

Botanical Sources of The New World Narcotics ❖

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Man has learned to rely upon the plant kingdom not only for life's necessities but also its amenities and ameliorants, in virtually every part of the world. None of the ameliorants has had a more absorbing history nor better shows man's cleverness and ingenuity than those which we call the *narcotics*.

The very word "narcotic" has taken on a sinister meaning in American culture. There is probably no field — save perhaps religion and politics — so replete with popular misinformation and purposeful misrepresentation. This condition is general, yes, even universal, insofar as the public is concerned. But its paralysis has invaded even our technical circles. The misuse of the terms "habit-forming" and "addictive," for example, is found even amongst our students. It is a fact that there are but two plant narcotics known to cause addiction and to be physically, morally and socially so dangerous that they must be strictly controlled — this fact is lost to most people, for whom it is enough that a substance be called a *narcotic* to draw away aghast.

I use the term "narcotic" in its classic sense. It comes from the Greek "to benumb" and, therefore, broadly applies to any substance (howsoever stimulating in one or several stages of its physiological activity) which may benumb the body.

The use of narcotics is always in some way connected with escape from reality. From their most primitive uses to their applications in modern medicine, this is true. All narcotics, sometime in their history, have been linked to religion or magic. This is so even of such narcotics as tobacco, coca and opium which have suffered secularization — which have come out of the temple, so to speak, have left the priestly class and have been taken up by the common man. It is interesting here to note that, when problems do arise from the employment of narcotics, they arise after the narcotics have passed from ceremonial to purely hedonic or recreational use. This historical background can explain much, especially when we realize that there are still some

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narcotics used by primitive peoples only in a religious or magic context: peyote is a good example. This is why the botanist who goes out to search for new narcotics in primitive societies must be versed in and sympathetic to anthropological or ethnological fields — and we have come to refer to this type of scientist as an ethnobotanist.

None of the New World narcotics, save tobacco and coca, has assumed a place of importance in modern civilization, and many are still rather unfamiliar even to our botanists, chemists and pharmacologists. It is for this reason that I have chosen, even at the risk of seeming rather superficial, to say a few words about each of the native New World narcotics, with almost all of which I have had personal experience in the field over a long period. By doing this, I hope to give you an overall picture of what we may term the "narcotic complex" of New World peoples. For sundry of these, the literature, though recondite, is extensive, covering many fields of research; but for the greater number, bibliographic sources are few and pertain to only one or two fields of investigation. Reference to tobacco and alcohol, both native American narcotics, will be omitted from this brief article.

The identification of the source plants of American narcotics has interested me since 1936. Consequently it is natural, I suppose, that my remarks should be heavily botanical. That the final and complete understanding of narcotic plants rests solely and fundamentally on a knowledge of their botanical sources makes it obvious that the first step must be made in the direction of botany or ethnobotany. Convinced of the importance of this step, I have studied narcotic plants among North American Indians in Oklahoma, have made several trips into the Mazatec, Chinantec and Zapotec Indian country of northeastern Oaxaca, Mexico, and lived almost without interruption, from 1941 to 1953, in the northwest Amazon and the northern Andes of South America.

For some of the plants mentioned, there are no chemical, much less pharmaceutical, data. For some, even, there are still serious problems concerning their botanical source or sources. Here, then, lies one of the most promising fields for research, for we know that tropical America still holds secrets in connection with narcotic plants.

For general purposes, there is probably no more serviceable classification of the plants man uses in his striving for temporary relief from reality than that proposed by the German toxicologist, Louis Lewin.

Of Lewin's five categories, i.e., *Excitantia*, *Inebriantia*, *Hypnotica*, *Euphorica*, *Phantastica*, none has stirred deeper interest through the ages, and none has foretold a greater field for discovery for the present and future, than the *Phantastica*. There have recently been proposed very learned and intricate words to distinguish the several kinds of narcotics. Our modern terminology has come to call these the *hallucinogens*, the *psychotomimetics*, or the *psychedelics*. Differing from the psychotropic drugs, which normally act only to calm or to stimulate, the hallucinogens or psychedelics act on the

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central nervous system to bring about a dream-like state, marked (as Hoffmann points out) by extreme alteration in the "sphere of experience, in the perception of reality, changes even of space and time and in consciousness of self." They invariably induce a series of visual hallucinations, often in kaleidoscopic movement and usually in rather indescribably brilliant and rich colors, frequently accompanied by auditory and other hallucinations and a variety of synesthesias. Notwithstanding this mushrooming new nomenclature, it seems to me difficult to find a simpler and more serviceable classification than that of Lewin.

It is of interest that the New World is very much richer in narcotic plants than the Old and that the New World boasts at least 40 species of hallucinogenic or phantastica narcotics as opposed to half a dozen species native to the Old World.

It is clear that medical and psychological research into these strange agents, at a painfully embryonic state at the present time, promises more than we are able fully to comprehend. Powerful new tools for psychiatry may be only one of the results of such investigations. But research into the effects of these substances on the human mind must be carried out carefully, without haste or superficiality and, above all, by the most qualified personnel, for what may be one of the most promising fields for progress ever within man's grasp can easily be jeopardized or utterly destroyed by irresponsible and inadequately planned research or by the manipulations of dilettantes.

Ayahuasca, Caapi, Yajé

One of the weirdest of our phantastica or hallucinogens is the drink of the western Amazon known as *ayahuasca*, *caapi* or *yajé*. Although not nearly so popularly known as peyote and, nowadays, as the sacred mushrooms, it has nonetheless inspired an undue share of sensational articles which have played fancifully with unfounded claims, especially concerning its presumed telepathic powers.

In spite of its extraordinarily bizarre ability to alter man's physical and mental state, this narcotic drink finally disclosed itself to prying European eyes only about a century ago. And it remains one of the most poorly understood American narcotics today.

The earliest mention of *ayahuasca* seems to be that of Villavicencio in his geography of Ecuador, written in 1858. The source of the drug, he wrote, was a vine used "to foresee and to answer accurately in difficult cases, be it to reply opportunely to ambassadors from other tribes in a question of war; to decipher plans of the enemy through the medium of this magic drink and take proper steps for attack and defense; to ascertain, when a relative is sick, what sorcerer has put on the hex; to carry out a friendly visit to other tribes; to welcome foreign travellers or, at least, to make sure of the love of their womenfolk."

A few years earlier, in 1852, that tireless British plant explorer, Richard

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Spruce, had discovered the Tukanoan Indians of the Uaupés in Amazonian Brazil using a liana known as *caapi* to induce intoxication. His observations were not published until the posthumous account of his travels appeared in 1908.

One of Spruce's greatest contributions to science was his precise identification of the source of *caapi* as a new species of the *Malpighiaceae* which was called *Banisteria Caapi*. The correct name is now *Banisteriopsis Caapi*, since it has been shown to be not a true *Banisteria*.

