

# From Witch Doctor to Modern Medicine: Searching the American Tropics for Potentially New Medicinal Plants

"And as there are discovered new Regions, new Kingdoms and new Provinces by our Spaniards, so they have brought unto us new Medicines, and newe Remedies, wherewith they do cure many infirmities, which, if we did lacke them, would be incurible, and without any remedie . . . for which cause I did pretend to treat, and to write of all things that they bring from our Indias, apperteyning to the Arte and Use of Medicine, and the remedie of hurtes and diseases that we doo suffer and endure . . .".

Nicholas Monardes [transl. John Frampton] "Joyfull Newes out of the New-found World" (1596)

## I.

The search for potential new medicines from the Plant Kingdom is not new. It has been carried on since man first became aware of the variety of effects that plants had on his mind and body. It is still under way. But we now have many advantages over man in all prior ages. We have millennia of experience behind us; a deeper understanding of what plants are and how they live; an intensity of modern technology to help us; and, what is more important than all of the other advantages, a determination to probe into the still virgin vegetal world for active compounds of promise for man's existence.

Today we follow several discreet paths in our search for "new" medicinal plants.

Some modern programs — ambitious, technologically complex and potentially promising — have emphasized the random or semi-random screening of plants from all parts of the world for new organic compounds. Emphasis lies usually in screening for a particular kind of compound: alkaloids, glycosides, etc. One such program, carried out over a ten-year period by an American pharmaceutical company, examined more than 40,000 species for alkaloids, bringing the number of known alkaloid-bearing plants to nearly 5,000. Although this kind of program



is costly, it is highly efficient. Alkaloids, for example, were unknown in 1800; in 1949, approximately 1000 were known; by 1959, 2175 were recognized; in 1969, the total number stood at 4350.

Another kind of screening stresses pharmaceutical activity instead of chemical constituency. Perhaps the best example of this type of program is that carried out by the Cancer Chemotherapy National Service Centre of the National Institutes of Health which has screened more than 8000 randomly collected species for antineoplastic activity and which still continues.

Governmental and private agencies undoubtedly will from time to time continue a variety of random samplings of the world flora, and these programs may be expected to yield more and better results with increasing sophistication of chemical and pharmacological techniques. As Farnsworth has said: ". . . in the light of present knowledge and experience . . . a random selection and testing of plants selected from a broad cross section of families and genera will prove of greatest value in attempts to discover new entities for the treatment of clinical malignancies".

Still another method of searching for new medicinal plants utilizes as a guide the ethnobotanical or herbalistic literature of the past. Programs based upon this method are costly in terms of the number of plants that can be investigated, but it is true that the literature of the past is voluminous and, except in isolated cases, has really not been systematically combed nor critically examined. There are many obvious drawbacks to the use of the older literature as the only guide for surveys: the exact identification of the plant in question may be, and more often than not is, open to serious doubt, and uncritical diagnosis of diseases negates the value of many, if not most, of the recommended medicinal uses of the plants.

The herbarium has recently been recognized as an unexplored repository of ethnobotanical references valuable in the search for new medicinal plants. There have been several surveys based upon reports of folk-medicine uses on the labels of specimens. The most inclusive of these surveys — conducted by Altschul — comprises a sheet by sheet examination of the 2,500,000 specimens in the Harvard University Herbaria. This survey, which uncovered 7,500 reports of interest, is at present in press. There is a wealth of ethnopharmaceutical knowledge in our world herbaria. Information stored away on herbarium labels represents first-hand observations made by the plant collectors themselves in the field. It is usually of much greater

reliability than reports in the various kinds of literature. It was written down usually in the field when the report was learned, and, since the information is physically attached to a specimen, there can be no uncertainty about the identity of the plant.

Ethnobotanical research amongst extant and still viable primitive societies represents undoubtedly one of the best avenues for searching out promising new drug plants. It is not an easy nor a rapid method, but time and time again it has proved its effectiveness.

Knowledge or understanding of the medicinal uses of plants in primitive societies has been the subject of some of the most absurdly laudatory enthusiasm on the one hand, and of the most abjectly damning deprecation on the other. Some students may feel that man in primitive societies possesses a particularly penetrating perception of the attributes of plants, a perception denied to men of more advanced cultures; others have interpreted the many superstitious beliefs concerning plants and their properties to discredit absolutely all of the understanding of plants in primitive societies. We now know how much into error both points of view fall. A good — the best — example is provided by the discovery during the past forty years of a succession of so-called "Wonder Drugs" — almost all from the Plant Kingdom and almost all from plants with rich ethnopharmaceutical histories in aboriginal societies. The "Green Revolution" uncovered the unbelievable muscle relaxants from South American arrow-poisons or curares; antibiotics from moulds and other plants are now known to have been employed in the Egyptian Empire; rutin comes from a number of species, some of them with a wealth of ethnobotanical lore; cortisone is a gift from sapogenin-plants that were variously employed by natives in Central America and Africa; cytotoxic principles have been derived from *Podophyllum*, a plant that enjoyed sundry medicinal uses amongst the Indians of the Northeast; hypertensive agents from *Veratrum viridis*, a species first brought to the attention of researchers as a result of native uses; khellin comes from the *Ammi Visnaga* of the ancients; and we should not forget the many psychoactive agents from the hallucinogenic plants — cryptogams and phanerogams — of the New World Indians.

