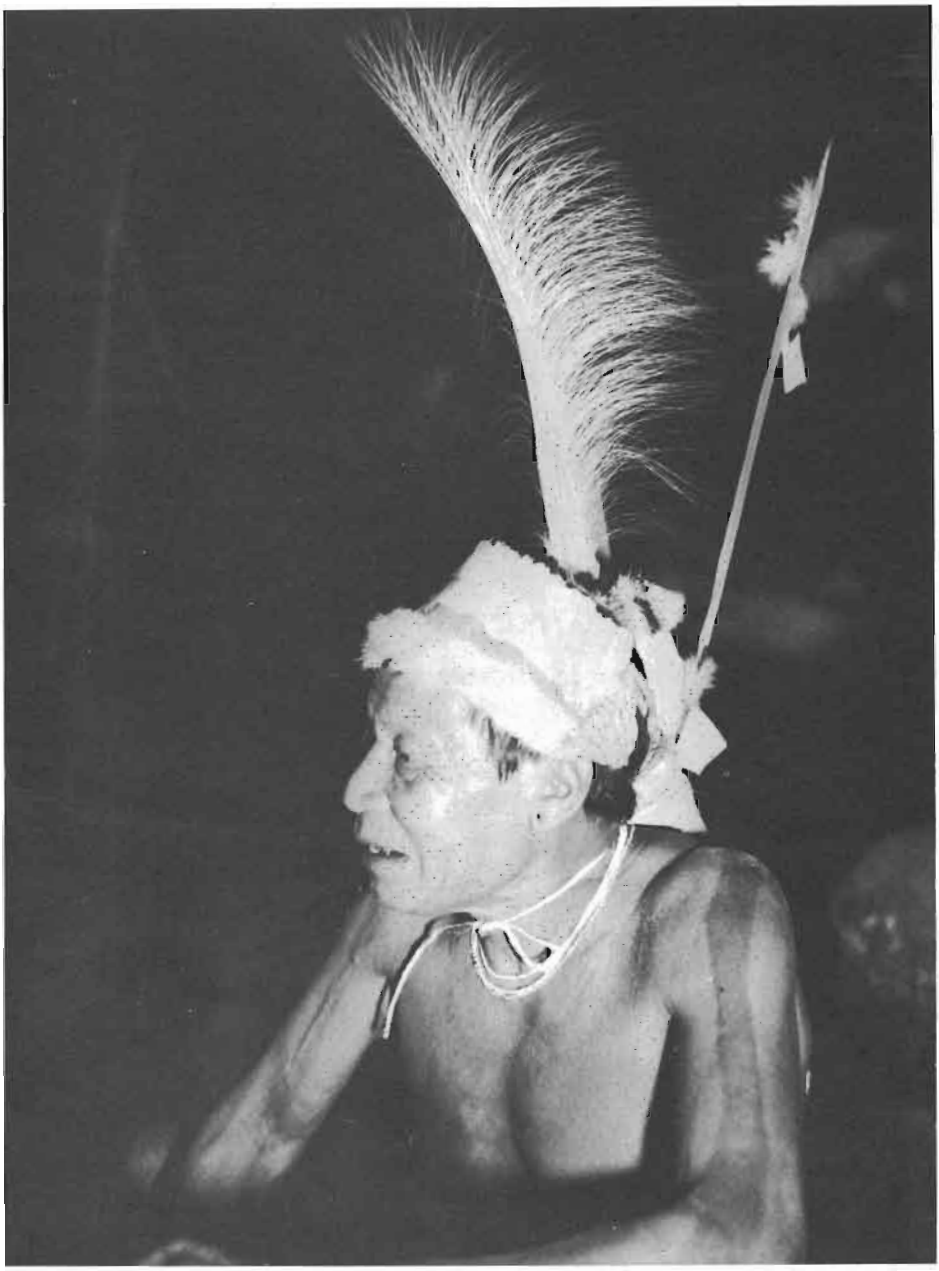
It is well established that a strongly hallucinogenic drink known variously, according to geographic area, as *ayahuasca, caapi and yajé* is prepared from one or more species of the malpighiaceous genus *Banisteriopsis*. Spruce in

1851 first identified the botanical source of this narcotic beverage. He discovered the natives along the upper Rio Negro in Brazil preparing it from a liana which he called *Banisteria Caapi*. It is now more appropriately accommodated in a related genus and bears the name *Banisteriopsis Caapi*. Several years later, he quite correctly identified a similar drink of the western Amazon of Ecuador, where it was called *ayahuasca*, as coming from the same species as caapi.

