NATIVE PLANT SOCIETY OF NORTHEASTERN OHIO

Founding Chapter Of

THE OHIO NATIVE PLANT SOCIETY

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On the Fringe

THE JOURNAL OF THE OHIO NATIVE PLANT SOCIETY

Volume No. 6 **November/December 1988** **Number 6**

JAY W. BESWICK

It is with great regret that we inform you of the loss of long time member, Jay Beswick. Jay was hiking in Hinckley Reservation on Sunday, October 16th and died instantly, surrounded by the glory of Fall and the things to which he had devoted his life. Jay was a widely renowned expert on ferns, and had just finished the text for a fern guide that will be published soon by the Museum of Natural History. The guide will cover the ferns of Northeast Ohio from the Erie Islands to the Pennsylvania border. Jay had collected numerous unusual specimens for the Museum's Herbarium as well as volunteering over 1200 hours in the last three years.

Jay was the first volunteer naturalist with the Cleveland Metro Parks, leading field trips, helping with natural resource planning, trail mapping and planning, and giving lectures. It was said that he had hiked virtually the circumference of the earth, over 23,000 miles. For the Native Plant Society, he had authored articles and led Spring wildflower and fern trips. He was an inspiration to all who knew him, and while he will be sorely missed, he will be remembered with great fondness and respect.

PROGRAMS AND EVENTS:

November 5 (Saturday) **Cleveland Chapter - 5:30 p.m.** - Garden Center. Dr. Kerry Walter, co-director of the Center For Plant Conservation in Jamaica Plain, Massachusetts, will give our Annual Lecture on "RARE AND ENDANGERED PLANTS OF THE UNITED STATES" and discuss the work of the Center. The Annual Dinner will precede the lecture.

November 6 (Sunday) **Dayton Chapter - 1:30 p.m.** - Tour of Sugar Creek Reserve led by Amy Munich of the Dayton-Montgomery County Park District. Meet at the Conference Road parking lot (off Wilmington-Dayton Pike or Ferry Road).

November 11 (Friday) **Cincinnati Chapter - 7:30 p.m.** - Avon Woods Outdoor Education Center, "Arctic Wildflowers", Page Burt, Chairman of Education, Cincinnati Nature Center.

November 14 (Monday) **Athens Chapter - 7:30 p.m.** - Hocking Valley Audubon Society will sponsor an information meeting presented by the Ohio Environmental Council titled "20,000 Leaks under Ohio", concerning the environmental and public health threats of leaking underground storage tanks.

November 19 (Saturday) **Wilderness Center - 2:00 - 4:00 p.m.** - Winter Tree Identification at TWC. Leader, Bob Hawes.

November 21 (Monday) **Dayton Chapter - 1:30 p.m.** - Cox Arboretum. Annual Meeting with carry-in supper. The speaker will be Paul Knoop, Education Director of Aullwood Center. The subject is "A Living Planet".

November 21 (Monday) **Columbus Chapter - 7:30 p.m.** Sharon Woods Metro Park. Metro Park Naturalist Mac Albin from Battelle-Darby Creek will share his multi-media slide show titled "The Edge of Appalachia".

December 4 (Sunday) **Cincinnati Chapter - 3:30 p.m.** - Hardy Souls' Hike, Sharon Woods Gorge, Northern Hills Fellowship, Fleming Road; **6:00 p.m.** - Covered-dish Dinner; **7:15 p.m.** - "The Flowers of the Fells", Cumbria, England, Ruth Brush, CWFPS.

December 12 (Monday) **Athens Chapter - 6:30 p.m.** - Annual Potluck Dinner and Slide Show; members should bring their best slides of backpacking, birdwatching, sightseeing, flower photography.

December 10 (Saturday) **Wilderness Center - 2:00 - 4:00 p.m.** - Field trip to Chagrin Reservation. Leader, Jerry Yoho.

December 17 (Saturday) **Athens Chapter** - Logan Christmas Bird Count, Bill Perine, Compiler.

December 19 (Monday) **Columbus Chapter - 6:30 p.m.** - Sharon Woods Metro Park, Annual Potluck Dinner; **7:30 p.m.** - Lecture by Dr. Charles King of the Ohio Biological Survey who will show slides and discuss the plant "Helianthus roadoplastica".

WHY SHOULD WE SAVE OUR PLANTS? by Robert H. Mohlenbrock

I met Dennis Hardin, botanist for the Florida Natural Areas Inventory (a Nature Conservancy-established natural heritage program), in the quaint town square of Monticello, Florida. Our objective was to try to locate the rare Miccosukee, or Florida, gooseberry (**Ribes echinellum**)--a tiny shrub that the U.S. Fish and Wildlife Service had just added to the federal list of endangered and threatened species. We were soon on our way, traveling over the back roads of Florida's Panhandle toward Lake Miccosukee.

Dennis knew the area well and, as we approached the lake, he turned off onto an abandoned logging road and headed across a heavily cut-over forest that was then growing back into a dense thicket of vegetation. We parked the car and headed off on foot, observing an occasional trillium and a violet or two poking through the underbrush. A short while later, Dennis announced that he had located our first gooseberry. I hurried over to the spot where he was kneeling. We were in further luck: the little plant with maple-like leaves was in full bloom; clusters of greenish-white tubular flowers graced the stem.

Although I was excited about our find, the discovery brought to mind a number of questions. How was this species able to survive the heavy timber cutting of the past when other plants in the area did not fare nearly as well? Why did it survive in Florida on only these few acres and not on adjacent land that seemed to be likely habitat for it? And, finally, how could this same species also occur at solely one other location almost 200 miles away--along Stevens Creek near McCormick, South Carolina?

Since the gooseberry is extant at both its Florida and South Carolina sites, and both areas are being protected (the Stevens Creek habitat was acquired by the Conservancy in 1976), ecologists may now have time to attempt to answer some of the aforementioned questions. In addition, we ultimately will be able to learn whether this uncommon little species may hold utilitarian benefits for humanity. We may even learn the exact role it plays in its ecosystem.

Sophisticated modern technology and the pressures of burgeoning populations are dramatically altering the face of the Earth. As a result, thousands of plant species worldwide that have taken thousands of years to develop their present genetic make-up are threatened with extinction. Many are disappearing without ever being discovered or named, much less studied.

As these species vanish, with them go any potential benefits they may have harbored for **our** species. Indeed, the planet's great diversity of plant life is a literal warehouse for human welfare. Will we continue to watch the destruction of this diversity (most notably that of the tropics) just as we observed unconcerned while the passenger pigeon was slaughtered, the rhinoceros brought to the brink of extinction for its horn, grasslands turned to monocultural crops, forests to lumber, and millions of acres of wilderness to highways and urban sprawl?

In the past only a few voices cried out for conservation of our natural resources. We paid little attention to their warnings. Perhaps the plight of the American bison brought the first realization that the loss of this great symbol of natural America would be an irreversible one.

By 1940 that small spark of environmental fire was fanned when the United States and several other countries in North and South America attended the Pan-American Convention devoted to nature protection and wildlife preservation in the western hemisphere. The governments signing the Pan-American document agreed in principle that they wished to protect and preserve (in their natural habitat) representatives of all species and genera of their nations' native flora and fauna.