The natives of the upper Rio Negro of Brazil use it for prophetic and divinatory purposes and also to fortify the bravery of male adolescents about to undergo the severely painful *yurupari* ceremony for initiation into manhood. The narcosis amongst these peoples, with whom I have taken *caapi* many times, is pleasant, characterized, amongst other strange effects, by colored visual hallucinations. In excessive doses, it is said to bring on frighteningly nightmarish visions and a feeling of extremely reckless abandon, but consciousness is not lost nor is use of the limbs unduly affected.

Two years later, in 1854, Spruce encountered the intoxicant along the upper Orinoco, where the natives chewed the dry stem for the intoxicating effects. Again, in 1857, he came upon *ayahuasca* in the Peruvian Andes and concluded that it was "the identical species of the Uaupés, but under a different name."

Later explorers and travellers — Martius, Orton, Crévaux, Koch-Grünberg and others — referred to *ayahuasca*, *caapi* or *yajé* but in an incidental, even casual, manner. All agreed, however, that the source was a forest liana.

In the years following the early work, the area of use of *Banisteriopsis Caapi* was shown to extend to Peru and Bolivia, and several other species of the genus with the same use were likewise reported from the western Amazon. Of outstanding interest was the work in 1922 of Rusby and White in Bolivia and the publication by Morton in 1931 of notes collected by Klug in the Colombian Putumayo. Similarly, the work of the Russians Varonof and Juzepczuk in the Colombian Caquetá in 1925-6 added information of interest to the whole picture.

Serious complications, however, early entered the story of the correct identification of *ayahuasca*, *caapi* and *yajé*. Back in 1890, Magelli, a missionary in Ecuador, through a misuse of the native names for Jivaro intoxicants, confused our malpighiaceous vine-narcotics with one of the tree-species of *Datura*. The effects of the two psychotomimetics differ widely. This confusion, fortunately, did not enter the pharmacological or chemical literature.

A complication which has, however, sorely plagued both the botanical and the chemical literature, even as recently as 1957, stems from the days of Spruce. This meticulous observer noted, when he discovered *caapi* and identified its source, that another kind called *caapi-pinima* or "painted *caapi*" in the Rio Negro area might be "an apocynaceous twiner of the genus *Haemadictyon*, of which I saw only young shoots without any flowers." "The leaves," he

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wrote, "are of a shining green, painted with the strong blood-red veins. It is possibly the same species . . . distributed by Mr. Benthham under the name of *Haemadictyon amazonicum*. It may be the caapi-pinima which gives its nauseous taste to the caapi . . . and it is probably poisonous, but it is not essential to the narcotic effect of *Banisteria* . . ." I have consulted Spruce's unpublished notes at the Royal Botanic Gardens at Kew and find that he stated 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 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."

It is clear that Spruce suspected that the apocynaceous vine might play a role in causing the intoxication. But he was not sure. Nor did he make any definite statement, being careful to point out that *Banisteriopsis* alone could produce hallucinogenic effects.

Recent botanical work has shown that the genus *Haemadictyon* is not distinct from *Prestonia*. *Haemadictyon amazonicum*, therefore, is now correctly called *Prestonia amazonica*. It is a species known from only one collection, that made by Spruce along the lower Amazon in Brazil. We must assume, consequently, that it is a very strict endemic.

Now, I have previously pointed out that the narcotic species of *Banisteriopsis* bear different vernacular names. In the northwestern Amazon of Brazil and in adjacent parts of Colombia, it is termed *caapi*; in Amazonian Bolivia, Peru and Ecuador, *ayahuasca*; along the eastern foothills of the Andes in Colombia and Ecuador, it is *yajé*.

For some unexplained reason, writers usually have assumed that ayahuasca and caapi refer to *Banisteriopsis* but that *yajé* refers to *Prestonia amazonica*, notwithstanding the fact that this apocynaceous species is not known in the region where *yajé* is prepared.

It was apparently the anthropologist, Reinberg, who, in 1921, first suggested that in Peru the source of ayahuasca and of *yajé* were different plants. He suggested tentatively that *yajé* might be *Prestonia* or a related genus. The following year, the Belgian horticulturist, Claes, said that the *yajé* of the Koregwahes of Colombia "might be" *Prestonia amazonica*. I have found no voucher specimens of Reinberg or of Claes' collections, but the pharmacologists Michiels and Clinquart, who worked on Claes' material, reported that it seemed to belong to *Prestonia amazonica*.

Another and an unnecessary complication arose when the Colombian chemist, Fischer, while admitting that no botanical identification of his material had been made, referred *yajé* to *Aristolochia*; and the French pharmacologist, Rouhier, at first accepted this determination. Later, however, Rouhier

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pointed out the similarity of the narcosis from ayahuasca and doubted the possibility that yajé could be *Prestonia amazonica*.

At about the same time, Barriga-Villalba and Albarracín, a Colombian chemist and pharmacologist, respectively, described yajé, on which they worked, as a "climbing shrub."

In 1927, two French pharmacologists, Perrot and Hamet, published an extensive review of what was then known botanically and chemically of this complex of intoxicants. Botanically, they pointed out that 1) yajé, ayahuasca and caapi referred to one species of plant — *Banisteriopsis Caapi* and that 2) no apocynaceous species is at all concerned with this narcotic complex.

In reply to Perrot and Hamet, the German botanist, Niedenzu, published several observations made from herbarium material. His specimens, of course, are no longer extant, for they were burned in the Berlin-Dahlem Botanical Garden during the last war, but his observations bear the stamp of authority, since Niedenzu was the outstanding specialist in the *Malpighiaceae*. His studies indicated that ayahuasca in Peru and Ecuador ought to be considered *Mascagnia psilophylla* var. *antifebrilis*, *Banisteriopsis quitensis* and *B. Caapi*. This introduced into the puzzle another genus, *Mascagnia*, albeit one closely allied to *Banisteriopsis*.

Another attempt to make order out of chaos came in 1930, when the French botanist, Gagnepain, stated 1) that ayahuasca was probably *Banisteriopsis Caapi*, but yajé could not be referable to this species; 2) that yajé seemed to approach *Prestonia amazonica*; 3) that material sent in from divergent regions by Reinberg and by Rivet seemed to represent the same malpighiaceae species. Gagnepain felt that yajé of Colombia was the same species as caapi of Brazil but that yajé of Ecuador was a different species of *Banisteriopsis*.

Hammerman, in 1929, basing his observations on the field studies of Varanof and Juzepczuk in Colombia, reported that Colombian yajé seemed to comprise several species of *Banisteriopsis*, though most of it was probably *B. quitensis*.

Perhaps the greatest single advance since Spruce's contribution occurred in 1931 when Morton described a new species of *Banisteriopsis* from southern Colombia, naming it *B. inebrians*. On the basis of meticulous field work and observations of the German plant explorer, Klug, Morton reported that at least three species are employed in this region: *Banisteriopsis Caapi*, *B. inebrians*, and *B. quitensis* and that *B. longialata* and *B. Rusbyana* may sometimes enter as additional ingredients.

During my 12 years of plant exploration in the Amazon Valley, I encountered ayahuasca, caapi and yajé and was able to partake of the hallucinogenic drink on a number of occasions with the natives. In all cases save one, the beverage was prepared with *Banisteriopsis*, regardless of the vernacular name that was employed for the drink.

