

AMERICAN HORTICULTURIST

APRIL 1982



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AMERICAN HORTICULTURIST

VOLUME 61 NUMBER 4



Pamela Harper

Florists' strain of *Primula X polyantha*. Turn to page 14 for more information about growing primulas.

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On the cover: Unusual *Arisaema sikokianum* is surrounded by *Primula sieboldii* in the garden of Harold Epstein. Turn to page 23 for more about his lovely plant collection. Photograph by Pamela Harper.

Judy Powell
EDITOR

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ART DIRECTOR

Barbara W. Ellis
ASSOCIATE EDITOR

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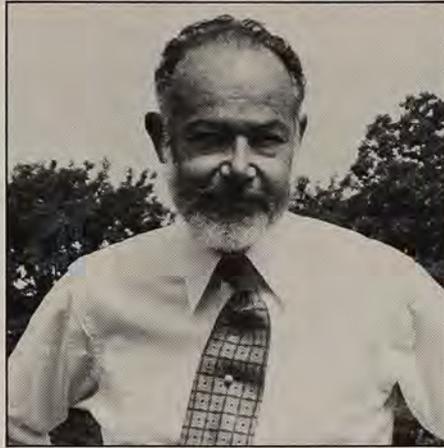
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AMERICAN HORTICULTURIST is the
official publication of The American
Horticultural Society, P.O. Box 6118,
7931 East Boulevard Drive, Alexandria,
Virginia 22308, (703) 768-5700, and is
issued monthly. Membership in the
Society includes a subscription to
AMERICAN HORTICULTURIST.
Membership dues start at \$20.00 a year,
\$12.00 of which is designated for
AMERICAN HORTICULTURIST.
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Horticultural Society. ISSN 0096-4417.
Second-class postage paid at Alexandria,
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PRESIDENT'S PAGE



The other day I was enjoying a slide presentation being shown by a fellow gardener who had just returned from a plant collecting trip to Namibia (formerly South-West Africa). He filled the screen with beautiful photographs of one of the world's strangest plants, *Welwitschia bainesii*. This primitive plant grows in the desert areas just in from the Atlantic Coast, and individual specimens are said to be thousands of years old. During its entire life it has only two leaves, which grow continuously in a wild, twisted pattern. A large plant can cover an area the size of a small house. As my friend flashed slide after slide of this strange plant on the screen I began to wonder why this species was one of the plants on the endangered species list. I asked my friend where he had seen so many of these "rare and endangered" plants, and I was amazed to hear they were extremely common for more than 400 miles along the northern coast of Namibia. In fact, in nature, they are neither rare nor endangered. So what are they doing on the list?

The *Convention on International Trade in Endangered Species of Wild Flora and Fauna* is an international agreement among nations that was originally formed to protect a small number of animals in danger of becoming extinct because of the commercial demand for their hides, horns, etc. It was a worthwhile endeavor, and in the animal world it has, to the best of my knowledge, been successful. For the moment, at least, it has saved such animals as tigers and rhinos from extinction at the hands of commercial hunters. But what

has it done for plants and why is *Welwitschia* on the list?

It seems to me that it is time to review the *Endangered Species Act* (the internal protective legislation in the United States) and the *Convention on International Trade in Endangered Species* (the international agreement among nations). Within nations, local protection of endangered species varies widely in both legislation and enforcement. We think of ourselves as a nation of laws, yet the listing of endangered species has become hopelessly bogged down in red tape, and the enforcement of the law is negligible. It is still common in the southwestern states to see a pick-up truck loaded with a pile of collected cacti for sale. And in such countries as Brazil, where all plant collecting is prohibited except by specific government permit, it is now estimated that as much as 25 percent of the great Amazonian jungle has been leveled by the bulldozer and the logger without any accounting for the thousands of plant and animal species that may have been driven to extinction by this "advance of civilization." In South Africa, one of the rarest species of aloe (*Aloe polyphylla*), has for years been decimated by the local population for its presumed medicinal value. Yet all collecting of this plant by botanists or horticulturists is strictly forbidden, even including the collection of seed, which in no way harms a plant. At the ports of entry into the United States the agricultural inspectors must now confiscate all plants brought in without the proper import permits. Some small part of these confiscated plants may be turned over to local botanic gardens where they are held in limbo until some bureaucratic decision can be made (if ever) to determine their fate. Most will eventually die because the holding agencies have little incentive to spend any effort on growing them or any way to ultimately share them with other organizations or individuals. The rest end up in the trash. That doesn't seem to me to be a very good way to "protect" an endangered species. The stated purpose of both the national and international legislation is to protect the flora and fauna from *commercial* onslaught. The result has actually been to make scientific collection difficult and amateur collection almost impossible. The

commercial collectors, however, are not complaining. Business is better than ever and prices are higher because the plants and animals are now "officially" rare. Just look at the advertisements for jungle collected orchids, or cacti, or rare parrots or other wild animals.

Extinction cannot always be prevented and is, in fact, part of the evolutionary process. If we really want to save some of our plants and animals from human destruction, then only the establishment of large areas of natural preserve (*i.e.* wilderness areas) will be effective in the long run. You cannot truly preserve a species by maintaining individuals in a botanic garden or a zoo. In a typically bureaucratic manner, endangered species legislation is almost a guarantee of extinction for the very plants and animals it seeks to preserve.

As for collecting, I believe that small quantities (say five or 10 specimens of a single plant species), and particularly cuttings and seeds of plants, should be exempt from the endangered species permit process. Such small quantities would enable the scientific and amateur collector to continue to sample the world's flora and to introduce new plants into cultivation. If you have walked along a jungle trail in the tropics you know that it is possible in only a few minutes to collect literally hundreds of orchids and other plants that have fallen to the ground and will, if left in place, be dead in a very short time. Yet it is now almost impossible for the casual amateur collector to save any of those plants by bringing them back to his home greenhouse.

If the Franklin tree (*Franklinia alata-maha*) had not been introduced into horticulture when it was first discovered it would have been lost forever, because the wild population of this beautiful flowering tree has been extinct for almost 200 years. *Aloe polyphylla*, which has been protected almost to extinction in South Africa, is now guaranteed a future because a few seed were illegally brought to California by a returning peace corps volunteer who had been stationed close to where this aloe still grows in nature. The plants in California are growing beautifully and certainly are not threatened by the native medicine men. As to *Welwitschia bainesii* and why it is on the endangered species list—I still don't know!

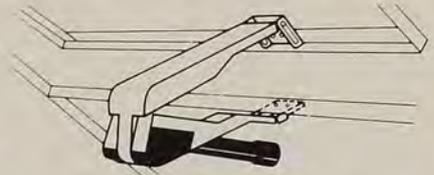
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Barbara W. Ellis

ABOVE: During the summer months a wide variety of flowering and foliage plants are featured in a display on the Botanic Garden's front terrace. RIGHT: Visitors often miss the Botanic Garden park, which is behind the main conservatory. It is one of the loveliest gardens in downtown Washington.

THE U.S. BOTANIC GARDEN

At the foot of Capitol Hill, amid enormous stone and marble buildings, a steady stream of traffic and the seat of the Federal Government, resides an institution with a past intricately woven into the horticultural heritage of the nation. It is the United States Botanic Garden. Most visitors come to enjoy the collections housed in the conservatory, conscious only of the Garden's present delights. Few know of the unique events that led to its creation and continued existence.

In 1818 an organization known as the Columbian Institute for the Promotion of Arts and Sciences was formed in Washington, D.C. The objectives of this Institute included the pursuit of knowledge and the collection of objects relating to many branches of science, but the primary goal was "To collect, cultivate and distribute the various vegetable production of this and other countries . . ." through a botanic garden. In 1820, Congress appropriated five acres of land for this purpose, located at the eastern tip of the Mall and almost at the doorstep of the Capitol building.

During the first decade of the Institute's existence plants were collected from around the globe. To encourage donations heads of government both at home and abroad were asked to appeal to individuals under their jurisdiction who might be willing to send seeds and plants to include in the garden's collection. This scheme resulted in the acquisition of a diverse collection, including many species introduced into the United States for the first time.

Although the efforts to establish a botanic garden were formidable, the project failed. The Institute lacked sufficient funds to operate and maintain the garden and Congress refused support. Even the organization's most influential members, including Thomas Jefferson, John Quincy Adams, James Madison, James Monroe, members of Congress and the Presidential Cabinet, scholars and scientists, could not prevent its demise. In 1837, the Columbian Institute disbanded, and the land occupied by the botanic garden was relinquished.

The Columbian Institute may have failed to establish a permanent national botanic garden, but it succeeded in establishing a precedent for creating such an institution



Michael J. Goergen

under the auspices of the Federal Government and paved the way for events to come.

In 1838, Captain Charles Wilkes, USN, led six ships and 440 men on an expedition that was to figure prominently in the development of a new botanic garden. Although the basic purpose of the voyage was to promote commerce, mainly the whale fishing industry, collecting objects of scientific value was a secondary objective. Toward this end several scientists accompanied Wilkes, including a botanist, a horticulturist and a naturalist. The saga of the Wilkes Expedition is as interesting from a literary point of view as it was horticulturally. The ruthless Wilkes, it is said, served as the model for Captain Ahab in Herman Melville's classic, *Moby Dick*.

The squadron returned to New York in 1842 with a collection of seeds and cuttings gathered from around the world. Many of the species collected had never been cultivated in the United States. The plants were placed in a greenhouse located behind the old Patent Office building in Washington, D.C., erected solely for this purpose. Here the plants thrived and attracted thousands of visitors and curiosity seekers. An addition to the building on the site occupied by the greenhouse, made necessary by the growing need for governmental office space, forced the Wilkes plants to be relocated. Congress acted quickly and appropriated funds to construct a con-

servatory on the eastern end of the Mall, on the exact site previously occupied by the Columbian Institute's botanic garden.

The plants collected during the Wilkes expedition were moved from the Patent Office greenhouse to the conservatory in 1850. Although many new species were acquired to fill the new building, the Wilkes plants formed the nucleus of the collection, and some of these plants are still growing in the Garden's collections. In 1856, the conservatory and surrounding grounds officially were designated The United States Botanic Garden. Funds were appropriated annually from Congress, as is the case today. The Botanic Garden became one of the nation's showplaces and attracted visitors world-wide.

