

The Missouri Botanical Garden celebrates its 150th anniversary in 2009. In addition to special displays such as a 20 x 20 foot floral clock, events such as the “Global Garden” lecture series will be offered to the public.

The Garden is a world center for botanical research. Its programs operate in 37 countries, its herbarium collection contains more than 6 million specimens, and its 150 scientific staff members not only carry out research on a variety of topics, but offer their expertise to institutions ranging from the U.S. National Cancer Institute to parks and conservation areas worldwide.

In honor of the sesquicentennial anniversary, we will publish a series of articles about the scientific activities that have earned the Garden its preeminence in the botanical world.

Ethnobotany: The intersection of people and plants

When Ranier Bussmann discovered a new plant species in the Andean cloud forest in Peru, he saw both opportunity for the native population and an inducement to preserve the forest where the plant grows. The seeds from that plant could be roasted and turned into a highly nutritious snack. The snack could be sold around the world and the revenue generated could improve the lives of Peruvian farmers.

Translating discovery into results is routine for Bussmann, an ethnobotanist and Director of the Missouri Botanical Garden’s William L. Brown Center. “Ethnobotany is the science of how people use plants,” he explains. Since plants enter into almost every human endeavor, from sustaining life as food to giving us pleasure in gardens and wilderness, ethnobotany covers a lot of ground.

A major part of the ethnobotanist’s focus is discovery. There is a sense of urgency about finding and evaluating new plant species, because specimen-rich environments like rain forests are being destroyed constantly. Since only a small fraction of the estimated plant species have been evaluated for human use, the very plant that holds the key to curing Ted Kennedy’s brain cancer might be wiped out from its restricted habitat in the Andean cloud forest when a new gold mine is excavated.



Rainer Bussmann

Photo courtesy of Missouri Botanical Garden, William L. Brown Center

Plants have long history as sources of new medicines.

Most of us are familiar with some important medicines that have been derived from plants. Aspirin originally came from willow bark, morphine from poppies. The anti-cancer drug taxol was first found in the bark of yew trees. Curare, previously used in surgery as a muscle relaxant, was originally used to coat poison darts in the Amazon regions of South America.

Wendy Applequist, assistant curator at the Brown Center lists a number of drugs used today that were originally found as the active ingredients in plants. (See inset box). She emphasizes that less 2% of the world’s flora has been thoroughly screened for medicinal properties. She is responsible for coordinating the Garden’s contribution to ICBG, the International Cooperative Biodiversity Group, funded by the U.S. National Cancer Institute and the USDA. Newly discovered plants are extracted, fractionated, and screened for anti-disease activity. Specimens are mounted for the herbarium, so that they might later be examined microscopically, perhaps even yield up some DNA.

Bussmann and Applequist point out that the western model of purifying a single molecule from a medicinal plant is a small part of the story, that indeed the world of traditional medicine uses crude extracts that may have a multitude of active ingredients. Often extracts from two or more plants are combined. Most of the world relies upon these extracts to treat their illnesses.

A short and very incomplete list of well-known medicines from plants

<u>The Drug</u>	<u>The Condition</u>	<u>The source</u>
Glucophage	Diabetes	French lilac
Morphine	Pain	Opium poppy
Vincristin	Childhood leukemia	Periwinkle
Digitalis	Heart arrhythmia	Foxglove
Aspirin	Pain, inflammation	Willow
Artemisinin	Malaria	Wormwood
Taxol	Breast Cancer	Yew
Etoposide, teniposide	Cancer	May apple
Topotecan, irinotecan	Cancer	Tree of life

Ethnobotany requires skills from anthropology for precise plant identification

To really learn about possible medicinal *application*, ethnobotanists seek out healers native to the plants habitat. So these scientists need some anthropological background to know the right questions to ask a healer. They need a background in ecology, to ensure that these plants are sustainably harvested or grown.

And, of course they must be very competent taxonomists (scientists specializing in classification and its corollary, identification.)

Bussmann fears that taxonomists may also become extinct, because theirs is seen as an old fashioned science. Yet they are the ones who can ascertain whether a collector has the right plant. An example is curare. The curare plant is a “nondescript liana with heart shaped leaves.” In Peru, where he works, 74 species look about the same, but only one contains the agent that paralyzes muscles. Only a highly trained taxonomist can identify the curare liana blooming in the canopy.



Curare

Photo courtesy of Missouri Botanical Garden

Missouri Botanical Garden employs 150 taxonomists. With their expertise, and with the 6.2 million herbarium specimens for reference, Bussmann says they can handle anything.

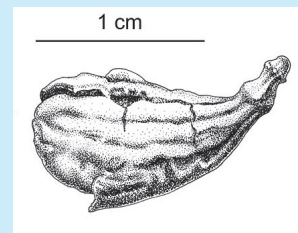
He gives an example of a question referred to him by historians. About 2000 years ago certain fruits appeared in South American paintings seemingly related to sacrifices or priests. People started to speculate on the possible role of the fruits in the sacrifice, but could not identify the fruits; in Peru, about twenty plant families have fruits that resemble those in the drawing. When the historians consulted Bussmann and his colleagues, they identified the plants using herbarium specimens and found good reasons for using them in human sacrifice. The seeds apparently served a dual function. The sacrificial priest would induce visions by grinding the seeds into a snuff and inhaling it. Meanwhile, prisoners about to be sacrificed were made to eat the fruits. Those fruits contain alkaloids that make the heart beat faster accompanied by a fatal rise in blood pressure—great for collecting blood from human sacrifices.

