Light in a Bottle: Plant-Collecting in the Philippines

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There has been no better time to be a field botanist. It is from the world of plants that cures are again being sought, and compounds isolated from plants are being tested for their anti-viral, anti-cancer, and anti-fungal activity. A small corps of botanists are journeying to the field, gathering samples of bark, leaf, and root, and trundling them back to the biochemistry labs of the world.

The status of botanical compounds has risen in recent years with the success of the taxane group of compounds in fighting cancer. However, funding for research on medicinal plants is notorious for its boom-and-bust cycles, and if the current well-funded efforts bring no major leads, a new downcycle in support may be triggered. At the same time, there is an urgent sense among botanists returning from the field that the work must be done now or never. The relentless spread of human population means that forests continue to be turned into fields and pastures and that individual plant species are harvested into extinction by the multitudes of people who value their timber, flowers, or aphrodisiac bark.

Botanical field collecting for medicinal leads usually proceeds in two phases. Initially a broad assortment of plants is collected from a certain region or from a specified set of plant families. Extracts are made and laboratory-tested for effectiveness against a variety of diseases. If a particular species shows promise—the San Pedro cactus, let us say—the second phase begins with a search for different populations of the same species or for other species within the genus—perhaps the San Roberto cactus—in hopes of achieving a still higher level of effectiveness. Essentially, then, it is find a needle in the haystack, then find a better needle.

Over the last twelve years most efforts have focused on cancer and the HIV virus, and scores of botanical compounds have been tested on cell cultures of these diseases. The work is coordinated by the Developmental Therapeutics Program of the National Cancer Institute (NCI) under the directorship of Dr. Gordon Cragg. Since 1985 over 30,000 plant extracts have been tested for in-vitro effectiveness against sixty types of cancerous tumors, and over 52,000 have been tested against HIV since 1987. Once an effective compound has been isolated and patented, the NCI licenses it to a pharmaceutical firm for further development.

Homalanthus as a Potential Anti-HIV Therapy

Dr. Cragg reported in 1994 that “four novel plant-derived agents with in-vitro anti-HIV activity have been isolated and selected for preclinical development.” Among these are extracts from a Conospermum species of Australia, Ancistrocladus korupensis of Cameroon, and Calophyllum of southeast Asia, which was collected and identified by researchers at the Arnold Arboretum and is now in Phase II human clinical trials. A fourth genus of interest to NCI is Homalanthus.

There are about 35 species of Homalanthus, ranging throughout Indomalaysia and Polynesia. Because none of these is very appealing aesthetically, little had been written about them since 1914, when Elmer Merrill (later director of the Arnold Arboretum) described a number of Homalanthus species from the Philippines. Then in the late 1980s, after a decade of work-
In lush and humid lowland rainforest, the plant-collecting party stops to catch their breath before a final push up Mt Apo, the highest peak in the Philippines.

Amid razor-sharp sawgrass and burnt trunks, expedition members were successful in locating a handful of young Taxus plants to be tested for anti-cancer activity.
ing with native healers in Samoa, botanist Paul Cox of Brigham Young University returned to the United States with a number of samples for laboratory analysis, together with documentation of their local medicinal uses. One of Cox’s specimens was *Homalanthus nutans*. As members of the euphorbia family, *Homalanthus* are related to such plants as crotons, poinsettia, cassava, and castor beans. Some members of the family contain milky latexes that cause gastrointestinal poisoning, dermatitis, or tumors, but a number of them have been used medicinally worldwide to relieve toothaches and oral infections, or as emetics and laxatives.

Plants of the genus *Homalanthus* are small trees, weedy colonizers that thrive along the edges of roads and fields or in newly opened spaces in the forest canopy. Samoans know them as *mamala* and use their bark, leaves, stems, and roots to treat a variety of ailments, one being yellow fever. In Western laboratories a compound extracted from the wood, prostratin, was found to strongly inhibit the killing of human host cells in-vitro by the HIV virus. This first flash of promise set off a cycle of activity. Botanists began collecting and studying the plant, and chemists initiated studies to decipher its mode of activity, thus giving it status as a candidate for clinical trials.