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Along the eastern foothills of the Andes in Colombia, yajé is prepared as a concentrated decoction from day-long boiling of the rasped bark of *Banisteriopsis inebrians*. I saw no admixture with any other plant, yet the drink had a very strong psychotropic effect. Its intoxication had an initial stage of giddiness and nervousness, followed by profuse sweating and nausea. Then began a period of lassitude, during which a play of colors, at first mainly a hazy blue, increased in intensity. This eventually gave way to a deep sleep, interrupted by dreams and accompanied by a feverishness. No uncomfortable after-effects, save a severe diarrhea, were felt on the next day.

My studies indicate that the Kofán, Inga and Siona Indians of the Putumayo area do often employ the leaves of *Banisteriopsis Rusbyana*, known locally as *chagro-panga* or *oco-yajé*, as an admixture with the bark of *B. inebrians*. I collected *Banisteriopsis Rusbyana* several times, when natives pointed it out as the plant employed to make yajé stronger. The botanist, Cuatrecasas, has likewise found both species used together in the Putumayo.

Klug reported that these Indians "added to the yajé (*Banisteriopsis inebrians*) the leaves and young shoots of the branches of the *oco-yajé* or *chagro-panga* (No. 1971) (*B. Rusbyana*), and it is the addition of this plant which produces the 'bluish aureole' of their visions." The Colombian botanist, García-Barriga, noted their use of two admixtures, one of the amaranthaceous *Altenanthera Lehmannii*, the other an unidentified plant; he reported that the *Altenanthera*, when added to native beers or *chicha*, increased their intoxicating properties.

It is, I think, quite significant that the relatively intensive, though sporadic, botanical work in the Putumayo has not turned up *Prestonia* in connection with yajé. And I think we are justified in doubting that the yajé of this area is wholly or partly made from this apocynaceous vine. Nevertheless, we must not dismiss the possibility for other regions. There have been several serious intimations that *Prestonia* enters the narcotic complex. And, in 1957, the chemists Hochstein and Paradies analyzed ayahuasca from Peru, calling it *Banisteriopsis Caapi*, and, from the same region, yajé which they attributed to *Prestonia amazonica*. I have been unable to check the voucher herbarium specimens upon which, apparently, the Peruvian botanist, Ferreyra, made his determination. These chemists stated that the natives of the Rio Napo "commonly consume a mixed extract of the *B. Caapi* and *P. amazonica* leaves in the belief that the latter suppress the more unpleasant hallucinations associated with the pure *B. Caapi* extracts."

Much of my field work was done in the eastern part of the Colombian Amazon, near Brazil. Here *Banisteriopsis Caapi* is usually used alone, but sometimes the leaves of *B. Rusbyana* are added. I noted a few reports of admixtures, such as powdered tobacco or dried tobacco leaves and the crushed leaves of an apocynaceous tree, the toxic *Malouetia Tamaquarina*. The drink is invariably prepared as a cold water infusion in this region.

As far as I was able to judge from six or seven experiences with caapi, the effects differ little from those from the boiled concoction used in the

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Putumayo. The intoxication is longer in setting in, and much more of the drink must be taken, but the symptoms of the intoxication and their intensity seem to me to be very similar.

It was my good fortune in 1948 to be able to witness the preparation and to partake of a narcotic caapi-drink amongst the nomadic Makus of the Rio Tikié near the Colombian boundary in Brazil. This is the same area in which Spruce worked a century ago. From the bark of a forest liana, a definitely hallucinogenic drink in the form of a cold water infusion, yellowish in hue and exceedingly bitter, is made. The liana represented an undescribed species of the malpighiaceus genus *Tetrapterys*, which I named *T. methystica*.

In summary, we may state that: a) the narcotic known in the western Amazon as *caapi*, *yajé* and *ayahuasca* is made basically from species of *Banisteriopsis* or from closely related malpighiaceus genera; b) the most widely employed species of *Banisteriopsis* are *B. Caapi*, *B. inebrians* and *B. Rusbyana*, but *B. quitensis* appears also to be a major source; c) the genus *Tetrapterys* is employed along the Colombia-Brazilian boundary, where only one species, *T. methystica*, is known to be used; d) *Mascagnia psilophylla* var. *antifebrilis* has been suggested as a source of ayahuasca, but the evidence is not strong; e) the identification of *yajé* as an *Aristolochia* is without foundation; f) *Prestonia amazonica* has frequently been named as a source of *yajé*; but there is little or no reliable evidence that it is ever employed, at least, as the prime ingredient, in preparing the narcotic; g) non-malpighiaceus plants are known occasionally, but apparently not frequently, to be added as admixtures together with *Banisteriopsis*.

If there be confusion in the botanical field, there is chaos in the chemical. This stems in great part, to be sure, from uncertainty as to precisely what the plants involved may be. The problem consequently is basically an ethnobotanical one.

An alkaloid was isolated from *yajé* in 1923 by Fischer who named it telepathine, but he gave neither structure nor other pertinent data. At the same time, Barriga-Villalba and Albarracín reported two alkaloids from specimens of *yajé*: *yajeine* and *yajimine*. Later, in 1926, Michiels and Clinquart isolated *yajeine*; and Reutter reported *yajeine* and *yajimine* from samples of *yajé* which, without herbarium specimens, he identified as *Prestonia amazonica*. In 1928, Lewin isolated what he called *banisterine*; this alkaloid, incidentally, was tried clinically in mental cases at that time.

In the same year, Wolfes, as well as Rumpf and Elger, claimed that both *yajeine* and *banisterine* were actually *harmine*, one of the indole derivatives found in the seeds and roots of *Peganum Harmala* of the family *Zygophyllaceae*. This point of view has been generally accepted. Although pharmacological similarities between the activity of these alkaloids and *harmine* are close, Hamet, while agreeing that telepathine, *yajeine* and *banisterine* are identical, felt that evidence was not yet sufficient to identify them with *harmine*.

Working, so far as I am aware, for the first time with accurately identified

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botanical materials, Chen and Chen demonstrated that the alkaloid of *Banisteriopsis Caapi* is harmine and that telepathine, yajeine, and banisterine are superfluous synonyms.

Recent chemical investigation has, however, apparently reopened the whole question. In 1953, working with material of *Banisteriopsis inebrians* which I collected in the Colombian Putumayo, O'Connell and Lynn found harmine in the stems and, in the leaves, "an alkaloid which was partly identified as harmine." Mors and Zaltzman, however, in 1954, questioned that harmine and yajeine were the same. Most recently, in 1957, Hochstein and Paradics, likewise on the basis of botanically determined materials, found that *Banisteriopsis Caapi* contains, in addition to harmine, the alkaloids *harmaline* and *d-tetrahydroharmine*, the three differing only in their state of oxidation and therefore of considerable biogenetic interest. They conclude that "in view of the low degree of psychotomimetic activity reported for harmine and the effectiveness ascribed to *B. Caapi* extracts, it seems likely that the harmaline or d-tetrahydroharmine may have substantial psychotomimetic activity in their own right."

