Ethnobotany, Biological Diversity, and the Amazonian Indians

It is estimated that the Amazon basin — an area as large as the United States — has some 80,000 species of higher plants, approximately one-sixth of the world's vascular flora.

Many of the species — particularly those that are widespread — have numerous localized geographic or ecologic strains, races, or ecotypes. Much of this unique vegetal wealth, widely of genetic value, has already disappeared, and it is certain that much more will soon become extinct, unless the increasingly rampant and uncontrolled destruction of the rain-forests, especially in such vulnerable areas as the Amazon region of Brazil, is restrained.

Amazonia has given the world some of its most important economic plants: the Pará Rubber-tree (*Hevea brasiliensis*), the Pineapple (*Ananas comosus*), Cacao (*Theobroma cacao*), the Tapioca Plant or Cassava (*Manihot esculenta*), Coca (*Erythroxylon coca* var. *ipadu*), the Brazil-nut Tree (*Bertholletia excelsa*), paradise nuts (*Lecythis* spp.), the Curare liana (*Chondrodendron tomentosum*), and yet others. Each of these species has local ecotypes and wild relatives that may be of inestimable value in future genetic projects that may be oriented towards various aspects of improving cultivated forms for greater yield, disease resistance, adaptation to different soil and climatic conditions, and sundry other characteristics.

While conservation of these many local variants is extremely important, there is, in addition, an appreciable assemblage of species worthy of attention as potential new domesticates.

Botanical Exploration Needed

There is no question concerning the necessity of more botanical investigation of the great and varied extension of Amazonia. A better understanding of the composition of the flora in general is essential for well-planned searches for local variants of our existing economic species.

The urgency of more intensive botanical collections and floristic studies is perhaps best illustrated in our quest for plants of potential new, medicinally valuable chemical constituents. The economic uses of many categories of plants can often be easily visible: fruit trees and other food plants, wax or oil sources, rubber and resin-yielding species, etc. The utility of medicinal and toxic plants, however, is due to chemical compounds that are contained in the tissues and cannot be seen. We are finding that literally hundreds of these chemical constituents are new to science. Some of these substances may prove to be of value in modern medicine; many of them, in the hands of synthetic chemists, can be molecularly modified to produce wholly new semi-synthetic compounds, some of which themselves may eventually be found to be of value in medicine or even in industry.

While the usual botanical collecting is most certainly basic to our increasing knowledge of the diversity of species, there is an allied field of research which has come to the fore in recent decades. It is *ethnobotanical conservation*, and concerns the study, directly with native aboriginal peoples, of their acquaintance with the plants of their ambient vegetation.

There have long been two strongly-divergent poles in the evaluation of ethnobotanical studies. Some research workers seem to assume that native peoples 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. Such denigration has even led some specialists to maintain that there is little correlation between native medicinal uses of plants and the chemistry of the species. Yet these negative viewpoints are not supported by the history of many of the most-recently-discovered so-called 'Wonder Drugs' of plant origin: an appreciable percentage of them resulted from scientific investigation of ethnobotanical references to their use in primitive societies.

The perspicacity with which Man in primitive societies understands and uses his vegetation, has long been a source of admiration amongst botanists. Most of this knowledge of plant properties is, of course, the result of millennia of experimentation. Most indigenous peoples are curious about everything natural in their environment, and are extremely skilful in making use of many of the results of their experimentation. Consequently — and particularly as so much aboriginal knowledge is based on experimentation — it warrants careful attention on the part of our scientific efforts to understand the utilitarian value of the world's flora.

It behoves us to preserve and take advantage of this extensive native knowledge that still exists in many parts of the world before it is lost as a result of the inexorable onrush of civilization and the extinction of one primitive culture after another. This knowledge will not remain available much longer. When our civilization arrives with roads, missionary activities, commercial interests, tourism or other penetrations, the products — especially the medicines — of our culture are quickly adopted. Rapidly — often in a single generation — the ethnobotanical knowledge of the native medicines is eroded or lost. This loss nowhere takes place faster than in the realm of biodynamic plants — medicinal, narcotic, and toxic, species and varieties.

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Extraordinary Native Insight

A few outstanding examples from the northwestern part of the Amazon basin, particularly that lying in Colombia, may illustrate the value of ethnobotanical research in our search for plants of potential medicinal interest, and the uncanny ability of the Amerindians to recognize biological diversity in the species that they use.