When he discovered caapi in northwestern Brazil and identified it correctly as a malpighiaceous narcotic, he also meticulously observed that another kind of caapi, known locally as *caapi-pinima* or "painted caapi," might be made from "an apocynaceous twiner of the genus *Haemadictyon*," but he saw "only young shoots without flowers." "The leaves," he writes, "are of a shining green, painted with the strong blood-red veins. It is possibly the same species . . . distributed by Mr. Bentham under the name *Haemadictyon amazonicum*. It may be the caapi-pinima which gives the nauseous taste to the caapi . . . and it is probably poisonous, but it is not essential to the narcotic effect of *Banisteria* . . ." (*59*). I have consulted Spruce's unpublished handwritten field notes at the Royal Botanic Gardens at Kew and find his statement that the caapi drink is made from the lower parts of the stems of *Banisteriopsis Caapi* "beaten in a mortar with the addition of water and a small quantity of the slender roots of the Apocynac (apparently a *Haemadictyon*) called *caapi-pinima* . . . ." "May not be the peculiar effects of the caapi," he queried, "be owing rather to the roots of the *Haemadictyon* than to the stems of the *Banisteria?* The Indians, however, consider the latter the prime agent, at the same time admitting that the former is an essential ingredient."

Spruce presumed that this apocynaceous admixture might play a role in caapi intoxication, but he was not certain. Nor did he make any definite assertions, pointing out cautiously that the malpighiaceous vine alone produces hallucinogenic effects. It was the French anthropologist Reinberg who, in 1921, without the benefit of voucher botanical specimens, tentatively suggested the possibility that yajé might be prepared from *Prestonia* or a related genus (*41*). Unfortunately, this suggestion has been taken up, its tentative nature forgotten or ignored, and is being propagated in technical papers.

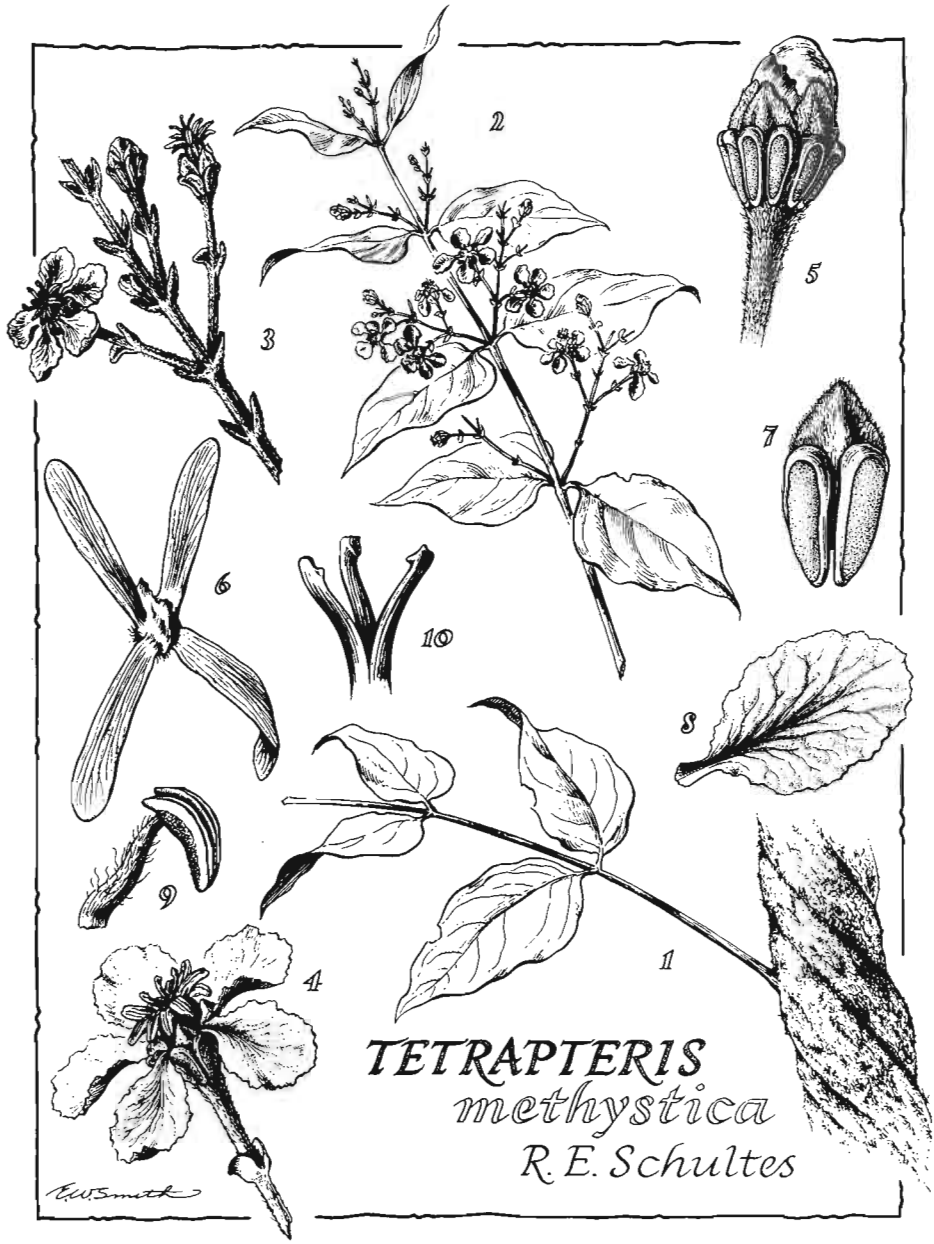
While we know that ayahuasca, caapi and yajé are different local names for the same narcotic drink prepared from the same malpighiaceous plants, we cannot too lightly dismiss from further ethnobotanical and phytochemical study this interesting apocynaceous genus *Prestonia*, a tropical American group of some 30 species. It is curious that so little is known about the chemistry of *Prestonia*, a member of one of the phytochemically most assiduously studied families of plants (*39*). No alkaloids have as yet apparently been isolated from *Prestonia*. N, N-dimethyl tryptamine has been reported from "*Prestonia amazonica*" (*25*), but there is every probability that this analysis, for which no voucher specimen is available, was made on leaves of a species of *Banisteriopsis* mistakenly identified through the vernacular name yajé as *Prestonia amazonica* (*58*). The possibility that this alleg-



