Conservation of Plant Lore in the Amazon Basin

Richard Evans Schultes

Salvaging irreplaceable knowledge about the properties of plants, gained over the millennia by fast-disappearing Amazonian cultures, has become an urgent goal of modern-day ethnobotany.

With all you potent herbs do I now intercede; and to your majesty make my appeal: ye were engendered by Mother Earth and given for a gift to all. On you she has conferred the healing which makes whole, on you high excellence, so that to all mankind you may be time and again an aid most serviceable.

—An ancient Roman prayer to all herbs

The vertiginous growth in the world's population has put a serious strain on natural resources. The dwindling supply of nonrenewable resources has long been a concern of plant scientists and conservation-minded citizens, and now the severity of the situation has begun to attract the attention of the public and, fortunately, even of some governmental institutions.

Man has only recently begun to take stock of the chemical and genetic potentialities offered by the Plant Kingdom. No botanist can with certainty tell how many species of plants there are in the world. Most estimates in textbooks cite about 280,000, but those of us who work in tropical floras—especially in poorly explored regions—believe that the figure may exceed 500,000. We are currently faced with the incredible task of studying the many thousands of species, most of them still untested and unexamined, many of them not even as yet botanically identified.

The Science of Conservation

There are several aspects of the interdisciplinary science known generally as conservation. Three are, however, most urgently in need of wide and constructive attention: one, the protection of plant species in danger of extinction; two, the salvaging of the knowledge about plants and their properties held by fast-disappearing cultures; and three, the domestication of new crop plants or, in broader terms, the conservation of germ plasm of economically promising species.

Tremendous strides have recently been made in many parts of the world towards protecting endangered species, though much remains to be done, particularly in the Tropics. Fragile ecosystems like that of the Amazon basin are especially susceptible to the extinction of species, primarily because of the large percentage of highly localized endemics which, with the present rapid and uncontrolled destruction of huge areas, may easily be exterminated even before they are discovered and classified by botanists. This aspect of conservation may be the most important, for if the plants themselves disappear, what is there left for us to conserve?

Ethnobotanical Conservation

The second aspect of conservation, which we have come to term ethnobotanical conservation, is not yet so widely recognized. But from the point of view of humanity's increasing dependence on the Plant Kingdom, it deserves to be given priority, especially in
the search for new health-related products. Only recently has this aspect of conservation been given serious attention. The World Wildlife Fund, for example, has organized an Ethnobotany Specialist Group centered in the Botanical Museum at Harvard University, the purpose of which is to collect and conserve as much knowledge about the properties and uses of plants as possible from indigenous peoples. Ethnobotanical leaders from around the world are united in a program destined to help salvage this precious information. Many experts in sundry scientific fields believe that this effort represents a milestone in conservation activities.

Conservation of Germ Plasm

The third aspect—and a most significant one—has been going on subconsciously for millennia, ever since the discovery of agriculture ten thousand years ago in the Old World, approximately seven thousand years ago in the New World, namely, the conservation of germ plasm. But it has now come into its own from a scientific point of view: germ-plasm collection must be considered an integral arm of the conservation of natural products.

It is surprising how many of our major economic plants were discovered, domesticated, changed, and improved by primitive societies long before advanced civilizations inherited them and began slowly to apply modern, sophisticated techniques to bend them further to man's use. Of the twelve or thirteen major food plants of the world—rice, wheat, maize, the common bean, soy bean, peanut, white potato, sweet potato, tapioca, sugar cane, sugar beet, banana, and coconut—only one, the sugar beet, did not come to us from primitive societies; it was developed in a deliberate breeding and selection project instituted in France one hundred seventy years ago.

Primitive man everywhere has lived close to Nature. An important—yes, an essential—part of his living has been a deep and discerning acquaintance with the plants around him. This acquaintance led inevitably to experimentation. From the experimentations, there gradually accrued a knowledge of properties, useful and harmful, of many plants. This knowledge, tested by time, has grown into an integral part of the various aboriginal cultures and has been passed on from generation to generation. Some of it is still with us today. It may not be here long, however.