Not only have promising new drugs been won from these and other common plants. These native "medicines" have yielded many new organic substances and in addition wholly new categories of secondary organic compounds the existence



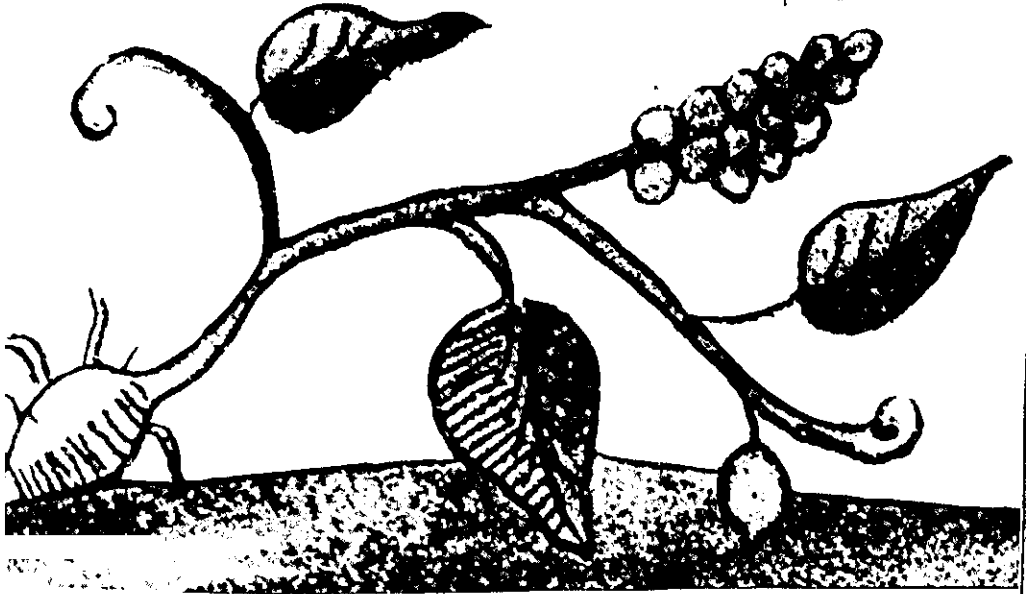
of which was hitherto unsuspected. And all of these new chemical structures have provided science with novel bases on which the synthetic chemist may build even more interesting and possibly more promising organic molecules.

In the prosecution of our search for potential medicines from plants, we must examine and evaluate any pharmacological activity. How often has modern man come upon important and new products with uses totally different from those amongst the native peoples whose knowledge of a strange property possessed by the plant first called it to the attention of sophisticated research? Examples are legion. Who would have predicted that a valuable ophthalmic medicine — physostigmine — would be derived from a tropical African liana used as a dreaded ordeal poison to administer aboriginal justice? How fortunate for modern medicine that scientific inquisitiveness led modern investigators to look at the curares — plant preparations employed by South American Indians to kill, yet the source of alkaloids capable, in the hands of surgeons, of safeguarding life when used as muscle relaxants? And where would our intensive modern agriculture be without that greatest of weapons against insect plagues, rotenone, a compound discovered in leguminous plants utilized in primitive societies as fish poisons? Could we ever have dared predict that the intensely poisonous false hellebore, employed by certain North American Indians to choose a new chieftain through a dangerous and sometimes fatal intoxication of young braves, would yield a valuable hypertensive agent?

Wherefore it behooves the ethnobotanist and ethnopharmacologist to scrutinize all biodynamically active plants — even those which, according to aboriginal belief, are so toxic that they are studiously avoided. The most noxious poison may well turn out, in the hands of a proper investigator, to be a life saver.

How much more remains to be discovered by delving into primitive pharmacopoeias? Nay — how much *has* been discovered and which lies available to researchers but which apathy, neglect or disbelief born of our well established habit of prejudgment has kept from the searchlight of modern investigation?

Although ethnobotanical studies amongst living and intact aboriginal societies offers undoubtedly the best avenue of approach, there are not enough trained ethnobotanists to carry out the necessary investigations against the ever increasing



Ololiuqui (*Rivea corymbosa*), as illustrated in the *Paso y Troncoso* edition (*Codex Florentino*) of the Sahagún *Historia de las Cosas de Nueva España*.

rapidity of disintegration of primitive societies. Botanists are usually far too occupied with the work of collecting plants essential to their own monographic or floristic studies to devote the time and effort in the slow sleuthing essential to assembling the pieces of an ethnobotanical puzzle. They often do make observations of far-reaching value in indicating avenues for later extensive ethnobotanical studies. Too many botanists, however, have manifested definite hostility to and distrust in ethnobotanical investigation and have refused to heed native lore, even when it was easily available and obviously authentic. The anthropologist, likewise, has normally been so deeply committed to unraveling obscure or complex sociological enigmas that he is occasionally unable to signalize an important point of departure for the ethnobotanist. And the anthropologist is, unfortunately, often discouraged from the pursuit of proper ethnobotanical research because of the collection of voucher specimens, which has too often been portrayed by professional



botanists as such a complex and burdensome chore as to be distasteful or even impractical for an anthropologist.

