ETHNOPHARMACOLOGICAL CONSERVATION: A KEY TO PROGRESS IN MEDICINE. (*)

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The perspicacity with which man in primitive societies takes advantage of his ambient vegetation has long been a source of admiration. Most of his knowledge of plant uses, of course, must be the result of trial and error. Some of his discoveries of plant properties, however, are so complex that it seems to be almost impossible to explain how they could have been accomplished. This complexity is nowhere more obvious than in the intricate recipes for the preparation of arrow poisons.

There have long been two strongly divergent poles in our evaluation of ethnobotany. Some students are carried away in an enthusiastic assumption that native peoples everywhere have a special intuition in unlocking the secrets of the Plant Kingdom. Others cast aside or at least denigrate all aboriginal folk lore as not worthy of serious scientific consideration. Both viewpoints, of course, are unwarranted.

The accomplishments of native peoples in understanding plant properties so thoroughly must be simply a result of a long and intimate association with their floras and their utter dependence on them. Consequently—and especially since so much aboriginal knowledge is based on experimentation—it warrants careful and critical attention on the part of modern scientific efforts. It behooves us to take advantage now of this extensive knowledge that still exists in many parts of the world, lest it be lost with the inexorable onrush of civilization and the resulting extinction of one primitive culture after another. This experimentally acquired knowledge may not much longer be available.

The denigration of aboriginal knowledge of the biodynamism of plants has even led certain specialists recently to assert that there is little or no correlation between native uses of medicinal plants and the chemistry of these species. This viewpoint is not borne out by the history of some of the most recently discovered drugs that have come originally from the Plant Kingdom—the so—called "Wonder Drugs" of the past half century.

These numerous "Wonder Drugs" that have revolutionized modern medical practices have almost all first been isolated from plants employed for one purpose or another in primitive or ancient societies: the curare alkaloids; penicillin and other antibiotics; cortisone; reserpine; vincoleucoblastine; the **Veratrum-alkaloids**; podophyllotoxin; stro-

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phanthine; and other new therapeutic agents (Schultes and Swain, 1976).

Nor is this spirit of denigration being supported by chemical and pharmacological studies of numerous native drug plants currently under investigation.

A statistical study of empirical medicine amongst the Aztecs indicates that their medicinal plants appear to be effective when judged by native standards. Of the 25 plants evaluated, 16 are known chemically to be able to produce the results claimed by the Aztecs; four could possibly be so active; whereas five—only 20%—seem not to be able to produce the effects attributed to them by the Indians (Ortíz, 1975). While magic and religion played an important role in Aztec medical practices, there did exist a real empirical basis which has often been ridiculed or ignored.

A very recent ethnopharmacological study of **Buddleja**, a loganiaceous genus of 100 species of the tropics and subtropics of both hemispheres, has found a high degree of correlation between the wide variety of uses in traditional medicine and what is known of the chemical composition of the genus (Houghton, 1984).

Numerous similar correlations may be cited amongst the few groups of plants that have to date been ethnobotanically studied.

We can no longer afford to ignore reports of any aboriginal use of a plant merely because they seem to fall beyond the limits 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.

Several botanical explorers of the last century - eg. von Martius and Spruce - stated that the Indians of the Amazon had a limited vegetal pharmacopoea. This opinion is not easy to reconcile with my own observations over the past 40 years amongst many tribes of the Colombian Amazonia.

Fourteen years of this period were spent in permanent residence in the region. I was able to make 24,000 plant collections; of these, I have notes on the aboriginal use of some 2000 species for their biodynamic properties. I am certain that many uses have escaped my attention, and that future students—if they hurry to get ahead of rapidly advancing acculturation and consequent loss of native plant lore—will discover many more.

Most of these plants for which I have notes have never been seriously investigated nor, in most cases, is their chemistry even vaguely understood. Some uses may be of little or no practical value, but for others it is possible easily to see or to appreciate their effectiveness. Still others would seem chemotaxonomically to hold promise of the discovery of interesting new active principles. And a few of the uses and claims are so bizarre as completely to mystify the scientific investigator, but no aboriginal use of a plant should be dismissed because it falls outside of our understanding.