The fire began to burn more brightly when the National Environmental Policy Act (NEPA) was signed into law on January 1, 1970. It requires that environmental impact statements be produced for "major federal actions significantly affecting the quality of the human environment." Among its provisions is the stipulation to "preserve important...natural aspects of our natural heritage..." Following this bedrock legislation, the Endangered Species Act of 1973—a model of conservation legislation to be emulated around the world—set up the mechanism whereby plants and animals warranting federal protection could be placed on an official roster of endangered species. Listing of plants began in 1977, after all taxa were reviewed and, as of now, only about 170 of the nearly 2,000 plant species botanists think may actually qualify for protection have been listed. The process is essential but unfortunately slow.

Sparked with the confidence given them by passage of the Endangered Species Act, botanists across the nation are aggressively tackling the problem of plant preservation. And the reasons for saving species are nearly as diverse as the plants themselves.

Today one of the soundest arguments for plant preservation is that it is impossible to know what virtues a plant species may ultimately prove to possess. After all, we have studied only a minuscule percentage of our planet's myriad plant species. Who could have predicted a little more than 50 years ago that a genus of molds with the name **Penicillium** would become a household word for treating various diseases? In recent years the succulent **Aloe vera** has become well known for its juice's ability to promote rapid healing of burns and some skin irritations. A tropical genus of plants called **Rauwolfia** has been found to contain substances that are effective in treating certain disorders of the heart. European scientists have discovered that the oily seeds of certain evening primrose species (**Oenothera**) harbor a nutrient known as gama-linolenic acid—a substance that may play a significant role in curing eczema and arthritis and in preventing coronary heart disease.

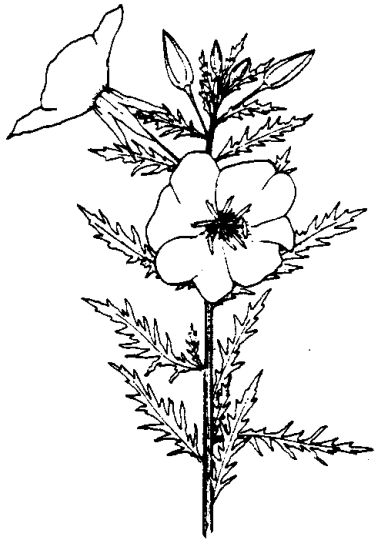
Florida gooseberry (Ribes echinellum)

Experimental botanists have shown us that closely related plants usually have a similar chemical make-up. (In fact, a cadre of plant

taxonomists is working to develop new schemes of classification based on the chemical similarities and differences of plants.) Is it not likely, then, that other molds related to **Penicillium** might also have properties that could alter medical history? Could it be that some of the other 250 species of **Aloe** in the world might have a soothing effect on burns? Until we examine the contents of every member of the dogbane family, to which **Rauwolfia** belongs, can we be certain that no other genera in this family possess similar attributes? The fact is that biologists have not had time to study all the **Penicillium**-related molds, or all the species of Aloe, or all the genera of the dogbane family, or all the evening primroses, to find the answers to these questions.

Because most **Aloe** species grow in the desert—an ecosystem that is being rapidly devastated—it is possible that some of the rarest species in this genus will become extinct before they can be examined. **Rauwolfia** and many of its relatives, on the other hand, live in the tropics, which are being destroyed at the rate of 27 million acres each year. How many species as significant as those of **Rauwolfia** will be eliminated before they can even be classified, let alone studied for human benefits? Several evening primroses (**Oenothera**) have been found to contain gamma-linolenic acid. Might not other species of **Oenothera** be rich in this promising substance? Two possible candidates are the Antioch Dunes evening primrose (**O. deltoides** ssp. **howellii**) and the Eureka Valley evening primrose (**O. avita** ssp. **eurekensis**), both on the federal list of endangered and threatened species. We should make every effort to preserve these plants if only for the potential that may be locked in their chemistry.

Plants with medicinal qualities, however, are but one part of the overall picture. Modern technology is just now beginning to reveal a few secrets that plants hold for agriculture and industry. Some species already are being grown commercially because they yield materials from which plastic and other synthetic substances can be manufactured. For instance, seeds of the jojoba (**Simmondsia chinensis**), a shrub of the American deserts, contain an unsaturated liquid wax that can be used as a substitute for the prized oil of the endangered sperm whale. A decade ago I roamed the Sonoran Desert, paying little attention to the jojobas that grew among the other xerophytic plants. Last summer when I drove from Phoenix to Payson via Highway 87, signs along the roadside warned against molesting the shrubs, which have become increasingly scarce since their oily content was realized. Now under cultivation, the jojoba is benefiting the cosmetics industry, though its oil has many other potential uses.



Antioch Dunes Evening Primrose
Oenothera deltoides ssp. *howellii*

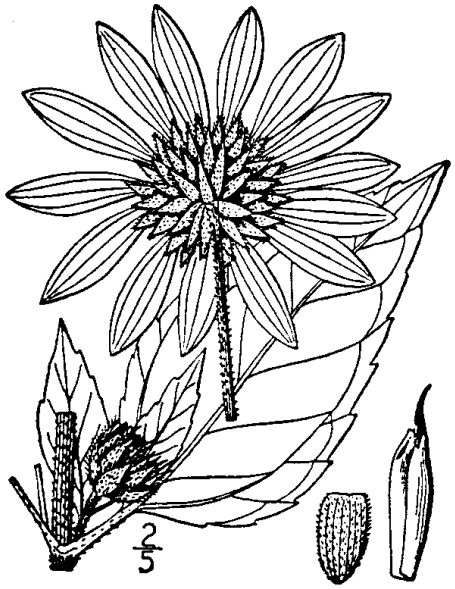
Research is currently underway on

members of the Euphorbiaceae, or spurge family (one of which gives us rubber). The milk-like sap of many of these species contain suspended hydrocarbons that are quite similar to those in petroleum and that could prove very useful in producing gasoline.

Native plant species should not be overlooked as possible sources of food as well. There is growing concern that the world's population is too dependent on only a few plants—species whose genetic diversity is being drastically narrowed through widespread monoculture of single purebred strains. The bulk of our diet is confined to fewer than 20 species of plants, most of them in the grass and legume (bean or pea) families. But what of the other 10,000 species of grasses and 18,000 species of legumes in the world? Might not many of them have potential as a world food crop?

The early settlers of the lands that became Kentucky, Indiana, and Illinois quickly learned that an inconspicuous native leguminous vine, the groundnut (**Apios americana**), had an enlarged subterranean tuber that tasted something like an Irish potato. The plant became a staple in these pioneers' diets when potatoes were not available. Although the groundnut never achieved the popularity of the Irish potato, interest in this wild vine has been renewed, particularly among third-world nations. Michael Woods at Southern Illinois University has undertaken a worldwide study on the taxonomy of the groundnut genus. Scientists from around the world wishing to learn more about the food potential of **Apios americana** frequently write to Woods asking for seeds and roots of the species.

Related to the common groundnut is Price's groundnut (**Apios priceana**), a species the U.S. Fish and Wildlife Service is considering for possible listing as an endangered or threatened species. Originally discovered in 1895 near Bowling Green, Kentucky, by a pioneer botanist, Sadie Price, this handsome flowering vine is restricted to only seven locations in the world. Its potential as a food plant is presently unknown, although it possesses an underground tuber much larger than that of the common groundnut.