Inasmuch as there appears to be little hope for the immediate training of enough men specifically in ethnobotanical research, the botanist and, to a lesser extent perhaps, the anthropologist must take the initiative to tap the reservoir of knowledge amongst aboriginal peoples of the unusual pharmacological properties of the vegetal organisms of the earth. We can no longer afford the luxury of complacency. This priceless lore — much of it admittedly of limited or no practical value — is too ephemeral in the rapid changes that today swirl around all primitive cultures. We can no longer afford to ignore reports of any aboriginal uses of a plant merely because they seem to fall beyond the limit of our credence. To do so would be tantamount to the closing of a door, forever to entomb a peculiar kind of native knowledge which might lead us along paths of immeasurable progress.

Almost all of my own ethnobotanical search for plants of biodynamic activity which might indicate potential medical value has taken place in Mexico, the northern Andes or the western Amazon. In the approximately fourteen years that I spent in the hinterlands of South America, I collected more than 26,000 plants, a good portion of them with ethnobotanical annotations. The path from ethnobotanical discovery to the production of an accepted pharmaceutical product is long and more often than not does not arrive at a definitive ending. But the first steps in any search for potential new medicines must be the botanical and ethnobotanical. The wealth of plant lore of tropical American peoples has provided me with a large variety of very interesting biologically active plants, some of which are presently under phytochemical investigation, others of which will soon be subjected to analysis. A few of these plants are discussed below.

## II.

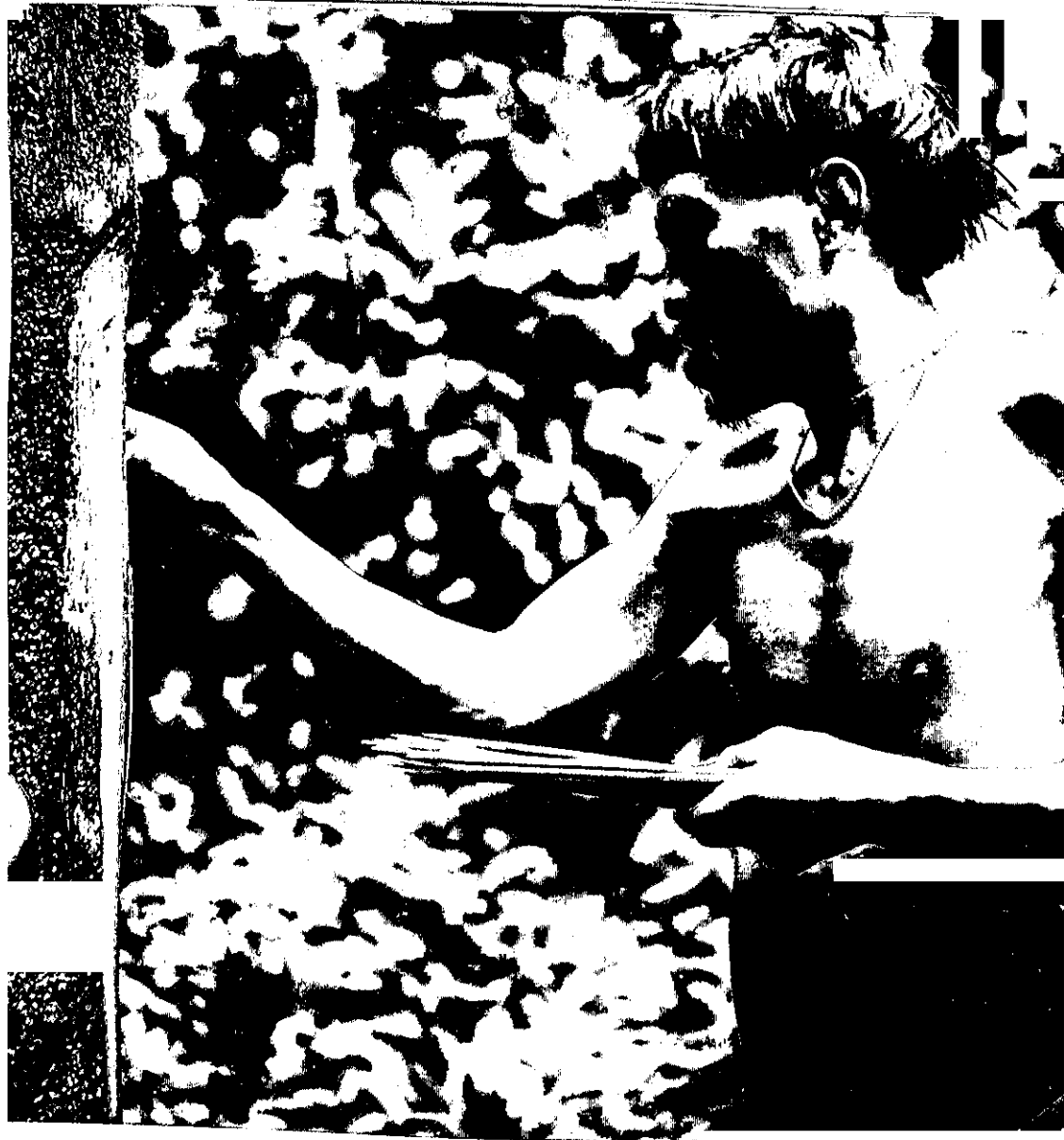
In studying the "medicinal" plants of aboriginal peoples in the Americas, we must always bear in mind that those "medicines" with psychic powers are often much more important than those with purely physical properties. This apparent anomaly is easy to understand. Illness and death in primitive societies are attributed to the intrusion into the body of malevolent forces from the spirit world. Consequently, what more logical way of diagnosing and often even of treating illness than

contacting these spirit forces? There is in the ethnopharmacopoeias of most American natives one or more plants capable, through a variety of hallucinations, of transporting the medicine man or even the patient to the realms where the spirits dwell and enabling one or both to communicate with the source of the evils. These plants, to which the Indian usually ascribes divine powers, are the hallucinogens or the psychotomimetics. They are the medicines *par excellence* of aboriginal America. And there are diverse indications that the active principles of some of them may, when thoroughly understood, become important in modern medicine in experimental, if not in therapeutic psychiatry.