Included in my ethnopharmacological notes are at least 32 species used in the northwest Amazon for purposes suggesting possible cardiovascular activity; 78 are involved in the preparation of arrow poisons; 27 seem to be insecticidal or insect repellent; 42 are employed as fish poisons, three are valued by the Indians as oral contraceptives; 52 are taken as vermifuges; six are said to be stimulants; 11 are esteemed as hallucinogens or narcotics—and so the list could go on.

There are few areas in the world, I believe, where indigenous populations possess a fuller acquaintance with the properties of their plants than the northwest Amazon. There are perhaps several reasons for this wealth of knowledge of medicinal and toxic plants: first, the region is sparsely populated by numerous tribes of very diverse origin, culture, language and methods of handling bioactive plants; second, the region has until recently, been by nature rather isolated and protected from penetration by commercial and missionary activity; and third, the region is floristically undoubtedly the most variable and the richest in the Amazon Valley, with certainly 60,000, perhaps up to 80,000 species.

It should, however, be borne in mind that appreciation and utilization of plants for medicinal purposes varies from tribe to tribe. Some—the Colombian Sionas, Kofans, Witotos, Yukunas, Tanimukas, Kubeos, Tukanos, Barasanas, Makunas, Kuripakos, Puinaves and others, for example—have rich pharmacopoeias. Other groups—the Waoranis of Ecuador for example, living in the same species-rich forests--have a surprising dearth of plants medicinally employed: intensive research indicates that they use only 35 species, 30 of which are valued in treating only six conditions (Davis and Yost, 1983), whereas their neighbours, the Kofans, have at least 80 species for 27 different ailments (Pinkley, 1973).

It is true that the "medicines" **par excellence** are those with psychic properties that enable the medicine man through various hallucinations to see or converse with malevolent spirits from whom, they believe, como all sicknesses and death. These "medicines" are manipulated by **payés** or medicine men. It is, however, most certainly untrue that the general native population of this region does not know and use those medicinal plants with purely physical properties to reduce pain or suffering, to lessen uncomfortable symptoms or illnesses, or even apparently, on rare occasions, to cure pathological conditions. They do have many such biodynamic plants which they employ, almost always as simples, eschewing complex recipes and mixtures in medicinal practice.

My experience has convinced me that, insofar as plants are concerned, the payé, as knowledgable as he is, often may know less about the flora in general and its properties than does the general practitioner; the payé usually employs "sacred" plants—hallucinogens or other psychoactive species—administering them in magico-religious ceremonies with superstitious helps such as sucking, blowing tobacco smoke, fanning with feathers, incantations, etc.

Most tribes have what we might term "regular" doctors—chiefs or "curacas" who do not normally practice much magic but who are well provided with a wide knowledge of the curative or presumed therapeutic value of plants with actual physically active principles. These practitioners might justly be called the ethnopharmacologists of the societies. They usually work cooperatively with the payés, frequently referring difficult or recalcitrant cases to these "specialists".

Then there is also a large body of knowledge of plant properties which is held and shared by the general population of these tribes, and it is this body of knowledge, based on hundreds of years of experience, that may be of the greatest ethnopharmacological interest to us.

It may be worthwhile now briefly to discuss several interesting native biodynamic uses of plants in the northwestern Amazon, that area lying in Colombia, Ecuador, and western Brazil, realizing that the selection of these few examples represents but a very small part of the rich ethnopharmacological lore of the region.

One of the best examples perhaps is the hallucinogenic drink variously called **ayahuasca**, **caapi**, **natema** or **yajé** in the western Amazon. It is prepared from the bark of two species of lianas of the malpighieaceous genus **Banisteriopsis**: **B. Caapi** and **B. inebrians** (Schultes 1957, 1972). This bark contains β-carboline alkaloids — harmine, harmaline, and tetrahydroharmine — capable of including visions, usually in blues, greys or purples. With the Indians, I have taken this drink during ceremonies and have experienced its extraordinary effects. To increase the intensity and duration of the intoxication, however, the natives—especially those in Colombia, Ecuador and Peru — sometimes add the leaves of another liana of the same family, **Diplopteris cabrerana** (formerly known as **Banisteriopsis rusbyana**), or the leaves of a bush belonging to the Rubiaceae—**Psychotria viridis**—from both of which have been isolated other types of psychoactive alkaloids: the tryptamines (Der Marderosian, Pinkley and Dobbins, 1968; Der Marderosian, Kensinger, Chao and Goldstein, 1970). Tryptamines are inactive in the mammalian body, unless they be protected by a constituent with monoamineoxidade inhibitory activity (McKenna, Towers and Abbott, 1984). The β-carbolines in the bark of the lianas of **Banisteriopsis** act as monoaminoxidase inhibitors. How did unlettered Indians find these two appropriate additives from the 80,000 species in their forests? And how did they learn that the tryptamines in the leaves of these two plants could be active when taken orally with a brew made from the β-carboline-rich Banisteriopsis?