The Threat from Civilization's Relentless Advance

Civilization is relentlessly advancing in many if not most regions still sacred to primitive societies. It has long been on the advance, but its pace is now accelerated as the result of extended commercial interests, increased missionary activities, widened tourism, and world wars. The feverish road-building in the Amazon basin serves as an example of how fast penetration is proceeding.

With an estimated eighty thousand species of plants, or approximately 17 percent of the world's flora, the Amazon basin must be classified as one of the world's least-tapped emporia of vegetal wealth. Its rain forests have given civilization numerous major economic plants: the pineapple, tapioca, cacao, achiote, coca, timbó, curare, and other useful species. And they have likewise given us the rubber tree, which in only one hundred years has drastically altered life of rich and poor around the world.

Yet the Amazon forest still holds many wild plants that could be of great benefit to mankind. There are many plants which, if we are to judge from their use in local, aboriginal societies, merit consideration for domestication: as sources of food, oils, gums, resins, dyes, and waxes.

The bases of utility of these types of economic plants are, of course, immediately
obvious to any observer, but what of those species whose utility depends upon chemical compounds that are invisible to the observer? The number of species that hold promise as potential sources of still-unrecognized constituents of biological activity cannot even be forecast.

We have an academic and a practical obligation to salvage some of the medicobotanical lore before it shall have been forever entombed with the cultures that gave it birth. From the practical point of view few activities can be more cogent than the search for new medicines from the Plant Kingdom. And on this practical obligation is directly founded all efforts in ethnobotanical conservation.

During the last forty-five years, I have concentrated my own ethnobotanical studies on tropical American plants, especially those of Mexico, the northern Andes, and the northwestern part of the Amazon basin. During this period I spent fourteen years of uninterrupted residence among the Indians of the Colombian Amazon and adjacent Brazil. This region is still one of the least acculturated parts of the hylea and, although it represents only a very small sector of the Amazon basin (which, incidentally, is an area larger than the United States), our investigations indicate that there are probably few places in the world where native peoples use a greater percentage of their flora for biodynamic or biological activity—that is as medicines, poisons, or narcotics.

A Nearly Limitless Chemical Factory

Everything points to the wealth of the Amazon’s green mantle as a nearly limitless chemical factory almost untouched by scientific study and yearning for conservation, until the properties of its species, discovered and utilized by those humans who have lived with it for millennia, can be subjected to the impartial scrutiny of the laboratory.

It has truly been said that the primitive medicine man may hold, in his knowledge of plants, the key to great new advances in modern medicine. As a Brazilian chemist has recently written: “Since the Indians in the Amazon are often the only ones who know both the properties of the forest species and how they can best be utilized, their knowledge must be considered an essential component of all efforts to conserve and develop the Amazon.”

Mainly as a result of the superstitious excesses of medieval European herbal medicine, pharmaceutical science during the last part of the Nineteenth and early Twentieth centuries turned definitely antagonistic to plant medicines. Synthetic chemistry would solve any and all problems, it was believed. Beginning in the early 1930s, there began a series of extraordinary discoveries of new drugs—the so-called “wonder drugs”—that have revolutionized modern medical practices: curare (muscle relaxants from South American arrow poisons); penicillin and a host of other antibiotics (all from lower plants); cortisone (from the Mexican yam); resperine (from the Indian snake root); vincristine (from the Brazilian periwinkle); the alkaloids from Veratrum (hypotensive agents); podophyllotoxin (a cytotoxic and antifungal resin from the May apple); strophanthine (a cardiotonic from an African arrow-poison plant); and others, all discovered and first isolated from plants—and usually from plants that play significant roles in primitive medicine. As a result of these marvellous discoveries, the pharmaceutical sciences have gradually turned back to the Plant Kingdom as an almost virgin field for new biologically active principles.

Ethnopharmacological Research

A few examples from my own ethnopharmacological research may suffice to indicate the perspicacity of the Indians of the north-
western Amazon basin and the basic reasons why conservation of ethnobotanical information is so fraught with promise. From the northwestern part of the Amazon, we have field notes on more than two thousand species valued by aboriginal populations for their biodynamic activity. Almost all need investigation, for many species (and even genera and whole families) have never been examined by phytochemists, even superficially.