The number of plants employed ceremonially as hallucinogens is vastly greater in the New World than in the Old. Some of the New World hallucinogens are well known and have been now for a century: peyote (*Lophophora Williamsii*) in North America; ayahuasca, caapi or yajé (*Banisteriopsis* spp.) yopo (*Anadenanthera peregrina*) in South America; and the species of *Datura* in Mexico, Central and South America. A surprising number — and some of those chemically most interesting — have but recently been botanically identified; and several have been discovered only during the past few years.

The ancient Mexicans ate hallucinogenic mushrooms which they called *teonanacatl* or "flesh of the gods". In 1941, the identification of *Panaeolus sphinctrinus* as one of these sacred narcotic fungi initiated the twenty-five year long field research which has resulted in the determination of at least two dozen species of mushrooms (species of *Psilocybe*, *Conocybe* and *Stropharia*) as the ceremonial hallucinogens of a number of modern Indian tribes, especially in Oaxaca. Phytochemical investigation of these intoxicating mushrooms has yielded psilocybine, a wholly novel kind of tryptamine with a phosphorylated hydroxyl radical — a structure not hitherto known from the Plant Kingdom.

In the same period came the definitive identification through voucher specimens of *ololiuqui* (*Rivea corymbosa*) — the narcotic morning glory so famous in early Aztec medical lore. And a few years later the discovery of another hallucinogenic convolvulaceous plant, *Ipomoea violacea* — enlarged our understanding of the use of the morning glories as sacred divinatory agents. Phytochemical studies succeeded in showing the unexpected presence in the seeds of these morning glories of ergoline alkaloids, principles closely related to the semi-synthetic lysergic



*Waiká Indian extracting resin for painting arrows from *Virola theiodora*.  
Tototobí, Território de Roraima, Brazil. Photo: R. E. Schultes.*

acid amide (LSD) and known elsewhere in the Plant Kingdom only in totally unrelated primitive groups of fungi, such as ergot, *Claviceps purpurea*.

Both the narcotic mushrooms and the hallucinogenic morning glories were well recognized in the ethnobotanical writings of the early Spanish conquerors of Mexico. We know much about their use by the Aztecs because of the long diatribes against their role in the pagan religions. But their use retreated to the hinterlands under the tremendous persecution, and they were lost to sight. In an attempt to identify teonanacatl and ololiuqui, modern botanists assigned them to other plants. Their correct identification took about four hundred years.

An ancient narcotic employed by the Indians of the American Southwest before the arrival from Mexico of peyote is the *red bean* or *mescal bean*, the bright scarlet seed of the leguminous shrub *Sophora secundiflora*. A highly dangerous narcotic because of its content of the poisonous alkaloid cytisine, the mescal bean fell into disuse as a ceremonial hallucinogen with the arrival of the relatively safe peyote cactus. Much of an ethnopharmacological nature must be learned about the mescal bean, a rather difficult task with its apparent demise as a religiously important plant.

Field work in Oaxaca during the past twenty years has identified several interesting narcotics: *Salvia divinorum* and two introduced Asiatic species of *Coleus* as sacred hallucinogens in the northeastern part of the state; two species of puffballs (*Lycoperdon* spp.) in the Mixtec country; and the composite *Calea zacatechichi* amongst the Chontal Indians. The puffballs and the *Calea* are unusual in acting as auditory hallucinogens. The active principles in these psychotropic mints, the puffballs and zacatechichi are still unknown.

Similarly, we find that in South America such an important hallucinogenic snuff as *yakee*, *epená*, *nyakuwana* or *paricá* — the basis of witch-doctoring and of ceremonies in the northwest Amazon and adjacent parts of the upper Orinoco basins — was unknown until the 1950's. We have recently learned that several species of the myristicaceous genus *Virola* — *V. calophylla*, *V. calophylloidea* and *V. theiodora* — are the basis of this snuff prepared from a red resin in the bark of these forest trees. Furthermore, the chemistry has been elucidated: the basic active ingredients are tryptamines, especially N,N-dimethyltryptamine and 5-methoxy-N, N-dimethyltryptamine.

The acanthaceous shrub *Justicia pectoralis* var. *stenophylla* is dried and pulverized as an aromatic additive to the snuff

made from *Virola*. A plant with many uses in folk medicine because of its pungent fragrance, it has recently been said to be the source itself of an hallucinogenic snuff in the uppermost Orinoco basin of Venezuela.