However, problems arose. Plans for the nation's Capitol called for a clear vista down the Mall between the Capitol and the Washington Monument with a memorial to General Ulysses S. Grant as the keystone to the Mall system. The Botanic Garden obstructed this vista and occupied the site where the memorial was to stand. Despite a public outcry to spare the garden, it was removed in the early 1930's and plans for the Mall as we know it today became a reality.

The cornerstone of the present Botanic Garden Conservatory was laid in 1931 directly opposite the old site. Today the conservatory, which houses collections of

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aroids, bromeliads, cacti, cycads, ferns, orchids and palms, attracts over one million visitors each year. The Botanic Garden Park, a one-acre site located opposite the rear of the building, is almost as popular. It features a wide variety of summer blooming annuals, rock garden perennials and unusual trees and shrubs.

The focal point of the Park is historic Bartholdi Fountain, named for its designer, Frederic Auguste Bartholdi, who also designed the Statue of Liberty. This fountain was originally exhibited in 1876 at the International Centennial Exposition at Philadelphia. Following the exposition the government purchased it and placed it on the old botanic garden grounds. It was moved to its present site in 1931. This graceful fountain, which represents the embodiment of light and water, could not be a more appropriate ornament to the Park.

When the Columbia Institute disbanded in 1837 their Botanic Garden went entirely unmaintained, and the portion of the Mall where the garden stood was used as a dumping ground. It is unlikely that any of the original plants acquired by the Institute survived. There are, however, several plants included in today's Botanic Garden collection that were almost certainly brought back by the Wilkes Expedition or at least have been propagated from the original plants. Included among them is a particularly fine specimen of Chinese date or jujube, *Zizyphus jujuba*, which in Mediterranean areas and the Orient is cultivated for its sweet, orange-red, date-like fruits used for making jellies and an apple butter-like concoction. The fruit tastes like a cross between an apple and a date. The jujube is in the Botanic Garden's park located directly across from the rear entrance to the Conservatory on Independence Avenue.

Other plants on exhibit that are likely to have been included among the Wilkes acquisitions are two cycads, both specimens of *Cycas circinalis*, which are positioned like giant sentinels at the entrance to the Conservatory's Great Palm House.

More recent major acquisitions on permanent display at the Garden are huge and magnificent century plants, *Agave* species, the source of durable fibers and more interestingly, a valuable sap used to make tequila; the banyan tree, *Ficus benghalensis*, which spreads by aerial roots and can single-handedly produce a forest of growth; and the chocolate tree, *Theo-*

broma cacao, which has the unusual habit of producing large pods along its trunk and main branches. When washed, ground, roasted and sweetened they yield commercial chocolate.

Orchids were among the most treasured plants housed in the Botanic Garden's first Conservatory. Over the years this collection has matured into one of the finest and most extensive in the country. Orchids still occupy the most prized display area in the building. The Garden raises almost 11,000 orchids at its nursery at Poplar Point, Washington, D.C., a facility open to the public by appointment only. Approximately 250 of these, always in full bloom, are exhibited in the Conservatory throughout the year and attract photographers, orchid enthusiasts and other admirers.

The Garden also sponsors four annual plant and flower shows each year. The Easter Show, featuring masses of spring flowering plants, is the first such event and is held from Palm Sunday through Easter Sunday. The second show, the Summer Terrace Display, is held on the patio in front of the conservatory from May through September. Hundreds of flowering and foliage plants in hanging baskets highlight this event. The third show, held from mid November through Thanksgiving Day, features a wide variety of chrysanthemums. Poinsettias dominate the last annual show, held from mid December through the Christmas holidays.

Each year the Garden hosts plant and flower shows sponsored by area garden clubs and plant societies. Other services sponsored by the Garden include group tours given the year round and a series of horticulture classes held from September through May.

Whether you visit the U.S. Botanic Garden in search of the oldest members of its collection or the more recently acquired specimens, you are almost certain to discover an unfamiliar species or at least one displayed in a unique and exciting setting. Enjoy yourself!

The U.S. Botanic Garden Conservatory, located at First Street and Maryland Avenue, S.W., Washington, D.C., is open from 9:00 a.m. to 5:00 p.m. daily. Admission is free of charge, and a brochure for a self-guided tour of the garden is available at the door. ☉ —Karen D. Solit

Karen D. Solit spent five years as a horticulturist for the U.S. Botanical Garden. During that time she compiled the first complete history of that institution.

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THE SOLANACEAE

Not since the days of Luther Burbank and his potato grown from seed has there been so much interest and excitement in the potato as there is in 1982. Now the home gardener can grow a potato crop from seed! The 'Explorer T.P.S.' (True Potato Seed) is being introduced by Stokes and is available from other vegetable seed sources as well. Commercial fields of sturdy, dark-green plants, with their white and lavender flowers, may not be shivering and shaking at the threat, but home gardeners can heave a sigh of relief at no longer facing the tedious task of cutting "seed potatoes" and dropping them in individual hills in the garden.

The cultivated potato is a wondrous thing, developed over centuries from a wildling of the nightshade family, the Solanaceae. So, here at the beginning of the gardening season, we take a further look at this paradoxical family that includes those other favorite vegetables, tomatoes, peppers and eggplant, as well as ornamental and poisonous relatives.

The so-called "Irish" potato is *Solanum tuberosum*. The edible portion is the swollen underground stem. Like all stems, it has joints at which leaves are borne; on the compressed potato stem, buds at these joints are known as "eyes." Pieces of underground stem, each with a latent bud or "eye," planted in the soil will produce the plants from which a crop of potatoes can be harvested. The potato plant has true roots that serve the same purpose as roots on other plants. Though we dig it from the ground, the tuber that we eat is a stem, not a root.

The potato is about 78 percent water and 18 percent carbohydrate, most of which is starch, but there is also a trace of sugar, two percent protein and 0.1 percent fat. Enough vitamin C is present to prevent scurvy, although it is not stable and is leached away by boiling or prolonged soaking in water.

Like some other members of the Solanaceae, the potato contains small amounts of the poisonous alkaloid solanine. Potatoes grown near the surface of the ground and turned green by exposure to the light may contain toxic amounts of solanine; if eaten raw they are dangerous, but cooking breaks down the solanine.



ABOVE: Eggplant was once thought to cause insanity, probably because of its relationship with the nightshades. LEFT: Peppers also are members of the Solanaceae. This is an All-America winner, 'Gypsy' hybrid.



All-America Selections

The potato grows well wherever there is a moist, cool climate. Although it was brought into cultivation and its use was widespread in South American countries for centuries, it is not a tropical plant; it comes from the cool regions of the high Andes. Its cultivation was commonplace from Chile to Colombia when America was discovered. It was used as food in various ways. In their high, cold mountains the Indians had even discovered a freeze-dry process to preserve it in a form we might term the original dehydrated food.

Lost in time is any record of who first introduced the potato to Europe. The first mention in writing is in Gerard's herbal of 1597. Its ease of culture made it a staple food over a broad area.

Today the potato is a major food in much of the world. Over 90 percent of the crop is grown in Europe. Although we use it for human food, in Europe much of the crop is used in other ways, for instance as livestock food and in production of alcohol used in the manufacture of synthetic rubber as well as for human consumption.

In a sad and devastating form the potato played a role in modern history. By mid-19th century, potatoes had become the chief food crop of poor Irish peasantry, whose main labor was devoted to the production of other crops for their English landlords. A destructive blight struck the Irish crop in the years 1845 to 1849. Because of their dependence on potatoes as food, the loss brought ruin, privation and starvation for many Irish peasants and caused an influx of Irish immigrants to the United States.

The story of the discovery of the efficacy of Bordeaux mixture, a fungicide, in control of the potato blight is in itself an interesting sidelight on cultural practices. The search for disease resistant *Solanum* species by botanical expeditions and the development of certified blight resistant potatoes is another sphere of inquiry for the curious reader.

In some areas where it is cultivated the potato plant seldom flowers and even more

rarely sets fruit. The white or lavender flowers are of the characteristic nightshade form with fused petals. The fruit is a berry similar in appearance to a small, green tomato. True seeds are produced in the berry. The genetics and chromosome numbers of potatoes are of interest to plant breeders in producing improved types of potatoes, but seed seldom is used to produce a crop.

So it was that just over 100 years ago a chance little green seedpod found by an inquisitive young man launched a great new potato, the Burbank, and a famous career of horticultural experimentation.

For salad-loving Americans the tomato is the choicest of vegetables. Some call it a vegetable, some, a fruit. Very few would identify it as a berry, but that is what this typical fruit of the nightshade family is. A berry, botanically, is a fleshy fruit without a stone, usually containing many seeds.

As a fruit, a vegetable, or a berry, acceptance of the tomato as a food was rather slow. Who would eat the fruit of a plant known to be related to plants with a reputation for being poisonous?

It appears that the tomato, *Lycopersicon lycopersicum*, was carried to Europe from the Americas; there is still controversy as to what part of America it came from. From evidence assembled and reported, it would seem that Mexico was the place of origin, or at any rate the source of the first tomatoes taken to Europe.

The tomato is one of a group of 10 or 12 species of South American lycopersicons, all with strong-smelling foliage. It has compound or deeply divided leaves, sometimes curly and often glandular. While closely related to *Solanum*, lycopersicons totally lack the solanum's prickles. Yellow, bell-shaped flowers are borne in clusters. The fruit is a red or yellow pulpy berry. The species *L. lycopersicum* is not grown in cultivation. Forms familiar to us are *L. var. commune*, the garden tomato, *L. var. cerasiforme*, cherry tomato, and *L. var. pyriforme*, pear tomato.

The name tomato is from the Indian *tomatl*. The fruit was used and appreciated by American Indians as much as it is by us today.

In common parlance and in written accounts the tomato became known in Europe as love apple from the French *pomme d'amour*. Claims of its aphrodisiac properties were never substantiated; probably a number of geographic and language shifts in its travels abroad are responsible for "d'amour" being applied. My mother, who

would have been over 100 by now, first related to me the story of its being known as love apple and of its being considered poisonous by many, even in her youth. Regarded with suspicion because of its kinship to nightshades, it was grown for many years as an ornamental or as a medicinal plant.