Recently, I counted the number of new alkaloids isolated from Amazonian species and reported in the literature during the last ten years. My very superficial and most certainly far from complete count gave a total of 278 alkaloids—and we must remember that alkaloids are only one of the many categories of biologically active secondary organic constituents in plants.

My field notes, for example, indicate that thirty-two species are used for purposes suggesting possible cardiac activity; seventy-eight are involved in the preparation of arrow poisons; twenty-seven seem to be insecticidal; forty-two are used as fish poisons; three are employed by the Indians as oral contraceptives; fifty-two are taken to expel intestinal parasites; six are said to be stimulants; eleven are valued as hallucinogens or narcotics—and so the list goes on.

Patinoa ichthyotoxica R. E Schult EO Cuatr., a bombacaceous tree the fruit pulp of which is used as a fish poison by the Tikuna Indians of the Colombian Amazonas. Shown here are the tree's flowers and leaves (left) and its fruit (right). Drawings by Irene Brady.
The Promise of Ethnobotany

Two examples illustrate the botanical perspicacity of the Indians of the northwestern Amazon basin and my reasons for suggesting that conservation of ethnobotanical information is filled with promise. There is an Amazonian hallucinogenic drink variously called ayahuasca, caapi, or yaje, prepared from the bark of species of liana (Banisteriopsis caapi), which contain beta-carboline alkaloids that cause visions in blues, grays, and purples. It is employed in magico-religious ceremonies and as in medicine. To increase the intensity and duration of the intoxication, the natives sometimes add the leaves of another liana of the same family (Diplopteris cabrerana) or the leaves of a bush belonging to the coffee family (Psychotria viridis). It has been found that these leaves contain other types of psychoactive alkaloids known as tryptamines. Tryptamines are inactive when taken orally, unless they are protected by a chemical constituent known to inhibit monoamine oxidases. The beta-carbolines in the bark of the liana are monoamine oxidase inhibitors. How did our unlettered Indians ever find these two appropriate additives among the eight thousand species in their forests?

A similar extraordinary phenomenon concerns the hallucinogenic snuff prepared from a resinous exudate from the bark of certain Amazon trees of the nutmeg family [Virola spp.]. This powder, recent investigation has discovered, contains very high concentrations of tryptamines, which, of course, can be active in the form of snuff. But several tribes—Witotos and Boras—do not use the narcotic as a snuff but take it ceremonially in the form of pills. How could these tryptamines be active when taken orally without the addition of a monoamine oxidase inhibitor? More precise chemical examination disclosed the presence in the exudate of trace amounts of beta-carbolines serving as a built-in monoamine oxidase inhibitor that activates the abundant tryptamines.

Domestication As Conservation: Curare

Finally, we might well consider two examples of domestication as a form of conservation; one a possible new departure in domestication, the other one of the world's most important crop plants.

It was a study of the preparation of curare, or arrow poison, that first took me to the northwestern Amazon, in 1941.

The Indians of this region have the most complex formulas and use the greatest number of plants in preparing their curare. Each tribe and each medicine man has its own recipe. Each recipe calls for a different number of ingredients—from one to fifteen or more. An alkaloid—tubocurarine—isolated from certain forest lianas of the mood seed Family (especially Chondrodendron tomentosum)
has become extremely important in modern medicine as a muscle relaxant and for other uses. The synthetic alkaloid apparently does not have the same properties as that isolated from the bark of the lianas. A serious shortage of curare from the forests seems to be imminent.

Pharmaceutical companies still must purchase for the extraction of tubocurarine the syrup prepared by Indians in Amazonian Ecuador and Peru. The liana is extremely slow-growing. Indians must fell it for its bark. Each year, they must go farther afield, and the liana is becoming scarce. Furthermore, rich deposits of oil are being developed in the region, and Indian labor for bark-collecting is harder to find each year. It would seem to be feasible to seek germ plasm of high-yielding lianas for cultivation under greenhouse conditions. The young sprouting shoots might repeatedly be harvested for extraction of the alkaloid and left to grow again, thus assuring a more or less continuous supply.