The chemistry of several historically well known and long identified hallucinogens has recently been elucidated, showing that their psychoactive properties are likewise due to dimethyltryptamine and other tryptamines: the snuffs prepared in the Orinoco basin from seeds of the leguminous *Anadenanthera peregrina*, where it is called *yopo*, and *vilca* or *cébil*, and elaborated in southern South America from the beans of *A. colubrina*; and the drink known in eastern Brazil as *vinho de jurema* and made from roots of the related legume, *Mimosa hostilis*.

The strange but only recently discovered snuff of the central Amazon, *rapé dos índios*, comes apparently from the fruit of the moraceous tree *Maquira sclerophylla*. Thorough ethnobotanical studies on this drug are still needed.



*Anadenanthera peregrina* in fruit. San Juan, Puerto Rico. Photo: R. E. Schultes.

The genus *Datura* has been used hallucinogenically from remote times in both hemispheres. The South American species belong to a subgenus, *Brugmansia*, and all six or eight species are trees. Many tribes in most parts of South America have employed these tree-Daturas, but the identity of the species utilized in a given area has often been uncertain. Recent studies have helped to clear up some of the uncertainties, but the discovery that the Indians in the high Andean Valle de Sibundoy in southern Colombia cultivate for ceremonial, medicinal and narcotic use curiously atrophied clones or races, especially of *Datura candida*, has greatly complicated our botanical and ethnological understanding of this solanaceous genus. The atrophied condition brings about not only morphologically monstrous "varieties" — so distinct that they have precise Indian names — but, according to the native practitioners, they have different biological effects, indicating, of course, that the atrophied conditions may have affected the chemical constituency as well as the morphology. The basic chemical make-up of the genus, with its tropane alkaloids, is well known; but little or nothing is understood about the chemistry of these atrophied clones. Nor do we know what has caused the atrophied conditions of these trees.

In this same mountain valley of Sibundoy, the Indians cultivate a solanaceous tree which has recently been described as a new genus: *Methysticodendron Amesianum*. Obviously closely allied to *Datura*, it may represent possibly a very extreme instance of the atrophied state so common in *Datura* in the region. But if this be so, then we are at a loss as to which species of *Datura* to assign it. The natives prize it as an especially potent hallucinogen and designate it by vernacular names pointing out its strength: *culebra-borrachero* or *mitsk-way borrachero*. Its chemistry, basally that of a tree-datura, differs from *Datura candida* in relative proportions of the several alkaloids present.

Several other South American solanaceous plants deserve attention as recently discovered or recently researched hallucinogens. The Chilean endemic *Latua pubiflora*, reported in 1858 as *árbol de los brujos*, a powerful poison employed by Mapuche Indians to cause permanent insanity, has been thoroughly studied, from a botanical, ethnobotanical and chemical point of view, only during the last three or four years. It is only six or seven years ago that *Brunfelsia* was found to be employed in the Amazon as an hallucinogen. And the hallucinogenic

status of *Iochroma* in the Colombian Andes, open to doubt during the past dozen years, is now more or less settled.

Even with such long known and relatively well understood hallucinogens as the malpighiaceae species called ayahuasca, caapi or yajé — even here there are exciting new discoveries. In 1948, *Tetrapteris methystica* was found to be the source of an hallucinogenic drink in Amazonian Brazil, and *T. mucronata* is indicated by the Karaparaná Indians of the Río Apaporis in Colombia as a source of the narcotic caapi. It is mainly, however, in the study of admixtures to the *Banisteriopsis* drinks that new and fascinating discoveries are being made. For many years, ethnobotanists have known that certain Indians in the

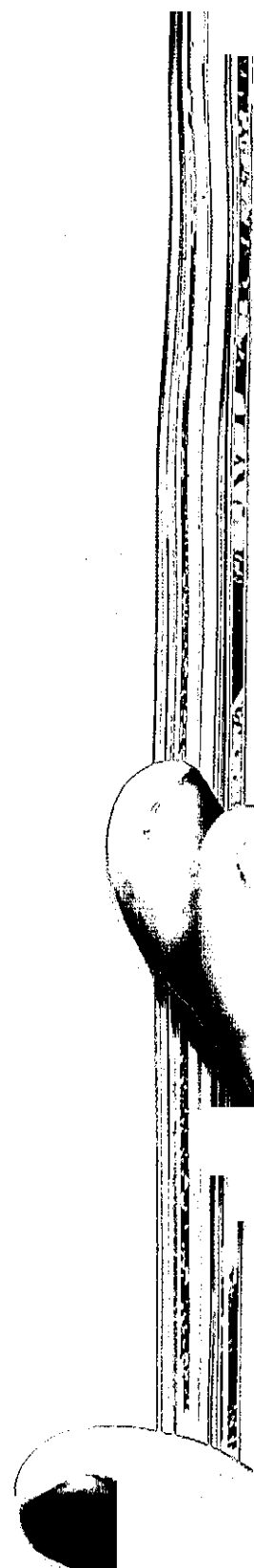


westernmost Amazon add to the ayahuasca, caapi or yajé drink made from the bark of either *Banisteriopsis Caapi* or *B. inebrians* the leaves of oco-yajé or *B. Rusbyana* to lengthen or strengthen the effects of the beverage. Only recently has it been ascertained that *B. Rusbyana* contains dimethyltryptamine, not the  $\beta$ -carboline alkaloids present in the other two species. The leaves of several species of the rubiaceous genus *Psychotria*, especially *P. viridis*, are similarly used on occasion as additives for the same purpose. Chemists have also found dimethyltryptamine in these species of *Psychotria*. This represents the first known occurrence of tryptamines in either the Malpighiaceae or the Rubiaceae. Some of the other plant additives may likewise yield interesting organic compounds when they are analyzed.