Genetically, tomatoes and potatoes have much in common, but they meet different

needs in the human diet, potatoes being rich in starch, poor in vitamins, whereas tomatoes are rich in vitamins and contain little starch. Geneticists report that certain species of *Lycopersicon* can be hybridized with relatives of the potato but production of a worthwhile hybrid is unlikely. Should you encounter a question about the reference to the possibility of a tomato being grafted to a potato, such a graft is possible,

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but the crop of tubers below ground and fruit above is insufficient to make the effort worthwhile.

Regally resplendent in purple, the fruit of the eggplant, *Solanum melongena* var. *esculentum*, is a striking garden ornament in addition to being a vegetable of diverse uses in cookery. When introduced to American gardens in 1806, it was grown for its ornamental value, another instance of a plant's being stigmatized by kinship to nightshades. Although it was known to be eaten in Spain and Africa, Gerard wrote in his herbal (1597): "It is better to esteem this plant and have it in the garden for your pleasure and the rareness thereof, than for any virtue or good qualities yet knowne."

In its native tropics the eggplant is a perennial shrub two to three feet high, but it grows as an annual in our gardens because it will not endure frost. Its place of origin appears to have been India or southeast Asia where it is still extremely important as a cultivated food plant. Its lobed leaves are rather large, 10 to 15 inches long, flowers are violet, as much as two inches in diameter, and some plants have spines, some do not. The fruit is a berry.

Eggplant, too, is a widely traveled vegetable. The botanical epithet *melongena* is thought to have evolved from an Italian word meaning "mad apple" because at one time the fruit was said to cause insanity. In European seed catalogs and on French menus, eggplant appears as aubergine, a corruption of earlier Spanish and even earlier East Indian names.

The greatest variation in the eggplant is in the part for which it is grown, the fruit. The fruit appears in a variety of shapes and sizes and may be white, yellow, purple or striped. The purple form was unknown to Gerard. Curiously enough, the common name "eggplant" came about because when first described in Europe the fruit was said to be of the size of a swan's egg and of white or yellow color. Modern plant breeders have developed many improved, high-yielding types. Just check your 1982 seed catalog for qualities and comparison of shapes and shade of purple. White and yellow are not common in vegetable seed lists, but in the novelty listing the modern pot plant version is often found—a two-foot plant with typical eggplant foliage and flowers, and egg-size fruits, white first, turning yellow in a couple of weeks; an ornamental curiosity for the indoor gardener.

Peppers, the capsicums, are a horticulturally important genus of American origin, probably from Central and South America. There is evidence that peppers were domesticated and widely used in the Americas in prehistoric times. The classification of the species has been confused, but it seems that all garden peppers are derived from *Capsicum annuum*. Its progeny in scores of forms are found all over the world.

***The common name
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The peppers that grow on bushes should not be confused with true black pepper of the East Indies, which is *Piper nigrum*, a vining plant. It was easy for the early Spanish explorers to associate the taste of these new world plants with the black pepper familiar to them and so the name was transferred. After all, Columbus sailed to this part of the globe in search of a route to the Indies to obtain spices.

Capsicum annuum is the species widely cultivated in all sections of the United States. The leaves are simple, the flowers are white or greenish, two or three in a cluster, generally wheel-shaped with five lobes of fused petals, and the fruit is a pod-like berry.

Both the sweet and hot peppers grown in American gardens belong to this species. Based on pungency, the species is divided into two major categories, namely the hot peppers used in flavoring and sauces and the mild, sweet peppers grown as vegetables for cooking, flavoring and salads.

Paprika, cayenne pepper and chili powder are all prepared from diced, ground, ripe fruits of various hot varieties. The "heat" from peppers has long been the basis of their use in a variety of medicinal preparations. The pungency is due to the presence of capsaicin, a volatile phenolic compound. It is extremely stable and lasts a long time in the part of the pod to which the seeds are attached, but not all varieties are equally pungent. 'Tabasco' is a cultivar of the species *Capsicum frutescens*. It is grown in the Gulf states and is the source of Tabasco sauce.

Sweet peppers are one of the most popular home garden vegetables because of their easy culture. Moreover, sweet peppers are a better source of vitamin C than tomatoes and they contain vitamin A also. Many improved varieties of these sweet or non-pungent peppers are an important commercial crop, chiefly in Florida and California.

The home gardener must learn to distinguish among varieties of peppers offered in the seed catalogs, depending upon the uses for which they are to be grown. If he grows both hot and sweet peppers and saves seeds of the sweet variety for future planting, he should be aware that crossing may have occurred. When crossing has occurred between the two varieties, all the progeny will have pungent fruit. The gene for pungency is completely dominant over that for non-pungency. If seeds from the hybrid are saved and planted, they will yield approximately three pungent fruited plants to one sweet. The inheritance in *Capsicum* is thus a good example for Mendelian inheritance.

C. annuum is the species that also provides the ornamental peppers so frequently seen as pot plants for indoors and as border plants in the garden. They are neat, small plants, with good foliage and flowers, but the attraction is the brightly colored fruit which can be had in various shapes and colors. Inviting names, such as 'Holiday Flame', 'Red Missile' and 'Inferno Mixed' have been assigned to tempt the grower.

Another article about peppers appeared in *American Horticulturist* for February 1982.

These two columns about Strange Relatives (February and April 1982) have not exhausted the subject of solanaceous plants. Venturesome home gardeners, especially in warm climates, will want to experiment with introducing some of the lesser known and exotic genera omitted from this inventory of the useful and decorative members of the Solanaceae. Gardening encyclopedias, *Hortus Third* or botanical references can be used as guides. A very readable small volume with which to begin is *Nightshades—The Paradoxical Family*, by Charles B. Heiser, Jr., a botanist, taxonomist and student of the origins of economic plants. ☉

—Jane Steffey

Jane Steffey is the horticultural advisor to the American Horticultural Society.

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Photographing Plants

TEXT AND PHOTOGRAPHY BY GEORGE BAETJER

If you have a keen interest in flowers, you have probably thought about trying to photograph them. Perhaps you have never pursued the idea because of a belief that the field is reserved exclusively for the professional photographer. This was quite true just a few years ago, when close-up photography demanded

George Baetjer is a writer and photographer whose work has appeared in *American Horticulturist*, *Earthwatch Oregon*, *Maryland Conservationist* and *Oregon Magazine*.

considerable technical expertise and painstaking experimentation. Fortunately, recent advances in camera equipment have brought high quality close-ups within the reach of even the most inexperienced photographer, and for a price that is less than you might expect.

I prefer to photograph flowers in the field using natural light. This technique allows me to record my subjects on film without disturbing them or removing them from their environment—a particularly

important consideration when travelling or when photographing wildflowers. I avoid the use of electronic flash units because of a personal belief that natural light provides the most pleasing renditions of my subjects and also adds individuality.

THE CAMERA

The heart of any good close-up system is the camera body. Your best choice will be a 35mm Single Lens Reflex (S.L.R.) equipped with a build-in light meter. When

using this type of camera, you view your subject through the lens. What you see in the viewfinder is the exact image recorded on film. This is essential for the precise framing and focusing required for good close-ups. A built-in light meter will provide an accurate reading no matter what lenses or accessories you may decide to use, and many standard lens reflex cameras even will provide the added convenience of automatic operation. When buying a camera, be sure to choose a model that will accommodate a complete line of lenses and accessories without modification. Cost: from \$200 to over \$700 with lens.

CHOOSING THE RIGHT OPTICS

The sizes of the subjects you wish to photograph will determine what equipment is right for you. Most camera manufacturers describe the capabilities of their close-up systems by means of magnification ratios. These ratios are determined by dividing the width of the negative (1.35 inches for 35mm film when the camera is held horizontally) by the width of the subject. A photograph taken at a magnification of 1x will include a subject 1.35 inches wide, thus 1x magnification means life-size reproduction. Similarly, a photograph with a magnification of 0.5x will include a subject 2.7 inches wide, or one-half life-size reproduction, and one with a magnification of 2x will include a subject 0.68 inches wide so reproduction will be twice life size. You can get a good idea of how much magnification you will require for your own flower photography and the combinations of equipment that will produce it by locating the size of the smallest subject you are likely to photograph in the table on page 37, under the heading "Subject Width."

SUPPLEMENTARY LENSES

Almost any lens is capable of producing adequate identification photos of most species, since good identification shots show not only the flowers of a plant but also its leaves and stem. For shooting many wildflower species and detailed shots of individual blossoms, however, you will need to increase the magnification of your camera's standard lens. An inexpensive way to accomplish this is through the use of supplementary lenses, which resemble filters and are mounted on the front of the standard or "prime" lens in the same way as a filter. A typical set of three close-up lenses, as they are often called, is described in the table on page 37. They generally will allow you to double the magnification of a standard 50mm lens. Small apertures (lens

openings) *must* be used with these lenses to ensure edge-to-edge sharpness of the negative. Using supplementary lenses to more than double the magnification of the prime lens will decrease the overall sharpness of the negative at any lens setting. Still, they are a good, low-cost way to experiment with close-ups and will provide satisfactory results if used carefully. Cost: from \$20 to \$30.

EXTENSION TUBES AND BELLOWS

Extension tubes, also called extension rings, are mounted between the camera and lens. Like supplementary lenses, they often are sold in sets of three. They are lightweight, relatively inexpensive and provide greater magnification than supplementary lenses with much better optical quality. Some models even will allow automatic operation. As you can see in the table, however, each possible combination of tubes has a very limited operating range. This can mean a lot of fumbling for the right set for a particular subject. Cost: from \$30 to \$150.

Extension bellows also are mounted between the camera and lens, but they are much more convenient to use. Since bellows are made of flexible material, their full capabilities can be exploited without removing the lens, and they are capable of even greater magnification. Their particular drawbacks are that they are bulky and difficult to carry, and only the most expensive models will permit automatic operation. Cost: from \$80 to \$250.

MACRO LENSES

The best single tool for close-up photography is the macro lens. Unlike the other systems described above, a macro lens is capable of focusing to infinity, so it can double as your camera's normal lens. Although it is especially designed to perform well at extremely small focusing distances, it is no larger or heavier than a standard 50mm. Many professionals recommend substituting a 50mm macro lens for the standard one when buying a new camera. Cost: from \$100 to \$250.