The Para Rubber Tree: Slavery, Then Emancipation

There is one very recently domesticated plant with which I have worked intimately in the Amazon from 1942 to the present: the Para rubber tree (*Hevea brasiliensis*), domesticated only one hundred years ago. No other plant has so drastically altered life around the world in so short a time. Before its domestication, most of the world’s natural rubber came from wild trees in the Amazon basin, produced by Indians living in deplorably subhuman conditions in the malarial forests, far from their homes, under economic conditions approaching slavery or worse, with inadequate diets and no health services against tropical diseases, often sadistically tortured or killed as punishment for not bringing in sufficient latex—a nefarious industry that decimated or extermi-


The flowers and leaves of the Para rubber tree, which yields almost all of the natural rubber used in the world. Photographed in Amazonian Colombia.
nated whole tribes of a wonderful race.

I am reminded of the feelings of the German anthropologist Koch-Grünberg, an early and earnest conservationist, who spent a long period in the northwestern part of the Amazon basin and who returned to the field there after an absence of five years, during which time the Natives had been impressed into rubber tapping. His words in German are forceful; they lose much of their power in my translation of them into English:

Hardly five years have passed since I lived in the Caiarý-Uaupés. Whoever goes there now will no longer find the idyllic region that I knew. The pestilential stench of a pseudo-civilization is sweeping over these brown people, who have no rights. Like an all-destructive swarm of grasshoppers, the inhuman hordes of rubber collectors press on and on ... and force my friends farther and farther into the deathly rubber forests. Raw brutality, mistreatment, murder are the order of the day.

... Their dwelling sites become deserted, their houses are reduced to ashes, and their gardens, deprived of caring hands, are taken over again by the jungle. Thus a vigorous race, a people with a magnificent spirit and friendly character, are annihilated, and human material capable of development is destroyed as the result of the brutality of these modern barbarians of culture.

In 1876, the British succeeded in domesticating the rubber tree. Two thousand seeds of seventy thousand collected germinated in greenhouses in Kew Gardens. Although the seeds were quite openly exported with the help of Brazilian officials, Brazil prohibited further exportation of rubber seeds. All the millions of acres of today's Asiatic plantations are populated with descendants of these few original trees.

The seeds were collected from one small locality and represent only one strain—and not the best—of the rubber tree. Yet what vast improvements have been brought about from the wild trees in only a century! The yield of rubber from the first plantations was 450 pounds per acre per year; some modern clones are yielding more than 3,500 pounds per acre per year.

**Plant Conservation and Human Salvation**

Domestication of the rubber tree yielded two results, both of which are relevant to the practical aspects of conservation. It furnished a steady, ample, and inexpensive supply of rubber without which our modern world, especially its transportation systems, could not have come into being. It also saved from virtual annihilation whole tribes of Indians, for once the well run Asiatic plantations began to fulfill the world's need for rubber, the extraction of rubber from wild trees in the jungle, for all practical purposes, died out. Thus, the commercial cultivation of a wild tree saved a whole people, an unexpected result of that branch of conservation known as domestication.

The Plant Kingdom remains an almost virgin field for the discovery of biologically active compounds waiting in silent hiding. Can we afford any longer to ignore the hunting ground that has provided, through folklore and serendipity, leads that the pharmaceutical industry has turned into products having annual sales in excess of three billion dollars in the American prescription market alone?

We cannot imagine the uses that the future may have for the thousands of genera that the world's flora holds out to us. For the good of our descendants, for the progress of civilization, and perhaps even for the survival of humankind it behooves us—nay, it obliges us—to protect this nonrenewable gift of Nature and to conserve the knowledge of aboriginal people on how to use it, for the benefit of the entire race.
Note

This article is a modified version of the talk presented on May 21, 1984, to the World Wildlife Fund's International Board of Trustees in Washington, D.C.

Suggested Reading


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