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The plant kingdom and hallucinogens (part III)

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Caltrop family

Zygophyllaceae
Peganum Harmala
An herb native to dry areas from the Mediterranean east to northern India, Mongolia and Manchuria, *Peganum Harmala* possesses undoubted hallucinogenic properties. Its seeds contain harmine, harmaline, harmalol and harman - bases known from at least eight different families. This and some of the other species in the genus are highly prized in folk medicine as vermifuges, soporifics, alteratives, aphrodisiacs, lactogogues and in the treatment of eye diseases. The fruits of *Peganum Harmala* are the source of a red dye and an oil. The esteem in which *Peganum Harmala* is held amongst peoples of the East is extraordinary. Although there are repeated but vague reports of the employment of *Peganum Harmala* as an hallucinogen, its actual narcotic use in inducing visions has not yet been established beyond a doubt. A critical search of the literature, especially the ancient records, and modern ethnobotanical field work are urgently needed in the study of *Peganum Harmala.*

Malpighia family

(Malpighiaceae)
***Banisteriopsis spp*.**
One of the weirdest of the hallucinogens is the drink of the western Amazon known as *ayahuasca, caapi* or *yaj?*. Although not nearly so popularly known as peyote or, nowadays, as the sacred mushrooms, this narcotic has nonetheless had an undue share of sensational articles that have played fancifully with unfounded claims, especially with regard to its "telepathic" powers. Notwithstanding its extraordinarily bizarre psychotomimetic effects, this narcotic preparation was hidden from European eyes until just a little over a century ago. The earliest report of ayahuasca appears to have been that of Villavicencio in his geography of Ecuador, written in 1858. The source of the drug, he wrote, was a vine used by the Zaparos, Angateros, Mazanes and other tribes of the Rio Napo basin: "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 defence; to ascertain, when a relative is sick, what sorcerer has put a curse; to carry out a friendly visit to other tribes; to welcome foreign travellers or, at last, to make sure of the love of their womenfolk".

Banisteriopsis Caapi

A few years earlier, in 1851, the British explorer Richard Spruce had discovered the Tukanoan tribes of the Rio Uaup?s in Amazonian Brazil using a liana called *caapi* to induce intoxication, but his observations were not published until later. One of Spruce's greatest contributions was his precise identification of the source of caapi as a new species of the Malpighiaceae. The species was described and called *Banisteria Caapi.* Recent botanical studies have shown that this concept cannot be accomodated in the genus *Banisteria* and it has been transferred to the allied genus *Banisteriopsis.* The correct name now is, accordingly, *Banisteriopsis Caapi.*

Spruce wrote of the caapi-drinking ceremony: "I had gone with the full intention of experimenting the caapi myself, but I had scarcely dispatched one cup of the nauseous beverage, which is but half the dose, when the ruler of the feast... came up with a woman bearing a large calabash of *caxiri* (mandioca beer), of which I must needs take a copious draught, and as I know the mode of its preparation, it was gulped down with secret loathing. Scarcely had I accomplished this feat, when a large cigar 2 feet long and as thick as the wrist, was put lighted into my hand, and etiquette demanded that I should take a few whiffs of it - I, who had never in my life smoked a cigar or a pipe of tobacco. Above all this, I must drink a large cup of palm-wine, and it will readily be understood that the effect of such a complex dose was a strong inclination to vomit, which was only overcome by lying down in a hammock and drinking a cup of coffee... ".

Cultivated vine of Banisteriopsis Caapi Rio Piraparan?, Colombia. Photograph R. E. Schultes

Two years later, Spruce met with caapi amongst the Guahibo Indians of the upper Orinoco of Colombia and Venezuela. Here the natives "not only drink an infusion, like those of the Uaup?s, but also chew the dried stem..." Again, in 1857, whilst working in the Ecuadorean Andes, he encountered the Z?paro Indians using a narcotic known as *ayahuasca* and felt that "it was the identical species of the Uaup?s, but under a different name ". Although, as Spruce noted, "of the

plant itself" Villavicencio "could tell no more than that it was a liana or vine ", his "account of its properties" coincided "wonderfully with what I had previously learnt in Brazil ".
In the century that followed Spruce's remarkable work, many explorers, travellers, anthropologists and botanists - von Martius, Orton, Crevaux, KochGr?nberg and others - referred to ayahuasca, caapi or yaj?, usually without details and often without botanical identification beyond the statement that the drug was prepared from a forest liana. In the years that followed the early work, the area of use of *Banisteriopsis Caapi* was shown to extend to the Amazon of Peru and Bolivia and even to the rain-forested Pacific coastal region of Colombia and Ecuador. 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 made by the botanical collector Guillermo Klug in the Colombian Putumayo, including the discovery of *Banisteriopsis inebrians* as a source of the yaj? drink. Similarly, the work of Varanof and Juzepczuk in the Colombian Caqueta in 1925-26 added important information to the whole problem. The most recent field work of Garcia Barriga, added to my own researches and those of my students Bristol and Pinkley, have furthered appreciably our knowledge, but there still remains much to do before a thorough understanding of the total picture of the malpighiaceous narcotics is gained. An outstandingly complete ethnobotanical summary of the use of *Banisteriopsis* as a narcotic has recently been published by Friedberg. Cuatrecasas's monographic study of the Malpighiaceae of Colombia now provides the firm taxonomic basis for clarification of numerous ethnobotanical problems.
Serious complications, however, arose early in attempts correctly to identify ayahuasca, caapi and yaj?. In 1890, a missionary amongst the Jivaros published an article in which he consfused the narcotic tree-species of *Datura* with the malpighiaceous hallucinogen - a confusion that entered pharmacological and chemical literature and has persisted there.
The presumption, arising from misinterpretation of Spruce's field notes, that, while ayahuasca and caapi were derived from *Banisteriopsis*, yaj? was prepared from the apocynaceous *Prestonia amazonica* (see below under *P. amazonica*). Although this error has been more or less discredited, the literature abounds with "identifications" of yaj? - and even of ayahuasca and caapi - as *Prestonia*. It has confused the ethnobotanical, chemical and pharmacological study of this drug to an extraordinary degree. In 1957, the chemists Hochstein and Paradies analyzed "ayahuasca" from Peru, calling it *Banisteriopsis Caapi,* and, from the same region, yaj?, which they attributed to *Prestonia amazonica.*
They stated that the natives of the R?o Napo area "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 ". The identification of *"Prestonia amazonica"* was made on an aqueous extract of the leaves through the use of the vernacular name *yaj?* which, in much of the literature, is actually so identified. What makes this particular instance unusually sensitive was the report of the discovery in *"Prestonia amazonica"* of N,N-dimethyltryptamine, a compound unknown in the Apocynaceae. In the light of recent studies, it appears possible that the aqueous extract of leaves called yaj? was, in reality, *Banisteriopsis Rusbyana* or *Psychotria psychotriaefolia.*
Still other confusions have entered the picture of the identity of the malpighiaceous narcotics of South America. *Yaj?* has been identified as a species of *Aristolochia* on the basis of misidentification of a wood specimen. On what was possibly a mixture in herbarium material, Niedenzu suggested that ayahuasca in Ecuador and Peru ought to be considered the malpighiaceous *Mascagnia psilophylla* var. *antifebrilis* as well as *Banisteriopsis Caapi* and *B. quitensis* - thus introducing an additional genus, for which none of the extensive field observations offers support, into the picture. From an evaluation of field work from all sources, it is now clear that the two main sources of ayahuasca, caapi and yaj? in the Amazon basin, *nat?m* in Ecuador, *pinde* along the Pacific coast of Colombia, are the barks of *Banisteriopsis Caapi* and *B. inebrians,* and that in certain parts of the westernmost Amazon the leaves of a third species, *B. Rusbyana,* may occasionally be added to fortify the drink.
A great amount of ethnobotanical work remains to be done in identifying the plants which certain Amazonian tribes use as additives with the basic *Banisteriopsis* ingredient. These additives may be very localized - even to one witch-doctor - or they may be widely employed. In many instances, there is reason to believe that their use alters or strengthens the effects that the *Banisteriopsis* alone would cause. The Sionas of Colombia add what is probably *Datura suaveolens* to *Banisteriopsis* in making yaj?, and their neighbours, the Inganos, are said to value *Alternanthera Lehmannii* as an admixture. I found that Makuna medicine-men of the R?o Popeyak? in eastern Colombia occasionally add a few crushed leaves of the apocynaceous *Malouetia Tamaquarina.* Tobacco is stated sometimes to be added. A most interesting anthropological report has recently enumerated five lianas, the barks of which are employed with *Banisteriopsis Caapi* by the Tukanos of the Brazilian part of the Rio Uaup?s; but, unfortunately, the plants are still identified only by native names; the admixture said to fortify the drink most strongly - a vine with thickened nodes

and known in Tukano as *kuri-kaxpi-d?* - may, I believe, possibly represent *Gnetum nodosum,* a very abundant element of the riverside vegetation.
Appreciable differences exist in the manner of preparing the malpighiaeceous narcotics - differences from area to area and even occasionally from tribe to tribe. In Ecuador, Colombia and Peru, near the eastern Andean slopes, the drink is made by long boiling of the ingredients; farther to the east, it is made simply by soaking and squeezing the freshly rasped bark in cold water and straining the liquid.
To this day, the natives of the north-west Amazon in Brazil and Colombia use the *Banisteriopsis* drink 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 on many occasions, is usually pleasant, characterized by visual hallucinations in colour, which initially is very often a shade of blue or purple. In excessive doses, it is said to bring on frighteningly nightmarish visions and a feeling of extremely reckless abandon, although consciousness is not lost nor is use of the limbs unduly affected

Leaves of Banisteriopsis Caapi, R?o Kananarl, Colombia. Photograph H. Garcia-Barriga

One encounters great difficulty in describing a *Banisteriopsis* intoxication for many reasons. First: the effects of harmine, the alkaloid apparently of prime psychoactive importance, is known to react variably from person to person. Second: the methods of preparing ayahuasca, caapi or yaj? differ from area to area. Third: sundry admixtures may be employed that alter the effects of the principal ingredient of the drink.
My own experiences from participation in many Amazonian *Banisteriopsis*-rituals might be summarized by saying that the intoxication began with a feeling of giddiness and nervousness, soon followed by nausea, occasional vomiting and profuse perspiration. Occasionally, the vision was disturbed by flashes of light and, upon closing the eyes, a bluish haze sometimes appeared. A period of abnormal lassitude then set in during which colours increased in intensity. Sooner or later a deep sleep interrupted by dream-like sequences began. The only uncomfortable after-effect noted was intestinal upset and diarrhoea on the following day. At no time was movement of the limbs adversely affected. In fact, amongst many Amazonian Indians, dancing forms part of the caapi-ritual.
Chen and Chen offered a good summary of *Banisteriopsis* hallucinations: "The most outstanding feature of caapi seems to be its ability to produce visual hallucinations and dreams in men. The Caucasians who took this preparation apparently confirmed the Indians' claims. Thus, Villavicencio experienced an aerial voyage, in which he saw the most beautiful sights, and Spruce quoted a Brazilian friend as saying that once, when he took a full dose of caapi, he saw all the marvels that he had read about in the Arabian Nights pass rapidly before his eyes as a panorama; the final sensations and sights were horrible, as usual. Cardenas made seven observations on men, including himself, with the decoction in various doses. All the subjects appeared to have optical illusions of different degrees. No excitement was recorded in any case."
The earliest sophisticated phytochemical work on "yaj?" was apparently that of the Colombian, Fischer-Cardenas, who, in 1923, isolated alkaloidal crystals which he called *telepathine*, a name which an earlier Colombian, Zerda-Bayon, had coined for a presumed alkaloid as early as 1905.