There is a real enigma amongst these Amerindians which bears intensive study, as botanists have not yet had much success in understanding the natives' ability to recognize, even at an appreciable distance, sundry 'kinds' or so-called 'varieties' — actually likely to be local ecotypes of some of their useful plants. In most cases, it is botanically impossible to discern any morphological differences on which subspecific differences might be recognized. A careful investigation of this ability on the part of the Amerindians may, when it is understood, have a positive value for scientists studying biodiversity.

This aboriginal skill is manifest not only regarding those few of the 80,000 higher-plant species of the region that are economically important to the local natives, but is also found in the native classifications of many species which apparently have little or no importance in utilitarian, ceremonial, magical, or mythological, respects.

Several 'solutions' of the enigma have been offered. Yet often an Amerindian can tell, at once and frequently on sight and at a significant distance — without feeling, touching, smelling, tasting, crushing, tearing, or other physical manipulation — to which named category an individual plant belongs. The 'identification' of these 'kinds' is indeed a complex and interdisciplinary problem, but, while it is obviously of deep significance to the anthropologist and psychologist, it is of extraordinary importance to the biologist and phytochemist, and of extreme significance to any research involving biodiversity.

It is very possible — especially with food, medicinal, narcotic, or toxic, species — that these named 'kinds' may be only different parts of a large plant, or various age-forms or portions growing in shade, sun, or other environmental conditions. And it may be possible that the named 'kinds' represent 'chemovars'. But if so, how can a native visually identify which 'chemovar' a particular specimen belongs to and give it its name in his language? I have repeatedly tested the perspicacity of Amerindians in this respect and have found them neither hesitant nor doubtful; and, through checking independently with other informants, I have never found them in error. Moreover, Amerindians belonging to different tribes, living at considerable distances from one another, will identify the variants with astonishing consistency.

Examples of Amerindian Perspicacity

Paullinia yoco is a forest liana of the Sapindaceae, the bark of which is rich in caffeine: almost 3%. Various natives of the Colombian and adjacent Ecuadorian Amazonia prepare, from the bark, a stimulating drink which is taken every morning and on hunting or fishing travels. It is so important to Kofán native living that, when individuals of the wild lianas are exhausted in the nearby jungle, the group merely changes its settlement to a new site where this Yoco is available.

Eighty years ago, a Colombian explorer reported that the natives recognized various 'kinds': a *yoco colorado* and *yoco blanco*. In 1942, I found the Siona and Kofán Amerindians recognizing these same two 'kinds' by name. I found no morphological or other differences, although the beverage from *yoco colorado* ('reddish yoco') was chocolate-coloured and that of *yoco blanco* ('white yoco') was a milky white. The natives do not prefer one to the other, and both taste the same and are equally stimulating. But the Amerindians can distinguish the two at a distance. I noticed that *yoco colorado* seemed to be a stouter and older liana than *yoco blanco*.

A recent collection of *totoa-yoko* of the Kofáns, bears the annotation that it 'has more *leche* ['latex'] than other types and is therefore the best type.' Notes on an earlier collection from the neighbouring Siona Amerindians indicate that *huarmi-yoco* is the 'strongest' kind. One very recent collection known as *yoco de brujo* ('yoco of the shaman') has unusually large leaves. Further studies in the field and in the herbarium have done little to advance our understanding of the ability of the Indians to recognize these named variants. On the contrary, the problem has been complicated by the discovery that there are many more aboriginally named 'kinds' of Yoco for which the botanist himself in the field or from the dried herbarium material can find no morphological distinguishing characters.

The named variants of Yoco now known number 14, and taxonomically all belong to the same species. In addition to those enumerated above are *markdownananguche yoco*, *po-yoco*, *tigre-yoco*, *taruco yoco*, *verde yoco*, *yagé-yoco* or *yoco yagé*, *yoco-ku*, and *yoco negro*. Two of these names — *cananguche yoco* ('yoco of the palm *Mauritia flexuosa*') and *yagé-yoco* ('yoco of the hallucinogen *Banisteriopsis caapi* or yagé') might suggest that the 'kind' of yoco is used with these other plants, but that cannot explain the skill of the natives in distinguishing the kind of yoco and correctly naming it from a distance.

Another good example of biodiversity as indicated in subspecific differences recognized by the Amerindians is the forest liana *Banisteriopsis caapi*, the bark of which is the source of an hallucinogenic drink that is widely employed in western Amazonia.