Mescaline, the phenylethylamine in peyote responsible for the visual hallucinations, has turned up in the columnar South American cactus *Trichocereus Pachanoi*, basis of the psychotomimetic drink called *cimora* and employed in Ecuador and Peru. A recent addition to the growing list of hallucinogens, this cactus-drink is employed as a sacred "medicine" in magic curing rituals.

There are other narcotics or hallucinogens that bear further ethnobotanical and phytochemical examination: *Lobelia Tupa*, known in the southern Andes as *tabaco del diablo* or *tupa*, is apparently smoked in Chile for its intoxicating effects. Little is known about *Desfontainia spinosa* var. *Hookerii* and the rare endemic *Gomortega Keule*, both used in Chile as narcotics. The well recognized poison *Coriaria thymifolia* has recently been reported as a narcotic in Ecuador where natives sometimes eat the fruit to induce a sense of flight; nothing definitive is known of the active principle. The same may be said for the fruits of several species of *Pernettya* employed in Ecuador and Bolivia.

Waihá Indians sorting leaves of *Justicia pectoralis* var. *stenophylla* preparatory to pulverizing them to add to *Virola*-resin snuff. Rio Tototobí, Territorio de Roraima, Brazil. Photo: R. E. Schultes.



## III.

It is not only in the realm of the psychoactive plants that hope for potential new medicinal agents may reside. Recent ethnobotanical field work has uncovered a large number of highly interesting uses of plants in tropical America as physically active medicines or as various kinds of poisons. These plants all deserve study. They represent a range of great diversity in use and effects. Many of them belong to families from which active constituents have rarely if ever been isolated. Consequently, their phytochemical investigation would be, even if only from the academic point of view, illuminating and worthy of attention.

Recent research has disclosed several new or rarely employed kinds of arrow poisons. One hundred and fifty years ago, the German plant-explorer von Martius reported that Indians in the western Amazon of Brazil and Colombia prepared a curare from a small annonaceous tree, *Unonopsis veneficiorum*. Although it is one of the rare curare-plants of the Amazon, this same basic ingredient has recently been discovered in use amongst the Kofán Indians of Ecuador. A wholly new kind of curare amongst the Kofáns is elaborated from the lauraceous *Ocotea venenosa*. The plant contains bisbenzylquinolinic alkaloids. One of the chemical mysteries still to be solved is the identity of the active curare-constituent in the resin of several species of *Virola*. The same species, mainly *Virola theiodora*, employed amongst the Waikás to prepare their hallucinogenic nyakwana snuff is likewise the source, with no admixtures, of one of their arrow poisons. These same Indians value the roots and fruits of the thymeliaceous *Schoenobiblus peruvianus* to prepare one of their numerous kinds of curare. The flacourtiaceous *Mayna amazonica* is also an ingredient of a Kofán arrow poison. The bark of *Connarus opacus* and *C. Sprucei* have recently been reported as ingredients of Witoto curares on the Río Karaparaná in Amazonian Colombia. Another fascinating and newly reported arrow poison is that which the Taiwanos of the Vaupés of Colombia prepare from the bark of the leguminous *Ormosia macrophylla* together with the bark of a *Strychnos* and of *Vochysia ferruginea* and the stems of an aroid (possibly a species of *Philodendron*).

Interesting new types of fish poisons have also recently come to light in South America. The pulp of the fruit of a species of *Caryocar* crushed and mixed with clay represents a principal piscicidal preparation amongst the Kubeo and other In-

dians of the Colombian Vaupés. In the same area, two aroids are employed for the same purpose: the Desanos cut and bundle the leaves of *Philodendron crasspedodremum* and allow them to ferment and rot for several days, whereupon they are macerated and cast into still water. Another species of *Philodendron*, still not described, is similarly utilized by the Kuripakos of the Río Guainía except that the leaves and petioles are crushed and used fresh. Nothing is known of the chemical composition of these two aroids. A fascinating new species of the bombacaceous genus *Patinoa* — *P. ichthyotoxica* — represents a rare fish poison of the Tikunas of the region of Leticia on the Río Amazonas. The pulp of the large fruit is dried and kept for use throughout the year: it is simply thrown upon the surface of still inlets or ponds to stupefy fish. The Kofáns of Colombia and Ecuador employ *Schoenobiblus peruvianus*, one of their curare plants, to poison fish. Recent investigation has shown that the Kubeo Indians along the Río Kuduyarí in the Vaupés fish with the leaves of the myrsinaceous *Conomorpha lithophyta*, just as the natives of Dutch Guiana use the leaves of *C. magnoliifolia* to narcotize fish. A most interesting newly discovered fish poison is the root of the acanthaceous shrub *Mendoncia aspera*, valued by the natives of the Río Kananarí in the Vaupés; phytochemically, this genus is wholly unknown.