**Botanists Take To the Field**

At the same time that studies were revealing the medicinal potential of *Homalanthus*, my research partner, Dr. Melvin Shemluck, and I secured a grant from the United States Department of Agriculture to continue our previous research on wild populations of yew, this time collecting live material in the Philippines. *Taxus*, the yew genus, had been the subject of intense research for over a decade thanks to the

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The cabbage fields of Mt. Pulog represent a classic dilemma of developing countries: increased food production vs biodiversity conservation.
discovery of the compound taxol, an anti-cancer agent found in its needles and bark. We were focusing on disjunct yew populations in order to learn which species or populations produce the most taxol, a crucial piece of information for selecting the best ones for biotechnological applications or plantations. We also hoped to determine the conservation status of wild stands of yews in the Philippines, as well as to procure samples for research groups that are studying the genetic and ecological aspects of yew biology. Since the intriguing results of tests against the HIV virus using prostratin were becoming well known by this time, the USDA extended our mandate to enable us to search for new species or populations of Homalanthus while we looked for yew.

Our pretrip research led us to an obscure book on the shelf of the Smith College library, The Vegetation of the Philippine Mountains, written in 1919 by William Brown, an associate of Elmer Merrill. His meticulous accounts were rich in all the kinds of data that help in planning a collecting trip, including the timing of monsoons and the altitude of various plant habitats. Brown also described the broad categories of forests found in the Philippines. At the lowest altitudes is the lowland Dipterocarp forest, a tropical rainforest with three stories of trees and a shrub and herb layer at the base. Some of these Dipterocarp trees can reach 130 feet in height and have been the source of Philippine mahogany lumber for hundreds of years. The lower montane, or mid-mountain, forest is found at altitudes of 3,300 to 8,200 feet. Evergreen oaks and laurels are the major component of this two-storied forest, with southern hemisphere conifers such as Podocarpus and Agathis found in this association. Finally, the lower montane mist forest, or mossy forest, is a high-altitude, single-layer assemblage of low-growing, gnarled, mossy trees bathed by daily mists or rain.

We acquired visual familiarity with Homalanthus by studying dried, pressed specimens in herbaria, noting the botanical characteristics of species that would help us distinguish them in the field. Field notes on herbarium labels give invaluable clues to location and often include altitude, associated species, local names of plants, and sometimes, more colorful information, as with the sample of Homalanthus nutans. Collected in the Solomon Islands by S. F. Kajewski in 1931, the notes included, "When a man has been infected by an evil spirit the sap of this tree is drunk to get rid of this spirit."

On the Ground in the Philippines

Our first stop in the Philippines was the National Museum in Manila, where we consulted with Philippine flora expert Dr. Domingo Madulid and put together our team. Our next destination was Mt. Pulog, at 9,607 feet it is the highest point on the northern island of Luzon. We drove north from Manila through a snarl of jeepneys, buses, cars, and motorbikes, at one point passing a 40-foot deep lahar flow six miles from its source, Mt. Pinatubo. Our party of four botanists and driver stayed that night in the mountain resort of Baguio, a city much damaged by a recent earthquake. The next day we began our ascent of Mt. Pulog on a road whose quality declined drastically as we hit steeper terrain. As if to further emphasize the power of nature in the Philippines, a front of thunderheads began to drop its moisture on us, making the last twenty miles a battle up the deeply rutted road, its clay soil slippery from the rain. Each time our efforts seemed doomed, we somehow coaxed our vehicle forward.

After reaching the entrance of Mt. Pulog National Park, we moved our gear into the cabin that serves as the park's headquarters and the camp for its solitary caretaker. While the torrent continued into dusk, we dried out under the tin roof, peering out at a Homalanthus plant across the stream that had once been a road. The clear light of morning showed the magnitude of settlement on the surrounding slopes: the forests of Benguet pine, Pinus insularis, had been intensively cut right up to the park's boundary, and the fields of the local Ifugao tribesmen surrounded our cabin.