Although there were apparently many early references to it as *yajé*, *ayahuasca*, and *caapi*, the source of the drug was botanically identified only in 1852 by Richard Spruce, the British plant explorer, when he encountered its use amongst Amerindians of the Rio Negro of the Brazilian Amazonia. Since that time, many scientists have published a variety of papers on this sacred intoxicant. We now know that it is prepared basically from the bark of *B. caapi*, although plant additives, commonly included with the beverage prepared from the *Banisteriopsis*, may be used to lengthen or alter the effects of the principal drug.

Enigma of Different 'Kinds'

There is no doubt that Amerindians in north-west Amazonia can 'identify' different 'kinds' of *yajé*, *ayahuasca* or *caapi*, at an appreciable distance without feeling, cutting, tasting, smelling, or otherwise seeking specific characters; and there exists a long list of native names that are presumed to designate these numerous variants. The natives, however, maintain that they are able to use these kinds of *caapi* to prepare drinks of different strengths, for various purposes, or in connection with various ceremonies, dances, or magico-religious needs, or what the partaker wishes to kill in the hunt.

An anthropologist, recognizing this perspicacity, wrote: 'Apparently, the native [Siona populations]... recognize many different kinds of *caapi* with different hallucinogenic properties. I consider these to be chemical variants. The ease with which *caapi* can be vegetatively propagated... makes it possible for clones of such variants to be maintained.' This, however, cannot explain the Amerindians' ability to name and recognize these local variants. On the basis of extensive field-work in Peru, it was reported that the Shananahua Indians distinguish three types — red, black, and white, kinds — and that the distinction is based on the colour of the drink more than in the appearance of the plant. Another investigator in Colombian Amazonia reports that several 'kinds' are distinguished mainly on the basis of psychoactivity that may be produced through their use.

The most thorough field study of the indigenous 'kinds' of this narcotic vine was done by an anthropologist who was able, amongst the Siona natives of the Colombian Putumayo, to collect eighteen different vernacularly-named 'kinds'. Botanical material of almost all was collected and botanically determined to a single species, *Banisteriopsis caapi*, with no distinguishing morphological differences that could be taxonomically employed to separate the 'kinds'. Still another field specialist indicated that, in the Colombian Vaupes, 'a large series of kinds' of *B. caapi* are distinguished primarily on the basis of psychoactive effects produced by the drink prepared from the bark.

Siona classification, according to this latter specialist, is seen 'as more complex than that of botany and depends on the conjunction of botanical features, chemical effects, or the mode of preparation and cultural suggestions in the visions experienced.' It is undoubtedly true that all of these criteria are considered by Amerindians for an eventual 'classification' of the kinds of the plant; but it would still be impossible for a native to identify the liana ocularly with certainty to a particular 'kind' of *caapi* by a vernacular name in the forest, and even at a distance, from knowledge or recognition of its chemical constitution and culturally what effects that he expects the drug to induce!

The whole problem is indeed an enigma. But its solution may in several ways be significant in our understanding of the native ability to distinguish minute but meaningful differences which might be of great importance in biodiversity studies. Only further and more penetrating ethnobotanical investigation can explain the indigenous understanding of plants and their minute diversification. It is, however, an aspect of great importance to the problem of biodiversification that has become such a major part of environmental conservation.

Case of the Rubber Tree

Whilst we are dealing with ethnobotany and biodiversity, let us consider one of the most important economic plants of the modern world: *Hevea brasiliensis*, source of 98% of the world's natural rubber and one of the most recently domesticated plants. It is a species that, in only one century, has completely changed life around the world. Introduced into cultivation only 115 years ago, its product — natural rubber — has become a prime item of modern living and industry the world around.

There are ten species of *Hevea*, a genus of *Euphorbiaceae* (Spurge Family) all native in the Amazonia or Orinoco drainage areas. Following the discovery of vulcanization by Charles Goodyear in 1839 in Woburn, Massachusetts, this substance began to be useful for many new applications, and demand for it experienced a phenomenal increase. All sources came from trees of various wild species of the genus *Hevea*. There grew up, with the increase of demand for rubber, a feverish exploitation of the wild trees in the jungle — a nefarious forest industry based, in many cases, on almost slave labour and, not infrequently, on mistreatment, torture, and even murder, of Amerindian rubber tappers.