There are many species of plants in the western Amazon which the Indians avoid as toxic. These poisons warrant study as potentially biodynamic agents for, in some cases, they belong to genera or families from which active principles have never been found. Several cucurbitaceous species of *Gurania* and *Anguria* are considered toxic. A large number of rubiaceous species, especially in *Psychotria*, *Palicourea* and *Duroia*, are believed to have dangerous properties when ingested. The resin that naturally exudes from *Retiniphyllum concolor*, *R. discolor*, *R. spectiosum* and *R. truncatum* is said to be poisonous and, because of this characteristic, enters into certain magical rites practiced by the medicine men in the Vaupés. There are many apocynaceous species in this same category of suspected poisons, especially in *Malouetia*, *Himatanthus*, *Tabernaemontana* and *Aspidosperma*; chemical studies of some of these genera bear out the veracity of the native lore. Various members of the Flacourtiaceae — some employed medicinally by the Amazon Indians — are suspect, especially in the genera *Mayna*, *Lunania* and *Ryania*: *Mayna muricida*, for example, has poisonous seeds employed to kill rats, and *M. toxica* is held to be one of the most poisonous plants of the Vaupés forests. *Lunania*



*parviflora* is said formerly amongst the Tikunas to have been added to the food to despatch enemies or unwanted visitors. Nothing is yet known of the chemistry of these flacourtiaceous species.

Ethnotoxicological studies in South America have revealed that the Malpighiaceae deserve closer scrutiny as a family with interesting biodynamic constituents. Several species of *Tetrapteris* are either avoided as poisons or are bent to use in folk medicine by Indians of the Colombian Vaupés. *Heteropteris macrostachya* provides the Indians of the Río Apaporis with an infusion made from the leaves and stems for bathing skin covered with what appears to be fungal infection, and the Sionas of the Putumayo value *H. riparia* in the treatment of gonorrhoea. Several tribes assert that *Mascagnia glandulifera* might be employed medicinally but that it is usually avoided because of toxic side effects. The same is true of several species of *Hiraea*, especially *H. apaporiensis* and *H. Schultesii*.

There are many plants in smaller families that enter into the ethnopharmacology of tropical America, and recent work has greatly increased our knowledge in this direction. A few examples of the many must suffice here to indicate the extent and promise for intensified research into the medicinal potential of the tropical floras.

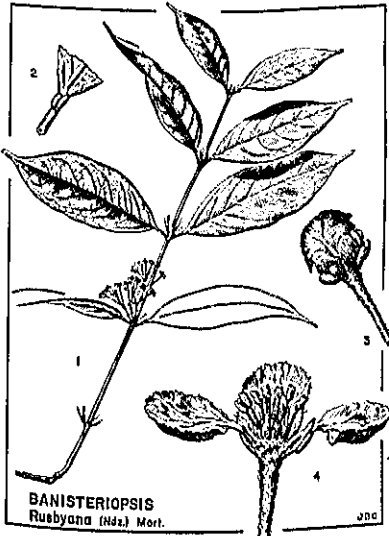
The Kubeos of the Vaupés use an astringent tea of the dried and powdered root of *Aristolochia medicinalis* in treating individuals who suffer from frequent attacks which may be epileptic; the infusion cannot be taken in large doses or too often because of the danger, according to native medicine men, of its causing permanent insanity and muscular paralysis.

There are two plants that are used, apparently with some success, to relieve eye infections such as conjunctivitis which is very common in the Amazonian regions: the yellowish leaves of the bignoniaceous vine *Arrabidaea xanthophylla* are made into an infusion by the Tikunas to treat eye infections; the Makunas of the Río Piraparaná cultivated the cucurbitaceous *Cayaponia ophthalmica* for this same use.

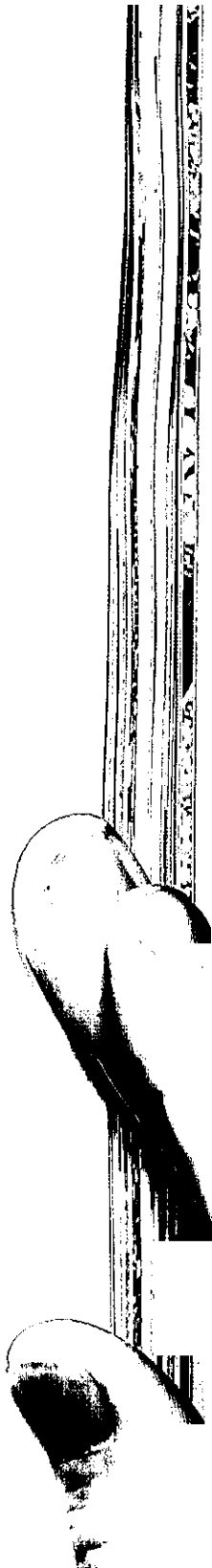
An interesting plant, the red saprophyte *Helosis guyannensis* of the Balanophoraceae, provides the Tikuna Indians of the Colombian Amazon with an haemostatic powder said to help congeal blood flowing from deep wounds. Whether or not its apparent effect is due to an active principle or to the mechanical increase in surface due to the fine powder cannot be stated at present. There is also the possibility that this use was sug-



Above: Cultivated vine of *Banisteriopsis* Caapi. Río Piraparaná, Vaupés, Colombia. Photo: R. E. Schultes.



Left: Detail of *Banisteriopsis* Rusbyana (Ndz.) Mort.



gested to the Indians by the bright scarlet colour of the mushroom-like plant.