This is how far 100 years has brought us. How much farther is there to go? Should we not step up the speed of our studies before time blots out much of the native lore of the western Amazon?

Datura and Other Solanaceous Plants

The well known intoxicating solanaceous genus, *Datura*, has two New World centers of aboriginal use. In the American Southwest (California, Arizona, New Mexico) and adjacent Mexico, several herbaceous species, chiefly *D. meteloides* and *D. innoxia* (the *toloache* of Mexico), have been a part of religious and magical rites from earliest times. They are still so employed. *Toloache*, reported as a narcotic by all of the early chronicles, is still widely employed in rural parts of northern and central Mexico.

In the Andes, from Colombia to Chile, and along the Pacific Coast of South America, where the *Daturas* are trees, a number of species are known to have been of extreme importance in some of the ancient civilizations, including the Incas and Chibchas, and are still valued in magico-religious and divinatory rites in isolated areas of Colombia, Ecuador and Peru. There is even a report of witch-doctors of the Ecuadorian highlands taking lessons recently from Jivaro medicine-men and re-introducing the use of *Datura* into the populous and now civilized Andean tribes. The important economic species are *Datura candida*, *D. sanguinea*, *D. aurea*, *D. dolichocarpa*, *D. suaveolens* and *D. arborea*. A recently discovered species, *Datura vulcanicola*, may also have been used.

The preparation and use of *Datura* differ widely. It is most generally taken in the form of pulverized seeds dropped into beverages such as *chicha* or native beers. Many South American Indians thus bring on the intoxication which is marked by an initial state of violence so furious that the partaker must be held down pending the arrival of the deep, disturbed sleep during

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which visual hallucinations, interpreted as spirit visitations, are experienced. This narcosis enables the witch-doctor to diagnose disease, to discover thieves and to prophesy the outcome of tribal affairs and hopes. The Jivaro value *Datura* in correcting very refractory children who are given the seeds in the hope that the spirits of their forefathers may come to admonish them. The Chibchas anciently gave women and slaves potions of *Datura* to induce stupor prior to their being buried alive with departed husbands or masters.

Accurate identification of the species used by the tribes for special purposes leaves much to be desired, but since most species are known to contain similar alkaloids — *hyoscyamine*, *scopolamine*, *atropine* — this is not such a serious problem as it is in the case of some other narcotics.

In one high mountain-girt valley in southern Colombia, inhabited by Kamsá and Ingano Indians, I collected in 1942 what, after 13 years of field and herbarium study, I decided was a new solanaceous genus, closely akin to the tree-Daturas. Apparently a strict endemic, this tree has 12-inch flowers and long slender leaves from which an infusion is made for use similar to that of the *Datura* species. *Methysticodendron Amesianum*, for that is what I called it, is stated to be more potent and more dangerous than the Daturas. Its chemical composition includes l-scopolamine and hyoscyamine, with evidence of the presence of very minor amounts of other alkaloids.

The Indians of this isolated Valley of Sibundoy may possess the most intricate narcotic consciousness of any peoples of the New World. In addition to several species of tree-Daturas and *Methysticodendron*, they recognize and keep through vegetative reproduction clones of Daturas which are variously atrophied as a result of virus infection. Some of these "races" are such monstrosities that it is difficult to discover the species to which they belong. The natives have special names for each clone. Since they are reputedly stronger, weaker, or in other ways different from healthy Daturas in their effects, they are conserved for very special uses by the witch-doctors. Here is an excellent problem never investigated but well worthy of research — are they really chemically different and, if so, is the difference associated with the virus infection?

The alkaloidal family *Solanaceae* is so excessively rich in genera and species in the Andean area that there would seem to be every probability that additional plants of the family may be found to be or to have been utilized as native narcotics. Only further field research will tell.

Mescal Beans

In Texas and other southwestern states and in adjacent Mexico, one of the characteristic plants of the drier areas is the shrubby *Sophora secundiflora*. The pods of this leguminose species bear dark red seeds known locally as *mescal beans* or, in Mexico, as *frijolitos*.

The genus *Sophora* is rich in alkaloids. The seeds of *Sophora secundiflora* have been found to contain *cytisine*, known also as *sophorine*, a crystalline

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alkaloid belonging pharmacologically to the same group as nicotine. Cytisine is highly poisonous. Its intoxication is characterized by nausea and convulsions, and death occurs as a result of respiratory failure.

In spite of its toxicity — or perhaps because of it — the seed of *Sophora secundiflora* was used formerly by Indian groups, especially in Texas and northern Mexico, as the basis for the Red Bean Dance. Various groups of the Plains Indians likewise employed the mescal bean in distinct patterns of use: as an oracular or divinatory medium, to induce visions in initiation rites and as a ceremonial emetic and stimulant. Its use today amongst the Kiowa and Comanche Indians as part of the ornamental dress of the leader of the peyote ceremony may point to its earlier employment as a narcotic, a role which it lost with the sweeping arrival of peyote which was so much safer and so much more spectacularly hallucinogenic.

References to the mescal beans go back to 1539, when Cabeza de Vaca spoke of them as objects of trade amongst the Indians of what is now Texas. They were mentioned in the mission literature of Texas as an oracular seed, and the Stephen Long Expedition in 1820 reported that the Arapaho and Iowa Indians used large red beans as a medicine and narcotic.

What interests us especially about *Sophora secundiflora* is how, in such a short period of time, its use has disappeared so completely that we have but a fragmentary knowledge of the whole picture. The same fate lies in store for other native narcotics, and it behooves us to act before aboriginal folklore be completely lost to us forever.

Ololiuqui and Tlilitlitzten

The early chroniclers in Mexico, writing shortly after the Conquest, discovered a number of intoxicants as major factors in native religions. One of the strangest was *ololiuqui*, the seed of which was a vision-producing narcotic. Several sources described the plant as a vine and illustrated it. Hernandez, the King of Spain's personal physician who spent a number of years studying the medicinal plants, animals and stones of the new country, accurately illustrated *ololiuqui* as a morning glory in his work which was not published until 1651.

Religious persecution of the native cults by the newly arrived Roman Catholic authorities drove the use of the sacred narcotic plants into hiding. For four centuries, no morning glory with intoxicating principles ever came to light. In spite of the insistence of reliable Mexican botanists in the literature that *ololiuqui* actually was a member of the Convolvulaceae, the American economic botanist Safford asserted that it must be a species of *Datura*. He reasoned that 1) no morning glory was known to contain principles active on the central nervous system; 2) the flowers of the morning glories were tubular and similar to those of *Datura* and the Indians could have fooled Hernandez with a substitution; and 3) the narcosis described in the literature for *ololiuqui* coincided well with *Datura*-intoxication. Safford's identification

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was readily accepted and, to this day, is well established in the scientific literature.