Makuna Indian witch doctor under the influence of caapi (*Banisteriopsis Caapi*). Río Popeyaká, Amazonas, Colombia. Photograph by J. Cabo O.

edly poisonous genus may be the source of an hallucinogenic drug makes the solution of the problem one of both academic and practical urgency.

That there remains much to learn concerning the ayahuasca-capi-yajé complex was recently emphasised by the discovery of the narcotic use of a new species of a genus allied to *Banisteriopsis: Tetrapterys methystica* (*47*).




It was my good fortune in 1948 to witness the preparation of and take a narcotic drink amongst nomadic Makú Indians along the Rio Tikié in the Brazilian Amazon. The extremely bitter beverage prepared from this plant had strong hallucinogenic effects, was yellowish, unlike the coffee-brown *Banisteriopsis* preparations. It may represent one of the other "kinds" of caapi that Spruce reported.

The identification of various admixtures utilized with *Banisteriopsis* in preparing the narcotic drink represents an interesting and still poorly under-

stood ethnobotanical problem (*19*). In addition to *Prestonia*, which may possibly be added to caapi during preparation of the drink, other plants are known to be employed in this way in sundry areas, and some of these species belong to families and genera that have physiologically active constitutents. It is to be supposed, therefore, that they may alter, sometimes significantly, the flavour and effects of the narcotic preparation. The Siona of the Colombian Putumayo, for example, add what is probably *Datura suaveolens* to *Banisteriopsis* in making yajé (*15*). The Ingano Indians of the same area are said to value *Alternanthera Lehmannii* as an admixture (*49*). I found that Makuna medicine men of the Río Popeyaká in eastern Colombia occasionally use a few crushed leaves of the apocynaceous *Malouetia Tamaquarina* (*49*). One of my graduate students has recently identified a species of *Psychotria* similarly employed by the Kofán Indians of Amazonian Ecuador. A most interesting anthropological report has recently appeared that enumerates five lianas, the barks of which are added to caapi by the Tukano Indians of the Brazilian part of the Rio Vaupés; unfortunately, these plants are as yet identified only by native names (*3*). How many other plants may be used as admixtures throughout the range of use of the South American malpighiaceous narcotics?