Fischer-Cardenas, without voucher botanical material, presumed that he was analyzing a species of *Atristolochia*.

Further chemical and pharmacological studies were undertaken without much real progress, until Perrot and Raymond-Hamet, in 1927, first isolated an alkaloid in pure condition, conserving for it the name telepathine. A year later, Lewin investigated *Banisteriopsis Caapi* subsequently publishing a monograph on this "magic drug" and, what is truly remarkable, making "... a film of the action of the drug in three patients... ", undoubtedly "the first documentation of the action of monoamine-oxidase inhibitors ". Lewin isolated an alkaloid which he called banisterine. Elger and Wolfe and Rumpf contributed by identifying the alkaloid in botanically authenticated material as harmine, known for many years and from the zygophyllaceous *Peganum Harmala*. Shortly thereafter, in 1939, the work of Chen and Chen confirmed the presence of harmine in stem, root and leaf material of botanically authenticated *Banisteriopsis Caapi.* Harmaline and tetrohydroharmine have likewise been isolated from *Banisteriopsis Caapi.*

In 1953, botanically determined material of *Banisteriopsis inebrians* was analyzed with the resulting discovery of harmine in the stems, but harmaline and tetrahydroharmaline were not found.

All the alkaloids isolated from *Banisteriopsis Caapi* and *B. inebrians* have a ?-carboline skeleton with varying degrees of hydrogenation in the pyridine ring.

While *Banisteriopsis* is normally employed as a beverage, there is evidence that in the north-westernmost Amazon it may be used as snuff as well: harmine, harmaline and tetrohydroharmine have been reported from snuff powders said to have been prepared from a vine which, according to reports, was also the source of an intoxicating drink in the Rio Negro basin of Brazil. Botanically identifiable material, unfortunately, is lacking.

A recent and unusual chemical analysis carried out on stem material of the type plant of *Banisteriopsis Caapi,* collected by Spruce in 1852, disclosed the presence still of harmine. This material, suffering considerable damage from rot when it was abandoned in shipment in the Amazon jungle, has been stored for more than a century at Kew. Gas chromatography - mass spectrometry showed that the alkaloid content consisted exclusively of harmine. Whether the stems originally contained harmaline and tetrohydroharmine or not cannot be stated, but it is more likely that, with time, they have been transformed into the chemically more stable aromatic ?-carboline, harmine. It is truly remarkable that botanical material collected from a type plant for chemical analysis 115 years ago has finally been subjected to examination by modern analytical microtechniques.

It was Poisson who, in 1965, reported in the leaves of *Banisteriopsis Rusbyana* the presence, in relatively high amounts, of N,N-dimethyltryptamine, a discovery corroborated by several later investigators. This species surprisingly did not contain the ?-carboline alkaloids.

As pointed out above, this plant is one of the important admixtures with *Banisteriopsis Caapi* and *B. inebrians* in preparing the narcotic drink in the westernmost Amazon. What is even more interesting is that this is the same indole derivative found in a number of hallucinogenic snuffs used in South America.

To my knowledge, leaves of *Psychotria psychotriaefolia* and *Banisteriopsis Rusbyana* are never used alone, notwithstanding their significant content of N,N-dimethyltryptamine. Since it is suspected that this hallucinogenic compound would have little if any effect taken orally, the way in which these two plants act as admixtures with harmine-containing species is still not clear. That they do alter or even intensify the intoxication is not questioned by any field observation, and, even though most of the South American narcotic preparations containing N,N-dimethyltryptamine are taken as snuffs, the natives employ at least one other - *Mimosa hostilis* - in liquid form as a drink.

It is obvious that there remains much field and laboratory investigation - - preferably well integrated - before we truly understand the drugs of the ayahuasca-caapi-yaj? complex, notwithstanding the fact that we have had a century in which to carry out such studies. What is disconcerting, indeed, is that time may be running out for pristine investigations of this kind, as tribe after tribe becomes civilized or disappears.

Tetrapteris methystica

Several writers - notably Spruce and the German anthropologist Koch-Gr?nberg - mention more than one "kind" of caapi in the Vaup?s basin.

Tetrapteris methystica, one source of the intoxicating caapi drink of the north-west Amazon region. Rio Tiki?, Brazil. Photograph R. E. Schultes

It was my good fortune in 1948 to be able to witness the preparation of, and to take a narcotic drink amongst, the nomadic Mak? Indians of an affluent of the Rio Tikie in north-westernmost Brazil. Specimens taken from a flowering vine, from the bark of which a coldwater infusion was made without the admixture of any other plants, were found to represent an undescribed species of a malpighiaceous genus closely allied to *Banisteriopsis - Tetrapteris methystica*.
The beverage prepared from *Tetrapteris methystica* was a yellowish hue, quite unlike the coffee-brown colour characteristic of all preparations of *Banisteriopsis Caapi* which I have seen.
A small amount of stem material for chemical study that I gathered from the wild vine from which the type material came was lost in the overturning of my canoe. Consequently, nothing is known chemically of this kind of caapi. That it is highly intoxicating, with effects very like those induced by *Banisteriopsis*, I can vouch from self-experimentation.
An important point in this connexion is worth considering. *Tetrapteris methystica* may represent the second "kind" of caapi mentioned by Spruce and KochGr?nberg, and it might be that the epithet *caapi-pinima* (" painted caapi ") alludes not to the painted leaves but to the unusual yellowish hue of the drink prepared from it.

Cactus family

(Cactaceae)
Lophophora Williamsii
One of the important native religions that the conquering Spaniards found amongst the Mexican Indians centered around a small, grey-green, napiform, spineless cactus covered with tufts of whitish hair. This sacred plant, known in Nahuatl as peyotl, is now technically called *Lophophora Williamsii*. It grows in the deserts of the central and northern parts of the Mexican Plateau, concentrated apparently in the Valley of the R?o Grande.
***Peyote*, as the cactus is known in modern Mexico, might appropriately be termed the "prototype" of the New World hallucinogens, since it was one of the earliest discovered and probably the most spectacular vision-inducing plant encountered by the first European visitors to Mexico. Firmly established at the time of the Conquest, the peyote-cult in Mexico has withstood four centuries of civil and ecclesiastical opposition and, during the past century, has spread, in greatly modified form, to many Indian groups in the United States and Canada. The extensive spread of peyote as a sacred plant is due obviously to its extraordinary psychoactive properties and the resulting belief amongst the Indians in its supernatural therapeutic powers.**

The peyote cactus, Lophophora Williamsii, in flower Photograph R. E. Schultes

How far into the past the use of peyote extends no one knows. The first European to discuss peyote, the missionary Sahag?n, suggested that the Chichimecas and Toltecs were acquainted with it as far back as 300 B.C., but the accuracy of this dating depends on his exactness in interpreting the native calendar. Sahagr?n, who worked in Mexico in the middle of the 16th century, reported that: "There is another herb like tunas of the earth; it is called *peyotl*; it is white; it is found in the north country; those who eat or chew it see visions either frightful or laughable; this intoxication lasts two or three days and then ceases; it is a common food of the Chichimecas, for it sustains them and gives them courage to fight and not feel fear nor hunger nor thirst; and they say that it protects them from all danger ". The Chichimecas, he wrote, "were the first to discover and use the root called *peyotl* which takes the place of wine in their diet ". Another early ecclesiastical chronicler, Cardenas, reported in 1591 that the natives eat peyote, lose their senses, see visions of terrifying sights like the devil and are able to prophesy the future; he denounced the drug as "satanic trickery ".

The first full description of the cactus, under the name *Peyotl zacatecensis*, was that of Hernandez, physician to Philip II of Spain, in his *De Historia Plantarurm Novae Hispaniae*: "The root is of nearly medium size, sending forth no branches or leaves above the ground, but with a certain woolliness adhering to it on account of which it could not be aptly figured by me. Both men and women are said to be harmed by it. It appears to be of a sweetish taste and moderately hot. Ground up and applied to painful joints, it is said to give relief. Wonderful properties are attributed to this root... It causes those devouring it to be able to foresee and predict things,... or to discern who has stolen from them some utensil or anything else; and other things of like nature which the Chichimecas really believe they have found out. On which account this root scarcely issues forth, as if it did not wish to harm those who discover it and eat it."

Spanish missionary efforts to stamp out the peyotecult failed, for it survived in the hills. In the latter part of the 17th Century, a detailed description of the peyote ritual amongst the Cora Indians still referred to the cactus as a "diabolic root ". Most of the early records were made by ecclesiastical writers and opposed peyote, not on any possible physical harm that its use might engender, but because of its pagan connotations. They went so far as to incorporate in a religious manual of 1760, questions that equated the eating of peyote with cannibalism. By 1720, the use of peyote was prohibited throughout Mexico, and Indians, except those in remote areas, were obliged to practise their rites in hiding. Even Indians nominally Christianized hung little bags of the plant around the necks of children "instead of the four gospels" and bowed in reverence when passing the plant in the field. So strongly rooted was the sacredness of this cactus that native lore of Christian Indians held that a patron saint, El Santo Ni?o de Peyotl, appeared amongst plants on the hillsides, a belief which still survives in Mexican folklore.

The earliest record of the use of peyote in what is now territory of the United States dates from 1760 in Texas. The plant was known to American Indians during the Civil War (1860-1864). Peyote came to public attention in the United States about 1880, when the Kiowa and Comanche tribes had a peyote ceremony which, although resembling in certain respects those of peyote-worshipping tribes of northern Mexico, had been almost wholly remodelled into a typical Plains Indian vision-

quest ritual. It is not known exactly how the peyote religion diffused from Mexico to the plains, but it is widely thought that a knowledge of the supposed virtues of the cactus was brought back by Plains Indians from raids into the Mescalero Indian country. Slow and gradual diffusion northwards might also have had an influence. At any rate, the cult was established amongst the Comanche and Kiowa tribes between 1880 and 1885.

Tarahumare Indian women dancing "Hikuli" in the peyote ceremony. Western Sierra Madre, Mexico. From C. Lumholtz "Unknown Mexico" 1 (1902)

Several years later, the "finished Plains peyote ceremony" had been established and was actively being disseminated by Indian missionaries from tribe to tribe. By the 1920s, there were some 13,300 adherents of this cult in more than 30 tribes, organized legally into the Native American Church, and, at the present time, an estimated quarter of a million Indians in tribes as far north as Saskatchewan, Canada, practise this religious cult which preaches brotherly love, high moral principles and abstention from alcohol.