Ironically, this degraded forest was ideal habitat for Homalanthus, and we had no problem finding several specimens of a large-leaf species, H. megaphyllus, a small tree with thick branches, large minaret-shaped buds, and a distinctive, rounded leaf with a red stem. We soon
A robust plant of Homalanthus megaphyllus found near the headquarters of Mt. Pulog National Park.

had a collection of a half-dozen samples of wood with corresponding cuttings for propagating back at the Smith Botanic Garden.

The cabin was sited at 7,500 feet, the point where the pine forest gave way to the moist, low, and dense mossy forest. Rather than carve out a trail through the heavy undergrowth, we stayed on the path to the summit of Mt. Pulog as we searched for yew trees and other Homalanthus species. Some of the species here were recognizable as common farther north in more temperate zones—spicebush (Clethra luzonica), Berberis barandana, Deutzia pulchra, Ilex crenata f. luzonica, and dense shrubs of Rhododendron subsessile. The most unusual collection of the day was a white-flowered epiphytic rhododendron unique for its thin needle-like leaves.

As we climbed higher the effects of the colder climate became evident in the stunted shrub-like forms of species that grew as trees lower down. At 8,700 feet, the woody flora disappeared altogether, giving way to a tussock grassland interspersed with a dwarf bamboo, Arundinaria niitakayamensis. At this point we were still 900 feet from the summit and the temptation to see the ocean from the top of the island beckoned, but our Philippine colleagues counseled that the rains would come again by noon. Since no Homalanthus or Taxus would be found above treeline, we retreated to search along other paths lower down. The rest of the morning produced nothing, and as predicted, the rain began again at noon, reducing visibility to 75 feet. Melvin and I spent the afternoon walking along the edges of cabbage fields and up and down the crude paths that crisscrossed the slopes. It was evident that the forest had been severely depleted since yew was last collected on Mt. Pulog. Each hour of trudging past three-foot-wide pine stumps made us more depressed, and we began to talk of an epitaph for this population of yew.

We returned to the cabin dejected and prepared for defeat, but our gloom changed to joy when our Philippine colleague Ephrain greeted us with a fold of newspaper containing a sprig of yew. Not a thousand yards from the cabin our Ifugao guide had found five adult yew trees (up to 80 feet tall) and a trio of saplings on the edge of a cabbage patch. Once the guide confirmed that this was the plant we sought, he remembered seeing more of them farther north on the other side of the mountain.

We realized, however, that the day of the yew on Mt. Pulog is almost past: because it germinates and grows under a solid canopy, yew is found only in forests of long standing. Homalanthus, by contrast, rapidly establishes itself in recently disturbed areas—for instance, in clearcuts or canopy gaps. With farmers clearing the forests higher and higher up the mountains on Luzon, Homalanthus is enjoying a newfound prosperity.

To ensure broad genetic diversity, we wanted to collect from widely separated populations. After returning to Manila, we flew to Mindanao, the largest of the Philippines' southern islands, to seek out the yew and Homalanthus populations previously documented on Mt. Apo. Mindanao is also home to some rare endemic species of Homalanthus, and we hoped to locate some of these.

Mt. Apo is the highest peak in the Philippines; the only access is by foot. Our party of four botanists and three porters began the ascent
at the village of Kitapowan and walked upward through lush lowland forest. Towering above us, one spectacular tree, damar, *Agathis dammara*, had an eight-foot-wide trunk oozing a sticky, milky resin, which is the source of a resin used in varnishes.