Now, what about the possibility of new hallucinogens in the Old World flora? Up to this point, we have concentrated our attention on plants employed in primitive cultures of the New World. As I have already mentioned, the New World seems to be far richer in known hallucinogenic plants than the Old. The argument that the New World flora might be richer in plants possessing psychotomimetic principles would be acceptable probably to few chemotaxonomists, including me. There may be several reasons for this real discrepancy, but most certainly one might be that Old World cultures as a whole seem, at least upon superficial examination, to be much less narcotic-conscious, to feel much less the "need" for these agents in magico-religious rites and in the practice of medicine—and this notwithstanding the great antiquity and probably original basic significance of narcotics to many Old World religious systems.

There must be an appreciable number of problems in the ethnopharmacological search for new hallucinogens in sundry parts of Africa and Asia, but I must content myself with a brief discussion of only a few potentialities.

What is the famous *kanna* or *channa* reported, more than 225 years ago, as a vision-inducing narcotic of the Hottentots who chewed it and held it in the mouth, much as the natives of South America employ coca? The intoxication is interesting, for "their animal spirits were awakened, their eyes sparkled and their faces manifested laughter and gaiety. Thousands of delightsome ideas appeared, and a pleasant jollity which enabled them to be amused by the simplest jests. By taking the substance to excess, they lost consciousness and fell into a delirium" (*29*). The name *kanna* designates, at the present time, in South Africa, various species of the aizoaceous genus *Mesembryanthemum*. While several species of *Mesembryanthemum* are known to be alkaloidal and to induce a state of torpor when ingested, at least one investigator (*29*) doubts that they could produce such startling effects.

The ceremonial clay pot in which caapi is prepared and from which it is served. The pot must hang always under the eaves at the left front corner of the house. Barasana Indians, Río Piraparana, Vaupés, Colombia. Photograph by R. E. Schultes.

He has suggested that the plant in question might have been *Cannabis sativa*, pointing out, the while, that other plants, like the anacardiaceous *Sclerocarya Caffra*, are employed in South Africa for their intoxicating effects. Here is an area where, because the inroads of civilisation have not been unduly drastic, ethnobotanical field investigation might be extremely productive.

Another Old World genus employed for its narcotic properties is the rubiaceous *Mitragyna*. *Mitragyna speciosa* seems to be the species most commonly used in southeastern Asia, especially in Siam, where the leaves are chewed alone or mixed with the betel quid or else prepared for smoking like opium (*26*). It was first reported as a substitute for opium apparently in 1836, and has cropped up constantly in the literature since that time (*8*). The use of *Mitragyna* is said now to be legally proscribed in Siam.

So much chemical attention has been given to *Mitragyna* in recent years (*5*, *40*) that the problems and potentialities offered by this genus are well

known. It might, however, be extremely helpful if we knew as much about its use amongst the natives.

Passing mention should further be made of two Old World plants known to possess hallucinogenic principles, but the narcotic use of which by native peoples for intoxication is not well documented. One of these is *Peganum Harmala* (*14*), a rather enigmatic plant that has been placed in the Rutaceae, although now it seems more properly located in the Zygophyllaceae. This species, native in North Africa, the Balkans and from Asia Minor west to China and India, is known to be toxic (*6*), to contain the alkaloids harmaline and harmine (the same constituents found in *Banisteriopsis*), and may have, in addition, a "narcotic hasheesh-like alkaloid" (*6*). Although the seeds of *Peganum Harmala* have proven narcotic properties and figure extensively in folk medicine, going back to the time of Dioscorides, I find no direct references to its religious or hedonistic use as an hallucinogen (*37*). That it may be so employed in Asia or Africa should not be ruled out of our thinking.

Another similarly interesting narcotic is *iboga* of the wet tropical forests of West Africa, especially of the Congo—the apocynaceous *Tabernanthe Iboga* (*61*). Its chemistry is relatively well known, with at least 12 active alkaloids reported, the principal one of which—ibogaine—has effects similar to that of cocaine (*60*). In high doses, it causes nervous excitement, mental confusion, a general state of drunkenness and is a true hallucinogenic agent (*44*). While it has been valued as a medicine and possibly also as an hallucinogen in primitive societies of West Africa, it is not clear that its use as a vision-inducing narcotic was extensive. Ethnobotanical field work is once again indicated.

There have been vague references to the zingiberaceous *Kaempferia Galanga*, to which the natives of several parts of New Guinea attribute hallucinogenic properties (*4*). We know, in fact, nothing about the psychotomimetic use of this genus, nor of its chemical constituents.