Amongst the tribes of northern Mexico, peyote worship takes place usually in a long ceremony in which dancing forms a major part. The Huichols, Coras, Tepehuanes, Tarahumares and others ascribe divine origin to the plant. The Tarahumares believe that when Father Sun left earth to dwell in the skies, he left peyote behind to cure all man's ills and woes. "So numerous and important are its medicinal applications and so exhilarating and glorious its effects... that it is regarded as the vegetable incarnation of a deity." They hold that peyote sings and talks when it grows, and that, when gathered into bags, it sings happily all the way home. Peyote enters heavily into legends and folklore of these Indians. The legends are inseparable from the religious ceremonies and, indeed, underlie them. Were there no legends, the plant would be employed merely in a hedonistic way as a narcotic. But it has been exalted to a position of near-divinity, and it holds this place even today.

The Indians of the United States have basically a standardized peyote ceremony, although interesting variations from tribe to tribe are evident. The KiowaComanche peyote ceremony, established in the latter part of the last century, is followed with minor modifications wherever peyote is worshipped in the United States. It consists usually of an all-night meeting, in a teepee, round house or other appropriate edifice, the worshippers sitting in a circle around a peyote altar, led in prayer, chanting and meditation by a leader or "road-man ", ending in the morning with a communal meal. The Native American Church incorporates many Christian with pagan elements, one of the reasons for its rapid spread.

Peyote is almost invariably eaten in the form of the so-called *mescal buttons*, the brown, dried, discoidal tops or crowns of the cactus. The crown is the chlorophyllbearing portion of the plant - the-only part above ground - which is severed from the root and desiccated. In this form, it is well nigh indestructible and may be easily transported long distances. When severed from the roots, the crown rapidly loses water, shrivelling to the thin, tough wafer or "button ". Mexican Indians, especially the Huicholes, who call the plant *hikuli*, collect peyote for sale to Indians in many areas. They often string the newly cut crowns on rope and hang them on the backs of mules to dry on the return journey from the peyote fields. They may journey more than 200 miles from their home base in a pilgrimage taking up to 42 days, made usually in early November. Peyote seekers must prepare themselves ritualistically before the trip, must wear special clothing and must follow strict taboos.

Since mescal buttons may be kept for long periods of time without losing their efficacy, most Mexican Indians to-day buy supplies from the Huicholes and keep them for use whenever needed. This indestructibility and durability of the dried crowns has, of course, made it possible for the peyote cult to spread so far north of the native area of the cactus. American and Canadian Indians, of course, rarely if ever now gather their own supply, preferring to purchase them from commercial dealers in areas near the native range of *Lophophora Williamsii*. The mescal buttons may then be

sent by express of by post to the users. In Mexico and the United States, they are, most commonly, simply taken into the mouth, softened with saliva and swallowed without mastication, Occasionally, Indians may soak the buttons in water and drink the intoxicating fluid.

"Indian Religion, Arapaho", painted by the Arapaho artist Carl Sweezy. This illustrate a typical Plains Indian peyote ceremony in the teepee and with the half-moon altar and fire. From O. B. Jackson and J. [?] American Indian Painters ", 1 (1950) t. 31 (Editions S[?]ezicki, Nice, France)

This extraordinary cactus was first described botanically by Lemaire in 1845 under the name *Echinocactus Williamsii.* In 1872 [?] considered that it represented a species of *A[?]* and made the appropriate transfer.
A few years later in 1885, Lemaire himself transferred this concept to the ? *Anhalonium,* and the binomial *A. Williamsii* persisted in the chemical and anthropological literature for many years. In 1891, Coulter included the peyote cactus in the genus *Mammillaria,* but three years later it was placed in Coulter's monotypic genus *Lophophora as L. Williamsii.*

Kiowa Indian teepee for the peyote ceremony Anadarko, Oklahoma. Photograph R. E. Schultes

Kiowa half-moon altar and remains of fire from the peyote ceremony, taken in the morning when the teepee is taken down following the all-night ritual. Anadarko, Oklahoma. Photograph R. E. Schultes

The botanical nomenclature of the peyote cactus is complex, and the binomial *Lophophora Williamsii* has at least 20 synonyms.
It is generally thought that the earliest chemical studies of *Lophophora Williamsii* were those undertaken

Kiowa Indian peyote leader or " roadman ", painted by Stephen Mopope, Kiowa artist. Property of Botanical Museum of Harvard University, Cambridge, Massachusetts

by Parke, Davis & Co. on material sent in from Laredo by a Mrs. Anna B. Nickels. What is certain, however, is that Lewin acquired material of peyote during his travels in America in 1886 and submitted it to Hennings who described it as a new species of Anhalonium: A. Lewinii. Lewin ascertained in 1888 that it possessed alkaloids - the first evidence of alkaloids in the Cactaceae. *Anhalonium Lewinii* was thought to differ morphologically from the concept that had been known as *A. Williamsii.* Thus began a confusion that has confounded phytochemical research for many years. Hennings had received dried mescal buttons which he soaked in water, described and crudely figured. It is now apparent that Hennings was describing merely an agephase of *Lophophora Williamsii* and that all intergraduations between the two may be found, for he used such characters as number of ribs and tubercles and differences in whiteness, length and silkiness of tufts of hair. There seemed likewise to be chemical differences, and he confessed that he could not recognize from morphological characters whether he had *"Anhalonium Williamsii or A. Lewinii"* but that he could distinguish the two chemically. In years following, *Anhalonium Lewinii* was bandied about: as a species of *Lophophora - L. Lewinii* (Henn.) Thompson or L. Williamsii var. Lewinii (Henn.) Coult. - and as a species of *Mammillaria* and *Echinocactus.*
There is now general agreement that the true peyote cactus represents one species and should be referred to the monotypic genus *Lophophora* as *L. Williamsii.*
At least 21 botanical names have been employed for the peyote cactus, but the only synonyms that have attracted wide acceptance have been those stemming from the description of *Anhalonium Lewinii.*

The chemistry of *Lophophora Williamsii* is of extreme interest. Up to the present time, 15 ?-phenethylamine and simple isoquinoline alkaloids have been isolated from it. The principal constituants are mescaline, N-methylmescaline, N-acetylmescaline, anhalamine, anhalonine, anhalidine, anhalinine, anhalonidine, lophophorine, O-methylanhalonedine and pellotine. Although all of these compounds are probably active biologically, mescaline alone apparently is responsible for the visual hallucinations, inducing hallucinogenic effects in doses of 0.3 to 0.5 gm. Weak antibiotic activity has likewise recently been discovered in *Lophophora Williamsii.*

Peyote intoxication, one of the most highly complex and variable of all hallucinogenic plants, is characterized especially by indescribably brilliant coloured visions in kaleidoscopic movement. These visual hallucinations are often accompanied by auditory, taste, olfactory and tactile hallucinations. Sensations of weightlessness, macroscopia, depersonalization, doubling of the ego, alteration or loss of time perception and other rather unearthly effects are normally experienced. The very real - and often overlooked - difference between peyote intoxication and mescaline intoxication must be constantly borne in mind. Amongst aboriginal users, it is the dried head of the cactus, with its total alkaloid content, that is ingested; mescaline injected is employed only experimentally and then produces the effects of but one of the alkaloids without the physiological interaction of the others that are present in the crude plant material. As a consequence, descriptions of the visual hallucinations found in psychological writings should not necessarily be too closely evaluated with the visual effects experienced by Indian peyotists.

Doses vary greatly amongst Indian users who may ingest anywhere from four mescal buttons (approximately 215 grains) to more than 30. Peyote intoxication may be divided into two phases: a period of contentment and hypersensitivity and one of nervous calm and muscular sluggishness, often accompanied by hypercerebrality and the coloured visions. Before visual hallucinations appear, usually three hours after ingestion of the drug, the subject sees flashes of colour across the field of vision, the depth and saturation of the colours, which always precede the visions, defying description.

There seems to be a kind of sequence frequently followed in the visions - geometric figures, to familiar scenes and faces, to unfamiliar scenes and objects, to secondary objects that vary with individual difference or which may be absent. The literature is rich in excellent and detailed descriptions of visual hallucinations from both peyote and mescaline intoxication, and they provide a wealth of data of interest for psychological and psychiatrical research. While the visual hallucinations are important in native peyote cults, peyote is revered in great part because of its appeal as a "medicine ". Its supernatural "medicinal" powers, in turn, derive from its ability, through the visions, to put man into contact with the spirit world from which, according to aboriginal belief, come illness and even death and to which medicine men turn for their diagnoses. The magico-therapeutic powers of *Lophophora Williamsii* are in such wide repute in Mexico that many other plants have been confused or related by vernacular name with it. Some of these plants belong to families other than the Cactaceae - to the Compositae, Orchidaceae, Leguminosae, Crassulaceae, Solanaceae. A number of cactus species in seven genera are related in folk medicine and folklore to *Lophophora Williamsii.* These include *Ariocarpus, Astrophytum, Aztekium, Dolichothele, Obregonia, Pelecyphora* and *Solisia* - popularly classed as peyotes because they bear some resemblance to *Lophophora* or because they have similar toxic effects and may be employed with *Lophophora* or as a substitute for it. There is much, indeed, that needs clarification in this whole picture.

Genera allied to Lophophora

In this connexion, it is well known that Indians of northern Mexico have esteemed other cactaceous species as peyote. The explorer Lumholtz, for example, reported that the Tarahumares use other narcotic cactuses, some of which are not yet even botanically determined. "High mental qualities", he wrote, "are ascribed especially to all species of *Mammillaria* 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. These plants live for months after they have been rooted up, and the eating of them causes a state of ecstasy. They are, therefore, considered demigods, who have to be treated with great reverence... The principal kinds thus distinguished are known to science as *Lophophora Williamsii* and *Lophophora Williamsii* var. *Lewinii*... The Tarahumares speak of them as the superior hikuli (*hikuli wanam?*) or simply hikuli, they being the hikuli *par excellence*... Besides *hikuli wanam?* ordinarily used, the Tarahumare know and worship the following varieties: (i) Mulato (*Mammillaria micromeris*[1]).

This is believed to make the eyes large and clear to see sorcerers, to prolong life and to give speed to the runners. (ii) *Rosapara.* This is only a more advanced vegetative stage of the preceding species - though it looks quite different, being white and spiny... (iii) *Sunami*(*Mammillaria fissurata*[2]). It is rare, but it is believed to be even more powerful than waname and is used in the same way as the latter; the drink produced from it is also strongly intoxicating. Robbers are powerless to steal anything where *Sunami* calls soldiers to its aid. (iv) *Hikuli walula saeliami.* This is the greatest of all, and the name means 'hikuli great authority'. It is extremely rare among the

Tarahumares, 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 waname with many young ones around it. All the other hikuli are his servants. The reason why so few of these plants are brought to the Tarahumare country is that he is very greedy, requiring oxen for food, not being satisfied with sheep, goats or anything else... 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. If anyone should happen to touch it with the foot, it would cause the offending leg to break."

Even in the modern Tarahumare culture, narcotic cactuses play a role in festivals: Hikuri, *Lophophora Williamsii; peyote cimarron, Ariocarpus.fissuratus;* and *Epithelantha micromeris.* All of these species grow far from present day Tarahumare country. Another cactus - *caw?*(*Pachycereus pecten-aboriginum*) - is still found in territory inhabited by the Tarahumares and is employed as a narcotic by them.