In 1876, the British domesticated *Hevea brasiliensis* from seed collected in the vicinity of Santarém in the eastern Amazonia of Brazil. It was the beginning of the great plantation industry of the British and Dutch colonies in south-east Asia, which, when they began to produce better rubber at a lower price than the wild trees, spelled the knell of the extraction of latex from *Hevea* in most of the Amazon basin.

During the so-called 'rubber boom' before an adequate supply was available from the plantations of the Orient, several species of *Hevea* were tapped. *Hevea brasiliensis* gave the best rubber; *H. benthamiana* yielded a slightly inferior product; the product of *H. guianensis* and *H. guianensis* var. *lutea* was of third quality. These species were the source of most of the rubber that came from the Amazon before approximately 1915, when the plantations of *H. brasiliensis* were beginning to supply the world's needs.

All of these three exploitable species have numerous local ecotypes. Even most of those species that, because of resin-high latex that gives a rubber of no industrial use (*H. microphylla*, *H. nitida*, *H. pauciflora*, *H. pauciflora* var. *coriacea*, *H. rigidifolia*, and *H. spruceana*), have local ecotypical variants.

Main Industrial Types of Natural Rubber

From the industrial point of view, however, the subspecific variants of *Hevea brasiliensis* are the most significant ecotypes. There is a variant of this species in the southwestern Amazonia — the Acre of Brazil, the Madre de Dios of Peru, and the Beni of Bolivia — that yields a rubber of such superior quality that it is employed for surgeons' gloves, condoms, and other products requiring strong rubber that can be used in extremely fine sheets. The rubber from this variant which, unlike that of the other ecotypes of *H. brasiliensis*, is of such high quality that, even after 1915 (when the production from wild trees in the Amazon practically ceased because of competition with the product of the plantations of Ceylon and Malaysia), there still was demand for the rubber of this ecotype — known in commerce as *acre fino*. This variant grows in high, well-drained soil, quite unlike most types of *H. brasiliensis*.

But in most of Amazonia, there are well-recognized ecotypes of *Hevea brasiliensis* — ecotypes so strikingly different that any *seringueiro* ('rubber tapper') can immediately distinguish them; they have very distinct colours of the interior of the bark, and tend to yield rubbers of slightly different qualities. These three ecotypes are recognized by bark differences and have different ecological preferences; they are everywhere known as *seringueira branca* ('white-bark rubber'), *seringueira roja* ('reddish-bark rubber'), and *seringueira prêta* ('black-bark rubber').

In the eastern Amazonia, *Hevea brasiliensis* is almost exclusively *seringueira branca*. For its rubber and exploitation, it is not the best ecotype: the bark is very hard and consequently not easy to tap, and the latex, more watery than that of the other two bark-types, yields a weaker rubber. *Seringueira roja* is found mostly in the central part of Brazilian Amazonia and in Colombia and Peru; its bark is softer to cut, and the latex is thicker than that of *seringueira branca*. A superior ecotype is very common in the western Amazonia — *seringueira prêta*, with a soft, dark-purplish bark when cut; it gives a thicker latex and an excellent rubber.

Seeds of Limited Genetic Potential

The seeds of *Hevea brasiliensis*, introduced in 1876 by Henry Wickham to the British Asiatic colonies, were collected near Santarém in the eastern Amazonia; they were all of the white-bark type and all from one small area — a very limited germ-plasm base, showing little or no biological diversity. Yet tremendous improvement in rubber clones have been effected in the past century in the plantations. All plantations are descendants of these original seeds and are of the *seringueira branca* ecotype. If Mr Wickham had been able, more than a century ago, to have collected his seeds in the Acre or in western Amazonia, the type of *H. brasiliensis* in modern plantations would probably have been a tree even far superior to the greatly-improved clones that are being planted today.

Here is still another proof of the value of ethnobotanical data for furtherance of biological diversity. The rubber tapper can tell the agronomist and botanist much of great value about the trees with which he lives and from which he makes his living.

It behoves scientists who are interested in biological diversity to seek out the knowledge of local natives and country people who live and work with their flora.

In many instances, this valuable knowledge will not long be available; for it will soon disappear with westernization. It is for this reason that ethnobotanical conservation is so urgently significant as a vital link in the conservation of biological diversity.

RICHARD EVANS SCHULTES, *Director Emeritus*
Botanical Museum of Harvard University
26 Oxford Street
Cambridge
Massachusetts 02138, USA.

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