All of the close-up systems described so far require fairly small working distances (the distance between the front of the lens and the subject) when the prime lens is a standard 50mm or macro. This can cause serious problems in available light photography, since shadows cast by the camera equipment often will fall on the subject, spoiling composition. Focusing on restless subjects such as bees or butterflies also is very difficult within these limitations. As a solution many camera manufacturers now offer 100mm macro lenses. They provide

the same magnification as 50mm macros but at twice the working distance. Using a 2x teleconverter with a 50mm macro will yield the same increase and also will double the magnification of the lens. A 2x teleconverter doubles the focal length, the length between a predetermined point in the camera's lens and the film when the camera is focused at infinity. Some loss in optical quality is inevitable with all but the most expensive teleconverters. Cost: 100mm Macro Lens—from \$150 to \$300; 2x Teleconverter—from \$30 to \$200.

ACCESSORIES

If you plan to use extension tubes or bellows in your work, a sturdy tripod will be an indispensable part of your camera outfit. Any macro system that uses extension devices is "slow" compared to one that uses macro or supplementary lenses. The greater the distance between the film plane and the prime lens, the greater the need for the use of slow shutter speeds. In addition, the extremely shallow depth of field characteristic of all macro systems means that even the slightest movement toward or away from the subject just prior to exposure will result in an unacceptably fuzzy photograph. A tripod will hold the camera rock steady and allow you to use the small apertures best for high magnification work. As an added precaution against camera movement during exposure use either a cable release or your camera's self-timer to trip the shutter. Cost: from \$40 to over \$100.

Another accessory that will greatly increase your comfort when shooting close-ups is an "angle finder." This is a small device that slips onto the camera's eyepiece and allows you to look down into the viewfinder. This is a real blessing when shooting from a low angle, as is often the case when the subject is a small wildflower. Cost: from \$30 to \$100.

ONE APPROACH TO SHOOTING FLOWERS

I prefer to use a 50mm macro lens when photographing wildflowers, often in combination with a 2x teleconverter. This is a lightweight system that allows me to shoot at a magnification of 1x (life-size reproduction) without adding any appreciable bulk to my camera outfit. When shooting in gardens where I don't mind carrying some extra weight I use extension bellows in combination with telephoto lenses more often than any other system. Increased working distance is the reason. A 200mm lens/bellows combination will yield 1x

Continued on page 37

Primulas

TEXT BY HERBERT DICKSON

PHOTOGRAPHY BY PAMELA HARPER

There are over 400 species in the genus Primula, which botanists have organized into 30 groups of related species called sections. All primulas grow so easily from seed that growing your own plants is the best, and for many the only way to obtain a supply.

There are many species and cultivars of primroses, *Primula* species, that can brighten your life with a riot of spring color. Many are hardy perennials, very easy to grow, and they come in a wide range of sizes, types and colors. With proper selection, and by paying some attention to the cultural preferences of the plants you select, you can have primroses in peak bloom from early spring to early or midsummer in most parts of the United States. There even are tropical species and cultivars suited to southern gardens or greenhouse culture in the North. With all of this variety and adaptability, it is a wonder primroses are not more generally grown and appreciated.

There are over 400 species in the genus *Primula*, which botanists have organized into 30 groups of related species called sections. All of the species in a section have important botanical similarities, such as similar flower or leaf forms, that indicate their natural relationships. Actually, these sections can be compared to the branches of a family tree. Most hybrids are the result of crosses between two species in the same section, since they are most closely related. Several of the larger sections are further divided into subsections. Because they have been grown, hybridized, selected and appreciated for several hundred years, there is a wide range of species and cultivars to choose from—from easy-to-grow selections for the amateur to plants that require all the expertise of the advanced fancier. Here, I will touch on several species of these lovely plants that can be grown with a minimum of fuss. By selecting plants that bloom during the early, middle and later portions of the season, it is possible to have plants that provide attractive color in the garden over a long period of time.

The blooming season starts in April or May with *Primula juliae* from the Cau-

Herbert Dickson is the President of the American Primrose Society and has been growing primroses for 34 years.

casus Mountains between the Black and Caspian Seas. *P. juliae* is an extremely hardy species that is dormant in the winter, spreads by creeping rootstalks and bears magenta-colored flowers on single stems when its heart-shaped leaves still are small. It is a member of the Vernales section of the genus, which contains most of the well-known primroses, the English primrose, *P. vulgaris*, the oxlip and cowslip primroses, *P. elatior* and *P. veris* and the showy *P. X polyantha*.

The cultivars of *P. juliae* are collectively known as julianas, and their blooming season varies according to the other parent in their background. *P. juliae* has been crossed with several species in the Vernales section, and, since it was introduced to cultivation in 1911, many cultivars with various flower forms and colors have been named. The oldest and most widely distributed of these is 'Wanda', a vigorous, almost indestructible plant that produces blankets of purplish-red flowers. Some other old, named cultivars include 'Dorothy', variously described as a cream or yellow-flowered cultivar, 'Snow Maiden', a pure-white, and 'Springtime', a pink. There also are many new cultivars to choose from. 'Margurite' is a bright-yellow cultivar that bears umbels of flowers on stalks like *P. X polyantha*, as does 'Royal Velvet', a dark, velvety-red flowered cultivar. 'Buttercup' is a light-yellow, cushion-like plant that also bears its flowers on stalks. 'Jay-Jay' is a cushion-like plant that bears deep-red, Jack-in-the-green blossoms. The Jack-in-the-green characteristic means that each flower is surrounded by a calyx that has developed into a leaf-like ruff. This ruff continues to grow after the flowers have faded. Cultivars with this characteristic were very popular in Elizabethan England because each flower resembled a miniature nosegay. There are many other named juliana cultivars to choose from, but most of them are not generally available.

Very recently a strain of miniature julianas called julians has been introduced. Both seeds and plants are listed in many of the major seed catalogs, which are named in the source list at the end of this article. The miniatures come in the most gorgeous array of colors imaginable—bright, neon-glowing reds, pinks, purples and yellows. There also are soft pastel shades and tints in fantastic color combinations. These new cultivars cover themselves with bloom in the spring, almost to the point of hiding their foliage. Their one fault is that they do not know when to quit blooming and growing, and this tendency makes them subject to winter damage in severe weather.



Hardy cultivars of *Primula X polyantha*, like those pictured here, add a great deal of color to the spring garden and are long lasting.



Primula japonica 'Postford White' and a red flowered cousin, 'P.J. Miller's Crimson'.

Along with the julianas, *P. rosea*, from the west Himalayas, awakens from its winter rest to send up four- to eight-inch stalks of eye-catching, hot-pink flowers just as its leaves are starting to unfold. Later the leaves reach a length of from six to eight inches, and the flower stalks elongate to 10 to 14 inches to produce seed held way above the foliage. The foliage stays light-green until the first autumn freeze, when the plants go completely and suddenly dormant.

Peter Klein of Tacoma, Washington created a hybrid between tall, bright-pink *P. rosea* and tiny, two-inch-tall, pale-pink *P. clarkei*, which is not a very hardy species, in the early 1950's. Both plants are members of the same section of the genus, the Farinosae. 'Peter Klein' is the hybrid cultivar that resulted from this cross, and it is intermediate between its two parent species in every way except hardiness. Luckily, 'Peter Klein' inherited the hardiness of *P. rosea* and added hybrid vigor to the plant and flowers. When it blooms it completely covers its young, developing foliage with a solid mound of light-pink flowers borne on three- to five-inch stems. This beautiful and desirable plant is available but still is in short supply.

At about the time 'Peter Klein' is bloom-

ing the English primrose, *P. vulgaris*, from Europe and the British Isles, offers up its display of pale-yellow acaulis flowers. This species, formerly *P. acaulis*, bears one bloom per stem, and many stems arise from the center of each plant. This type of flowering habit is called acaulis flowering. The myriad of modern cultivars of *P. vulgaris* come in any color imaginable as well as several flower forms. Double flowers, Jack-in-the-green blossoms and another unusual flower form, hose-in-hose, which has a double-decker or a cup and saucer appearance because it has both a colored, petaloid calyx and petals, are available. The old double-flowered cultivars, with their heavy, drooping flowers, are a sorry sight when compared to these brilliantly-colored or lovely, pastel-shaded cultivars. All are eye-catchers in the garden. Like all other highly-bred plants selected only for their flower characteristics, these new double-flowered cultivars have lost much of the hardiness of their parent species. Many people have continued to work with these plants, and at least one breeder, Rosetta Jones of Kent, Washington, is having success with breeding hardiness back into these gorgeous new double acaulis primroses.

As the cultivars of *P. vulgaris* reach their peak, the popular polyanthus primroses,

P. X polyantha, start their long season of color. The polyanthus primroses are a hybrid group whose parents probably are *P. veris*, *P. elatior* and *P. vulgaris*. Their flowers are borne in many-flowered umbels. Polyanthus breeding and selection is still in a vigorous state, and there are new, exciting cultivars appearing all the time. Perhaps one of the best known strains, 'Pacific Giant', was produced by Frank Reinelt. These cultivars were bred to grow very quickly, to produce profuse bloom as seedlings and to be used as bedding plants for mid-winter bloom in the southern portions of the country. A more recent introduction is the 'Dwarf Jewel' strain. These cultivars are smaller than the eight- to 12-inch 'Pacific Giant' cultivars and have clearer, brighter colors. The 'Pacific Giant' strain, because of its rapid growth habit, is subject to winter damage here in the Pacific Northwest where we often have two or three spring-thaw and winter-freeze cycles each season.

The 'Pacific Giant' and 'Dwarf Jewel' strains and the new miniature julian strain are now grown as a greenhouse crop and sold as house plants in the mid-winter and early spring. Their bright, cheerful colors are irresistible, especially at that time of year.



The florist's strains of *P. X polyantha* can be grown indoors.

Breeders also are working to improve the hardier polyanthus cultivars, and some cultivars with eye-catching colors are becoming available. One of the important parents in these breeding programs is a polyanthus with an unknown background, discovered in a garden near Lake Cowichan on Vancouver Island in British Columbia. This plant, which has given rise to an entire strain called the Cowichan polyanthus primroses, bore deep, dark-red flowers without a yellow eye in the center of the flower and had dark-reddish foliage. As a parent plant in breeding programs, Cowichan strain primroses give glowing life to otherwise ordinary colors, and the characteristic of having little or no eye in the center of the flower increases the total color effect of the plants.