Helianthus ánnuus L.
Common Sunflower.

The giant sunflower, **Helianthus annuus,** is a major food oil crop that is grown in many parts of the world. But what about the scores of other sunflower species that are native to the U.S.? How many of them might be used to produce good quality sunflower oil? We may never know the potential of a New Mexico sunflower, **Helianthus praetermissus,** for it may have disappeared from the face of the Earth. Another sunflower, **H. paradoxus** from New Mexico and Texas, is on the verge of extinction. Will we learn of its virtues before it is too late?

Because agricultural practices worldwide are becoming so intensive, plant diseases and

insect pests are becoming increasingly greater problems. As a result, field botanists are always on the lookout for **wild** species whose possibly disease—or pest—resistant genes may be combined with those of cultivated relatives. For instance, wild plant species are an excellent source of root stock for grafting. Cultivated European grapes would have been wiped out long ago (victim of an introduced insect) if the "Old-World" species had not been grafted onto the insect-resistant roots of a wild American grape.

Juglans hindsii, an exceedingly rare native walnut confined in the wild to central California, serves as excellent root stock material because the species is less subject to disease and insect depredation. Shoots of cultivated walnuts grafted onto the Hinds walnut grow into commercially valuable trees that possess the drought, pest, and disease resistance of **Juglans hindsii.**

Among the imperiled plants of the United States are a roster of species that, like domestic azaleas, lilies, and roses, would enhance any garden. Many Hawaiian species, for example—especially those of the mallow family—are exceptionally beautiful. Regrettably, some are known in the wild from only a limited number of individuals. A sedum-like succulent from California's Channel Islands, Trask's dudleya (**Dudleya traskiae**), or Santa Barbara Island liveforever, could serve as an ideal ornamental groundcover. It is federally listed and protected as an endangered species.

Ironically, it is the potential use of many species as lawn or garden adornments that has placed them in jeopardy. Entire colonies of cacti in particular have been removed from the wild to be brought into cultivation. Moreover, many of these species cannot survive the transplantation. If propagation of rare and endangered plants is to be pursued, it should be done from seeds and not from wholesale digging of species in their natural habitats. The Center for Plant Conservation in Jamaica Plain, Massachusetts, is coordinating the growing of endangered species from seed at 19 botanical gardens around the country.

Besides the direct economic benefits that wild plants provide, one must consider their broader ecological roles. Along with animals and microorganisms, plants work together in nature through complicated interrelationships. Thus the disruption or removal of any one component of an ecosystem may have an adverse chain reaction that will affect countless organisms throughout the ecosystem. How much the loss of one species of legume that possesses nitrogen-fixing bacteria in its root nodules will have on the balance of nutrients in an ecosystem is not known. Nonetheless, it is safe to say that the impact would be felt by one or more organisms (some perhaps rare) in the habitat. In the Uinta Basin of eastern Utah, the uncommon showy milk vetch (**Astragalus detritalis**) is one of the few leguminous plants that grows in the oil-rich shale covering the basin. If the milk vetch were eliminated, would the loss of nitrogen held by its roots affect other rare species in the surrounding habitat? The fact that we cannot definitely say "no" is reason enough for preserving the showy milk vetch.

Every species whether common or endangered in an ecosystem has a vital role to play in the web of life. Each contains a unique set of genetic material—material that has been developing over eons of time—which it alone

possesses. If a species is lost, neither it nor its genes can ever be regained or reduplicated.

Biologists maintain that a rich diversity of species ensures a healthy ecosystem because all the principal players are present to carry out their functions in providing for a natural balanced environment. Thus, as we progressively simplify Earth's ecosystems by destroying habitats for wild species and by producing only traditional strains of crops with little genetic variability, we are increasing the instability of entire ecosystems. In 1980 Alastair Gunn pleaded that we should maintain rich and diverse ecosystems in order to avoid the possibility of large-scale ecological collapse.

An additional argument for plant preservation is that we need to save species to enrich the lives of future generations, just as those plants and animals enrich our lives. I for one hope that the people of coming centuries can delight in seeing the small whorled pogonia orchid (**Isotria medeoloides**) growing in its natural habitat, as I did. I would like to have seen the spurless blue columbine growing along the Mancos River in Colorado, as Alice Eastwood did in 1892. Unfortunately, my predecessors did not leave me that opportunity.

There is yet another justification for species preservation, one that goes beyond the aesthetic, economic, or ecological value of plants and animals. We are morally obliged to coexist with and to help sustain other forms of life, be they the most spectacular animals and strikingly beautiful plants, or some seemingly insignificant organism. **Thismia americana** is a minute non-green flowering plant that was found in south Chicago from 1912 to 1914 and has not been seen since. The fact that it existed at one time should have made us want to keep it alive. I would have liked that.

Robert H. Mohlenbrock is Distinguished Professor at Southern Illinois University, Carbondale, where he has taught in the Dept. of Botany since 1957. In addition to being a monthly columnist for **Natural History**, he has published 32 books and nearly 300 scientific and popular articles. His most recent book is **Wildflowers: A Macmillan Field Guide.** Professor Mohlenbrock is chairman of the North American Plant Specialists Group of the Species Survival Commission of the International Union for the Conservation of Nature (IUCN).

This article is a reprint from **The Nature Conservancy Magazine,** November/December 1987.

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NOTICE ON NEWSLETTER SUBSCRIPTIONS FOR STATE MEMBERS

If you wish a subscription to "On The Fringe" they are available at the rate of $7.50 per year. Send your check made payable to: Native Plant Society, 6 Louise Drive, Chagrin Falls, Ohio 44022

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NATIVE PLANTS AND THE NURSERY TRADE by Jane Scott

The horror stories abound. A man in North Carolina peddles wild pink lady's-slippers. **Cypripedium acaule,** from the back of a pickup truck. A Texas nursery pays Mexican workers a nickel a plant to collect wild cacti from the Chihuahuan Desert. An exhibitor at a large flower show mentions in passing that he is sending a truck out to collect **Helonias bullata. H. bullata,** commonly called swamp pink, is a bog-loving member of the lily family, and is listed on the federal Register as a candidate for Threatened or Endangered status. At a commercial booth at the same flower show, a botanist finds a rare species of peyote, **Lophophora williamsii.** It is mislabeled, pershaps because it is illegal. (Peyote contains hallucinogen that is included on the Food and Drug Administration's schedule of controlled substances.) This particular specimen is well over 100 years old, yet forms a cushion that measures only $3\frac{1}{2}$ inches across.

Of course, not all nurseries are guilty of such blatant plant rustling. Yet the fact remains that a sizeable portion of the native North American species offered for sale through nurseries have been collected from the wild. Native plant nurseries acquire plants in three ways: they propagate them from seeds and stock plants obtained from a variety of sources; they dig plants from the wild and sell them "as is"; or they buy plants from wholesalers, who may or may not have collected them from the wild. Thus, even a nurseryman who does not "wild collect" himself may buy from suppliers who do.

What impact does all this digging actually have on wild plant populations? In the case of woodland plants, many nurserymen claim that removing a few plants here and there does no permanent harm, because they are not taking endangered species, but rather plants that are abundant in the wild.