Clumps of epiphytic orchids, some of them three feet across, cluttered the path, brought down by their own weight from the branches above. Some of the trees were so tall that the first branch was too high to identify, although tentative identification could be made from fragments of floral matter fallen on the path. Other plants, like the bizarrely primitive-looking screwpine (*Pandanus*) or the lush tree ferns, grew in the lower canopy layer and were unmistakable. We found one species of *Homalanthus* on the uphill climb—*H. populneus*—a solitary specimen of 45 feet that had sprouted near a treefall. After a grueling five-hour climb, we set up camp at 7,200 feet on the shores of Lake Venado. Again we found ourselves in a lush, mossy forest belt of southern conifers like *Dacrydium* and *Falcatifolium*, with the vivid scarlet blossoms of epiphytic *vireya rhododendrons* punctuating the green curtain.

Rain was pouring down again as we rested in camp and botanized around the lakeshore. Here we found trees more closely related to the southern flora: *Tasmannia*, *Leptospermum*, and *Pittosporum*, but no yew. From our camp we could see the north-facing slope of Mt. Apo. A fire had burned a considerable portion of its forest in 1986, and silvery dead trunks now rose out of a sea of ten-foot sawgrass. The lone path traversing this thicket seemed our only practical route for the next day’s climb.

We set off early, aware now that the workday would be cut short by afternoon rains. The only prior collection of *Taxus* on Mt. Apo had been by the botanist Robbins in 1965, at an altitude of 7,500 feet. We moved upward nervously, fearing that Robbins had approached the peak from another direction, or that the fire had eradicated what may have been the only *Taxus* population on Mt. Apo. But at 7,300 feet we spotted a yew seedling, an eight-inch sprig in the moss on the edge of the path, and within the next 400 feet of altitude, we found an additional fifteen seedlings and saplings. These few plants had probably sprouted from seed deposited in the soil prior to the fire, and it seems unlikely that they will survive competition from the sawgrass or withstand the intensity of the full sun should they rise above it.

Although the specimens were too small to yield a sample for laboratory testing, we collected a few cuttings from each to root back at the Smith College greenhouses and to provide material for researchers working on other aspects of the yew. We tried one additional foray off-path in the direction of a promising ravine. But when clouds pumped up and postured threateningly, we turned back. Suddenly the rainy season began in earnest, with a downpour that dwarfed all previous storms. On the way back down the mountain we found one

*While curious townspeople looked on, the author and other expedition team members prepared samples for the trip down the mountain*.
more species of Homalanthus, H. rotundifolius, bringing our total to four.

Conclusion
Upon our return to the U.S. our Taxus samples were analysed for relevant medicinal compounds, and data concerning individual tagged trees was sent back to the Philippines. Should plantation culture become an option, these tags can identify elite trees. Cuttings were rooted at Smith College, and from these plants, material was supplied to other researchers working on the yew’s taxonomy, biochemistry, and genetics.

Samples from our Homalanthus collection were sent to the Natural Products Branch of the National Cancer Institute to begin the long process of analysis and trial. Initial extracts showed significant activity against HIV cell lines, but further development has stalled for a variety of reasons; other plant compounds have shown more promise, as have certain non-plant-derived compounds. Although prostratin, unlike other compounds in its class (phorbol-esters), does not induce tumors, taint by association has dampened interest on the part of pharmaceutical firms. Dr. Paul Cox, the botanist who brought prostratin out of the rainforest, has suggested some plants may produce “gray pharmaceuticals,” drugs of proven safety and efficacy that are not marketable in the Western world. Possibly prostratin may fall into this category, a low-cost, plantation-grown treatment option that offers an alternative to high-priced Western drug regimes. The colonizing nature of Homalanthus may make it an ideal subject for plantations in forested areas.

In the daily grind of plant-collecting, it is easy to fixate on the immediate goal, the plants themselves, and to forget that each collection, long shot though it is, may be the basis of a cure for thousands or millions of people. The renewed interest in botanical compounds makes collecting far afield possible, yet with each trip comes the realization that we may be chasing and bottling the last rays of light before an eclipse of uncertain dimension and duration.

Bibliography


Rob Nicholson manages the conservatories of the Smith College Botanic Garden, Northampton, Massachusetts. His article on cutleaf maples appeared in the summer 1997 issue of Arnoldia