Nothing could have been further from the truth. In 1938, in the hills of Oaxaca, I found a convolvulaceous vine growing in the door-yard of a *curandero*. The seeds were employed as a sacred divinatory narcotic. As had been pointed out by Mexican botanists without the aid of voucher specimens, it was referable to the white-flowered morning glory, *Rivea corymbosa*. The few seeds available were examined by Santesson in Sweden who reported that in frogs they induced a kind of "half-narcosis" and who suggested that perhaps the active principle might be an alkaloid linked with a glucoside.

In 1941, I published a modest survey of our knowledge of the ololiuqui plant, but nothing further was done until a Canadian psychiatrist, Osmond, became interested in the effects described for the narcotic. In 1955, he reported four experiments with ololiuqui, characterizing *Rivea*-intoxication as consisting of apathy and anergia together with heightened visual perception and increased hypnagogic phenomena. He found no mental confusion but instead an acute awareness combined with alteration of time perception, followed a few hours later by a period of calm, alert euphoria. We might well harken back at this point to Hernandez' statement that Aztec "priests communed with their gods . . . to receive a message from them, eating the seeds to induce a delirium when a thousand visions and satanic hallucinations appeared to them." It was so powerful that he wrote ". . . it will not be wrong to refrain from telling where it grows, for it matters little that this plant be here described or that Spaniards be made acquainted with it."

Recently, Wasson has established that the seeds of another morning glory, *Ipomoea violacea*, are employed in Oaxaca for the same purpose and in the same way as those of *Rivea corymbosa*; he has identified *Ipomoea violacea* as the *ilitiltzen* of the Aztecs.

For many years, chemists were unable to isolate any narcotic principle which could cause the characteristic intoxication, but in 1960, Hofmann was able to find the active constituents. They are the amides of lysergic acid and of d-lysergic acid, chanoclavine and clymoclavine, substances hitherto known only in the fungus ergot (*Claviceps purpurea*). They have been found in *Rivea corymbosa* as well as in *Ipomoea violacea*.

Peyote

Another of the sacred plants closely tied in with religious practices which the conquerors of Mexico encountered was the now famous *peyote* cactus, *Lophophora Williamsii*. The spineless heads of this small gray-green cactus with a long carrot-like root are sliced off and dried to form the so-called *mescal buttons*. The intoxication induced by eating mescal buttons is one of the most highly complex known and has been too often and expertly described in the literature to detail here. The most spectacular phase of this intoxication is made up of the kaleidoscopic play of richly colored visual

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hallucinations. It is primarily this extraordinary phase of the narcosis which has convinced Mexican and North American Indians that the plant is a divine messenger enabling the partaker to communicate with the gods without the medium of a priest and has occupied the serious attention of experimental psychologists now for a number of years.

Peyote goes back far in Mexican history. The chronicles of the Conquistadores are full of fanatic and vituperative condemnation of peyote as a diabolic root. Missionaries combated its use in native religions as a sacred element and compared the eating of the cactus with cannibalism.

Peyote survived, however, as a divine therapeutic agent and religious hallucinogen in northern Mexico, where the explorer Lumholtz in 1892 discovered its use in ceremonial dances amongst the Huichols and Tarahumares and sent back to Harvard University material upon which a definitive botanical determination was made.

During the last half of the past century, Indian tribes from the United States brought back knowledge of the peyote from their raids into northern Mexico. After 1880, peyote was accepted with great speed amongst many tribes in the United States as the central sacrament in a religious cult which incorporated both Christian and aboriginal elements. By 1922, the adherents to the peyote cult numbered some 13,300 and, for protection against fierce and often unjust persecution from missionary and political circles, it was legally incorporated as the Native American Church. There are now many more tribes, as far north as Saskatchewan, represented in the peyote cult in the United States and Canada; the figure has been put as high as a quarter of a million. Having attended peyote ceremonies in Oklahoma, I must say that I am impressed with the reverence and seriousness of the Indian in his practice of the peyote ceremony, the moral teachings of which are of the highest. Since science has not demonstrated that peyote is a dangerous and addictive narcotic, I personally can see no reason for political interference with its use in the American Indian religious rites.

There are some eight isoquinoline alkaloids in the peyote cactus. While all of them undoubtedly contribute to the characteristic peyote intoxication, one — *mescaline* — is responsible for the fantastic visual hallucinations.

So much has been written on the various aspects of peyote that I need not elaborate in this brief survey. What should concern us, however, is the advisability of intensive chemical and pharmacological investigations of the *Cactaceae*, especially of those genera allied to *Lophophora*. Alkaloids similar to or identical with those of *Lophophora* have been found in species of *Anhalonium* and *Ariocarpus*, but there seems never to have been carried out a concerted screening of the family. Of the more than twenty plants which, in Mexico, have been called "peyote," either because their physiological effects are similar or because they are used with *Lophophora Williamsii*, more than half belong to the *Cactaceae*. Here is one area, I believe, where the attention of chemists and pharmacologists is strongly indicated.

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Rapé dos Indios

In the central part of the Brazilian Amazon, along the upper Xingú, to be precise, a psychotomimetic snuff has recently been discovered. It is known in Portuguese only by the name *rapé dos indios* or "Indian snuff." Nothing has as yet been published. My source of information was the late Dr. George A. Black, botanical explorer of the Brazilian Amazon, where he lost his life in a rapids. Black informed me in a letter that this snuff is made from the fruit of the gigantic forest tree, *Olmedioperebea sclerophylla*, a member of the *Moraceae*. One could hardly have chosen a less likely source-family for an hallucinogen. Unfortunately, we have no information about its manner of use, and no chemical study has, to my knowledge, been carried out, so that we do not know anything as yet as to the nature of the active principle.

Salvia and Other Mints

A species of *Salvia*, of the Labiatae or Mint Family, has very recently been discovered by Wasson as an hallucinogenic narcotic in use in northeastern Oaxaca, Mexico. The species, *Salvia divinorum*, new to science, has the vernacular names *hojas de la pastora* or *hojas de Maria Pastora* in Spanish and *ska-Pastora* among the Mazatec Indians.

Although the plant and its properties are familiar to virtually all Mazatecs, there seem to have been no very early reports of the use of *Salvia divinorum* in magico-religious rites. Its area of diffusion comprises only the Mazatec country and possibly adjacent regions inhabited by Cuicatec and Chinantec Indians. The leaves are consumed, usually by chewing them directly, but the effects may be induced when the leaves are drunk in water after having been crushed. *Salvia* leaves are taken when the mushrooms are not available, their narcotic effects coming on quicker, but, while these are similar to the effects of the mushrooms, they are "less sweeping" and of shorter duration. The psychotomimetic properties have been adequately experienced in the field of Wasson and others in his party.

Wasson has recently identified *Salvia divinorum* as probably the *pipiltzintzintli* of the Aztecs.

The chemical constituent or constituents responsible for the narcotic effects of *Salvia divinorum* have not yet been determined. As a mint, of course, the plant would normally be rich in essential oils.

Coleus pumila and two "forms" of *C. Blumei*, both of the Mint Family and both species of Old World origin, have been pointed out by natives in the Mazatec country to be likewise psychotropic, but these lack field corroboration by critical researchers. As Wasson has stated, "it would seem . . . that we are on the threshold of the discovery of a complex of psychotropic plants in the Labiatae or Mint Family."