If the collector owns the land where the plants are growing, or has an agreement with the landowner, it is true that the digging can be regulated so as not to deplete the wild population. This is especially true if some of the plants that are taken are used as breeding stock (unless, of course, the demand far exceeds the supply). However, few suppliers of native plants have such control over their sources. Many "suppliers" turn out to be local residents in choice areas who are paid so much per plant by wholesalers. All too often, the plants are simply stolen from public or private land as the opportunity arises. Choice sites are dug over repeatedly, and the populations of popular species in these areas soon disappear, forcing the collectors to move farther and farther afield. Yet, according to William Brumback of the New England Wild Flower Society, each population of a species is important to the survival of the entire species, especially because so much of our native flora is threatened by the continued destruction of habitat by man and his activities.

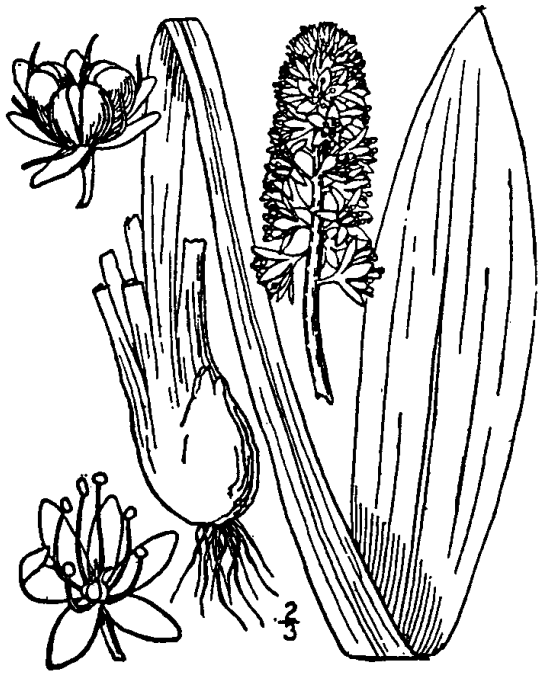
The germ plasm represented by each population of a species contributes to the genetic wealth of the entire species. The genetic diversity found in naturally occurring populations of a species provides evolutionary potential, thereby making it possible for the species to survive unexpected changes in the environment. When the number and the range of individual populations decrease, the loss of genetic

diversity limits the potential for variation and may eventually threaten the continued existence of the entire species. Often, when the number of individuals within a population falls below a critical number (called the genetic minimum) further decline is inevitable.

Cultivated varieties, both by design and by default, often have a different genetic constitution than do their wild parents. They may no longer be able to survive in their original habitat, or they may harbor hidden genetic weaknesses that make them vulnerable to environmental stress, such as insect attacks or disease. Because of their genetic uniformity, cultivars have less evolutionary potential. (The original wild species is the only source of new genes that can improve or restore both wild populations and garden ones.)

Taking "a few plants here and there" not only has long-term genetic consequences, but also reaches alarming proportions in some sections of the country. It has been estimated that well over 100,000 herbaceous plants are removed from the mountains of North Carolina and Tennessee every year. Harry Phillips, the propagator at the North Carolina Botanical Garden believes this number has remained constant, even though many younger nurserymen are now propagating their stock, because the older nurseries continue to dig as they always have. Over the years, this digging has exacted a significant toll. In many parts of North Carolina, the pickings of choice species are now so slim that collectors have moved into Tennessee.

In Arizona and New Mexico, the notorious cactus rustling that drove as much as 29 percent of our native-American cacti species to the brink of extinction has been slowed to some extent by legislation.



HELÒNIAS

However, in Texas, collectors are still digging cacti such as **Echinocereus, Mammillaria, Epithelantha, Echinocactus** and **Ariocarpus** by the thousands. Sometimes the excess plants are simply left to rot after being uprooted. Wild Mexican cacti also come through Texas, according to Douglas Fuller of the World Wildlife Fund. Growers on both sides of the border are involved in the Mexican bribery system known as "La Mordida" ("The Bite"), despite the existence of an international treaty that is supposed to regulate trade.

Sad to say, it is horticulturists who are partially to blame for this pressure to collect. The number of species plants collected from the wild rises—and falls—according to the demand we gardeners place on nurseries. (By species plants, I mean plants that are not

cultivars or hybrids that have been specifically developed for garden use. Such "man-made" hybrids and cultivars must be horticulturally propagated.) Obviously, much of the demand is created by the nurseries themselves, through catalogue advertisements and flower show exhibits. However, this demand is abetted by enthusiastic articles in horticultural publications detailing gardeners' success with this native species or that. Clearly, it is our urgent responsibility as gardeners to seek out reputable nurseries who do their own propagating or purchase from nurseries who do so. We must also learn to make intelligent decisions based on a knowledge of the plants themselves so that we can avoid purchasing plants that were probably collected in the wild.

In the case of woodland plants, keep in mind that monocots (those flowering plants that generally have flower parts in multiples of three, strap-like leaves and parallel veins) are harder for nurseries to propagate than are dicots. The woodland species most vulnerable to digging for commercial sale are members of two monocot families: the orchids, Orchidaceae, and the lilies, Liliaceae. Members of both the iris family, or Iridaceae, and the gentians, or Gentianaceae (a dicot family), follow close behind, according to Paul Wiegman, Director of the Natural Areas Program for the Western Pennsylvania Conservancy.

Native terrestrial orchids are especially threatened by wild collecting, and most botanists seem to agree that inexperienced gardeners should not attempt to grow these plants. The reason is simple: terrestrial orchids have never been propagated successfully in the quantities necessary for commercial trade, so plants offered for sale have probably been dug from the wild. Nevertheless, orchids such as the lady's-slippers, **Cypripedium** spp., continue to be advertised widely. To buy one is to contribute to the species' unnecessary destruction in the wild.

Kalmia latifòlia

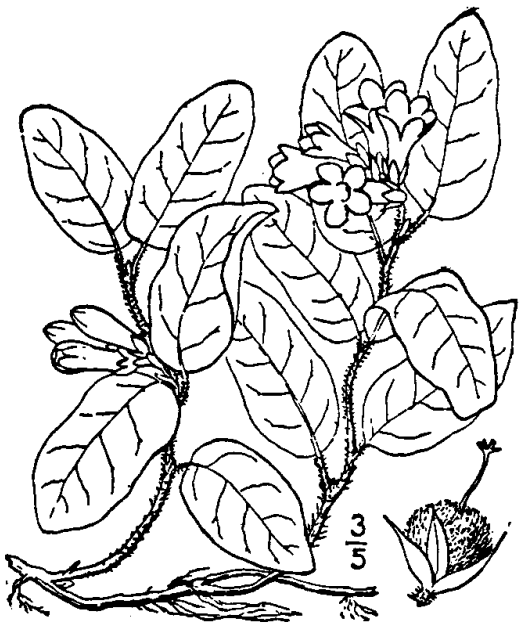
Furthermore, collected plants usually do not survive in the garden for more than a few seasons, if at all. Lady's-slippers, like most terrestrial orchids, depend on the presence of a group of fungi found in acid soils, called **mycorrhizae**, which live symbiotically with the plants' roots. For the orchid to survive, both its needs and those of the fungi must be met, a very difficult assignment. Research is being done on propagating terrestrials by asceptic seed culture (a method used for tropical orchids), but so far, supplies of plants propagated in this way are almost nonexistent.