As the polyanthus primroses reach their peak, the species and cultivars in the Auricula section start their bloom. The auriculas are a group of European alpine species with smooth, succulent-type, rounded leaves and brightly-colored flowers borne in many-flowered umbels high above the foliage. These are extremely cold-hardy species (U.S.D.A. Zone 3). The Auricula section is a large, diverse group of species and cultivars that horticulturists classify into several groups. Many of these plants

are suited only for the specialty grower and serious hobbyist but there are species that make excellent rock garden plants. The species or cultivars of *P. rubra* (formerly *P. hirsuta*), *P. viscosa*, *P. auricula*, for which the section is named, and also a hybrid species, *P. X pubescens* (*P. auricula* X *P. rubra*) are all possibilities. There are many cultivars of all these species, often referred to collectively as simply *P. X pubescens* or *pubescens* plants, but many named selections are unobtainable except in England. Fortunately, very beautiful and interesting specimens can be grown from seed that is available from a few sources. Selection and breeding have made dirty, dull, uninteresting colors a thing of the past, and now there are auricula cultivars for the garden with flowers in many different, brightly-colored shades borne on sturdy stems high above the foliage.

Primula marginata, another member of the Auricula section, and its cultivars bloom early, sometimes with *P. juliae*, and always in shades of lavender. Even if they never flowered they would be worth growing for their beautiful foliage, which is deeply serrated with a heavy white edging of farina, a powdery coating, often called meal, produced by microscopic, gland-tipped hairs. *P. marginata* can be a very long-lived plant

in the wild —there are specimens known to be over 100 years old.

Along with and after the auriculas come the easy-to-grow woodland primroses of the *Cortusoides* section. *P. sieboldii* from Japan is a hardy (U.S.D.A. Zone 5) woodland plant that likes moist, well-drained soil and partial shade. It becomes dormant during hot, dry weather, and its rootstalk lies just under the surface looking about like a one- or two-inch section of a large centipede. If you weed the garden when this plant is dormant, it is possible to throw all of the dormant roots away without seeing them. Provide plenty of moisture before and during flowering, remove the weeds once before flowering, and then forget them until the same time next year.

There are many species of primroses in the *Candelabra* section, but they cross-breed so completely when grown close to each other that seed of a true species is hard to obtain. Fortunately, crossbreeding only tends to improve their color range and garden quality. The Candelabras are Asian species that bear successive whorls of blooms around the stem as it elongates. Sometimes as many as 16 whorls will develop on one stem. Candelabras such as *P. japonica*, species in the *Denticulata* section as well as the bell-flowered primroses

Primroses: A Cultural Guide

Section	NAME Species	Hardiness Zone U.S.D.A.	GROWING MEDIA					SOIL CONDITIONS				GARDEN LOCATION			EXPOSURE		NOTES	
			Grit	Coarse Sand	Well Decayed Manure	Rich Vegetable Loam	Leaf Soil	Peat	Boggy	Damp	Evenly, Moist	Good Drainage	Rock Garden	Streambank/Bog	Woodland	Border		Sun
Auricula																		
	<i>P. auricula</i>	Zones 2-3																
	<i>P. marginata</i>	Zone 6																
	<i>P. X pubescens</i>																	
	<i>P. rubra</i>																	
	<i>P. viscosa</i>	Zone 6																
Candelabra																		
	<i>P. japonica</i>	Zone 6																
Cortusoides																		
	<i>P. sieboldii</i>	Zone 5																
Denticulata																		
	<i>P. denticulata</i>	Zone 5																
Farinosa																		
	<i>P. clarkei</i>																	
	<i>P. rosea</i>																	
Sikkimensis																		
	<i>P. alpicola</i>																	
	<i>P. florindae</i>	Zone 6																
	<i>P. sikkimensis</i>	Zone 6																
Vernales																		
	<i>P. elatior</i>	Zone 6																
	<i>P. juliae</i>	Zone 6																
	<i>P. X polyantha</i>	Zone 4																
	<i>P. veris</i>	Zone 6																
	<i>P. vulgaris (acaulis)</i>	Zone 6																

All of the plants listed here make excellent, easy-to-grow perennials that will provide a great deal of color and enjoyment if the gardener attends to a few basic cultural requirements. For primroses, the climate of the Pacific Northwest is ideal. The region's cool summers, moist atmosphere and mild winters suit their tastes. Even there, however, primroses need winter protection if there is not an adequate snow cover. Winter and spring freeze-thaw cycles that heave plants out of the ground will do a great deal of damage. Plant them in a protected location such as on the north side of a house where the winter sun will not reach them, or mulch in winter. Even a strategically placed stone or small slope on the north side of a planting will provide protection. The alpine plants in the Auricula section will have a tendency to work free of the soil and will appreciate a spring mounding of gritty loam.

One of the worst dangers to all primulas is drought. Even the alpine species, such as the plants listed in the Auricula section, need a regular supply of water. They are deep-rooted plants, and melting snow provides water throughout the growing season. On the

other hand, few species can withstand soil that is poorly aerated due to lack of drainage. Even the plants suggested for the bog garden appreciate a well drained soil. The best solution is to find a location where the crowns of the plants can remain high and dry and the roots can find a reliable source of moisture at a deeper level. Damp soil in the winter is especially lethal.

Several of the species listed here are recommended for planting in full sun, however, in areas with hot, dry summers all will need protection during the hottest parts of the day. This is primarily because of their distaste for droughty conditions. High trees that cast a bit of midday sun are perfect, and generally the protection given plants to prevent drought will serve.

Those plants suggested for a shady location will appreciate some light and will not thrive in dark shade.

Primroses can be propagated by division, root cuttings or seed. Division is probably the easiest method for most gardeners, in fact, primroses benefit from regular clump division. Overcrowding is a problem

in clumps that are not divided regularly, and the plants will have a tendency to become woody. Use a sharp spade to separate offsets from the main clump, making sure that each new plant has an adequate number of roots. Divide after the flowers have faded, but be sure to avoid disturbing the plants when periods of hot, dry weather are expected.

To propagate from root cuttings lift the plants from the soil, shake the excess dirt from the roots and cut off one of the thick, fleshy tap roots where it joins the crown. Place the root in a pot filled with sandy loam and cover the pot with a sheet of glass or plastic to increase the humidity. Be sure to keep the cut end of the root just at the surface of the soil and cover it with a thin layer of clean sand to prevent it from drying out. Root cuttings also can be placed horizontally in a tray filled with sandy loam and covered with glass or plastic.

To propagate primroses from seed, collect and sow the seed as soon as it is ripe. See the March issue of *American Horticulturist* news for suggestions on how to sow and germinate seed.

in the Sikkimense section are known as bog plants. They have been the downfall of many a gardener trying to grow them in a stagnant bog, because their water must be fresh and moving. They will grow nicely under ordinary garden conditions when given plenty of water, but they are best grown as stream-side plants if you have a stream. A critical time in the garden for these plants is just after flowering when they have used up the stored food in their fleshy, over-wintering root systems and are starting to store food for next winter's rest. Be sure they receive optimum conditions during this time. Like all other primulas that have a dormancy period, these plants can be divided as they break dormancy in the early spring.

Primula denticulata, the drumstick primrose of the section *Denticulata*, ends its winter dormancy very early in the spring to send up round, two- to three-inch balls of closely packed, small flowers in shades of white through lavender to red. A cultural tip: if a plant flags or wilts on a hot day, wait until it has recovered in the evening to water, because to give it cold water from the garden hose while it is wilted will suddenly and certainly kill it.

The bell-flowered *P. sikkimensis*, *P. apiculata* and *P. florindae* of the Sikkimensis section close the season with their sweet-scented, pendant, bell-shaped flowers borne atop tall, straight stems. These also are stream-side plants that will prosper in almost any garden if given ample moisture and some shade. Here on the coastal side of the Cascade Mountains the three- to four-foot stems of *P. florindae* can always be counted on to bloom over the Fourth of July.

All primulas grow so easily from seed that growing your own plants is the best, and for many, the only way to obtain a supply. In areas with a reliable snow cover there are a great many primroses that will remain perfectly hardy even if the air temperature drops to 50 degrees below zero just so there aren't any winter or early spring freeze-thaw cycles that would melt the snow and leave the plants exposed. In the absence of snow, some form of a deep, airy mulch that does not pack down under rain or snow is best. Winter sun on frozen, unprotected plants is nothing short of murder.

There are many more beautiful and desirable species that have been left out of this list because of their exacting cultural requirements. If you want to grow and learn about primroses and the genus *Primula*, join the American Primrose Society, G. K. Fenderson, Treasurer, Grout Hill,



Primula sieboldii is originally from Japan and northeastern Asia.

South Acworth, NH 03607. Members receive the quarterly publication, *Primroses*, and are able to participate in the society's seed exchange. Local primrose shows, especially those held in the Pacific Northwest during the month of April, are an excellent place to learn more about these plants. At the shows you will be able to see top quality plants on display and also purchase seed and plants of species and cultivars unavailable from commercial nurseries. Primrose fanciers also will be able to direct you to local specialty nurseries which have unusual plants not available by mail. ●

PRIMULA SOURCE LIST

Plants

- Carroll Gardens, P.O. Box 310, Westminster, MD 21157
- Daystar, Route 2, Litchfield, ME 04350, formerly The Rock Garden, catalogue \$1.00
- Siskiyou Rare Plant Nursery, 2825 Cummings Road, Medford, OR 97501, catalogue \$1.00
- Andre Viette Farm and Nursery, Route 1, Box 16, Fisherville, VA 22939, catalogue \$1.00

Plants and Seed

- Far North Gardens, 15621 Auburndale, Livonia, MI 48154, catalogue \$1.00
- Spring Hill Farm, PO Box 42, Gig Harbor, WA 98335

Seed

Most major seed companies list some

primrose seed, including Thompson and Morgan, PO Box 100, Farmington, NJ 07727
Geo. Park Seed Company, Greenwood, SC 29647

Other Sources for seed

Members of AHS are able to order three species of *Primula* through this year's Free Seed Program.

Small quantities of double acaulis seed are available from Rosetta Jones, 6214 South 287th Street, Kent, WA 38031.

Small quantities of double auricula seed are available from Cyrus Happy, 11617 Gravelly Lake Drive, SW, Tacoma, WA 98499.