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Teonanacate (teonanacatl)

The Spaniards, like most Europeans, are mycophobes — that is to say, they have an innate dislike of mushrooms. At the time of Spain's great expansion into the New World, they were fired by a religious fanaticism the like of which has never been seen since. We can, consequently, understand the utter disgust of the conquerors of Mexico when they discovered certain intoxicating mushrooms called *teonanacatl*, "flesh of the gods," employed as a kind of sacrament or communion in Aztec religious rites.

Most of the early chroniclers were clerics, and they put special emphasis on the need for stamping out such loathsome pagan customs. The peyote cactus and the morning glory, *ololiuqui*, fell under their ban, too, but particular wrath was directed towards the mushrooms which, through the visions induced by the sacred powers residing in the plant, permitted the Indian to commune with the spirit world.

Sahagún, a Spanish friar, was one of the first Europeans to refer to *teonanacate*. He made several references to mushrooms "which are harmful and intoxicate like wine" so that those who eat of them "see visions, feel a faintness of heart and are provoked to lust." He detailed the effects in one reference, saying that the natives ate them with honey and "when they begin to be excited by them start dancing, singing, weeping." "Some," Sahagún continued, "do not want to sing but sit down . . . and see themselves dying in a vision; others see themselves being eaten by a wild beast; others imagine that they are capturing prisoners of war, that they are rich, that they possess many slaves, that they had committed adultery and were to have their heads crushed for the offence . . . and when the drunken state had passed, they talk over amongst themselves the visions which they have seen." In addition to the detailed reports, several editions of Sahagún's writing give crude illustrations of the sundry mushrooms employed.

There are four or five references to the sacred fungi in these early writings. According to Tezozomoc, for example, inebriating mushrooms were part of the coronation feast of Montezuma in 1502. Friar Motolinía, who died in 1569, mentioned the sacred psychotomimetic mushrooms in a work on pagan rites and idolatries. The physician, Hernandez, who studied the medicinal lore of Mexican natives for seven years, spoke of three kinds of mushrooms used as narcotics and worshiped. Of some, called *teyhuinti*, he wrote that they "cause not death but madness that on occasion is lasting, of which the symptom is a kind of uncontrolled laughter . . . these are deep yellow, acrid and of a not displeasing freshness. There are others again which, without inducing laughter, bring before the eyes all kinds of things, such as wars and the likeness of demons. Yet others there are not less desired by princes for their festivals and banquets, and these fetch a high price. With night-long vigils are they sought, awesome and terrifying. This kind is tawny and somewhat acrid."

Notwithstanding the relatively numerous and forceful Spanish reports,

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nothing was known about these mushrooms until very recently. The first attempt to determine them botanically was made in 1915, when the American botanist, Safford, asserted that teonanacate was, in reality, only the peyote cactus. The dried, brown, discoidal head or "button" of *Lophophora Williamsii*, he wrote, resembled "a dried mushroom so remarkably that, at first glance, it will even deceive a mycologist." Safford was led into this serious error first by his oft-stated belief that the Mexican Indians were deficient in botanical knowledge and secondly by the similarity of the effects of peyote and teonanacate. Safford's outstanding reputation stamped his conclusions with authority, and they became generally accepted.

Dr. Blas P. Reko, a physician who did extensive botanical collecting in Mexico, raised a lone voice in protest and, though he failed to produce specimens, wrote, as early as 1919 and 1923, that teonanacate in reality was a dung-fungus and was still employed in religious rites in Oaxaca.

In 1936, an engineer, Robert J. Weitlaner of Mexico City, secured a few specimens of a mushroom used in ceremonial divination in northeastern Oaxaca and sent them to the Harvard Botanical Museum. They were poorly preserved but it was possible to assign them to the genus *Panaeolus*. In 1938 and 1939, during the course of ethnobotanical field work in Oaxaca in the company of Reko, I collected *Panaeolus sphinctrinus* as one of the narcotic mushrooms employed by the Mazatec Indians of Huautla de Jiménez. During the same field studies, a specimen of *Stropharia cubensis* was likewise collected as one of the psychotomimetic mushrooms. In the time available, I was unable to witness a ceremony, and so few mushrooms were available because of the very dry season that it was not possible for me to take them experimentally: all were needed as voucher herbarium specimens.

I was able to publish two papers in which I suggested that *Panaeolus sphinctrinus* (*P. campanulatus* var. *sphinctrinus*) was probably the teonanacate or sacred mushroom of the Aztecs, and my work then took me to the Amazon Valley for twelve years, so that I never returned to Oaxaca to continue the research.

About fifteen years later, Mr. R. Gordon Wasson of New York and his wife, intensely interested amateur ethnomycologists, read my papers and decided to visit Oaxaca to pursue this fascinating phase of their life-long study of mushrooms. Their first trip was made in 1953. It has been followed by seven or eight expeditions to Oaxaca and other parts of Mexico. Wasson sensed the need for intensive study of all phases of the use of the sacred mushrooms, so he enlisted the collaboration of specialists. The resulting research, woven by Wasson into an intricately interrelated whole, will long hold a high place as an outstanding model of what can be accomplished by well planned and carefully executed ethnobotanical investigation. Amongst his collaborators, he numbers the French mycologist, Dr. Roger Heim, and the Sandoz pharmaceutical scientists under Hofmann. Wasson and his associates were able to witness and to take part in mushroom ceremonies and to eat of the mushrooms themselves.

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The work of the Wassons and Heim has indicated that a number of different species of *Basidiomycetes* are employed as sacred, psychotomimetic mushrooms in Mexico. This was expected, in view of the ancient chronicles, but the wealth of genera and species still used — and probably not all have been uncovered as yet — is unexpectedly great. Furthermore, a large percentage of those employed represent species new to science.

Wasson and Heim failed to find *Panaeolus* employed by their informants, but it must be remembered that different *curanderos* may use different mushrooms and that the purpose for which the intoxicant is taken in a given ritual or séance may likewise have a part in choice of the species. The following mushrooms make up the Wasson-Heim list of Mexican hallucinogens: *Cantharellaceae-Conocybe siliginoides*, growing on dead tree trunks; *Strophariaceae-Psilocybe mexicana*, a small tawny inhabitant of wet pastures, apparently the most highly prized by the users; *Psilocybe astecorum*, called "children of the waters" by the Aztecs; *Psilocybe sapotecorum* of marshy ground and known by the Zapotecs as "crown of thorns mushroom"; *Psilocybe caerulescens* var. *mazatecorum*, the so-called "landslide mushroom" which grows on decaying sugar cane refuse; *Psilocybe caerulescens* var. *nigripes*, that has a native name meaning "mushroom of superior reason"; and *Stropharia cubensis*.

The interest stirred up in the scientific world by this work encouraged others to enter the field, but due primarily to the rapid nature of their work as compared to the sustained investigations of the Wasson group, they have contributed little to the total picture. The principal additions have been made by Singer and Guzman who, in 1957, visited Oaxaca and found several other species of *Psilocybe* used.