Lilies are also threatened by collectors. The lily family includes such popular woodland plants as **Trillium**, trout lilies or dog-tooth violets (**Erythronium** spp.), Solomon's-seal (**Polygonatum biflorum**), bellworts (**Uvularia** spp.) and wild hyacinth (**Camassia scilloides**). Many are dug in great quantities, principally

because they are extremely slow to propagate from seed. For example, the seed of white trillium, **Trillium grandiflorum**, takes at least two years to germinate, and up to 10 years may pass before the plant reaches blooming size. It is no wonder, then, that these plants have been over-collected for generations; it simply makes no economic sense for nurseries to propagate them from seed. Sometimes mature plnats can be divided, but division is too slow a process when one needs a supply of thousands.

Tissue culture (the technique of reproducing plants in quantity from a small piece of meristem tissue) may relieve the commerical pressure on such plants in the future, but it still requires highly specialized skills and facilities. It is important to remember that tissue culture, although useful for producing plants for the gardening public, is like any kind of vegetative propagation, that is, it reproduces the parent plant's exact genetic make-up. Thus, although it can be used to produce plants that will help satisfy gardeners' demand for plant species, it is of little value in preserving the full genetic diversity necessary for survival in the wild. This technique can be helpful in rescuing a species in imminent danger of extinction.

Carnivorous plants and cacti also continue to be seriously threatened by commercial trade. Carnivorous plants grow in the wet, acidic soil of bogs and are generally of more interest to plant collectors than to gardeners. Ironically, when a plant such as **Trillium grandiflorum** is sold for less than a dollar, it has probably been collected in the wild. In the case of carnivorous plants, this "price clue" works the opposite way. According to Rob Sutter of the Plant Conservation Program of the North Carolina Department of Agriculture, collectors may pay $25 to $50 for an endangered species of pitcher plant that has been illegally dug, even though the same plant can be propagated and sold for about three dollars. In addition, the propagated plant is already adapted to cultivation and is far more likely to survive.



Epigaea rèpens L. Trailing Àrbutus.

The wild populations of Venus's-flytrap, **Dionaea muscipula**, are protected by law, but they, too, continue to fall prey to unscrupulous collecting--in spite of the fact that they also can be easily grown from seed. (It is worth noting that Venus's-flytrap is a native of temperate climates and does not usually thrive in heated houses.)

Recently, a Delaware botanist had a guest from Texas who, quite unknowingly, brought him a wild specimen of an endangered species of cactus, **Coryphanta minima**, as a house present. Fortunately, the World Wildlife Fund reports tighter trade restrictions are beginning to relieve the pressures on cacti by stimulating growers to select and propagate desirable species. These growers are permitted to select and propagate desirable

species. These growers are permitted to collect breeding stock from the wild, and many of the young cacti now for sale in supermarkets and specialty shops have been grown from seed or offsets. However, buyers should view mature cactus plants, such as those used for landscaping, with suspicion. In Arizona, it has been illegal to remove such plants from the desert without a permit since 1976, but enforcement is difficult, and other states are not so careful. Mexican cacti continue to be dug in alarming quantities, and many of these plants come through Texas, despite the efforts of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), as well as a Mexican decree banning export of cacti for commercial purposes.

In general, native woody plants are less likely to be dug from the wild than herbaceous plants, because they are usually propagated from cuttings. Plants of the Ericaceae, or heath family, are the exception. Ericaceous plants include (among others) native azaleas, mountain laurel and trailing arbutus (**Epigaea repens**), a species that has been virtually eradicated in many of its former sites because of over-collecting. Mountain laurel, **Kalmia latifolia**, is dug out of the southern Appalachians by the truckload because it roots so poorly from cuttings. Nurserymen take seedling plants and grow them in containers, or they cut down a mature plant and let it come back from the roots. Fortunately, tissue culture propagation has proven to be an effective technique for mountain laurel, and selected cultivars are now beginning to appear in trade. (For more information on the new mountain laurel cultivars, see "A New Look at Mountain Laurel," by Ruby Weinberg, in the June 1984 issue of American Horticulturist.)

Native ferns of all species are also dug for commercial sale, since their propagation is slow. Fern spores must first develop into a tiny plant called a prothallus before fertilization can take place and the true fern can grow. Some fern species are not only widespread and persistent in the wild, but easily propagated by division. Others, however, are more vulnerable. Fern fanciers should learn the differences between the various species before buying plants for their collections.

The Mount Cuba Center for the Study of Piedmont Flora is concerned with selecting attractive cultivars of native flora that can eventually be introduced into the nursery trade. (Ease of propagation is one important factor in the selection process.) The Director of Mount Cuba, Dr. Richard Lighty, offers several suggestions for gardeners who want to grow native plants without harming wild populations.

First, he warns that nurseries often dig even those woodland species that are easy to propagate, because so many of these plants produce relatively few seeds. Also, the seeds of these species usually require complex treatment before they will germinate, a process that is not always economically feasible. Therefore, Dr. Lighty (as well as both Hal Bruce of Winterthur Gardens and Harry Phillips of the North Carolina Botanical Garden) suggests that we gardeners move out of the woods and into the meadows when selecting native plants for our gardens. For instance, many species in the aster family (Compositae) are easy to grow from seed, and cultivars have been selected and propagated specifically for garden use.

In fact, cultivars of Joe-pye weed (**Eupatorium**), black-eyed Susans and goldenrod (**Solidago**) can all be found in English and German gardens, where they add a touch of elegance and sophistication. The pea family (**Leguminosae**), the snapdragon family (**Scrophulariaceae**) and the evening primrose family (**Onagraceae**) also include many species that are appropriate for garden use. When grown under ideal conditions, many of these field flowers develop into handsome specimen plants.

In addition, Dr. Lighty suggests that gardeners leave rare plants alone, unless they are certain that the plant they are buying has been propagated by a nursery and that wild plants are not necessary to maintain the supply. Gardeners should select only those species that are suited to their growing area, and should choose named cultivars whenever possible. (Named cultivars of wild plants usually must be propagated vegetatively.) If cultivars do not exist, Dr. Lighty suggests buying a maximum of one to three plants and dividing them. This technique is often successful if the gardener replants the divisions immediately in a permanent location. Propagation by division is preferable to buying large orders of plants that were obviously dug and that may arrive so dried out and under stress that few will survive.

In garden centers, the discriminating gardener can often spot a collected plant. Any plant that appears to have been recently potted—with leaves askew and not oriented as they would be in nature—is suspect. Ordering through the mail presents a more difficult problem. Botanists and others have suggested setting up a national referral system that would list commercially propagated plants in nursery catalogues and on plant labels. Until then, gardeners should use price-charged as a key, avoid plants that are known to be difficult to propagate, and, if in doubt, ask the nurseryman where the plants originated. In 1984, the New England Wild Flower Society asked 430 North Amiercan nurseries to list the percentage of their stock that was collected from the wild (as opposed to stock that was propagated on the premises or bought from wholesalers). The responses of 193 nurseries have been published in a booklet available to the public.

Since 1980, North Carolina has had a law making it illegal to trade in those species that have been officially deemed most in need of protection. Any nursery selling one or more of these species must certify that the plants have been horticulturally propagated and that the nursery's supply is not dependent on wild plants. Eventually, there may be an entire network of certified nurseries that would have to meet certain propagation requirements before dealing in any native species. The public would then be urged to buy native plants only from those nurseries.