Many bitter plants are valued as febrifuges — most of them probably without any positive activity against fevers except possibly to relieve stomach discomfort and nausea that often accompany malarial and other fevers. One of the most widely esteemed is a species of the solanaceous *Brunfelsia*, known in Peru as *chiric-kaspi*. Another species highly valued in the Vaupés region is the bignoniaceous *Martinella obovata*, from the root bark of which a strong infusion, reputedly rather dangerously toxic, is prepared.

The myristicaceous plants of tropical America are ethno-toxicologically of extreme interest and bear pharmacological investigation. Quite aside from the importance of certain species of *Virola* as hallucinogens, some members of this family appear, at least from native uses, to be psychoactive. *Campsonera capitellata* is the source of a tea which the Makunas and Barasanas give to warm natives "who go crazy and shake all over"; it is said to help "to calm them down". In Brazil, the resin of *Virola Bicuhyba* is reputedly a "brain stimulant". A surprising variety of myristicaceous species finds use in the western Amazon in the preparation of a wash for fungal or other skin infections or for infected wounds: *Campsonera debilis*, *Iryanthera crassifolia*, *I. longifolia*, *I. polyneura*, *I. tricornis*, *I. Ulei*, *Virola carinata*, *V. flexuosa*, *V. Schultesii* and *V. surinamensis*.

During my many years of botanical exploration in the north-western Amazon, I encountered three plants used in the belief that they have properties that make them oral contraceptives: *Philodendron dyscarpium*, *Urospatha antisyleptica* and *Anthurium Tessmannii*. These three plants belong to the Araceae. The first two are employed by a number of tribes in the Vaupés; the third by the Tikunas in the Colombian Amazonas. Corroborative pharmacological tests have not been carried out nor is anything known about their chemical constitution.

#### IV.

What of the future? How much longer will this fund of ethnopharmacological lore be available for us to tap in our search for new medicinal plants?

The future looks dim. What we euphemistically call civilization is on the march everywhere. It has long been on the march, but its pace is now accelerated. Wars, easier tourism, the construction willy-nilly of roads, increased commercial and missionary activity are penetrating vast areas, especially in tropical



*Above: Helosis guyannensis. Near Leticia, Amazonas, Colombia. Photo: R. E. Schultes.*

*Below: Flowers of Brunfelsia sp. Río Guamiés, Comisaría del Putumayo, Colombia. Photo: T. Plowman.*



America — areas hitherto more or less virgin and left to primitive societies, if indeed they were inhabited at all. Our political leaders equate “progress” with destruction of natural resources. The forest is, to many of them, an obstacle to be removed.

What concerns us primarily as ethnobotanists is the progressive divorcement of primitive peoples to a greater or lesser degree from dependence upon their immediate ambient vegetation. Even if peoples are not exterminated or eliminated by racial and cultural absorption, the arrival and cheap availability of the aspirin pill and quinine tablet, for example, seems often to start an astonishing disintegration of native medicinal lore. The rapidity of this disintegration is frightening. That the aspirin may be more efficient than native herbal remedies and magic is not ours to consider here. What does interest us — and worry us — is the almost certain loss in the next half century of the greater part of America’s nature herbal lore. Our search amongst the Plant Kingdom’s half million species for new medicines will then have lost a most valuable and promising field of exploration.

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*Selected Reading*

- Altschul, S. von R. *Drugs and Foods from Little Known Plants: Notes in Harvard University Herbaria* (1973, in press). Harvard University Press, Cambridge, Mass.
- Farnsworth, N. R. "Biological and Pharmacological Screening of Plants" in *Journ. Pharm. Sci.* 55 (1966) 225-276.
- "Folk Medicines: Credible or Incredible" in *Tile & Till* 54, No. 3 (1968) 58-61.
- Kreig, M. B. *Green Medicine. The Search for Plants that Heal* (1964). Rand McNally & Co., New York.
- Schultes, R. E. "Tapping our Heritage of Ethnobotanical Lore". *Econ. Bot.* 14 (1960) 257-262.
- "The Role of the Ethnobotanist in the Search for New Medicinal Plants" in *Lloydia* 25 (1962) 257-266.
- "De Plantis Toxicariis e Mundo Novo Tropicale Commentationes VI. Notas Etnotoxicológicas acerca de la Flora Amazónica de Colombia" in [J. M. Idrobo, Ed.] *II Simposio de la Biología Tropical Amazónica* (1970) 177-196.
- "An Overview of Hallucinogens in the Western Hemisphere" in [P. T. Furst, Ed.] *Flesh of the Gods* (1972) 3-54. Praeger Publishers, New York.
- "The Future of Plants as Sources of New Biodynamic Compounds" in [T. Swain, Ed.] *Plants in the Development of Modern Medicine* (1972) 103-124. Harvard University Press, Cambridge, Mass.
- and A. Hofmann. *The Botany and Chemistry of Hallucinogens* (1972, in press). Charles C. Thomas, Publishers, Springfield, Ill.
- and B. Holmstedt. "De Plantis Toxicariis e Mundo Novo Tropicale Commentationes VIII. Miscellaneous Notes on Myristicaceous Plants of South America" in *Lloydia* 34 (1971) 61-78.
- Spruce, R. *Notes of a Botanist on the Amazon and Andes* 2 (1908) chap. xxv, 413-455. Macmillan & Co., Ltd., London.

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