Several of these Tarahumare narcotic cactuses contain alkaloids capable of inducing visual hallucinations.

Trichocereus Pachanoi

A large columnar cactus -- the San Pedro of northern Peru -- forms the basis of an hallucinogenic drink taken by witch doctors for diagnosis, divination and to make oneself owner of another's identity. San Pedro, once erroneously identified in the literature as *Opuntia cylindrica,* is now known to be referable to *Trichocereus Pachanoi.* This and several other species of *Trichocereus* have been found to contain mescaline and other alkaloids.

Loosestrife family (Lythraceae)

Heimia salicifolia

An interesting and still poorly understood Mexican narcotic is *Heimia salicifolia,* known by the vernacularname *sinicuichi, Heimia salicifolia* and the very closely allied H. myrtifolia, which may represent but a geographical variant, range in the highlands from Mexico south to Uruguay, Paraguay and northern Argentina. Although unusual uses in folk medicine are reported from widely separated parts of this range, only in Mexico, apparently, has the small shrub been valued as a narcotic. Some of the local vernacular names are suggestive of the biodynamic properties of *Heimia salicifolia,* such as *abre-o-sol* (" sun opener ") and *herva de la vida* (" herb of life ") in Brazil. The name *sinicuichi,* or derivatives of it such as *sinicuilche* and *sinicuil,* refer to other plants in Mexico, all of which are, in one way or another, intoxicating: species of *Rhynchosia, Piscidia* and *Erythrina;* the *sinicuiche*of the Mexican highlands, however, refers to *Heimia salicifolia.*

Heimia salicifolia

The leaves of *sinicuichi,* slightly wilted, are crushed in water and the juice is set in the sun to ferment. The resulting drink has mildly intoxicating properties, usually devoid of unpleasant after-effects, with a slight feeling of giddiness followed by a drowsy euphoria characterized by a darkening of the partaker's surroundings, a great shrinking in size of the world around, auditory hallucinations, an altered sense of time and place, forgetfulness and a removal from a state of reality. Sounds seem to come distorted from a great distance.

This plant typifies an hallucinogen of which the hallucinogenic characteristics are auditory, not visual. The natives believe that sinicuichi has sacred or supernatural qualities, since they hold that

it helps them recall events which took place many years earlier as if they had happened yesterday; others assert that they are able, with sinicuichi, to remember pre-natal events.
Alkaloids were first reported in *Heimia salicifolia* in 1958. More recent work has isolated and characterized five alkaloids. One of these alkaloids, cryogenine, has been shown to "mimic qualitatively and semi-quantitatively the action of the total alkaloid extracts of *Heimia salicifolia* " Much observation of an ethnobotanical nature must be carried out in Mexico to amplify our understanding of the possible use in native cultures of the psychotomimetic effects of *Heimia salicifolia.* It has apparently not elsewhere been employed as a narcotic.

Dogbane family (Apocynaceae)

One of the enigmas in the study of aboriginal narcotics is why the richest alkaloidal family of plants - the Apocynaceae - should be so sparingly represented in the list of species valued and utilized as psychotomimetics. There are undoubtedly sundry species of this family with organic constituents capable of inducing visual hallucinations, but either they have not been discovered by aboriginal peoples or they are too toxic for human consumption.
Tabernanthe Iboga
Probably the only member of this family known definitely to be utilized as an hallucinogen is iboga, the yellowish root of *Tabernanthe Iboga* an African narcotic of great social importance, especially in Gabon and adjacent parts of the Congo.
In the middle of the last century, French and Belgian explorers began to report that this remarkable plant was employed as a powerful stimulant and aphrodisiac, that it doubled muscular strength and endurance. A few tribes had discovered that large doses would induce unworldly visual hallucinations, doses which, however, might often produce death. These natives incorporated iboga into initiation rites in secret cults. The earliest published report, dating from 1864, stated that iboga root, when eaten, "is not toxic except in high doses in the fresh state. In small quantities, it is an aphrodisiac and a stimulant of the nervous system; warriors and hunters use it constantly to keep themselves awake during night watches... ".
The plant was described in 1889, and by the turn of the century, phytochemical studies of the roots had been initiated and the principal alkaloid, 5-methoxy indole, ibogaine, was isolated. A number of chemical and pharmacological investigations followed these preliminary studies and have established the presence in *Tabernanthe Iboga* of 12 alkaloids. The total alkaloid content of the root bark may reach 5 % or 6 % in dried material.

Tabernanthe Iboga, source of iboga root of eastern Africa From A. Landrin, "De l'iboga et de l'ibogaine" (1905)

The pharmacological effects of ibogaine, which has been compared with cocaine in its activity, may be divided into three phases - First, it is a cholinesterase inhibitor, as are some of the other associated alkaloids, causing in man hypotension and stimulation of digestion and appetite. Secondly, it is a strong central stimulant - like an excessive dose of caffeine - leading, in large doses, to convulsions, paralysis and arrest of respiration. Thirdly, it has definite hallucinogenic properties. These effects, deduced from experiments with dogs, have been confirmed by Sigg who

personally took a dose of ibogaine and described its effects. Visual hallucinations - blue discs appearing only in the dark - were accompanied by many other syndromes common to hallucinogenic intoxication, but no undesirable after effects, exhaustion or depression were noted. The hallucinogenic dose is several times the normal stimulant dose, meaning that the partaker must suffer intense and unpleasant central stimulation in order to experience the desired hallucinogenic effects. Observations on the native use of iboga coincide with this characteristic of the action of the drug.

Tabernanthe Iboga **is used throughout its range - Gabon and parts of the Congo - and even beyond but it is cultivated only in Gabon, where its hallucinogenic properties are considered to be as important as its stimulant and presumed aphrodisiac effects.**

The earliest report of the hallucinogenic effects of iboga date from 1903 when Guien described an initiate into a fetishist cult in the Congo: "Soon all his sinews stretch out in an extraordinary fashion. An epileptic madness seizes him, during which, unconscious, he mouths words, which, when heard by the initiated ones, have a prophetic meaning and prove that the fetish has entered him."

In Gabon, the hallucinogen is employed in initiation rites of secret societies, the most famous of which is the Bwiti or Bouiti, where the drug has far-reaching social effects. An initiate enters the cult, according to the natives, when he has "seen Bwiti" or "has eaten the iboga ", the only way to see Bwiti. The complicated ceremonies and tribal dances involved in eating of the iboga root and the ensuing intoxication vary from locality to locality, and iboga enters into other aspects of life of the Bwiti. Sorcerers, for example, take the drug before seeking information from the spirit world, and cult leaders eat iboga root for a whole day before asking advice from ancestors.

Sometimes other plants, occasionally as many as 10, are taken with iboga. A chemical investigation of these additives might well turn up new hallucinogenic plants. One of the most interesting is the euphorbiaceous *Alchornea floribunda.* Employed in the same way as iboga in another secret society in Gabon, the Byeri, this species may well be an hallucinogen as well.

There is evidence that the Bwiti Cult has been growing, not disappearing, during the past half century, and it may well offer the strongest single force against the missionary spread of Christianity in Gabon, unifying many of the once warring tribes in resistance to European innovations. It will undoubtedly continue for a long time to exert great social influence in Gabon.

Prestonia amazonica

Ethnobotanical and chemical literature abounds with reports that *Prestonia* (*Haemadictyon*) *amazonica* is the source of an hallucinogenic preparation in the Amazon Valley .

. Although recent work has all but discredited this suggestion - an "identification" stemming from misinterpretation of botanical field data, careless determination of specimens and even guesswork - its widespread acceptance demands a consideration of the circumstances leading to the error.

The narcotic preparations made from South American malpighiaceous lianas of *Banisteriopsis* and *Tetrapteris* are known as *ayahuasca* in Peru and Bolivia, *caapi* in Brazil and Colombia, and *yaj?* in Ecuador and the parts of Colombia adjacent to Ecuador. In 1921, the French anthropologist. Reinberg, wrote that this narcotic drunk in the Rio Napo area of Ecuador and Peru, was prepared from two plants: *ayahuasca,* a liana the diameter of a man's thumb, and *yaj?,* a small tree about 4 1/2 feet tall with entire, ovate, petiolate leaves 20 cm. long and 7 cm. wide, regular and acuminate with a tip 2 cm. long. These leaves called yaj? he identified, with reservation, as *Prestonia,* stating that they approached *P. amazonica,* or related genera. The following year, the Belgian horticulturist, Claes, said that according to De Wildeman, the *yaj?* of the Koregwahe Indians of Colombia "might be *" Prestonia amazonica.* I have found no voucher herbarium specimens in Paris or Brussels to substantiate this "identification" which was based almost certainly on a suggestion made in 1852 by Spruce who, when he described the preparation of the narcotic drink from caapi, wrote that there was another kind of caapi known as *caapi-pinima* or "painted caapi" in the Rio Negro area of Brazil and that this might be "an apocynaceous twiner of the genus *Haemadictyon,* of which I saw only young shoots without any flowers ". He reported that the leaves "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 of *Haemadictyon amazonicum* ".

The carefully qualified suggestion of Spruce was taken up and, through repetitions in the literature, lost the qualifying caution, until today the literature - anthropological, botanical, and chemical - has been plagued with its misleading influence. No specimens referable to *Prestonia,* in which *Haemadictyon* is now accommodated, have ever been collected as admixtures with *Banisteriopsis*. Furthermore, *Prestonia amazonica* is apparently a very strict endemic, known only from one collection along the lower Amazon in Brazil, some 2,000 miles from the Ecuadorian Amazon where it is presumed to be the source of a narcotic.

There is every reason to believe that the leaves "identified" as *Prestonia amazonica* belonged, in reality to *Banisteriopsis Rusbyana*, which, as detailed above, constitute a common admixture of the narcotic drink in the westernmost Amazon of Colombia and Ecuador. Superficially, the leaves of the two species do resemble each other, especially in shape and texture; but the presence or absence

of white latex should have alerted the earlier investigators who suggested an apocynaceous source of the leaves.
Unfortunately, this erroneous identification has gained acceptance in chemical and pharmacological literature. Michiels and Clinquart, who published pharmacological observations no Claes's material, believed that the material was referable to *Prestonia amazonica*. The most grievous chemical misstep due to this error resulted from the study published in 1957 by Hochstein and Paradies who reported that *ayahuasca* or *Banisteriopsis Caapi* contained the expected harmala alkaloids and *yaj?* or leaves *of Prestonia amazonica* yielded "another psychotomimetic amine, N,N-dimethyltryptamine". Upon inquiry, I learned that there were no voucher specimens and that the leaves of yaj? had been identified as *Prestonia amazonica* from the use of the common name yaj?. I now believe that these leaves represented *Banisteriopsis Rusbyana* from which, as stated above, N,N-dimethyltryptamine has been isolated. This tryptamine is unknown in the Apocynaceae, as pointed out in 1960 when Raffauf and Folger insisted that the "reported occurrence of only one simple indole in the Apocynaceae ... is of sufficient interest to warrant some speculation. The structure looks enough out of place to suggest that the sample studied was not *Prestonia* at all, and indeed N,N-dimethyltryptamine was isolated from an aqueous extract of leaves, the botanical origin of which appears to be in doubt."
There is, at present, no botanical support, nor any reliable support in the literature, for the assumption that any species of *Prestonia*is employed as a prime ingredient of the hallucinogenic drink known as ayahuasca, caapi or yaj?. While we have known that this narcotic complex is malpighiaceous, we should not too lightly dismiss from further ethnobotanical and chemical study the interesting genus Prestonia, a tropical American group of some 30 species about which next to nothing is known phytochemically.
The possibility that an apocynaceous species may be employed as an hallucinogen in the Colombian Amazon does exist. The Tanimuka Indians, who live in complete isolation on the Rio Apaporis, employ an as yet undetermined plant to prepare a vision-inducing drink for the initiation rites of boys into manhood. It is used much as is the well known *Banisteriopsis*-drink, but it is certainly not malpighiaceous, and the natives are quick to point out that it is not the same plant. The bark of the root of an extensive lacticiferous forest liana, without the admixture of any other plant material, is subjected to long boiling to prepare the narcotic beverage. On my short visit with these Tanimukas in 1952, I was not able to see the vine, but all information pursuant to my questioning was consistent. There is some possibility that this liana, reportedly rich in latex, may represent an apocynaceous species, but only field studies amongst these natives will be able definitively to solve the question.