A similar extraordinary peculiarity concerns the hallucinogenic snuff prepared from a red, resin-like exudate of the bark of certain tropical American trees of the Myristicaceae: **Virola** (Schultes, 1954). This powder has high concentrations of tryptamines—up to 11%, 8% being the highly psychoactive 5-methoxy-N,N-dimethyltryptamine (Schultes and Holmstedt, 1968). These tryptamine alkaloids, of course, can be bioactive in the form of snuff. I discovered, however, that the Boras and Witotos of Colombia and Peru do not use these narcotic plants as a snuff but ingest the exudate prepared in the form of pills with no additive except an inert ash coating (Schultes, 1969; Schultes and Swain 1977; Schultes, Swain and Plowman, 1977). How could thses tryptamines, then, be active when taken orally? Further chemical examination disclosed the presence in the exudate of trace amounts of β-carbolines which, of course, serve as a built-in monoaminoxidase inhibitor.

This genus **Virola** is of further ethnopharmacological interest. Numerous tribes in Amazonian Colombia apply the resinous exudate fresh to fungal skin infections with positive results which may be cures or merely suppressants (Schultes and Holmstedt, 1971). Twice I dried bark specimens and sent them to laboratories for analysis; nothing fungi cidal was found in the samples. Recent chemical work in Brazil on fresh material has yielded several chemical constituents—lignans and neolignans—that may account for the anti-fungal activity (Gottlieb, 1979; Gottlieb, pers. comm. 1984). In drying the bark under the tropical sun, I may have altered the chemical composition—perhaps through enzymatic activity.

One of the unexplained ethnopharmacological phenomena in the northwest Amazon is the Indian's ability to distinguish ocurlarly in the forest—and often at considerable distance—differences in plants that cannot be perceived by even the most experienced taxonomic botanist (Schultes, ined.). Two examples will suffice to indicate this keen familiarity with the plants he uses.

Yoco is a caffeine-rich liana of the westernmost Amazon of Colombia and Ecuador: **Paullinia yoco** of the Sapindaceae. The high concentration of caffeine--3%--occurs in the bark, from which the Kofans, Sionas, Inganos and other Colombian and Ecuadorian Indians prepare a cold-water drink taken in the early morning as a strong stimulant (Schultes, 1942). These native distinguish and have names for at least nine "varieties"(Schultes, ined.). Some are said to be "stronger"; others are employed for certain purposes(eg.,on days when hunting is to be done); some are reputedly "inferior." I have worked on yoco for many years, and other botanists have collected of these "varieties": none of us has been able to find any visible morphological differences. They may represent age-forms ecologically specialized adaptations, chemovars or other variants: yet the ability of the native collector who chooses a special variant for collection never erro in identifying the kind that he wants without any tactile or taste experiment and often many yards from the huge trunk of the liana, the leaves of which are usually high and out of sight in the tree-tops. We have not yet had an opportunity for analyzing the bark of these several variants—and even if we did learn of chemical differences,the question remains: What criteria enable such quick-sighted identification of wild lianas in the forest?