Foreign Sources

The Goodwins, Bagdad South, 7407, Tasmania, Australia
Edrom Nurseries, Coldingham, Eyemouth, Berwickshire TD14 5TZ, England

Jack Drake, Inshriach Alpine Plant Nursery, Aviemore, Inverness-Shire, Scotland PH22 1QS

For more information on primroses join the American Primrose Society, G. K. Fenderson, Treasurer, Grout Hill, South Acworth, NH 03607.

Another excellent source of information on primulas and other rock garden plants is the American Rock Garden Society, Route 1, Box 282, Mena, AR 71953.

A Gardener's Detente

TEXT BY ADELE AUCHINCLOSS
ILLUSTRATION BY ANNIE LUNSFORD



Last spring I sat and watched the tender shoots of a particularly expensive lily slowly disappear into the ground. Minutes later, a saucy chipmunk with bulb scales oozing from his mouth like a luscious Neapolitan with a mouthful of the best fettucini scolded me from the wall. I thought of the beauty of the lily in my garden book and of the time and money I had spent on it. Murder crept into my heart, but the insolent beast chirped, grinned and scuttled off. I could only smile.

I just can't bomb a woodchuck, kill a chipmunk or shoot a deer. They have as much right to life as I have. Also, I'm squeamish. Compassion stops, however, when it comes to slugs, termites, flies, mosquitoes and the wasps that insist on building their nests over the front door. They may be my great-aunts in reincarnated forms, but who wants a great-aunt with the soul of a slug or the sting of a mosquito? One can only declare war: salt, swatters, safe sprays, baking soda (for ant invasions), a firmly heeled shoe and strategy form the basis of defense.

The rest of the mammals, birds and insects that share the land with our family are subjected to a policy of detente. Many land animals, birds and insects are considered by many as pests to be exterminated. But without them the flowers would not be pollinated, nor the soil fertilized, nor the diversity of life celebrated.

Detente involves understanding the habits of the "enemy" and then applying methods of control that are acceptable to us and to them. Known today as "wildlife management" or "biological control," such programs are being practiced by scientific organizations such as the Cary Arboretum in Millbrook, New York, and increasingly advocated by state and federal agencies such as the U.S. Forest Service.

Our resident woodchuck doesn't like to stray too far from his burrow's entrance, so he can be kept happy with extra zinnias, petunias, grass and the like planted close to home. It's called making a "buffer zone." He also doesn't appear when visiting dogs patrol and will run from any loud noise. We can't get him to enter a Havahart trap (a cage that captures without injury). He is fat, sleek and smart. I'm told he might be lured by apples. However, chipmunks and rabbits can be enticed by the proper combination of tender vegetables, and for raccoons, fish. The problem is what to do

with the snarling animal once caught. I grit my teeth, bribe my sons to help and de-acquisition them in a park that is at least two miles from home. We don't expect or get a thank-you letter from the ranger.

Prevention keeps our mole, vole and mouse population in check. Bird seed that might attract them is stored in tins; bits and pieces that might make nice nesting material are locked away and cracker crumbs are swept up. Succulent tree trunks (especially fruit trees, dogwood and viburnum) are wrapped with plastic "tree guard," to a height of about 20 inches above ground so the mice or voles (and also rabbits) can't reach the trunk when there is snow on the ground. It also is necessary to check to be sure the wrapping does not gird the tree as it grows. [Editor's note: The U.S.D.A. recommends that to discourage mice from tunnelling under the grass to feed on succulent bark you should dig a shallow (1- to 1 1/2-inch) trench around each tree and fill it with sharp-edged stone such as marble chips or bluestone.]

Mole runs are carefully stamped down. I admit the moles just make a new run the next day, but at least the lawn has a chance to recover and I don't have a poor dead mole in a ghastly spiked trap on my conscience. And we encourage our local hawks to stay around by leaving piles of brush for the mice to hide in and "houses" for kestrels. Nature's system, though at times seemingly cruel, has been proven pretty effective and kinder than our interference. It is at least predictable to the animals.

Sometimes retreat is necessary. I spent hours making wire cages to keep the mice out of the tulip beds only to find that once sprouted, the tulips to the deer seem better than caviar. We no longer have tulips in the garden.

At other times encouragement is a better policy. All last summer a large green frog and two toads kept company with the marigolds and tomatoes because we left a small basin of water and a nice shady cover for their delectation. They ate an awful lot of aphids. The purple martins have appropriate lodging from which to launch their attacks. They eat their weight of insects every day. The beautiful pair of pileated woodpeckers have stopped making holes in the willow tree (we did encase part of the trunk in wire mesh) and have moved to a grub-filled dead elm we left standing on purpose.

One still gets mad.

Last Christmas, the deer ate the wreath off the front door. Today, I watched a spike-horn buck grazing on juniper, then

spring up the hill, his white tail a flash against the snow. I forgave him the wreath and hope he gets only a slight stomach-ache from the juniper.

Deer are perhaps the worst garden predators. They will eat anything and everything. As housing encroaches on the forests and fields that were the deer's territory, they are forced to forage on garden or orchard specimens. The Cary Arboretum has concluded that deer browse with their heads down and that a simple fence with ten non-electrified strands of wire slanted outward at a 45° angle and five feet high will keep them out of a garden or orchard. Scientists at Cary also have found that deer are repelled by the smell of human hair and that a double fistful of it enclosed in mesh bags and hung 28 to 30 inches high and two to three feet apart in a bush or tree will spoil the animal's appetite. The hair balls retain their scent for about a year before having to be replaced. We eat a great many onions (to acquire mesh bags) but my husband has finally rebelled about getting hair. He will no longer go to our local beauty parlor on Saturday mornings to beg for shorn tresses. I now go, but the ladies under the driers are not so amused. Several new products based on scents that deer do not like are coming on the market. "Magic Circle," "Chaperone," "Chew-Not" and "Deer-Bath" have been approved for home use but you have to reapply the product every time it rains.

Detente usually works, in spite of occasional saber rattling by both sides. Unlike Lady Macbeth, I have no blood on my hands; nor do I have furry dead bodies to plague my dreams. Maybe in time even the slugs and I will make our peace. ♣

SOURCE LIST

Detailed information on how to construct an anti-deer fence can be acquired by writing to Jay Hare, The Cary Arboretum, Box AB, Millbrook, New York 12545. Send your mailing address and \$1.50 to cover postage and handling.

Havahart traps, tree wrap, deer repellent and other supplies can be purchased from a local nursery or garden center, or by mail-order they can be purchased from: W. Atlee Burpee Company, Warminster, PA 18991

Gurney's Seed and Nursery Company, Yankton, SD 57079

Deer repellent also can be purchased from Deer-Away, Dept. AH, 712 15th Avenue, N.E., Minneapolis, MN 55413

Adele Auchincloss is a manager of the New York Botanical Garden and a trustee of the Natural Resources Defense Council. She has a small greenhouse in Bedford, New York.



A Connoisseur's Garden

TEXT AND PHOTOGRAPHY BY PAMELA HARPER

Wandering in the 1 1/2-acre Epstein garden, the culmination of 43 years of planning and planting, there is an inclination to say, "Aren't you lucky?". Lucky to have a wooded site here in suburban New York, lucky to have the great rock outcroppings, lucky to be able to grow so many rare and lovely plants. Bite back the words. Many factors contribute to the making of a beautiful garden, but luck is seldom one of them.

In the case of this garden, Harold Epstein's lifelong love and knowledge of plants certainly contributed to the overall effect. A past director of the American Horticultural Society and a past president of the American Rock Garden Society, Epstein's credentials as a gardener are impressive, but his own garden is the greatest testimony to his talent for being an imaginative plantsman.

The dappled shade around the Epstein home cast by tall trees creates an environment liked by many plants, but trees are thirsty things and stake first claim to soil moisture, thereby creating dry shade, a major problem with which to grapple. Hoses snaking about a garden are a nuisance and detract from its charm. The ingenious solution here has been to run buried pipe to the base of tall trees, lead it inconspicuously up the trunk, and attach a rotating spray nozzle at the top. Not only is this neater, but water sprayed from above falls more evenly than it does when sprinklers are placed among shrubs.

The coal-gray granite could easily look bleak, but so skillfully has it been managed, in places left exposed or elsewhere camouflaged by vegetation, that though intrinsic to the character of the garden it is never overwhelming. There is no obvious demarcation between original rock and that added by the gardener, nor is it apparent which tiny ferns, dwarf conifers and other plants have seeded themselves

into crannies and natural declivities, and which were put there after painstaking chiselling or careful blasting away of rock.

In clearing the original "jungle" 14 big trees were taken down, and some rock outcroppings were blasted to open them up and give root area for larger trees, particularly the background hemlocks, but the level stretches of lawn typical of suburbia were never the goal, the intention being to use and enhance the natural characteristics of the site. As for the plants, Harold Epstein is quick to point out that many have come and gone. There are plants that reject even green-thumbed cajolery, and there is no home here for woebegone or moribund plants. To earn its place a plant must not only grow, but grow handsomely. Each is adjudged with an eye as keen and discriminating as a gourmet's palate. And growing skill alone could not have brought about this garden. Harold once wrote: "The horticultural enthusiast today has to be like a sleuth with a bloodhound when he seeks rare or distinctive plants." A sleuth he has been, and his efforts have resulted in many choice plants reaching the gardens of other enthusiasts.

What kind of a garden is it? Rocks abound but it is not, in the usual sense, a rock garden. There are native flowers in abundance, including treasured double forms of trillium, bloodroot and rue-anemone in white and pink, yet it is not a wildflower or woodland garden.

Japan is almost second home to the much-travelled Epsteins, and their garden houses one of the East Coast's finest private collections of Japanese plants, but it is not a Japanese garden either. It could be called a collector's garden, but that might misleadingly suggest an indiscriminate assemblage of plants within a garden lacking cohesion or overall design. It was not first planned on paper —plantsmen's gardens seldom are, for the plants take precedence

Azaleas and weeping hemlocks grace a slope in front of the Epstein house, providing a suitable backdrop for the many rare plants also found in this garden.