Morning glory family (Convolvulaceae)

Ipomoea violacea, Rivea corymbosa
The early Spanish chroniclers of conquered Mexico reported time and again on the religious use of the hallucinogenic lentil-like seeds called *ololiuqui* by the Aztecs. They came from a vine with cordate leaves known in the Nahuatl language as *coaxiluitl* or "snake-plant ". Its use has persisted to the present time and, although it represents probably the major Mexican divinatory narcotic best known and most widely employed by Indians in parts of southern Mexico, it is the least known to the outside world.
In 1615, Xim?nez published a portion of Hern?ndez's ethnobotanical notes collected in Mexico between 1570 and 1575. He did not identify the plant, stating merely that " ... 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 ". Sahag?n, a contemporary of Hern?ndez, enumerated three plants called ololiuqui, one of which was " ... an herb called *coatl-xoxouhqui,* and it bears a seed called *ololiuqui*". Another early record, dated 1629, reported that " ... when it is drunk, this seed deprives of his senses him who has taken it, for it is very powerful ".
A number of early Mexican chronicles contained highly interesting references to ololiuqui. One, for example, recorded that many things (springs, rivers, mountains, ololiuqui, etc.) "have their deities. Ololiuqui ... deprives those who use it of their reason ... The natives communicate in this way with the devil, for they usually talk when they become intoxicated with ololiuqui, and they are deceived by various hallucinations which they attribute to the deity which they say resides in the seeds ... ". Another chronicler, in 1634, reported the answers of an Indian penitent to questions during a confession, one of which was: "I have believed in dreams, in magic herbs, in peyote, and in ololiuqui, in the owl, etc. ".
Still another stated, in part, of ololiuqui: "These seeds ... are held in great veneration ... They place offerings to the seeds ... in secret places so that the offerings cannot be found if a search be made. They also place these seeds amongst the idols of their ancestors ... They do not wish to offend ololiuqui with demonstrations before the judges of the use of the seeds and with public destruction of the seed by burning."

A more medically oriented early report from 17th Century Mexico informs us that " ... it was a serious fever and the medicine man advised the patient to take ololiuqui. The patient refused. Finally, however, the medicine man persuaded all members of the family ... to drink ololiuqui to help the patient. After drinking, they lighted candles and gave ololiuqui to the sick man.
All became drunk ... and when they regained their senses, the sick man began to rage in agony, calling the doctor a knave and witch. With this, the patient died ... It is not without concern that the Christian priests see the facility with which the devil works amongst these people, even after they have been ... accepted into the church."
There is a still unexplained aspect concerning the use of ololiuqui in ancient Mexico: that aspect pertaining to its employment in a magic potion supposed to possess an apparent analgesic effect. One report states that the Aztec priests, before making sacrifices on mountain tops, " ... took a large quantity of poisonous insects, ... burned them... and beat their ashes together ... with the foot of the *ocotl,* tobacco, ololiuqui and some live insects. They ... rubbed themselves with this diabolical mixture and ... became fearless to every danger". Another stated that " ... this unction was made of divers little venomous beasts ... with much tobacco or *pectum*, ... an herb that they use much to benumb the flesh ... They ... also mingled with those ashes scorpions, spiders and palmiers alive ... then they put to it a certain seed ... called *ololuchqui,* whereof the Indians make a drink to see visions ... The priests being slobbered with this ointment lost all fear." This same report continued in a more specific vein: " ... they said that they felt thereby a notable ease, which might be, for that the tobacco and *ololuchqui* have this property of themselves, to benumb the flesh, being applied in the manner of an emplaster ... and for that it did appease and benumb the pain, they held it for an effect of health and a divine virtue ". Hern?ndez, likewise, mentioned the pain-killing properties of ololiuqui.
The most reliable discussion of the hallucinogenic effects and uses of ololiuqui appear to be those of Hern?ndez who, after describing in great detail its many presumed medicinal virtues, stated that "when the priests wanted to commune with their gods and to receive a message from them, they ate this plant to induce a delirium. A thousand visions and satanic hallucinations appeared to them."
Most of the chroniclers who railed against this" diabolic seed" represented the ecclesiastical power of Spain, and Christian persecution drove the native cult into hiding. Corroboration of the identity of ololiuqui waited for more than 400 years. All evidence from the literature and several early, though crude, drawings, especially the excellent illustration provided by Hern?ndez, indicated that the plant must be a morning glory. Botanists first identified ololiuqui as a morning glory as early as 1854. Later reliable Mexican botanists, notably Urbina, insisted that ololiuqui was, in fact, a morning glory - *Ipomoea sidaefolia* - even though no member of the Convolvulaceae had been found in use as an hallucinogen in Mexico and no intoxicating constituents were known to exist in this family.

Dr OLILIUHQVI, feu planta orbicularium foliorum. Cap. XIV.

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LILIVHQVI, quam Coaxibuitl, feu herbam Serpentis alij vocant, volubilis herba eft, folia viridia ferens, tenuia,cordis figura. caules teretes,virides,tenuefq;. flores albos, &longiufculos. femen rotundum fimile Coriandro,vnde nomen. radices fibris fimiles, calida quarto ordine planta eft . Gallicam curat . dolores ? frigoreortos fedat . flatum, ac prater naturam tumores difcutic. puluis refina mixtus pellit frigus . luxatis aut fractis offibus, & lumbis f?minarum laxis,aueto robore mirum auxiliatur in modum.S eminis etiam, eft vfus in medicina, quod triutm, ac deuoratum, illicumq; capiti, & fronti, cum lacte & chilli, fertur morbis oculorum mederi, deuoratum ver?, venerem excitat. Acri eft fapore, & temperie, veluti & planta eius, impens? calida. Indorum facrifici cum videri volebant verfari cum Superis, acrelp?fa accipere ab eis,ea vefcebatur planta, vt defiperent, milleq; phantafmata, & d?monu obures?tium effigies circumfpectarent. qua in re Solano maniaco Diofcoridis fimilis fortaffe alicui videri poffit.

The earliest illustration and detailed discussion of the uses of ololuiqui in Francisco Hernandez' Rerum medicarum Novae Hispaniae thesaurus, seu plantarum, animalium, mineralium historia (published in Rome in 1651)

It was Hartwich who, in 1911, first stated that ololiuqui might well be a member of the Solanaceae, a suggestion that was furthered by Safford in 1915 when he identified ololiuqui as *Datura meteloides.* His identification, even now still widely accepted by botanists and anthropologists, was based on several arguments. Many Indian groups in Mexico used *Datura* as an hallucinogen, and, while this genus certainly was well provided with psychoactive compounds, no convolvulaceous genus was known to possess any principles affecting the central nervous system. The flowers of the morning glories were tubular and superficially resemble those of *Datura,* and the Indians could easily have misled the early Spanish writers with a substitution of the former for the latter. Furthermore, the symptoms described for ololiuqui-intoxication coincided well with those known for *Datura*-intoxication . Underlying Safford's arguments was his belief that "...a knowledge of botany has been attributed to the Aztecs which they were far from possessing ... The botanical knowledge of the early Spanish writers... was perhaps not much more extensive: their descriptions were so inadequate that, even to the present day, the chief narcotic of the Aztecs, *ololiuchqui,* which they all mention, remains unidentified ". Although I believe-that Safford's lack of faith in the botanical knowledge of the Aztecs and of early writers like Hern?ndez seems unjustified, it was probably very influential in his dismissal of the Convolvulaceae as a source of ololiuqui.

Rivea corymbosa

In Mexico, the attribution of ololiuqui *to Rivea corymbosa* was rather generally accepted. In 1919, for example,B. P. Reko, on the basis of field observations, defined *ololuc* as the round, lentil-like seed of *Rivea corymbosa* and, in 1934, published an historical review of the use of ololiuqui. Narcotic seeds which-he sent to Safford were determined as representing this convolvulaceous species. Admitting that narcotic constituents were not known from the family, Reko argued that chemical investigation in the Convolvulaceae had been sparse.

It was not, however, until 1939 that unquestionably identifiable voucher specimens of *Rivea corymbosa* were collected when, in northeastern Oaxaca, I encountered a cultivated plant in the dooryard of a Zapotec witch doctor who employed the seeds in his divinatory rituals. I reported these seeds from several other tribes of Oaxaca: Chinantecs, Mazatecs, Mixtecs and sundry groups of Zapotecs, and, as Wasson has aptly written, "today in almost all the villages of Oaxaca one finds the seeds still serving the natives as an ever present help in time of trouble". In 1941, I published a summary of what was then known of ololiuqui and *Rivea corymbosa,* and the identification of the ancient and modern hallucinogen appeared finally to have been clarified.

Rivea corymbosa in flower. Photograph J. Morton, University of Miami, Coral Gables, Florida

All doubt as to the narcotic properties of *Rivea corymbosa* was dispelled when, in 1937, Santesson discovered psychoactive substances in the seeds. Due to an insufficient supply of seed material, he was unable thoroughly to investigate the nature of the substance, but he intimated that it might be a glycoside masked in some way, possibly a glycoside linked somehow with an alkaloid, since, after but not before "splitting" with hydrochloric acid, all tests for alkaloids were strongly positive. His experiments showed that the extract induced "a partial deadening of the mind, a kind of narcosis or semi-narcosis ".

Following publication of my report on *Rivea corymbosa* in 1941, little interest was evident until the appearance, in 1955, of Osmund's fascinating paper containing a description of the first psychiatric self-experiment with an intoxication from seeds of this plant. Phytochemical investigation soon followed, but early work failed to uncover hallucinogenic principles. Finally, Hofmann, discoverer of the synthetic lysergic acid diethylamide (LSD 25), turned his attention to *Rivea corymbosa* and announced to a disbelieving scientific world that the seeds contained lysergic acid derivatives. One of the reasons why it was difficult to accept such an announcement lay in the fact that this class of compounds was known to exist in the plant kingdom only in the lower fungi, in the ergot parasite *Claviceps purpurea.* It would be chemotaxonomically highly improbable, the argument ran, to find in one of the highest metachlamydeous families substances known only from the fungi.