Another even more astonishing example concerns the different aboriginally recognized variants of the narcotic liana **Banisteriopsis caapi**. In the Colombian Vaupés,the Kubeos Tukanos, Barasanas, Makunas and other tribes have names for and different uses of a large number of "kinds" of **Banisteriopsis caapi** (Reichel-Dolmatoff, 1978; Deltjen, 1978-79). Schultes, 1972). Again, botanists can find no morphological characters with which to distinguish these "kinds", although the native can identify them at sight. They are differentiated by the Indians primarily on their biodynamic effects, even though the natives insist that in identifying them they must consider such aspects as soil type, whether or not the liana grows in dense forest or near clearings, if it is found in a locality held to be sacred or bewitched, distance from a river or a cataract,age or size of the vine, the part of the plant from wich the material is to be taken, whether the narcotic drink is to be used in a curing ritual or in a magico-religious ceremony and many other peculiarities. Even the method of preparing the intoxicating beverage must vary in accord with the "kind" of the plant to be used. Then, further, the effects are said to differ widely: the colours and objects that appear in the hallucinations may vary from one to another; certain "kinds" enable easier communication with ancestors or friendly spiritual forces; some enable the payé more easily to diagnose an illness and prescribe the cure; others, the Indian believes, make prophesy of future events more accurate. To be sure, there is much of superstition at the basis of this type of classification and use of the narcotic, but there is enough agreement from numerous tribes and sufficient challenge to warrant intense investigation by ethnobotanists and chemists of recognition of the "kinds" of **Banisteriopsis caapi**.

South America—especially the Amazon—is the world centre for the use of arrow poisons, although peoples around the world have learned to use lethal darts or arrows.

Notwithstanding the extraordinary amount of research that has gone into the study of curares or arrow poisons in the last half century, I believe that our understanding of the vegetal constituents and admixtures of the often complex recipes is still embryonic. This incomplete knowledge is probably nowhere more in evidence than in our inability to explain the role of many of the additives employed together with the active plants. Which of these additives increase the toxicity of the main ingredient, which enable the poison to adhere to the darts, which may facilitate easier penetration of the bioactive principles into the blood, which may be acting synergistically, which are added for magic or superstitious reasons?

Much—in fact, most—of the recent research has centered upon several menispermaceous genera—**Abuta**, **Chondrodendron**, **Curarea**, **Sciadotenia**, and **Telitoxicum**—and upon the loganiaceous genus Strychnos; these are the bases of the commonest Amazonian curares. But we have discovered many other plants employed either alone or in formulas for preparing minor arrow poisons; few of these plants have ever been chemically studied.

The leguminous alkaloid-rich genus Ormosia—especially the arrow-poison ingredient **Ormosia macrophylla**—ranks high in the need for analysis (Schultes, 1967). The Kofan Indians of Colombia and Ecuador, who seem to employ the greatest assortment of arrow poison plants, make an effective and their most highly prized curare from the fruits and roots of the thymeliaceous **Schoenobiblus peruvianus** (Schultes, 1949) with no admixtures. This plant is likewise used as a fish poison by these Indians (Schultes, 1969). While coumarine derivatives are known from the Thymeliaceae, there is no indication that these constituents may act in killing animals. These Indians likewise use the fruits of **Unonopsis veneficiorum** of the Annonaceae-reported in the early part of the last century from the Rio Japurá in Brazil by von Martius (Schultes, 1969). The Barasanas of the Colombian Vaupés still make one of their best curares from the bark of this tree (Schultes, 1977, 1980). Although **Unonopsis** was reported as a source of curare 150 years ago, its alkaloidal content was not elucidated until 1959 (Fries, 1959). It is significant that the Indians of the Vaupés still utilize species of **Guatteria** of this alkaloid-rich family as ingredients of some of their minor arrow poisons (Schultes, 1980). The Kofans value also the bark of another annonaceous treelet—a species of **Anaxagorea**--in preparing a type of curare (Schultes, 1977, 1980). Cyanogenesis has been reported from a Philippine species of this genus. The Waika Indians of northern Brazil tip their arrows with the resinous exudate of the bark of **Virola theiodora**—the same tryptamine-rich exudate from which they prepare their hallucinogenic snuff (Schultes and Holmstedt, 1968); although these Indians prepare a curare also from Strychnos, it appears that the **Virola** exudate, with no admixture, is their preferred curare. No chemical constituent capable of acting as a curare has as yet been isolated from the plant. A most challenging report of a curare plant is the use by the Makú Indians of the Rio Piraparaná of the bark of **Vochysia columbiensis** (Schultes, 1977). These nomadic Indians have the reputation in the Columbian Amazonia of preparing the strongest curare, and they consider this **Vochysia**--which they employ apparently with no admixture except the leaves of **Urospatha**--to be the active ingredient. Yet we know almost nothing of the chemical constituents of the Vochysiaceae.