Pamela Harper is a garden writer, owner of Harper's Horticultural Slide Library in Seaford, Virginia and a frequent contributor to *American Horticulturist*.

and must be treated as living things with individual needs, not as "plant material" to fit a preconceived plan. And what would be the use of deciding, on paper, that a tree or shrub should go in a given spot only to find, on digging in a fork, that a solid layer of rock lay just below the surface? It is a highly individual garden, stamped with its owner's personality and interests. An inventory of the plants would fill many pages. Here we look at but a few of those most in evidence on a mid-May day.

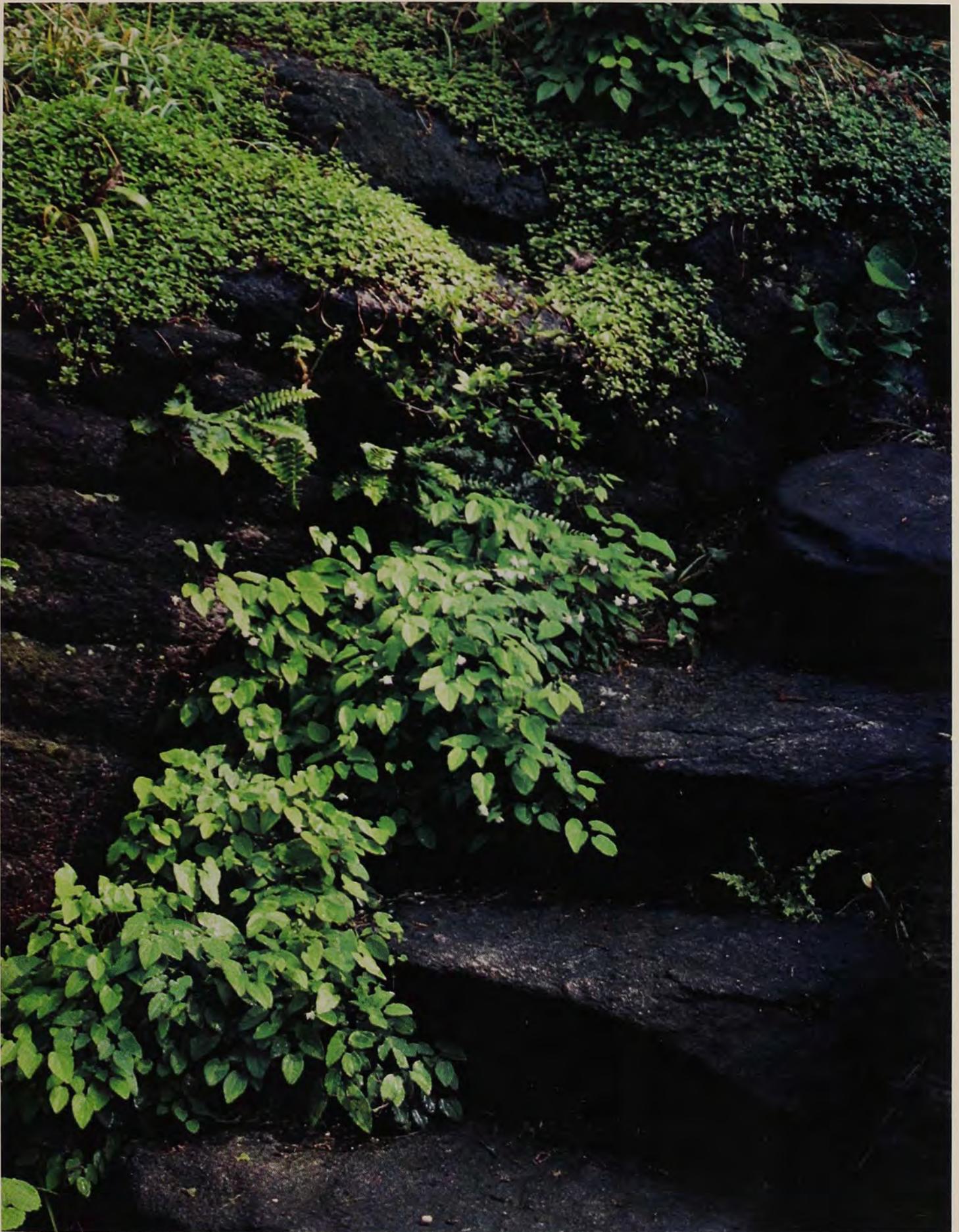
The trunks of two oaks on the front lawn provide support for the self-clinging, climbing hydrangea, *H. anomala* subsp. *petiolaris*, one of them a particularly fine form. Though slow to get started they are now, after 35 years, high up in the trees. In an ell by the front entrance grows a white-flowered *Rhododendron carolinianum*. A mountain goat would look at home poised on the huge rock ledge on the right boundary, a vantage point for viewing the front garden. The two-foot stems of *Tricyrtis macrantha* arch over the brink. Because the flowers of *Tricyrtis*, yellow in this species, are darkly freckled and spotted, this Oriental autumn-flowering genus bears the soubriquet toad lily.

Where the ground falls away to the left of the house the corner is bright with dwarf azaleas, and a specimen of the weeping hemlock, *Tsuga canadensis* 'Pendula', commands attention. Viewed from the driveway at the side, the house sits high on an outcropping of rock. Granite steps lead up it, an unobtrusive artifice, the side joints softened with *Epimedium X youngianum* 'Niveum'. Harold is fond of epimediums, a genus of refined yet sturdy plants for semi-shady, even very shady sites, preferring rich, moist soil but growing willingly, if with less rapid spread, in drier, poorer places. The many species and cultivars vary in size, vigor and flower color. This is one of the daintiest, six to nine inches high, with pale-green, saw-toothed, angel-wing leaflets above which in spring, rise airy sprays of flowers resembling tiny, snowy columbines held aloft on dark, wiry stems. This patch has been in place for many years, slowly spreading and entirely trouble free.

Continued on page 40

ABOVE RIGHT: *Arisaema sikokianum*, the Japanese version of our Jack-in-the-pulpit, is surrounded by *Primula sieboldii*, which the garden's owner pronounces "unkillable." RIGHT: Azaleas and rhododendrons add spring color to this vista at the rear of the house. FAR RIGHT: *Epimedium X youngianum* 'Niveum' accents the front steps.





Lilacs

TEXT BY JUDITH HILLSTROM
PHOTOGRAPH BY PAMELA HARPER

Does growing a “lilac tree” pique your sense of garden adventure? This is exactly what I intend. The image a “lilac tree” presents is one of whimsy and artistry hand in hand—a smooth but graceful trunk topped by a rounded crown of lacy plumes to scent the spring breeze. My purpose, however, in disciplining a young and flexible sapling into a mature, flowering “tree” was not primarily for the aesthetic value a specimen of this sort lends to the landscape. It was, instead, for a purely functional reason—that of taming



Syringa vulgaris, the common lilac.

a rather bulky, yet beautiful, old-fashioned shrub to fit a small city garden and still leave room for companion plants.

In this horticultural adventure you are the creator, the master in total control. With one eye toward its future development and maturity, and the other eye considering its present line and form, select a young lilac having the greatest “tree” potential. This means you will choose from among the nursery containers a plant possessing one strong central stem that is to be the trunk. Should this stem have a latent curved quality, it is even more desirable. Remove all obtrusive stems and branches—those rising from the soil line and others that may have sprouted along the stem-trunk you selected. If you buy a nursery-grown lilac there are a wealth of varieties from which to choose.

Judith Hillstrom is a free lance writer whose articles have appeared in *American Horticulturist*, *Garden*, *Better Homes and Gardens Houseplants* and *Family Food Garden*.

When your budget is tight, or you enjoy starting from scratch, search around for a donor—an amicable neighbor or generous friend who will allow you to dig a small plant from underneath the parent. This free-growing type ordinarily will be *Syringa vulgaris*, the common lilac and varieties thereof, the Bulgarian wilding from which most domesticated species descend.

The one drawback attributed to *S. vulgaris* is its enthusiastic sprouting of suckers several feet and, in some instances, several yards away from the enlarging trunk. Ironically, it is because of the lilac’s ability to produce suckers freely that your “lilac tree” becomes a reality and is able to maintain a single, unencumbered trunk. I find its suckering not a great deterrent, especially with improved cultivars of *S. vulgaris*, as pale-green shoots do not push through the earth until several seasons after roots are established and then mainly during the spring. When doing your gardening chores these suckers are easy to raise by a yanking

motion and the aid of a sharp garden spade or long-bladed knife, which will sever them a few feet from the trunk.

In search of my sapling I crawled beneath the spreading limbs of Grandmother’s ancient lilac, discovering the perfect candidate. I carried home a rather adolescent specimen, having a slightly arching stem-trunk approximately an inch in circumference and already colored corky black. It had a self-formed crown of numerous small branches and an overall height of four feet. This was indeed a lucky happenstance since my selection wanted no

basic training, only an occasional nipping off of foliage buds along the trunk. As years passed, pruning the crown into a pleasing shape combined with the need to remove suckers.

When there is no alternative but to choose a plantlet a little less developed, and you begin with a limber whip, the initial step is to clip off the terminal growing end. This will induce lateral buds to sprout in the formation of a “tree’s” top. Techniques of bonsai may be loosely applied. By recruiting the use of heavy gauged wire to sculpt crown-branches and support the trunk, together with clipping and pinching foliage large and small, you are able to give your “lilac tree” a certain grace within a structured frame. However, lilacs do possess a natural tendency toward a graceful form of their own, drooping and curving at just the right places.

Early, cool spring is an appropriate time for transplanting. This permits the lilac’s roots, which may have been injured and

cut in the moving, a recuperative period before warm weather arrives. The common lilac does have the reputation of establishing itself on a minimum of roots and most any type of soil. Once it is well-rooted, usually evident by the appearance of new growth, dig a balanced fertilizer around the plant. Old, established lilacs appreciate a dusting of lime over their roots every second year, and a scattering of wood ash supplies the potash that furnishes brighter color to the flowers.

Remember when pruning that blossoms appear on last year's growth and in shaping a "lilac tree" some sacrifice of bloom is to be expected for the sake of the desired form. Not allowing faded flowers to go to seed, which occurs rather quickly with *Syringa*, and deadheading cause the plant's strength to return to manufacturing next season's show. Caution must be taken in snipping off old blossom heads so as not to damage buds that are forming just behind.