Furthermore, there were suspcions - later experimentally discredited - that spores of these fungi might have contaminated the seeds of *Rivea corymbosa.* It was soon established beyond a doubt, however, that this morning glory in reality was a veritable factory of hallucinogenic lysergic acid derivatives: the principal psychotomimetic principle, ergine or *d*-lysergic acid amide; an alkaloid of secondary importance, isoergine or d-isolysergic acid amide; as well as chanoclavine, elymoclavine and lysergol, all apparently without psychotomimetic effects.

As with many species of the Convolvulaceae, there is much confusion and disagreement in taxonomic and nomenclatorial aspects of the plant which is widely called *Rivea corymbosa.* It has at least nine botanical synonyms, of which *Ipomoea sidaefolia* and *Turbina coryrmbosa* are frequently employed. Since *Rivea corymbosa* has become firmly established in the ethnobotanical and phytochemical literature, however, it is advisable to continue to use *Rivea corymbosa,* until a thorough and authentic study should prove it not to be the acceptable binomial.

Another step in the study of the narcotic morning glories of Mexico came in 1960 with MacDougall's remarkable announcement of the use of seeds of *Ipomoea violacea* (1. tricolor) in conjunction with or in place of those of *Rivea corymbosa,* especially amongst certain groups of southern Zapotec Indians in Oaxaca. The narcotic seeds called *badoh negro* amongst the Zapotecs of Mitla, reported by Parsons, I first believed were referable to *Rivea corymbosa,* but it now appears that they are correctly identified as *Ipomoea violacea.* They are both employed in the same way and for the same purposes. The seeds of the two species differ so significantly that they cannot be confused: those of *Rivea coryrmbosa* are brown and round; of *Ipomoea violacea*, black, long and angular.

As with *Rivea corymbosa,* there has been confusion and uncertainty concerning the proper binomial for the concept here called *Ipomoea violacea.* It has sometimes been called *Ipomoea tricolor.* The best name, however, appears to me to be *Ipomoea violacea,* at least until critical studies indicate that a change is in order.

Wasson has suggested that *Ipomoea violacea* may be the narcotic plant known amongst the ancient Aztecs as *tlitlitzin,* a term from Nahuatl derived from the word for "black" with a reverential suffix. An old chronicler, for example, wrote of " *ololiuhqui, peyote* and *tlitliltzin*" ascribing to all three the same properties.
Chemical studies of the seeds of *Ipomoea violacea* have completely substantiated ethnobotanical data pointing to their use as an hallucinogenic. They have been found to contain the same or similar lysergic acid derivatives as those isolated from *Rivea corymbosa*: ergine, isoergine, chanoclavine, elymoclavine; lysergol was not present; while ergometrine, a strong uterotonic and hemostatic alkaloid known from ergot, is a constituent of *Ipomoea violacea* but not of *R. corymbosa.*

Ipomoea violacea

Later comprehensive phytochemical studies have indicated that numerous species of the Convolvulaceae contain these indole derivatives. In sundry species of *Argyreia, Convolvulus, Ipomoea* and *Stictocardia,* the following ergoline derivatives have been found: ergine, isoergine, ergosine ergosinine, chanoclavine, elymoclavine, lysergol, ergometrine, ergometrinine, agroclavine, penniclavine and lysergic acid - *d*-hydroxyethylamide.
It is interesting that, once the hallucinogenic properties of the Mexican morning glories became common knowledge, certain fringe groups in European and American society began to ingest convolvulaceous seeds, mainly horticultural varieties of sundry morning glories, procuring their supplies primarily from the nursery and garden industry. This abuse grew so serious at one time that, in certain areas, methods for control have had to be adopted and enforced by public health officials.
The perplexing question is: why, with hallucinogenic compounds geographically and philogenetically so widespread in the Convolvulaceae, have primitive peoples outside of Mexico apparently never employed these plants for their psychotomimetic effects ? Or - have they ?

Mint family (Labiatae)

That hallucinogens be found in the mint family, so rich in essential oils, should not come as a surprise. Perhaps the curious fact is that natives have employed so few species for their psychoactive properties.
Lagoehilus inebrians
An interesting narcotic of Central Asia is derived from the small shrub, *Lagochilus inebrians*, that occurs on the dry steppes of Turkestan. For centuries the Tajik, Tartar, Turkomen and Uzbek tribesmen have used this intoxicant, gathering the leaves usually in October. A tea of the toasted leaves, occasionally mixed with stems, fruiting tops and the white flowers, is prepared, with honey or sugar to lessen the intensely bitter taste of the plant. The aromatic fragrance is said to increase on drying and storage.
A crystalline material called lagochiline and thought at first to be an alkaloid was isolated in 1945, but more recent studies, in 1957, showed that it was a polyhydric alcohol, present up to 3 % of the dried plant material. The versatile pharmacological effects of *Lagochilus inebrians* have led to its being adopted officially in the 8th edition of the Russian Pharmacopoeia. It is employed as an

infusion or tincture as an antihemorrhagic for its hemostatic effects, to reduce permeability of blood vessels and aid in coagulation of the blood. It has also been recommended for use in treating certain allergies, glaucoma, and skin diseases, and has been reported to be valuable for nervous disorders as a hypotensive, anti-spasmodic and sedative. Its properties as a sedative are due possibly to the same constituents responsible for the central nervous activity basic to the folk use of the plant as a narcotic.

Further ethnobotanical research should be carried out as a basis for more critical and extensive phytochemical and pharmacological studies which the plant merits.

Salvia divinorum

One of the recently discovered psychotomimetic mints is *Salvia divinorum* of Oaxaca, Mexico, employed by the Mazatec Indians of the northeastern part of this state in divination. They may chew the leaves fresh but more commonly crush them on a metate, dilute the plant materials with water and strain the mixture. Formerly, it is reported, the whole plant was employed, but, at the present time, leaves alone are preferred.

Salvia divinorum

The Mazatecs call this drug *hojas de la Pastora* in Spanish or *shkapastora*, the equivalent in the native tongue: both mean "leaves of the Shepherdess ". The plant is familiar to all Mazatec Indians and many, if not most, families possess a supply of the plants which are reproduced vegetatively. The Indians usually choose isolated or remote mountain ravines for planting *Salvia divinorum*. It appears to be a cultigen, rarely if ever setting seed and possibly not occurring as a wild plant. Wasson, who first reported and identified this unusual intoxicant, believes *Salvia divinorum* to represent the ancient narcotic which the Aztecs called *pipilzintzintli* and used as a sacred hallucinogen.

What may have been *Salvia divinorum* was the plant referred to by Reko in 1945 as "... another magic plant whose leaves produce visions and which the Cuicatecs and Mazatecs... call 'divination leaf'. The loose leaves that I have received do not permit their scientific identification ". Another reference, undoubtedly to this narcotic mint, is that of Weitlaner who spoke of leaves of *yerba Mar?a*, collected only after the Indian medicine man kneels and prays to it, employed in medical divination amongst the Mazatecs.

In Oaxaca, *Salvia divinorum* is employed usually only when supplies of the sacred narcotic mushrooms or morning glories are short. The hallucinating effects, as experi- enced by Wasson, resemble those of the mushrooms but last a shorter time and are not so striking; colours in kaleidoscopic motion and three-dimensional designs characterize the intoxication induced by ingesting the juice of 68 leaves. Wasson states that the "effect of the leaves came sooner than would have been the case with the mushrooms, was less sweeping and lasted a shorter time. There was not the slightest doubt about the effect, but it did not go beyond the initial effect of the mushrooms - dancing colours in elaborate, three-dimensional designs."

Up to the present, chemical studies by Hofmann have failed to isolate a psychotomimetic constituent, due probably to the ephemeral or unstable nature of the active principle.

Coleus spp.

Curiously, these same Mazatec Indians may have discovered hallucinogenic properties in the leaves of several other species of mints, *Coleus Blumei* and *C. pumila* - both Old World introductions from southeastern Asia.

It is interesting that the Mazatecs, according to Wasson, consider *Coleus pumila* and *C. Blumei* to belong to the same "family" as *Salvia divinorum*. The *Salvia* is "the female ": *Coleus pumila* is "the male" and two forms of *C. Bhamei* are known as" the child" and" the godson ".
Corroborative experiments proving whether or not these two species of *Coleus* are definitely hallucinogenic have not been carried out. Chemical studies on these two species - at least on Mexican-grown material of them - have not yet been initiated. Although other Old World species of *Coleus* valued in folk medicine have been investigated, nothing approaching a psychotomimetic agent has been isolated from any member of the genus.
Other species of the mint family
There have been occasional reports of the use in bohemian circles in the United States of large doses of some of the spices of the mint family, such as sage and marjoram, to induce hallucinations. Perhaps the economically important mint most widely misused in sophisticated circles is catnip, *Nepeta Cataria*. Hallucinogenic effects of these plants may be attributable to components of their essential oils, but little research in this direction has as yet been undertaken.

Potato family (Solanaceae)

Atropa, Hyoscyamus and Mandragora spp.
The *deadly nightshade* or *belladonna, Atropa Belladonna*, one of the famous poisons and hallucinogens thought to have formed part of the witches' brews of the DarkAges of Europe, has had a long history in medicine and folklore. The ancient classical writers - Theophrastus, Dioscorides and others - were aware of its drastic psychotropic properties. It was apparently first admitted to a critical pharmacopoeia in 1741, when it appeared in the Wurttemberg Pharmacopoeia, but it figured significantly in all of the mediaeval herbals of Europe.
***Atropa Belladonna*, like many of the other solanaceous hallucinogens, owes its toxic properties to a relatively high content of the tropane alkaloid atropine.**
***Hyoscyamus niger*, an annual or biennial native to Europe but now growing spontaneously across northtemperate Asia and North America, is commonly known as *henbane* in English because of its extremely poisonous properties. It has been employed medicinally from early times. It has been valued as a sedative and anodyne for inducing sleep, both the leaves and seeds being used in pharmacy, but hallucinations frequently accompany its incautious ingestion. Sundry accidental poisonings from henbane are recorded from medieval times and earlier in Europe, and it is thought to have been one of the active ingredients in some of the potently psychoactive witches' brews of the Dark Ages, when visual hallucinations and flights of fancy were effects frequently sought by those practising this form of witchcraft.**
The biodynamic activities of *Hyoscyamus niger* are due to two alkaloids: 1-hyoscyamine and 1-hyoscine or scopolamine.
Some of the other 20 species of *Hyoscyamus* - especially *H. muticus* - may likewise have been similarly employed as narcotics.
The famous mandrake of Europe, *Mandragora officinarum*, has long been known for its toxic properties and actual and presumed medicinal virtues. Its intricate history as a magic plant has hardly been equalled by any other species. The fear in which the Europeans of the Middle Ages and earlier held the mandrake and many of its folk uses were inextricably bound up with the so-called "Doctrine of Signatures". Folk medicine regarded *Mandragora* as a panacea and recommended its use, notwithstanding its great toxicity, as a sedative and hypnotic agent in treating nervous conditions and pain. It actually was widely valued by surgeons during medieval times for its pain-killing properties. It was employed further for many other illnesses and abnormal conditions, and, in many regions was considered to be an effective aphrodisiac.
***Mandragora officinarum*, like *Atropa* and *Hyoscyamus*, may be hallucinogenic and was undoubtedly a common ingredient of witches' brews used in Europe during the Dark Ages, and may be one reason for the German vernacular name *Hexenkraut*. The psychoactive effects are due to its content of tropane alkaloids. The root may contain up to 0.4 % of hyoscyamine, atropine and scopolamine.**
Brunfelsia spp.
One of the most promising possibilities of increasing our knowledge of hallucinogens concerns the solanaceous genus *Brunfelsia* in South America. A tropical New World genus of 25 or fewer species, *Brunfelsia* plays an important role in aboriginal folk medicine in equatorial America. The fluid extract of one species - *Brunfelsia Hopeana* - is employed in Brazilian medicine as a diuretic and antirheumatic. Although almost nothing chemically is known of other species, *Brunfelsia Hopeana* has been reported to contain brunfelsine, manacine and mandragorine, atropine-type alkaloids which, in view of the phylogenetic position of *Brunfelsia* would not be surprising. The aglycone scopoletine, a coumarine derivative found in a number of plant families, has likewise been isolated from *Brunfelsia*. We know full well, therefore, that the genus does possess very definitely psychoactive constituents.