Undoubtedly there were many tribes in ancient Mexico who employed teonanacate, but we know with certainty only of the Chichimecas, who spoke Nahuatl. We know that today the sacred mushrooms are consumed by the Mazatecs, Chinantecs, Chatinos, Zapotecs, Mixtecs, and Mijes, all of Oaxaca; by the Nahoas of Mexico; and possibly by the Tarascans of Michoacan and the Otomis of Puebla.

The Wassons have uncovered much indirect evidence which they have interpreted, correctly I believe, to indicate a very great extent for the use of psychotropic mushrooms in Mexico and Guatemala, as well as an astonishing age for the mushroom cults. Certain frescoes from central Mexico, for example, dating back to 300 A.D., have designs which seem to put mushroom worship back that far. There are likewise the archaeological artifacts now called "mushroom stones" from the highland Maya of Guatemala, going back to 1000 B.C. Consisting of an upright stem with a man-like figure crowned with an umbrella-shaped top, these stone carvings have long baffled archaeologists who supposed them to be phallic symbols. It is now rather clear that they represented a kind of icon connected with mushroom worship.

The most important of the narcotic mushrooms of Oaxaca is *Psilocybe mexicana*. Besides the kaleidoscopic play of visual hallucinations in color,

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the outstanding symptoms of *Psilocybe*-intoxication are: muscular relaxation, flaccidity and mydriasis early in the narcosis, followed by a period of emotional disturbances such as extreme hilarity and difficulty in concentration. It is at this point that the visual and auditory hallucinations appear, eventually to be followed by lassitude and mental and physical depression, with serious alteration of time and space perception. One peculiarity of the narcosis which promises to be of interest in experimental psychiatry is the isolation of the subject from the world around him — that is, without a loss of consciousness, he is rendered completely indifferent to his environment which becomes unreal to him as his dreamlike state becomes real.

Heim and his colleague Cailleux succeeded in growing cultures of *Psilocybe mexicana* and other species. This opened the way for chemical study of the fungus in the Sandoz laboratories in Switzerland. Hofmann and his group there isolated white crystals which were soluble in water and methanol but almost insoluble in usual organic solvents. They called the substance *psilocybine* and found that it had an unusual chemical structure which research indicated to be an acidic phosphoric acid ester of 4-hydroxydimethyltryptamine. It is, therefore, allied to other naturally occurring compounds such as *bufotenine* and *serotonin*. *Psilocybine* is the first known naturally occurring indole derivative containing phosphorus. The discovery of such a substance has implications of great import, for example, for the study of biogenesis of the ergot alkaloids and for many other aspects of chemical investigation of the psychotropic indole alkaloids such as *harmine* and *reserpine*.

Psilocybe mexicana contains another indolic compound in minute amounts which, while closely allied to *psilocybine* is apparently not stable and has not yet been crystallized. It is called *psilocine*.

Since reporting on his preliminary work with *Psilocybe mexicana*, Hofmann has discovered *psilocybine* in other psychotomimetic species of this genus and in *Stropharia cubensis*. And I have heard unofficially that the same compound is suspected to occur in the genus *Panaeolus*.

Psilocybine is now under clinical examination as an aid in experimental psychiatry and in therapy, and promises to be as fruitful perhaps as *lysergic acid* has been.

Vinho de Jurumena

Another little known South American intoxicant is a beverage called *vinho de Jurumena*, prepared from the seeds of the leguminose *Mimosa hostilis*. Identification of this narcotic drink, employed by the Pancarú Indians in Pernambuco, Brazil, was made by Gonçalves de Lima, who described its role in the magico-religious ceremonies of this tribe. It is an hallucinogen and is believed to transport the soul to the spirit world.

The isolation of an alkaloid called *nigerine* was reported in 1946, but work completed last year indicates that *nigerine* is, in reality, N,N-dimethyl-

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tryptamine, the same constituent found in species of the closely related genus *Piptadenia*.

Yakee or Paricá

At the beginning of this century, the German ethnologist, Koch-Grünberg, mentioned an intoxicating snuff prepared from the bark of an unidentified tree by the Yekwana Indians of the headwaters of the Orinoco in Venezuela. There is every probability that this snuff was prepared from trees of the genus *Viola* of the *Myristicaceae*, the family to which our nutmeg belongs.

During my ethnobotanical field work in the Colombian Amazon, I learned of a particularly intoxicating snuff used only by the witch-doctors in several tribes. This was the *yakee* or *parica*. After eight years of search, I discovered that yakee was prepared from several species of *Viola*, *V. calophylla*, *V. calophylloidea* and, perhaps, *V. elongata*. The natives strip bark from the trunks before the sun has risen high enough to heat up the forest. A blood-red resin oozes from the inner surface of the bark. It is scraped off with a machete or knife and boiled in an earthen pot for hours until a thick paste is left. This paste is allowed to dry and is then pulverized, sifted through a fine cloth, and finally added to an equal amount of ashes of the stems of a wild cacao species. The ashes give the snuff consistency to withstand the excessive dampness of the air which might otherwise quickly "melt" the powdered resin-paste to a solid lump.

The active principle is undoubtedly the same essential oil — *myristicine* — that is common throughout the family and that makes our household nutmeg a dangerous narcotic when used in the appropriate amounts. Work on samples brought from the Colombian Amazon has not yet been completed. In the ethnological literature, yakee snuff has been consistently confused with both tobacco and yopo snuffs, so that it is difficult to get a clear picture from the literature of the extent of use of these three narcotics. We may say, however, that yakee is employed by tribes in the Colombian Vaupés and in the Orinoco drainage basin and in the upper Rio Negro basin in Brazil; if we are correct in ascribing the "bark snuff" reported by Koch-Grünberg to *Viola*, we should then include the headwaters of the Orinoco in Venezuela.

It may be interesting to append a few observations which I made personally after taking yakee. I took about one-third of a teaspoonful in two inhalations, using the characteristic V-shaped bird-bone snuffing tube. This represents about one-quarter the dose that a diagnosing medicine man will take to bring on an eventual state of unconsciousness.

The dose was snuffed at five o'clock one afternoon. Within fifteen minutes, a drawing sensation was felt over the eyes, followed very shortly by a strong tingling in fingers and toes. The drawing sensation in the forehead gave way to a strong and constant headache. Within a half hour, the feet and hands were numb and sensitivity of the fingertips had disappeared; walking was possible with difficulty, as with beri-beri. I felt nauseated until eight o'clock, and experienced lassitude and uneasiness. Shortly after eight, I lay

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down in my hammock, overcome with a drowsiness, which, however, seemed to be accompanied by a muscular excitation except in the hands and feet. At about nine-thirty, I fell into a fitful sleep which continued, with frequent awakenings, until morning. The strong headache lasted until noon. A profuse sweating and what was probably a slight fever persisted throughout the night. The pupils were strongly dilated during the first few hours of the intoxication.