As with curare, the Amazon basin appears to be the region of use of the greatest number of ichthyotoxic plants. While the most common Amazonian fish poisons belong to the genera **Lonchocarpus**, **Phyllanthus**, **Clibadium**, and **Tephrosia**, many plants are employed in remote areas as minor fish poisons in times of emergency or when the major types are not easily available. A curious fish poison is prepared from the leaves of the araceous **Philodendron crasspedodromum** amongst the Indians of the Vaupés: the leaves,bound up and left to ferment for several days, are then crushed and thrown into still water. The Kofans mix the leaves of **Phytolacca rivinoides** with those of Phyllanthus(Pinkley,1973). In the Rio Kuduyarí, the bush **Conomorpha lithophyta** of the Myrsinaceae is employed;it is perhaps significant that a related species of this genus is a major fish poison in British Guiana. Amongst the various tribes of the Rio Vaupés, the pulp of the fruit of a species of **Caryocar**, rich in saponines, is commonly mixed with mud for stupefying fish (von Reis, 1982). The Witotos employ the bark of **Rourea glabra**, crushed and thrown into the water (Schultes, 1969). The tikunas of the Rio Loretoyacu dry the pulp of the large fruit of the bombacaceous Patinoa ichthyotoxixa and keep it throughout the year as a minor fish for use on short canoe trips. To date, nothing is known of the possible biodynamic chemical constituency of this pulp (Schultes and Cuatrecasas, 1972).The Waorani Indians of Ecuador esteem the bark of the bignoniaceous **Minquartia guianensis** as an ichthyotoxic plant (Davis and Yost, 1983). **Anthodiscus obovatus** and **A. peruanus** are employed as fish poisons in the Brazilian and Colombian Amazon, respectively. Nothing is as yet known of the chemistry of these two caryocaraceous species (Schultes, 1969). The natives of the Colombian Vaupés use the bark of the stem and root as well as the leaves of the connaraceous **Connarus opacus** and **C. sprucei** as fish poisons (Schultes, 1969); the chemistry of the Connaraceae is very poorly known, and the family most certainly represents one of the areas in the angiosperms where phytochemists should concentrate attention.

Amongst the ten or twelve plants valued as insecticides or as insect repellants, there are several that deserve study. Perhaps the most interesting is a common weedy shrub of the leguminous genus **Cassia** which is known in local languages as "flea plant." Indians of several tribes in the Vaupés dust their clothes and hammocks with the powder of the dried leaves (Schultes, ined.).

The medicinally employed plants number too many to detail, but a few are of such interest that they should be noted.

The Makunas and others cultivate **Cayaponia ophthalmica** of the Cucurbitaceae for preparation from the leaves of a wash for the eyes in treating the ever prevalent conjunctivitis, apparently with success (Schultes, 1964); other notable anti-conjunctivitis plants that seem to be effective are two: malpighiaceous lianas **Hiraea apaporiensis** and **H. schultesii** (Schultes, 1972). In this connection, a recently published ethnobotanical study of **Martinella**, a bignoniaceous genus of several species ranging from Mexico to the Amazon, is of extreme significance (Gentry and Cook, 1984). An extract of the root of **Martinella obovata** is widely employed by aboriginal grouos throughout South America as an "eye medicine." There are numerous references to this use by botanists who have worked in widely separated regions. These references, according to the author of the report, yield "compelling evidence that **Martinella** contains medically useful properties" and that chemical analysis and clinical testing is in order. In my own ethnobotanical studies I found that the Barasana Indians employ the bark of this plant as a febrifuge (Schultes 1970), but, in connection with a medicinal use for eye problems, my notes indicate that another related bignoniaceous liana—**Arrabidaea xanthophylla**—is valued in the Colombian Vaupés in treating conjunctivitis (Schultes, ined.).

The incidence of intestinal parasitism is high, and many plants are reported to be effective vermifuges. Amongst the most interesting is an oil from the seed of the leguminous trees **Monopteryx augustifolia** and **M. Uaucu** (Schultes, ined.) and a tea of the bark of the violaceous **Corynostylis volubilis** (Schultes, 1964).

Several plants, I found, are used in the belief that they have contraceptive properties: **Philodendron dyscarpium**, **Urospatha antisyleptica** and **Anthurium tessmannii**--all members of the Araceae—are valued for this purpose. The Bara-Makú of the Rio Piraparaná in Colombia know **Pourouma cecropiaefolia** as **we-wit-kattu**, a name which means "no children medicine": scrapings of the root are rubbed in water, and the drink is given to women and, according to the natives, causes permanent sterility (Schultes, ined.; voucher herbarium specimen **Silverwood-Cope** 14).