Inevitably, the question of "plant rescue" or "salvage" comes up whenever gardeners talk about growing native plants. First, gardeners must understand that "salvage" does **not** mean rushing to a site about to be destroyed by a bulldozer and digging up plants to take home to private gardens. This form of rescue may be permissable for the more common species, but the sad fact is that no private garden in a country with as mobile a population as ours can be considered a safe haven for rare plants. In addition, too often gardeners take such action at the wrong time of year or without a full understanding of the facts. Consider the case of

the yellow lady's-slippers, **Cypripedium calceolus,** that were "rescued" from a piece of property about to be developed near Pittsburgh. Actually, there was no plan to build on the exact spot where the lady's-slippers grew, but by the time this fact became clear, the lady's-slippers were lost.

Nevertheless, plant salvage is appropriate in certain situations. Horticulturists can take credit for the survival of plants such as franklinia (**Franklinia alatamaha**) that would otherwise be extinct. Plants that have been legitimately salvaged can often be used for breeding stock, and the more common species can be incorporated into nature trails. However, only experts who are trying to help the species survive in the wild should attempt to salvage rare and endangered plants. Sometimes this kind of action involves moving the plants to a botanical garden for study, but saving plant populations by growing them in botanical gardens is, in the end, no more satisfactory than trying to save wild animals by keeping them in zoos. Botanists agree that a wild species usually disappears because its habitat has been destroyed, although indiscriminate collecting can also push a vulnerable species over the edge. Therefore, the best way to save rare plants is to preserve their natural habitats in sufficient quantity and diversity so that native populations can continue to reproduce without being disturbed. A good source of horticuturally propagated plants can help diminish collecting pressures.

The Endangered Species Act of 1973 is a landmark piece of legislation that reflects the public's interest in preserving America's wildlife, plants as well as animals. However, complex requirements must be met and detailed studies made before a plant can be listed as officially Threatened or Endangered. As a result, only a small fraction of the number of species that need attention have been listed. In the meantime, many states have already taken steps to protect these species.

In addition, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has compiled a list of species that are already seriously threatened by trade (CITES Appendix I), as well as of species that might become threatened if trade is not monitored and controlled (CITES Appendix II). All members of the orchid family are listed in Appendix I, and all North and South American cacti are currently included in Appendix II. Also included in Appendix II are such horticultural favorites as **Shortia galacifolia** and **Cyclamen** species. Various cycads and species of **Aloe** are listed in both Appendix I and II. Obviously, all horticulturists would benefit by becoming familiar with both the Endangered Species and CITES lists.

Thanks to the botanists working with The Nature Conservancy, state agencies, federal agencies such as the U.S. Fish and Wildlife Service, and universities and botanical gardens throughout the country, our national store of botanical knowledge has increased dramatically since the passage of the Endangered Species Act in 1973. Even so, much more needs to be done. One particularly encouraging development has been the formation of native plant societies in several states. Many members of these societies have become expert advocates on behalf of their local flora. Joining or starting one of these societies—or working with a local garden club conservation committee—is a good way for gardeners to become involved in the preservation of native plants.

The American Horticultural Society has joined the movement to educate gardeners about native plants and the threats they face. In 1984, AHS took over the Wildflower Rediscovery Project and publication of the **Endangered Wildflowers Calendar** from the Rare and Endangered Native Plant Exchange. Both the Calendar and the Wildflower Rediscovery Project focus on stimulating public knowledge of and concern for rare plants.

Although many of the wild-collected species sold in the nursery trade today are not yet on the list of Endangered and Threatened species, it is inevitable that they will one day be added if collecting pressures continue unabated. As gardeners, we have a responsibility to see that such action is never necessary.

Jane Scott is the author and illustrator of **Botany in the Field, An Introduction to Plant Communities for the Amateur Naturalist,** published by Prentice-Hall, and co-author of **Grow Native Shrubs in Your Garden,** published by the Brandywine Conservancy in Chadds Ford, Pennsylvania.

* * * * *

PLANTS THAT SHOULD NEVER BE BOUGHT FROM NUSERIES:

We do not know how to propagate them in commercial quantities and they rarely do well in gardens.

Cypripedium spp. - Lady's slippers
Isotria spp. - Whorled Pogonia
Platanthera (Habenaria) - Fringed orchis and allies
Aureolaria - Wild Foxglove

PLANTS ALMOST ALWAYS COLLECTED IN THE WILD EVEN THOUGH SOME CAN BE PROPAGATED BY SPECIALISTS:

Arisaema triphyllum - Jack in the Pulpit
Dicentra cucullaria - Dutchman's Breeches
Iris cristata - Crested Iris
Sanguinaria canadensis - Bloodroot (NOTE: S. canadensis 'Multiplex' is okay as it must be propagated)
Trillium grandiflorum - White trillium

PLANTS THAT ARE OFTEN COLLECTED EVEN THOUGH THEY CAN BE PROPAGATED IN COMMERCIAL QUANTITIES: Evidence of nursery propagation should be demonstrated before buying.

Cimcifuga spp. - Snake root or Fairy candles
Dodecatheon spp - Shooting Stars
Erythronium spp. - Trout lilies
Hepatica spp.
Mertensia virginica - Virginia Bluebells
Viola pedata - Bird's-foot violet

PLANTS THAT CAN BE WILD-COLLECTED MORE CHEAPLY THAN THEY CAN BE NURSERY GROWN: Again, evidence of nursery propagation should be demonstrated before buying:

Helonias bullata - Swamp Pink
Chamaelirium luteum - Devil's Bit
Uvularia grandiflora - Large Flowered Bellwort

Dr. Lighty stresses that gardeners look at the reasons behind these lists, that is, that sun-loving meadow plants (members of the Composite Family and others) tend to produce lots of seed that is easily germinated. Therefore, there is no reason to dig them. Woodland plants, and those that are strict cultural requirements that are not easy to meet, for nurserymen as well as gardeners, and are usually dug.

Also, readers should look for tell-tale signs that a plant has been dug from the wild. These include roots that have been pressed into the pot every which way, differences between the soil in the pot and that clinging to the roots and leaves that are skewered and irregular.

The previous information comes from Faith Campbell of the Natural Resources Defense Council, 1350 New York Avenue, NW, Washington, D.C. 20005, and Dr. Richard W. Lighty, Director, The Mount Cuba Center for Piedmont Flora, P.O. Box 3570, Greenville, DE 19807-0570.

* * * * *

WHERE TO WRITE FOR PLANT CONSERVATION INFORMATION

Many different organizations are involved in the fight to save this country's rare and endangered native plants. The following is a partial list of some of the national organizations. For more information on their programs, please write to them at the addresses listed below.

° The American Horticultural Society, P.O. Box 0105, Mount Vernon, VA 22121. Through publication of the **Endangered Wildflowers Calendar**, the American Horticultural Society is working to increase public awareness of the plight of America's native plants. Calendar sales support the Society's Wildflower Rediscovery Project, a program that provides awards to individuals who rediscover populations of species thought to be extinct in the wild.