The role of mushrooms in the so-called "mushroom madness" of the Kuma people of the Wagti Valley in New Guinea has been, and still is, puzzling. A species of *Russula* has been suggested as the psychotropic agent that suddenly causes individuals or groups to go berserk. Even though the "natives attributed their extraordinary behaviors to mushrooms, several species of *Boletus, Russula and Heimiella*—or at least most of them—do not seem to cause physiological effects leading to madness." (*24*). I am convinced that much more field work must be done in this fascinating part of the world.

Undoubtedly the greatest enigma in the field of the hallucinogens has been the identity of *soma* (*61*). Some 3,500 years ago, a people who called themselves Aryans, who were the first so to style themselves and who had a right to the name, swept down from the north into the Indus Valley of India. They brought with them the cult of a sacred plant, called soma. They deified the plant and worshipped it, extracting its juice and drinking it. They composed more than one thousand hymns about it, and these have come down to us intact.

What was *soma?* No one knows at the present time. For more than two thousand years, its identity has been clouded in a mystery. For some unexplained reason, the Aryans abandoned the original plant soon after they arrived in their new home, and its identity was forgotten. Other plants took its place as substitutes—plants chosen for reasons other than the psychic effects which, in the case of the substitutes, seem to have been non-existent.

Western civilization discovered the enigma of soma about a century and a half ago when it began to learn about the cultural wealth that India had to offer to the world. Since then, more than a hundred species have been suggested as the source of the original soma, but none of the suggestions has won acceptance. Amongst these, the principal contenders were numerous species of *Ephedra*, *Periploca* and *Sarcostemma*: the first genus a gymnosperm; the last two asclepiadaceous genera; but all similar in being vine-like, fleshy, leafless or almost leafless desert plants.

For some years now, Wasson has devoted full time to a deep study of the historical, literary and ethnobotanical records concerning soma. He has spent several years in the Far East and much time in European university centers and libraries. We are justified in stating, I believe, that never has greater thoroughness and meticulous scholarship gone into the enigma of soma, for Wasson's avenues of ethnobotanical research have been ingeniously devious and complex. "When I first approached the problem in 1963," he (*63*) wrote, "I could hardly believe what I found . . . a clear-cut botanical question—a psychotropic plant that calls for identification. The clews should be in the Vedic hymns . . . True, the poems contain no botanical description . . . for those remote singers were not modern botanists . . . they were writing for contemporaries . . . and their imagery and terms often elude our understanding . . . But the hymns are all shot through with soma, and about 120 of them are entirely devoted to the plant-god. Was it possible that so much could have been written about a plant, over centuries . . . and its identity not revealed? It was no secret for the poet-priests. How extraordinary it would have been if all of them . . . had withheld from their verses the revealing descriptive terms, the tell-tale metaphors, that the trained reader today needs to spot the plant! But this did not happen. All that has happened is that no ethnobotanist with an interest in psychotropic plants has applied himself to an examination of the texts."

To this age-old enigma, Wasson has suggested a solution: that the true soma was a mushroom, the fly agaric, *Amanita muscaria*, the same mushroom used narcotically today by certain natives in Siberia. All of the many intricately interlocking pieces of indirect evidence gleaned from the Vedic hymns seems to fit in with this clever suggestion so well that Wasson has asked: "Could any key unlock this combination save the fly agaric?" He is now engaged in writing his conclusions and, in view of his contributions to our knowledge of the sacred Mexican mushrooms, of the narcotic morning glories and of the new hallucinogenic *Salvia* of Mexico, we await the completion of his fascinating study with great anticipation.

## Guidelines for the Future

The ethnobotanist, especially in his ethnopharmacologic search for hallucinogenic plants, is confronted with these and many more problems throughout the world. Faced with the ever more rapid disintegration of primitive societies and an extraordinary dearth of trained ethnobotanists, science would seem to be doomed to lose. The outlook, however, may not be so dour. Specialists in those fields upon which ethnobotany impinges are experiencing a growing realization of the potentialities of the interdisciplinary approach that ethnobotany affords. There is growing interest in ethnobotanical research amongst younger men going into botanical, anthropological and pharmacological fields. Some of the most startling scientific advances of the past twenty years have been made in various branches of ethnobotany. The future should, therefore, solidly be ours, and our trust must be to prevent its slipping from us.

It might here be appropriate to end with the words of Harshberger, author of the term *ethnobotany*, who wrote: "It is of importance . . . to seek out these primitive races and ascertain the plants which they have found available in their economic life, in order that perchance the valuable properties they have utilized in their wild life may fill some vacant niche in our own."

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