An interesting abortifacient reputedly of great strength is said by the Makú Indians to be the leaves of **Vochysia lomatophylla** in warm **chichá**, a slightly fermented drink made from **Manihot esculenta** (Schultes, ined.). This same species is valued by the Campa Indians of Peru as a possible contraceptive (Altschul, 1970).

As might easily be suspected, plants employed as febrifuges are many. Those seeming to deserve very special chemical and pharmacological attention are the solanaceous **Brunfelsia grandiflora** and **B. chiricaspi**, the chemistry of which is extraordinarily complex and still far from being fully understood (Plowman, 1977). Other important febrifuges are the malpighiaceous **Tetrapteris styloptera** (Schultes, 1975); the apocynaceous **Aspidosperma schultesii**, **Himatanthus bracteatus** and **H. phagendoenicus** (Schultes, 1979).

An interesting recipe for a vermifugal preparation combines the boiling of bark of the menispermaceous **Adontocarya tripetala**, the bark of the sapotaceous **Matisia cordata** and the fruits of **Capsicum annuum** (Schultes, ined.).

Several species are utilized as styptics to staunch the flow of blood from wounds: **Helosis guianensis** (Schultes, 1949) of the Balanophoraceae — or to stem nose-bleeding: **Costus erythrocoryne** and Quiina leptoclada of the Zingiberaceae and Quiinaceae, respectively (Schultes, ined.).

Various infections of the skin, such as ulcers and slow-healing wounds are poulticed with the ashes of several species of **Tetrapteris** mixed with an oil, frequently from the fruits of the palm **Jessenia bataua**. Crushed boiled leaves of the malpighiaceous **Mascagnia glandulifera** are said to be effective as a poultice in ripening boils (Schultes, 1975).

There are numerous plants valued for treating skin infections of probable fungal origin, a very common ailment in the wet tropics—the resin-like exudate of **Campsoneura** debilis, of several species of **Iryanthera**, **Dialyanthera** and **Virola** (especially **V. theiodora**)—all of the Myristicaceae (Schultes and Holmstedt, 1971). At least two species of the guttiferous genus **Vismia—V. angustifolia** and **V. guianensis**, both of which have reddish brown resins, are likewise employed (Schultes, ined.). The gum extracted from the pseudobulbs of the abundant orchid **Eriopsis sceptrum** (Schultes, 1977), a decoction of the bark of several species of **Vochysia** (Schultes, 1977), an infusion of the leaves of the markgraviaceous **Souroubea crassipetala** and the powdered bark of **Calycophyllum acreanum** and **C. spruceanum** of the Rubiaceae (Schultes, ined.). A warm decoction of the leaves of the araceous **Anthurium crassinervium** var. **caatingae** is used by the Kubeos as an ear-wash to relieve a condition due probably to fungal infection (Schultes, 1978).

One of the most commonly used medicinal plants of the Makunas is the malpighiaceous **Mezia includens**: the root is considered to be strongly laxative, crushed and soaked in water in which fariña flour (from **Manihot esculentum**) has been setting for several hours. The boiled leaves make a strongly emetic tea, and, when applied as a cataplasm on the abdomen, they are said to help a condition that appears to be hepatitis (Schultes, ined.).

Despite its toxicity, **Aristolochia medicinalis** is administered in the Vaupés as a tea amongst the Kubeos to calm what appear to be epileptic seizures. The treatment, it is said, may sometimes be worse than the disease, since use of this tea, it is alleged, can lead to permanent insanity if it is not given with extreme caution. Another plant employed as a kind of tranquilizer is the myristicaceous **Campsoneura capitellata**: a tea of the leaves and twigs is administered when a person, in the words of the Indian, "goes crazy and shakes all over" (Schultes and Holmstedt, 1971). It may be significant that in southeastern Brazil, another species of this family—**Virola bicuhyba**—is said to have narcotic properties and to be employed as a "brain stimulant".

The number of plants valued in treating such common problems as rheumatism and arthritic pains, dysentery and diarrhoea, sores in the mouth, festering wounds, pains in the chest, edema, persistent coughs and other pulmonary conditions, debility due to age and a host of other physical abnormalities and pathological conditions is exceptionally large.