° The Center For Plant Conservation, The Arnold Arboretum, Harvard University, The Arborway, Jamaica Plain, MA 02130. The Center is a non-profit organization devoted to building a living collection of America's most endangered plants in member botanic gardens across the country. The collection will be used for basic research to determine cultural requirements of individual species and how to care for those plants in the wild, as well as for education and display.

- Environmental Defense Fund, 1616 P Street, NW, Washington, DC 20036. This organization works at both state and federal levels to secure enactment of plant protection laws and ensure their effective implementation.

- Federal Wildlife Permit Office, U.S. Fish and Wildlife Service, 1000 North Glebe Road, Room 611, Arlington, VA 22201. This office issues permits under the Endangered Species Act, as well as other laws, for "removing and reducing to possession," listed plants from lands under federal jurisdiction. It also administers CITES by issuing import and export permits, and issues interstate commerce permits.

- Garden Club of America, 598 Madison Avenue, New York, NY 10022. The GCA strives to educate both its members and general public about endangered native plants through a variety of programs. It has recently co-produced two educational programs on native plant issues: "Roots of Life," in conjunction with the World Wildlife Fund; and "Garland of Generations," produced with the Center for Plant Conservation.

- National Wildflower Research Center, 2600 FM 973 North, Austin, TX 78725. The Center conducts basic research on native and naturalized plants and their cultivation. It also provides information on wildflower projects, programs and research efforts across the country.

- National Council of State Garden Clubs, Operation Wildflower, 4401 Magnolia Avenue, St. Louis, MO 63110. Operation Wildflower is a National Council of State Garden Clubs program dedicated to the beautification of roadsides and other approved sites and to public education about the application, preservation and propagation of our native wildflowers and grasses.

- The Nature Conservancy, 1800 North Kent Street, Arlington, VA 22209. TNC uses a variety of strategies to protect native plants, including acquisition of land by purchase or donation, protection through easements, management agreements and participation in public lands protection.

- Office of Endangered Species, U.S. Fish and Wildlife Service, Washington, DC 20240. The Office of Endangered Species evaluates taxa of both plants and animals to decide which ones should be included on the federal list of Endangered and Threatened Species. After a taxon has been listed, the Office consults with federal agencies regarding the taxon, carries out recovery actions, and works with states, private groups and individuals.

In addition to general brochures on endangered species, the Office of Endangered Species publishes **Endangered and Threatened Wildlife and Plants** (the current edition was published January 1, 1986; 50 CFR17.11 and 17.12) and **Endangered and Threatened Wildlife and Plants; Review of Plant Taxa for Listing as Endangered or Threatened Species; Notice of Review** (50 CFR part 17). Both publications are available free of charge. To order, write the Publications Unit, 148 Matomic, U.S. Fish and Wildlife Service, Washington, DC 20240.

° Plant Conservation Project, Natural Resources Defense Council, 1350 New York Avenue, NW, Washington, DC 20005. NRDC monitors horticultural trade in wild plants, and works to improve legal protection for rare species in the trade. The Council also actively supports the enactment of plant-related legislation and oversees their effective implementation.

° TRAFFIC (USA), World Wildlife Fund US, 1601 Connecticut Avenue, NW, Washington, DC 20009. TRAFFIC (USA) monitors trade in endangered species and CITES-listed species. This organization has publications on a variety of trade-related topics and also publishes a newsletter, **TRAFFIC** (USA).

Native Plant Societies:

Gardeners who would like to join a native plant society in their state will want to write for the New England Wild Flower Society's list of native plant societies and botanical organizations. The list, which is under constant revision, is available for $1.00, including postage and handling. To order, write the New England Wild Flower Society, Inc., Garden in the Woods, Hemenway Road, Framingham, MA 01701.

Nursery sources for Native Plants:

For a list of nurseries that propagate their own plants, readers can request: "Nursery Sources for Native Plants" from the American Horticultural Society, P.O. Box 0105, Mount Vernon, VA 22121.

The New England Wild Flower Society's publication, **Nursery Sources: Native Plants and Wild Flowers,** is a summary of the Society's 1984 survey of 430 nurseries that deal in native plants. The booklet lists each nursery's answers to questions about stock source (percentage of stock that is propagated, wild-collected and purchased from unknown sources), wild orchid source, stock type (seed, herbaceous, trees or shrubs and grasses), and nursery type (retail, wholesale or mail order). **Nursery Sources** is available for $3.50, including postage and handling, from the New England Wild Flower Society, Inc., Garden in the Woods, Hemenway Road, Framingham, MA 01701.

Native Plants Book List:

The American Horticultural Society has prepared an annotated list of books on native plant topics. The list includes field guides as well as books on both gardening with native plants and environmental issues. All of these publications are available to Society members at AHS member prices. To order the free "Native Plants Book List" write to the American Horticultural Society, P.O. Box 0105, Mount Vernon, VA 22121.

HOW PLANTS FIGHT BACK by Mary Batten

Like a ravenous dark cloud, millions of migrating adult locusts descend on Africa's farmland each year; devouring the crops in their path. Corn, rice and sugarcane are reduced to leafless stalks in field after field. But in the midst of the devastation a few plants stand out conspicuously, healthy and green, little touched by the insect swarms.

These green survivors are dramatic proof of what scientists are increasingly discovering: that plants are about as defenseless as Attila the Hun. Far from being passive victims, many plants wield a potent arsenal of chemical weapons to ward off voracious insects, grazing mammals, diseases and even other plants.

Scientists have now identified more than 10,000 chemicals deployed by plants in the struggle for survival. Some of these substances are remarkably effective, protecting their possessors from a whole host of enemies, while others have been effectively neutralized by insects and herbivores over the course of evolution.

As researchers begin to understand this unseen world of chemical thrust and parry, they are discovering how useful plant defenses can be to people. "Many poisons that we know about and almost all medicines that we know about are plant substances which probably at some stage have served as chemical defenses," says botanist Robert Dressler, orchid expert with both the Florida State Museum in Gainesville and the Smithsonian Tropical Research Institute in Panama.

So far, this rich chemical reservoir has barely been tapped. But efforts now underway to collect, analyze and test thousands of species of plants could significantly affect both the pesticide and the pharmaceutical industries, leading to better drugs and safer pesticides.

"The plant world is not colored green," writes ecologist Daniel Janzen of the University of Pennsylvania. "It is colored morphine, caffeine, nicotine, tannin, phenol, terpene, canavanine, latex, oxalic acid, saponin, L-dopa, etc."

The plant that can survive locust infestations provides a good example of the potential still to be unlocked. The story began in 1974 when Berkeley chemist Isao Kubo visited Africa to study desert locusts, the worst crop pests in East Africa. When Kubo arrived at the border between Somalia and Kenya, he was too late to see the swarming adults, but he saw something more significant. In the midst of the dead fields one species of plant remained lush and green. That plant was a type of grass, **Ajuga remota.** Kubo, who learned from African witch doctors that infusions made from the plant's leaves were used to treat everything from malaria to dysentery, was intrigued.

Taking specimens back to his laboratory for analysis, Kubo discovered that the species contains substances virtually identical to key insect hormones within the bodies of insect larvae. During normal development, insect larvae release these hormones when it is time to molt--shed an old skin and grow a new one.