Evidence for the narcotic use of *Brunfelsia* is quite real but is not yet corroborated by a good body of evidence and field observation. Annotations on labels of several herbarium specimens collected in eastern Colombia and Peru indicate that the plant, cultivated in Indian dooryards, is considered to be narcotic and medicinal. Other collections from Bolivia, Brazil, Colombia, Ecuador and Peru indicate a broad spectrum of therapeutic uses, ranging from the treatment of "yellow fever" to snake bite. Its most widespread uses in folk medicine seem to be to relieve "rheumatism" and as a febrifuge, since its ingestion is usually followed by a sensation of chill and coldness: both of these uses might easily be explained on the basis of atropine-like alkaloids.

Several vernacular names appear to indicate former employment of *Brunfelsia* as an intoxicant. The Kof?n Indians of Colombia and Ecuador grow a species of *Brunfelsia*extensively as an ornamental but refer to it as *borrachera*, a term in Spanish applied to sundry narcotic or intoxicating plants, especially the tree-Daturas.

Datura spp.

Probably the most important of the solanaceous hallucinogens - at least in so far as its widespread use is concerned - is the genus *Datura*. Although the botany of the group is still far from well understood, the esteem in which primitive societies in both the Old and the New Worlds have held sundry species is attested by innumerable references.

The history of the narcotic use of *Datura* goes back beyond written records. It is thought, for example, that the priestesses at the Oracle of Delphi foretold the future under the influence of *Datura*. In the classical literature of Mediterranean and Near Eastern lands, references to the use of *Datura*abound. The early Sanskrit and Chinese literature likewise richly extols the medicinal and narcotic properties of these plants.

A very early account of *Datura Metel* was offered by the Arabian physician, Avicenna. He described the fruit of the medicinal and narcotic species known as *jouzmathel*, from which the technical specific epithet and vernacular term *metel nut* are derived. Later writers reported its extensive employment in the East Indies and in India as an aphrodisiac or in love-potions. Acosta, writing of this topic in 1578, stated that "he who partakes of it is deprived of his reason..." and "... I have seen some who have gone about for several days perturbed !" from the effects of *Datura Metel*. The Chinese valued this drug far back into ancient times. A comparatively recent Chinese medical text, published in 1590, reported that "when Buddha preaches a sermon, the heavens bedew the petals of this plant with rain drops ". *Datura Metel* has been intimately connected with numerous religions of the Far East, mainly because of its psychoactive properties. In Africa, the Tonga administer this species as an ordeal poison, and in Tanganyika the seed and root are used as an intoxicant and the leaf as a poison. In China, it is valued as a fish poison.

The generic name *Datura*, chosen by Linnaeus, derives from an Indian name of D. *Metel, dhatura*. In many parts of Asia, even at the present time, the seeds of *Datura Metel*, crushed and parched, are sometimes mixed with food and tobacco for illicit use, especially by thieves for the purpose of stupefying victims who are often intoxicated for several days.

Other Old World species also valued for their narcotic and medicinal properties are *Datura ferox* and *D. fastuosa*, sometimes considered a synonym of *D. Metel*.

The real centre of the hallucinogenic use of *Datura* lies in the New World, where many more species play major roles in magic, medicine and religion in sundry cultures.

In North America, the importance of *Datura* finds its highest concentration in the American Southwest and Mexico, but even the Algonquin and other tribes of the Eastern Woodlands are thought to have employed *Datura Stramonium* - *jimson* weed - as the principal ingredient in an inebriating medicine - *wysoccan* - administered to youths undergoing initiation rites. The youths are confined for long periods, given "... no other substance but the infusion or decoction of some poisonous, intoxicating roots..." and "they become stark, staring mad, in which raving condition they are kept eighteen or twenty days... ". These poor creatures drink so much of that water of Lethe that they perfectly lose the remembrance of all former things, even of their parents, their treasure and their language. When the doctors find that they have drunk sufficiently of the wysoccan... they gradually restore them to their senses again... Thus they unlive their former lives and commence men by forgetting that they ever have been boys."

There has been much disagreement as to whether *Datura Stramonium* is native to the Old World or New.

Modern investigators tend to accept this species as indigenous to the Western Hemisphere.

The species of *Datura* employed as the source of a narcotic in the American Southwest appears to be *D. inoxia*. This species appears in the literature usually under the name *Datura meteloides*, but recent botanical investigations have shown that it preferably should be called *D. inoxia*. In Mexico several others may also be valued: *D. ceratocaula, D. kymatocarpa* and *D. reburra.*

In the American Southwest, many tribes have utilized *Datura* ceremonially, with an especially noticeable concentration in California, Arizona and New Mexico. Amongst the tribes using *Datura* in their rituals are the Yokuts, Tubatulabals, various groups of the Yumans, Papagos, Navahos, Tewas, Luise?os and Zunis.

The Zunis employ *Datura inoxia*, called *a-neg-la-kya*, extensively as a narcotic, anaesthetic and, in the form of a poultice, for treating wounds and bruises. When the rain priests commune at night with the feathered kingdom, they put the powdered root in their eyes, and they chew the root to commune with the spirits of the dead who intercede for rain. According to the Zunis, this plant had a divine origin and it still belongs only to the rain priests who alone may gather it. The Luise?os employ *Datura inoxia* in an initiation ritual known as *mani*. A decoction is administered to boys who begin to dance, screaming like animals, until they finally succumb to the effects of the narcotic and are carried off; the following day is devoted to the instruction of the boys in certain mysteries.
The River Yumans took *Datura inoxia* to induce dreams and gain occult powers. The future could be predicted through these powers. The roots were chewed or a decoction of the leaves was drunk, but care had to be exercised not to take a lethal dose.
Amongst the Yokuts, this species, called *ta-nai*, finds its commonest use in an early spring ceremony designed to ensure future good health and long life to adolescent children of both sexes. Some of the young people believe that they acquire supernatural helpers through the power of the drug, and much secret knowledge is thought to be gained during the ceremony. Yokuts usually take the seeds only once in a lifetime, but the boys who are seeking supernatural powers must undergo the intoxication once a year.
These several examples indicate how widely the use of *Datura inoxia* varies amongst the south-western Indians. In most of the tribes, however, the hallucinating effects of the plant seem to be basic to its use for divinatory, magic or religious purposes.
The utilization of *Datura* in Mexico goes far back into pre-conquest history. It was valued both as a medicine and narcotic. One of the earliest accurate reports is that of Hern?mdez who described *Datura inoxia - toloatzin* to the Aztecs, from which has come the modern Mexican term *toloache* - and listed its many therapeutic uses amongst the natives. He recorded its use in poultices as an anodyne, warning that excessive application could drive the patient to madness and "various and vain imaginations ". Toloache is still widely employed in Mexico as a medicine and narcotic. The Tarahumares, for example, add *Datura inoxia* or *tikuwari* to tesquino (a drink prepared from sprouted maize) to make it strong, and the roots, seeds and leaves of this species are the basis of a beverage used ceremonially to promote visions - and taken by Tarahumare medicine-men to help diagnose disease.

Datura inoxia or t olohuaxihuitl , a medicinal and narcotic plant of ancient Mexico. From "The Badianus manuscript" (Ed. E. W. Emmart) t. 49 (1940)

An extremely interesting Mexican species is *Datura ceraticaula*, a fleshy plant with thickish forking stems that grows in marshes or shallow waters. It has very pronounced narcotic properties, as its Mexican name *torna-loco* (" maddening plant ") indicates. The ancient Mexicans invoked its spirit in treating certain diseases.
In South America, where the indigenous species - all arborescent - belong to *Brugmansia*, a distinct section or subgenus of *Datura*, they have been and still are of great significance to many tribes and, in certain ancient Andean civilizations, they assumed roles of inestimable importance. Handsome trees with large, showy flowers and now highly valued in horticulture, they are probably all chromosomally aberrant cultigens unknown in the truly wild state as, probably because of their medicinal

Flowers and leaves of Datura candida. Bogot?, Colombia Photograph R. E Schultes

and narcotic properties, they have been associated with man from earliest times. There are only a few species *: Datura arborea, D. aurea, D. candida, D. dolichocarpa, D. sanguinea* and *D. vulcanicola* in the Andean highlands from Chile to Colombia; and *D. suaveolens* in the warmer lowlands.

Flowers and fruits of Datura sanguinea, Zipaquira, Colombia Photograph R. E. Schultes

A recent taxonomic study has suggested that the tree-Daturas be treated as comprising three species - *D. candida, D. sanguinea* and *D. suaveolens* - and numerous cultivars of these species. They are known by many local names, amongst the most frequently encountered being *borrachero, huacacachu, huanto, chamico, campanilla, fioripondio, maicoa, tonga* and *toa*.

While *Datura suaveolens* is recognized as toxic and employed to some extent medicinally in the Amazon, the hallucinogenic use of the tree-Daturas is concentrated mainly in the west: in the Andes and along the northern Pacific coast of South America. Although they are employed widely, the literature is very deficient and has reported only a few tribes as using *Datura*: the Chibchas, Chocos, Inganos, Kamsas, Sionas, Kofans of Colombia; the Quechuas of Bolivia, Ecuador and Peru: the MapucheHuilliches of Chile; and the Canelos, Piojes, Omaguas, Jivaros and Zaparos of eastern Ecuador and Peru. In some of the western Amazonian tribes of Ecuador - as with the Mapuche-Huilliches of Chile - *Datura*, probably *D. candida* and *D. sanguinea*, is valued as a correctional measure for unruly children. The Jivaro expect the spirits of their ancestors to speak to and admonish the children in their intoxication-dreams and hallucinations. The Chibchas of pre-conquest Bogota gave chicha with *Datura* - probably *D. candida, D. aurea* or *D. sanguinea* - to wives and slaves of dead warriors or chieftains to induce a state of stupor before being buried alive with their husbands and masters.