This brief account, I hope, will afford an indication, even though superficial, of the wealth of material that ethnobotanical studies in one small area of the tropical world present--the northwest Amazon. Multiply this, if you will, many times to include the numerous still more or less untouched parts of America, Asia and Africa. It is at once obvious what a vast reservoir of still virgin information on plant properties remains to be tapped and salvaged. This ethnopharmacological information has not only its academic interest but can be put to practical use for the benefit of all of mankind.

We can profitably employ ethnopharmacological data to help orient programmes of phytochemical analysis in combination with chemotaxonomic knowledge. Searching for new biodynamic compounds in those parts of the Plant Kingdom known to have an abundance of biodynamic constituents is certainly an excellent avenue for research. To take advantage of what aboriginal peoples have learned over the centuries, however, can provide us with a kind of "short cut" for deciding which of the 500,000or so plant species in the world most urgently demand examination. For, if chemists are to set about analyzing one by one all of the 80,000 species in the Amazon, the project will probably never be carried to completion. Let us, therefore, take advantage of the store of knowledge in the possession of the payés and native practitioners of the world's so-called primitive societies.

Belief in the wisdom of this approach and the realization that much ethnobotanical knowledge is disappearing faster than some of the plants themselves are the bases for a new thrust in ethnobotanical conservation being supported by the World Wildlife Fund—U.S. at the Botanical Museum of Harvard University. It is not only financing a modest programme of field investigation in parts of tropical South America still ethnobotanically rich but threatened with the advance of western civilization, but it has set up an Ethnobotanical Specialists Group. This Group consists of botanists, anthropologists and experts in related disciplines around the world. Its purpose is primarily to encourage ethnobotanical efforts through publication of a newsletter, interchange of ideas, reports of projects and evaluation of progress of programmes underway by researchers working often alone and sometimes internationally unknown—in short, the bringing together of investigators dedicated to ethnobotany in many countries (Plotkin, 1983).

During this discussion, we have mentioned **ethnopharmacology**. Exactly what is ethnopharmacology? It refers, of course, to the medical or pseudomedical use of plants and animals in pre-literate societies—but it is much more than that. It is a branch of that fast-growing interdisciplinary field commonly called ethnobotany—a field that has developed si rapidly in recent years that it now has subdivisions such as ethnopharmacology, ethnomycology, ethnoecology, archaeoethnobotany, etc., so rapidly that sections of international congresses are given over to it and so rapidly that several prestigious new journals have been established during the past ten years for the publication of research in this area of science.

A very recent paper entitled "Ethnopharmacology—a Challenge" sets forth a succinct definition of **ethnopharmacology**: "the observation, identification, description and experimental investigation of the ingredients and the effects of indigenous drugs" (Holmstedt and Bruhn, 1983). The writers, both chemists, further argue that "ethnopharmacology is not just a science of the past, utilizing an outmoded approach. It still constitutes a scientific backbone in the development of active therapeutics based upon traditional medicine of various ethnic groups. Although not highly esteemed at the moment, "they submit" it is a challange to modern pharmacologists." "The ultimate aim of ethnopharmacology," these specialists maintain, "...is the validation (or invalidation) of these traditional preparations, either through isolation of active substances or through pharmacological findings." It remains, however, that only intensified field work will save ethnopharmacological information from disappearance, that the ethnobotanical and botanical steps are the first ones that must be taken and that they are the most urgently needed for the preservation of this information for further, more critical, examination.

We are left, then, with the indisputable assurance that the Plant Kingdom remains a fertile and, in great part, virgin field for scientists interested in the discovery of biologically active compounds that are waiting in silent hiding. The Plant Kingdom, in other words, is a veritable emporium of new chemical compounds, many of them biodynamic some of them undoubtedly of value as potential new therapeutic agents or bases for new semi-synthetic compounds.

The pharmaceutical industry in the United States has attainned, in the prescription market alone, annual sales in excess of $3,000,000,000 from medicines isolated first from plants, many of them discovered in use amongst unlettered peoples in aboriginal societies around the world (Schultes and Farnsworth, 1980). Can we afford any longer to neglect this prolific and promising treasure-trove of knowledge and disregard ethnobotany, a major key that can help unlock it for the benefit of humankind?

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