When insect larvae feed on the plants, however, they receive powerful doses of the hormone-mimicking plant chemicals. The substances in **Ajuga remota**, for example, are five times more potent than the natural insect hormones. The chemicals disrupt the molting process, causing gross deformities.

When Kubo fed the plants to two major cotton pests, pink bollworm larvae and fall army worm larvae, each insect became unable to completely shed its hard external skin, or cuticle, every time it molted. Eventually each larvae was saddled with up to three unshed cuticular head capsules, all stuck together. The unshed cuticle covered the insects' mouths and prevented them from eating. Within 96 hours, the insects died of starvation.

Because of these chemicals, Kubo believes, locusts either learn to avoid **Ajuga remota**, or are unable to eat enough leaves to kill the plants. The same substances, he says, may be responsible for the plant's medicinal properties.

Some plants employ different chemical strategies. Orchids, for example, produce needlelike crystals of calcium oxalate, the material that makes kidney stones in human beings. The crystals probably make orchids taste bad to insects and may have physical effects as well. Bracken fern, black cherry and a variety of other plants manufacture cyanide, which is poisonous to most insects.

"When an animal takes a bite out of a plant, it is gustatorily and digestively treading on a battlefield implanted and strewn with traits generated by natural selection during millions of years of acts of herbivory," says Janzen, who has probably done more than anyone else to make people aware of the evolutionary battle between plants and the creatures that feed on them.

The chemical weapons of plants, however, may sometimes backfire. Oak leaves produce substances called tannins that successfully slow the growth of gypsy moth caterpillars, a major pest. But the tannins also have an unfortunate side effect; they help protect the caterpillars from a deadly virus. As a result, the chemicals actually increase the gypsy moth population and the damage caused by the insects. In addition, many predators have evolved mechanisms for detoxifying the poisons in plants.

Discovering such relationships is a key step towards understanding cycles of pest infestations and other ecological phenomena. The interactions, however, are complicated by an additional factor; many plants are actually able to manufacture defensive chemicals in response to attacks by insects and other enemies.

"When a potato or tomato leaf is crushed or chewed by an insect, it releases a wound hormone into the plant's vascular system," explains biochemist Clarence Ryan of Washington State University, who uncovered the basic phenomenon back in 1971.

The wound hormone is carried throughout the plant, triggering the production of chemicals called "antinutrients" that block digestive enzymes in an insect's gut. The insect then has great difficulty digesting the plant it is trying to eat.

Ryan found that after an insect attack, a potato or tomato plant will continue

to accumulate these substances for up to two or three days. But if insects continue to feed on a plant, "it really goes into high gear," says Ryan. "It will release more hormone and accumulate antinutrients as long as it's being attacked."

Some experiments suggest that attacked plants even "warn" nearby plants to produce defense chemicals. When Ian Baldwin of Cornell and Jack Schultz of Penn State defoliated sugar maple seedlings, they discovered that both the damaged trees—and nearby undamaged trees—increased their levels of protective chemicals. Schultz believes that some sort of wound hormone from attacked plants may waft through the air and stimulate the defenses of plants that have yet to come under siege. Recent research at Stanford and UCLA shows that ethylene, a gaseous chemical, could carry the "signal." "Plants are both producing and responding to ethylene," says Schultz.

While many scientists are skeptical about chemical communication among plants, Schultz, Ryan and others suspect that the basic ability to make chemicals in response to attack may be universal among plants. Ryan has found the system operating in alfalfa and believes that it occurs in most other crop plants.

Recently Ryan and his colleagues identified the genes that control the production of defensive substances in response to the wound hormone. He is now removing these genes from alfalfa and potato plants and putting them into tobacco plants. With these experiments, Ryan is laying the groundwork for future technology that could genetically alter crop plants to make them resistant to specific pests. "We're on the threshold of a whole new approach," says Ryan.

Crops that are genetically engineered to resist pests are still years away. But commercially used pesticides created from extracts of plants' defensive chemicals are becoming a reality. Perhaps the most promising candidate comes from the neem tree of India.

For centuries Indians have revered this tree and used its leaves, bark and seeds to treat everything from tuberculosis and snake bite to warts and diabetes. In addition, the tree is remarkably resistant to insect attack—and its seed extract has been effectively used as a mosquito repellant.

Scientists are now uncovering some of the neem tree's secrets. After an Indian woman told him that she kept locusts out of her garden by squeezing sap out of neem fruits onto her plants, natural products chemist Koji Nakanishi of Columbia University isolated the plant's active substance, a chemical called azadirachtin.

Nakanishi then discovered that the substance is effective not only against locusts, but also against army worms, spruce budworms and other pests. When forced to eat leaves treated with azadirachtin, tobacco budworms and corn earworms grew two heads or developed other deformities while molting.

Work on neem is now proceeding in a number of countries. So far, more than 60 types of insects, including houseflies, aphids and tobacco caterpillars, have been studied and found to be repelled by chemicals from the plant's seeds. And through

the efforts of Robert Larson, president of Vikwood Ltd. in Wisconsin, an extract from the neem tree is being marketed as an EPA-approved insecticide for non-food crops.

While plants produce defensive substances in order to kill, maim or otherwise repel their enemies, a small but significant number of these chemical weapons have a very different side effect—the ability to heal. Traditional medicine men and witch doctors have long known that many plants make potent medicines, and western scientists have gradually caught on. Over the last 25 years, researchers have isolated such valuable drugs as vincristine, used to treat childhood leukemia, from Madagascar's rosy periwinkle; digitalis, a heart stimulant, from foxglove; and etoposide, used to treat lung cancer, from the American mayapple.

Now scientists from dozens of universities and laboratories are rushing to the tropics to collect potentially useful plants, often relying on advice from local healers. Berkeley chemist Isao Kubo learned Swahili in order to talk with African witch doctors. With the help of the Bwana Mganga (Swahili for medicine men), he collected some two hundred potentially useful East African plants.

A more ambitious effort is underway at the National Cancer Institute. To search for anti-tumor drugs, the institute has contracted with the New York Botanical Garden, the University of Illinois and the Missouri Botanical Garden to collect 10,000 plants from the tropical forests of South America, Southeast Asia and Africa. As the plants are gathered, researchers at the institute will test extracts from leaves, bark, roots and stems for anti-cancer properties.

There is a special urgency to this project and others like it because tropical forests are disappearing before their chemical potential can be tapped. "We need to know more about tropical plants," says Gerrit de Boer of the University of Kansas. Much of the chemically useful flora comes from the tropics, de Boer explains. In addition to having to defend themselves against many predators, these plants also have a year-round growing season, providing more time to develop a chemical arsenal. The hope is that people can identify these substances before the plants disappear forever.

Los Angeles writer Mary Batten is the author of **The Tropical Forest: Ants, Ants, Animals & Plants.** (Crowell, 1973). This article has been reprinted from the International Wildlife, July/August 1988 issue.

REFERENCE PHONE NUMBERS FOR CHAPTER PROGRAMS:

Athens	-	Scott Moody	-	614/593-2360	Day
Cleveland	-	Tom Sampliner	-	216/932-5481	Eve
Cincinnati	-	Jim Innis	-	513/385-0670	Eve
Columbus	-	Jim Stahl	-	614/882-5084	Eve
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Natural Areas	-	Switchboard	-	614/265-6453	Day
Toledo	-	Denise Gehring	-	419/535-3058	Eve
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