In most of the Andean area except Chile, *Datura* assumed an important role in shamanistic, magic and religious rituals. The preparations and uses differ widely in areas of South America, but the drug is taken usually in the form of pulverized seeds dropped into fermented chicha or as an infusion; or leaves and twigs may be utilized. Amongst some - such as the Sionas and Kofans of Colombia and Ecuador - leaves of *Datura suaveolens* may be added to the yaj?-drink prepared from *Banisteriopsis inebrians* to fortify its hallucinogenic effects.

Intoxication from the tree-Daturas is marked usually by initial effects so furious that the partaker must be restrained pending the onset of a deep, disturbed sleep during which hallucinations, interpreted as spirit visitations, enabling the witch-doctor to diagnose disease, discover thieves and prophesy the future of tribal affairs and aspirations, are experienced.

As in North America, information on the species used by South American tribes for special purposes is rarely available. The species involved in each instance must usually be guessed from

phytogeographic or ecological reasoning, or, perhaps, from a vernacular name. Since most, if not all, species of Datura, however, contain similar tropane alkaloids - hyoscyamine, scopolamine, atropine - varying only in relative concentrations, this does not pose the serious problem that it might with some other hallucinogens. The time is long overdue when comparative chemical analyses of all species against voucher specimens be undertaken, for if the taxonomy of this genus can be described still as uncertain - which is indeed the case - the chemistry is chaotic due primarily to careless or superficial plant identification and failure to file away an authenticating specimen for each analysis.

Not only is there a suspicion that all species of treeDaturas are cultigens, but these plants offer other fascinating but complex biological problems connected with their use by man. Bristol has stated: "Many writers have noticed the frequency with which the tree-Daturas are associated with human habitations, but the extent of this association and its implications have not been fully understood. I have seen no indication in herbaria nor during 13 months of field work in southern Colombia and northern Ecuador that any tree-Datura was not associated with human activity; and Schultes (*pers. comm*.), in his many years of familiarity with northwestern South America, has never seen a tree-Datura that he could say was truly wild. The northern Andes, however, is the centre of variability and probable area of origin of this group."

The Kamsa Indians of the Valley of Sibundoy in the Colombian Andes employ several species of *Datura* - *D. candida, D. dolichocarpa, D. sanguinea* - and sundry named clones of *D. candida*. These clones which are vegetatively propagated simply by planting pieces of stem in the damp soil, are so highly atrophied that they may possibly represent incipient "varieties" as the result of mutations. Some of these clones or "races" are such monstrosities that their botanical identification to known species has, until recently, defied efforts, even though the Indians have very definite native names for them and recognize them easily. They are said by the natives to differ in their narcotic strength and, since they are stronger, weaker or in other ways different from "healthy" Daturas in their effects, they are employed for very specific uses by the witch-doctors and medicine-men.

One of the atrophied" races" of Datura candida which the Kams? Indians reproduce vegetatively for use as a source of a narcotic drink. Sibundoy, Colombia. Photograph R. E. Schultes

There has been no satisfactory explanation of the concentration in this high, mountain-girt Valley of southern Colombia of so many atrophied "races" of *Datura*. One suggestion attributed the condition to extreme viral infection, not at all uncommon in the Solanaceae, but here is an excellent and almost wholly untouched problem well worthy of investigation. In this connexion, furthermore, Bristol's suggestion is pertinent: "The very extensive work of Blakeslee and his associates ... with the herbaceous Daturas demonstrated a great range of variability and the spontaneous appearance of many unusual characteristics. Of the 541 gene mutations encountered, 72 appeared following heating, wounding and ageing, or spontaneously in nature. Recessive genes controlling leaf shape, flower size, shape and colour, and fruit form are amongst those uncovered. It is entirely possible that these single recessive genes affecting taxonomically significant characters are present also in the tree-Daturas."

Flowering branch of the tree Methysticodendron Amesianum. Sibundoy, Colombia.Photograph R. E. Schultes

Kams? Indian holding leaves and flower of Methysticodendron Amesianum from which an hallucinogenic drink is prepared by witch doctors for use in divination. Sibundoy, Colombia. Photograph R. E. Schultes

Methysticodendron Amesianum

In addition to their several species of tree-Daturas and the clones or "races" of *D. candida*, the Kams? Indians cultivate a most extraordinary and enigmatic tree which I described as a new genus: *Methysticodendron Amesianum*, known locally as *culebra borrachera* or, in Kams?, as *mits-kway borrachero*. Apparently a strict endemic of the Valley of Sibundoy, it is propagated vegetatively and reserved for very specific medicinal and narcotic use.

***Methysticodendron* is obviously closely akin to the tree-Daturas and it may be shown - as has already been suggested - that it represents not a distinct genus but an extraordinarily atrophied clone. If it is a clone, it is not possible, with our present understanding, to assign it to any species of *Datura*. It differs from *Datura* primarily in having a deeply lobose corolla slit nearly to its base, very elongated, ligulate leaves and a major and possibly fundamental departure in the morphology of the ovary and styles. The Indians assert that it is more potent and dangerous to use than the Daturas themselves. Its chemical composition includes 1-scopolamine and hyoscyamine with very minor amounts of other alkaloids.**

Although Indians have stated that *culebra-borrachera* grows wild in the neighbouring mountain forests, it has never been found by botanists and this information is now doubted. When the tree is in cultivation, it is apparently the hereditary property of certain families, forasmuch as the witch-doctors pass it on to the eldest son together with the secrets attending its use.

Latua pubiflora

More than a century ago, a highly toxic plant native to the coastal mountains of Chile was described as a new species, *Latua venenosa*. The correct name of the spiny shrub, known locally as *latu?* or *?rbol de los brujos* (" sorcerers' tree "), is now *Latua pubiflora*.

This unusual solanaceous plant was employed by medicine men as a virulent poison capable of producing delirium and hallucinations and oftentimes occasioning permanent insanity. It was used especially by the Indians of the Province of Valdivia. No cult or ritual apparently accompanied its utilization, but it was widely known and feared. It was said that a madness of any duration could be induced according to the strength of the dose, and that the natives kept the dosage a guarded secret. Accidental poisonings also happened, since *Latua pubiflora* closely resembled *Flotowia diacanthoides*, a shrub known as *tayu* employed medicinally as a decoc- tion of the bark to treat bruises and blows and with which many people confounded it.

***Latua pubiflora* is apparently nowhere abundant, and there are even very few specimens of it in the world's herbaria.**

Chemical analysis of *Latua pubiflora* has not been rigorously carried out, and, although alkaloids presumably of the tropane series were reported from earlier studies, modern techniques should be employed in an examination of properly vouchered material.

Composite family (Compositae)

The most recently reported hallucinogenic use of a plant concerns a popular Mexican folk medicine, *Calea Zacatechichi*, an inconspicuous shrub ranging from central Mexico to Costa Rica. The specific name is derived from an Aztec word signifying "bitter grass ", an appropriate name since it is an intensely bitter plant. The same vernacular name is applied in Mexico to another composite, *Conyza filaginoides* DC.

Although there is no evidence of a magico-religious cult in connexion with this plant, MacDougall reports that the Chontal Indians of Oaxaca who "believe in

visions seen in dreams" employ a "secret plant" to induce hallucinations. Crushed dried leaves are infused in water and the resulting tea is imbibed slowly, after which the Indian lies down in a quiet place and smokes a cigarette of the dried leaves of the same plant. According to MacDougall, "sufficiency of dose taken is said to be indicated by a sense of repose, when the person 'hears his own heart and pulse beats' ". Amongst the Chontal medicine-men, *Calea Zacatechichi* is called *thle-pela-kano*or "leaf of god" and is valued "for the clarification of the senses ".
***Calea Zacatechichi* is a well known folk medicine in Mexico, utilized especially for use in treating intermittent fevers and, while it apparently does reduce fevers, it is of no value in curing malaria. It is employed also as an aperitive and as an astringent in cases of diarrhoea. A dose consists usually of about 10 grams of dried leaves in water thrice daily, before meals; it may be taken also in the form of a tincture. *Calea Zacatechichi* and other species of this genus have been employed as weak insecticides.**
Alkaloids have not been found in the plant. Its medicinal reputation seems to be attributable mainly to a bitter principle, the precise nature of which has not yet been determined, and an aromatic constituent.
Further ethnobotanical studies of this interesting plant are indicated, and more thorough chemical investigations, using modern techniques, may uncover an hallucinogenic principle.

VIII

"The most fascinating part of ethnopharmacology ", it has truly been said, "is perhaps that dealing with man's use of intoxicating compounds."
This brief and cursory survey of hallucinogenic plants that man has found useful indicates, if it does nothing else, how widely and unpredictably psychotomimetic constituents occur in the plant kingdom. It likewise hints at how tantalizingly rich in potentially psychoactive substances must be the plant world... "into whose silent growth and creative abundance" in the words of Lewin, "man has not yet fully penetrated."
When one considers the total number of species of plants, the census of those known to be employed as hallucinogens is insignificantly small. There must, however, be many more species with hallucinogenically active constituents than we have suspected. How many of the total number has man ever known or used ? During the past 30 or 40 years, ethnobotanical investigation has uncovered a heartening array of plants still employed in primitive societies for their psychotomimetic properties. There can be no doubt that an appreciable number of plants with hallucinogenic uses undiscovered by modern science still lurk unheeded in the frantic rush of the civilized world.
There is an urgency to our need for interdisciplinary research into hallucinogenic plants. Civilization is on the march in many, if not most, regions of the world still sacred to primitive societies. It has long been on the advance, but its pace is now accelerated as the result of world wars, extended commercial interests, increased missionary activity, widened tourism. The rapid divorcement of primitive peoples from dependence upon their immediate environment for the necessities and amenities of life has been set in motion, and nothing will check it now. The rapidity of disintegration in aboriginal societies of a knowledge of plants and their properties and uses is frightening. Our challenge must be to salvage some of the native botanical lore, especially that relating to folk medicine in its broadest sense, before it becomes forever entombed with the cultures that gave it birth.

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[1]

Now known as *Epithelantha micromeris.*

[2]

Now known as *Ariocarpus fissuratus*.

Within the plant kingdom the hallucinogens occur only among the evolutionarily advanced flowering plants and in one division - the fungi - of the more primitive spore bearers. Most hallucinogens are alkaloids, a family of perhaps 5,000 complex organic molecules that also account for the biological activity of most toxic and medicinal plants. These active compounds may be found in various concentrations in different parts of the plant - root, leaves, seeds, bark and/or flowers - and they may be absorbed by the human body in a number of ways, as is evident in the wide variety of folk preparation...Â To date about 120 hallucinogenic plants have been identified worldwide. Golden Guide to Hallucinogenic Plants. Hallucinogens on the Internet: A Vast New Source of Underground Drug Information John H. Halpern, M.D. and Harrison G. Pope, Jr., M.D. , School of Science/Natural Product Discovery (NPD), Faculty of Science, Griffith University. Alexander T. Shulgin, Psychotomimetic Drugs: Structure-Activity Relationships. UNODC The plant kingdom and hallucinogens (part II). UNODC The plant kingdom and hallucinogens (part III). Virola â€“ Dried Herbarium Specimens. Virola Species Pictures â€“ USGS.