Solving an archeological mystery



Top, left to right, objects from Moche culture in Peru

“Hawk Runner, with fruits on belt and floating fruits, harvest of the fruit,
mythical figure holding mortar and pestle with fruits on headdress



Left, fruit from “Lord of Sipan” archeological site.

Below, two of the herbarium specimens used to identify the mysterious fruit.



With permission of Rainer Bussmann. Drawings from “Naming a Phantom--the quest to find the identity of Ulluchu, an unidentified ceremonial plant of the Moche culture in northern Peru,” by Rainer Bussmann and Douglas Sharon.

Missouri Botanical Garden is changing the conservation model.

In the quest for discovery, modern ethnobotanists have adopted new strategies for maintaining old environments. As Wendy Applequist explains, they needed to get away from the model of conservation where local people are the enemy. It doesn't work to put up signs around the forest and keep the indigenous people out.

What works is benefit sharing with the local people, and contractual guarantees that those people would share in any income resulting from discoveries. Furthermore, the Garden's philosophy is that even if nothing is discovered, the local population should gain from having permitted the collection, perhaps through help with community development. (The Missouri Botanical Garden itself never collects royalties for anything—it takes its fees in herbarium specimens.)

Bussmann explained how protected areas are established with the new model.

Bussmann explained how the Garden undertakes exploration and discovery. He used as an example the Andean cloud forests in the upper Amazon region of Peru, where he is currently doing much of his research.

First he identifies an interesting remote area like these cloud forests, which have not been well explored, and asks "What's there?"

As an ethnobotanist, he works with the local population to find plants that are important to them. He asks the questions

- How is it used?
- Where does it grow?
- How is it prepared?
- What does it contain?
- Is it nutritious or medicinal?
- Could it create local income while maintaining the forest?



As one example, he found a new plant with seeds high in omega-3 and omega-6 fatty acids. These can be roasted like peanuts and make a healthy snack, which is beginning to find its way into some Peruvian markets. What makes this plant of special interest to conservationists is that it grows only in undisturbed cloud forests (about 3500-7000 feet above sea level.) It can't be grown in plantations, because in the sun it is susceptible to pests. So, in order to keep harvesting these seeds, the forests must be maintained.

However, in this upper Amazon area there are many obstacles to maintaining these forests. Much of the cloud forest is being destroyed by erosion because colonial agricultural practice was not sustainable; the Spanish abandoned terracing as too labor intensive (they wanted their laborers in the mines.) Forests and native grasslands are being cleared to grow canola for biofuels. In addition, logging concessions have been granted, and mining companies are thinking of moving in. Peru is still the world's fifth exporter of gold, and new methods of



Wendy Applequist

*Photo courtesy of
Missouri Botanical Garden*

mining using cyanide leach pools make it profitable to mine where gold is as little as 1/20 ounce/ton of rock.

So he and his colleagues bring in the Garden's Center for Conservation and Sustainable Development, whose mission is to create and manage protected areas. They plan to establish a conservation area, in this case about 700,000 acres. In their commitment to making this conservation area beneficial to the local Peruvian population, they already have a product for sale in the Garden Shop and other outlets around St. Louis. Shade-grown coffee from small family farms, grown with no pesticides and no synthetic fertilizer, is being roasted by Kuva Coffee of St. Louis, who donate 10% of proceeds to the Garden. The Peruvian farmers get double the usual price for this special coffee in return for their agreement not to destroy the forests. A win-win situation.

A new attraction at the Kemper Center will demonstrate ethnobotany in this region.

Visitors to the Garden will be able to learn more about our local ethnobotany in a new "Sacred Seeds" area in the Kemper Center. This garden will concentrate on important medicinal plants used by pioneers and native Americans. It is one of a number of such gardens to be established worldwide where people can learn how to grow useful plants important in their local areas. "Sacred Seeds" gardens have already been established in Kenya and Costa Rica, and one will soon be sown in Peru.

The study of ethnobotany can lead to insights in seemingly unrelated fields. Rainer Bussmann's first began his South American studies in the Andes of southern Ecuador. When he and his colleagues decided to extend their collections into the basically the same geographical region in northern Peru, they found that Peruvian healers used many more plants and combinations of extracts than Ecuadorian healers. In addition, markets in Peru do a thriving business in medicinal plants, while no medicinal plants are sold in Ecuadorian markets. Experimentation with new plant-based medicines is an ongoing enterprise in Peru, but not in Ecuador.

The difference in use of native medicinal plants traces back to the colonial occupation. In Ecuador, the Spaniards forbade the use of native plants for health purposes. In Peru, the use of native plants was encouraged. The reason? Peru had mines, and the Spanish colonials needed to keep their laborers healthy. In Ecuador, there were no mines, and thus no incentive to keep the Indian population healthy.

Readers interested in learning more about ethnobotany might be interested in attending a lecture in the Global Gardens series by Chris Kilham of the University of Massachusetts. Details are available at <http://www.mobot.org>.