Though performed under primitive conditions in the jungle by myself, this experiment does, I think, indicate the great strength of the snuff as a psychotic agent. The witch-doctors see visions in color, but I was able to experience neither visual hallucinations nor color sensations. The large dose used by the witch-doctor is enough to put him into a deep but disturbed sleep, during which he sees visions and has dreams which, through the wild shouts emitted in his delirium, are interpreted by an assistant. That it is a dangerous practice is acknowledged by the witch-doctors themselves. They report the death, about 15 years ago, of one of their number from the Punave tribe during a yakee-intoxication.

Yopo and Huilca

The snuffing of narcotics is widespread in aboriginal America, especially in South America. A number of different narcotics are involved, and there is still much to do to clarify all aspects of their botanical identity.

The most widely employed snuff, of course, is tobacco. From records in the literature, it is not always possible to distinguish when snuff is made from tobacco or from other plants, and this has caused much confusion.

The first scientific report concerning *yopo* or snuff from the leguminose *Piptadenia* is apparently that of Humboldt who, in 1801, saw the Otomacs along the Orinoco pulverize the seed of *Piptadenia peregrina*, mix the powder with quicklime and use it like tobacco snuff. Spruce gave us the earliest detailed report, however, when he wrote about *niopo* amongst the Guahibos of the Orinoco of Colombia.

The principal area of use of the *Piptadenia peregrina* snuff seems to be the Orinoco basin and Trinidad. Safford has identified the cohoba snuff of ancient Hispaniola as *Piptadenia peregrina*, and he seems to have good, even though indirect, evidence.

As practiced today in the Orinoco basin of Colombia and Venezuela, *yopo*-snuffing is a dangerous habit carried on, not by witch-doctors alone, but the whole population — men, women, children. The frightening intoxication first produces convulsive movements and distortions of the face and body muscles, then a desire to dance which is rapidly overwhelmed by an inability to control the limbs; it is at this point that a violent madness or a deep sleep disturbed by a nightmare of frightening sights takes over. The intoxication always ends in a long stupor. The use of *yopo* in daily life in the *llanos* area of Colombia and Venezuela may be relatively recent, for it was anciently employed only for specific purposes, such as to induce bravery before a battle,

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to give hunters keener sight and as an agent for prophesying, clairvoyance and divination.

Recent chemical work on carefully identified material has shown that the major alkaloid of a number of species of *Piptadenia* is *bufotenine*. Present also may be another hallucinogenic alkaloid, *N,N*-dimethyltryptamine. *Piptadenia colubrina*, a species closely allied to *P. peregrina*, has up to 2.1 percent of *bufotenine*.

Another species of *Piptadenia*, *P. macrocarpa*, is the source of a snuff of the Andean regions of Peru, where the plant is called *huilca*. Little of a definite nature seems to be known about *huilca* and its uses, but it is believed to have been the source of the strong, divinatory snuff of early Peru.

Coca

Although *coca*, the dried leaves of *Erythroxylon Coca*, does not constitute an hallucinogen, we should not terminate a discussion of South American narcotics without a mention, howsoever brief, of this very ancient drug. It belongs to Lewin's *Euphorica*, along with the opium poppy, *Papaver somniferum* of the Old World. I include these cursory remarks on coca merely because, by and large, it is, next to tobacco, America's most important narcotic and one which, even at this late date, deserves further study from many points of view. It is unquestionably, as employed by the Indians, one of the most maligned of narcotics.

There is no need to go into details which are easily available to all readers. The few lines which I shall devote to coca, the source of our *cocaine*, will discuss certain aspects not commonly found in the literature nor easily available to those who have not had personal experience in the field with the narcotic.

The chemical makeup of coca is extremely complex, with numerous alkaloids in six groups of the tropane series. The chemical literature usually attributes the source of coca to several species of *Erythroxylon*, but there seems to be little botanical reason for referring all of the slight geographical variants to different species. *Erythroxylon Coca* is a cultigen of long association with man, now unknown in the wild state and with a very wide altitudinal range.

Coca was a divine plant in pre-Colombian Andean cultures where it was once restricted to the priestly class but early escaped to the common man. Dried leaves have been found in Peruvian mummy bundles dating back at least 2000 years.

Coca chewing today is an integral part of the culture pattern in many isolated parts of the highlands of Colombia and in most highland parts of Peru, Bolivia and the northwesternmost corner of Argentina. Its use in highland Ecuador has all but died out. From the Andes, the habit spread into the lowland in most parts of the northwesternmost Amazon Valley in Colombia and Peru, where, however, it is employed in a rather different way. All highland groups chew the toasted leaves together with small pieces of lime or *lliptu*, of mineral, plant or animal origin. The Amazonian Indians pulverize

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the toasted coca leaves and mix the green powder with finely sifted ashes from leaves of the *Cecropia* tree; the resulting gray-green powder is packed over the gums and is not actually chewed but allowed to dissolve slowly and trickle down to the stomach. Most Indian coca-users keep the cheeks full of the material throughout their waking hours.

What is very commonly overlooked or even purposely ignored in many governmental and sociological circles is the fact that coca, as chewed by the native, is not of necessity physically, socially and morally dangerous enough to warrant prohibitive laws. It has nothing in common with cocaine addiction, and coca-chewing apparently does not lead to addiction. Peruvian Indians conscripted for the army where coca is forbidden are not unduly bothered by the lack of the narcotic. For the greater part of eight of my twelve years in exploration of the northwest Amazon, I used coca daily and found no desire for it when, back in the capital city, I had no supply. It is perhaps roughly comparable to the use of tobacco in our culture, and is certainly much less of a problem in the Andes than is alcohol in a mechanized society such as ours in the United States. Unwise legal prohibitions in certain Andean areas, aimed at extirpation of the coca-custom, have invariably driven the Indian — deprived in his inhospitable, cold altitudes of the euphoric coca — to the dangerously poisonous, locally distilled, alcoholic drinks, with an attendant rapid rise in crime of every description. As Taylor has wisely summed it up: "If medicine and addiction were its only uses, no one would bother to read what follows. But neither the addicts nor most doctors, nor many others, realize that the birth of cocaine was tended by the gods, nurtured in the high purity of the Andes without a taint of depravity, and was, if not divine, so considered for countless centuries. Even today, it has the touch of the miraculous."

* * * *

This brief discussion of native American narcotics of plant origin comprises but a very superficial panoramic view of the work that has been done on the hallucinogenic drugs and which has opened up such vistas of promise in both practical and academic fields of medical and biological research.

I have wanted to emphasize the part that many apparently unrelated fields may take in such an interdisciplinary attack. And I trust that we have been able to point out very specifically the two most important methods for the discovery of new drugs — on the one hand, examination of ancient records and interpretation of folklore; on the other, field work amongst primitive peoples who still live in close association with the plant world.

Certainly none of us could have been ready to accept some of the fantastic reports of the early writers on the unearthly effects produced by the sacred mushrooms. Now we know that they are true. We can no longer afford to ignore reports of any aboriginal use of a plant merely because they seem to fall beyond the limit of our credence. To do so would be tantamount to the closing of a door, forever to entomb a peculiar kind of native knowledge which might lead us along paths of immeasurable progress.