The lilac is an exceptionally hardy shrub, particularly the common lilac. I have seen evidence of its stalwart heritage on the Iron Range in northern Minnesota where gnarled, lavender-clustered clumps survive at the stony foundation of a cottage long dismantled. This is a plant rarely attacked by insect or disease. It is said to be occasional host to the lilac borer and oyster scale, although I have never been witness to this tendency. Powdery mildew is the usual offense, and though unsightly when it occurs in the high humidity of late summer, it is harmless.

I'm certain that Grandmother's lilac is some sort of *Syringa vulgaris*, yet still I cling to suspicions of its having its share of hybrid blood. The flower color is not the pale lavender of the true common lilac but a vibrant, deep purple. Perhaps my imaginings are fanciful and unproven, yet I enjoy believing my "lilac tree" is a descendant of the Rouen lilac. The genus *Syringa* is rich historically and the Rouen lilac, the first known hybrid, plays an important role. But let us begin at the beginning . . .

Lilacs have perfumed and added beauty to cultivated gardens of the world for 300 years. Plant hunters brought the plant from Constantinople during the reign of Queen Elizabeth. Somewhere around the mid-1600's the Persian lilac, *S. X persica*, was introduced to English gardens. Strangely enough, in its native homeland of Bulgaria the lilac led an unknown existence until just a century ago. Then, too, about 60 years ago wildlilacs were found in Afghanistan as well as eastern Europe, India and far northern India. Studying these wild

types makes it apparent to what extent hybridization has altered and improved *Syringa*, until today there are 24 species and more than 500 cultivars, as compared to the original two species introduced to America in 1770.

Around the late 18th century the second hybrid, a cross between the Persian and common lilacs, made its debut in the Rouen Botanic Garden. Known correctly as *S. X chinensis*, and commonly called Chinese lilac, its name refers to its having grown for a century within the 2,000-mile Wall of China and gardens throughout the Far East. How it rooted there is a puzzle, but the theory is that aside from being domesticated in China it entered the Orient trade market by way of France or other European ports.

One French grower, most famous of all *Syringa* breeders, was Victor Lemoine of Nancy who started his work in 1850. Over many years he developed single, double and semi-double cultivars and was the originator of a double white lilac, 'Madame Lemoine', named for his wife. Hues and shades credited to Lemoine range from light blue, azure-mauve and violet to soft magenta, pink, rose, deep red and purple-

red, claret to carmine and purple. A list of 100 lilacs suggested for American and Canadian gardens, judged by their superior performance, was found to include 75 from the Lemoine nursery.

In 1920 additional work on the lilac was done at the Ottawa Experimental Farm under the auspices of Miss Isabella Preston. The result was an interbreeding of *S. reflexa* with *S. villosa*, a new species from China, which culminated in the later-blooming hybrid *S. X prestoniae*, a pink June-bloomer.

Syringas are now divided into these groups: early, mid-blooming and late lilacs. The table that accompanies this article lists several of the more desirable species and cultivars within each group.

As with many plants that have long been in cultivation, the lilac has an interesting history. Botanists have discovered new species, and horticulturists, gardeners and plantsmen have crossed, recrossed, selected and nurtured the syringas until there is a wealth of species and cultivars to choose from. Whether you select a rare, exotic species or fashion a lilac tree from a common sapling of *Syringa vulgaris*, consider a lilac for your garden. ☉

Selected Lilac Species

Horticulturists divide *Syringa* species into four groups according to their season of bloom. By selecting species and cultivars from each of the four groups, a gardener can have lilacs in bloom for at least five weeks, from early May through mid June.

GROUP ONE:

These are the early bloomers. In U.S.D.A. Zone 6 they bloom about May 10, and the farther north one gardens the later the flowering—conversely, the farther south, the earlier.

- *Syringa oblata*, an early lilac, bears dense, five-inch panicles of lilac-colored flowers. It has attractive orange and red autumn foliage, the only *Syringa* with this characteristic. Its buds may be damaged by harsh winters. Cultivars with both double and single flowers in shades of pink, reddish-purple, mauve, magenta and white are available. *S. oblata* var. *dilatata*, a naturally occurring variety with large, lilac-pink flower heads, is especially attractive. U.S.D.A. Zone 4.
- *Syringa X hyacinthiflora* (*S. oblata* X *S. vulgaris*), hyacinth lilac, also is an early bloomer. U.S.D.A. Zone 4.

GROUP TWO:

These species and their cultivars blossom with the common lilac, *S. vulgaris*, about 10 days after the plants in Group One, or approximately May 20 in U.S.D.A. Zone 6.

- *Syringa vulgaris*, common lilac, bears beautifully scented, lilac colored blooms. It is a vigorous plant with about a 10-day blooming period. White flowered 'Alba' is a popular and commonly seen cultivar, but there are over 400 other cultivars to choose from in all colors and with both double and single flowers.
 - *Syringa X chinensis* (*S. X persica* X *S. vulgaris*), Chinese lilac, also called Rouen lilac, reaches a height of about 15 feet and bears purple or lilac colored flowers. 'Saugeana' is a very attractive cultivar with deep-pink blossoms. U.S.D.A. Zone 3.
 - *Syringa X persica* (*S. afghanica* X *S. laciniata*), Persian lilac, bears masses of lilac colored flowers, almost to the point of hiding the foliage on plants that reach a height of 10 feet. U.S.D.A. Zone 5.
 - *Syringa laciniata* (formerly *S. X persica* var. *laciniata*), cut-leaf lilac, bears finely
- Continued on page 37

BIOLOGICAL CONTROL OF **INSECT PESTS**

SECOND OF A TWO-PART SERIES
BY MIGUEL ALTIERI, JUNJI HAMAI, ANN HAJEK and KATHY SHEEHAN.



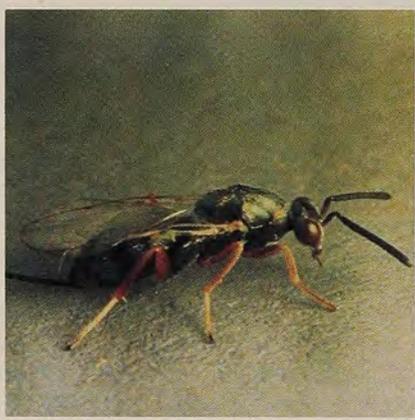
Assassin Bugs



Braconid Wasp



Brown Lacewing



Chalcid Wasp



Damsel Bug



Flower Bug or Minute Pirate Bug



Green Lacewing



Ground Beetle



Hover Fly or Flower Fly

All insect pests have natural enemies—predators, parasites and disease organisms—that feed on them and can control their populations with little or no human intervention. In fact, pest control practices such as insecticide use often kill beneficial predators and parasites in the garden, and without their natural enemies pest populations may rebound unrestrained. In this era of increased ecological awareness the use of beneficial insects and other organisms to control pests in the garden is a viable alternative to insecticide use. Such pest control by natural enemies is termed biological control.

The first step toward increased control by natural enemies is an increased knowledge of them. Twenty-five different natural enemy groups are described and discussed in the following paragraphs. Each group is extremely diverse and only the most common members are pictured and discussed. Natural enemies may be parasitic, predatory or they may cause disease in pest insects.

Biological control specialists have developed several different strategies for natural enemy use: importation—introduction of natural enemies from the homeland of a specific insect pest species; augmentation—periodic releases of large numbers of imported or native natural enemies; conservation—increasing the numbers of natural enemies by providing them with a favorable environment.

Conservation of natural enemies is the most useful strategy for the home gardener. Small changes in gardening practices may result in increased natural enemy populations. For example, growing plants that bear nectar will attract insect parasites and keep them in your yard. Spraying food supplements (mixtures of sugar, water and protein hydrolysate) can increase reproduction and thus populations of predaceous lady beetles and lacewings. Home gardeners also can augment the natural enemies in their gardens to control several different types of pests.

The following discussion describes the techniques for augmentation and conservation of natural enemies when this information is available. Many of the groups discussed occur naturally, but techniques have not yet been developed for home gardeners to effectively manipulate them. Learn

to recognize these beneficial species and allow them to remain in your garden. They definitely should not be sprayed with insecticide whenever possible.

Ants (Formicidae). This large, easily recognized family of insects is extremely common. Although generally ants are regarded as pests, this family contains many beneficial predatory species that aid in insect control. Ants have a complex social system with different castes performing different duties living together in a nest. Most ants are in the worker caste, the food gatherers. In spring, winged ants, the reproductive caste, often appear to mate and search for new areas to colonize. Ants make nests and search for food both on the ground and in trees and bushes. Probably man's earliest attempts at biological control were in China, where tree-dwelling ants were used to control citrus pests. In Europe, laws have been passed protecting the beneficial, pest-feeding ants. The ants' beneficial role is less well known in the United States. Our government has spent millions of dollars to control the imported fire ant, a species that lives almost entirely on insect prey (its sting is dangerous). Many ants are general predators beneficial to the garden, but ants that are associated with aphids, mealybugs and scales are detrimental. These ants obtain honeydew from pests and protect them from their natural enemies. Argentine ants, in particular, should be prevented from visiting plants by placing a sticky barrier around the plant stem.

Assassin Bugs (Reduviidae). Assassin bugs are "true bugs," that is, members of the insect order Hemiptera, a group of insects that use elongate sucking mouthparts, carried as a beak beneath the head, for feeding. The assassin bugs are medium to large sized, black or brownish and sometimes have bright-colored patches. Adults often are very mobile and will fly readily. The head is elongate, narrowing behind the eyes to appear neck-like. Nymphs appear similar to adults, but sometimes are camouflaged by debris that collects on the sticky hairs of their bodies. These voracious insects attack a wide variety of insects, including aphids, leafhoppers and caterpillars. Reduviids also can prey on beneficial insects such as honeybees and lady beetles. The giant wheel bug, *Arilus cristatus*, occurs from the southern United States north to Pennsylvania and can be important in gardens. It feeds on caterpillars and adult Japanese beetles.

Braconid Wasps (Braconidae). This is one of the most important groups of insect parasites. It is a varied group of wasps that mainly parasitizes caterpillars of moths and butterflies, immature beetles, flies, aphids and assorted other insects. Each braconid species may only parasitize one or two species of insects. Their life cycles are relatively short and several generations may occur per year. Adult braconids are mostly less than one-half-inch long, with delicate, thin bodies—not what most people envision as a "wasp." The adults feed mostly on flower nectar and honeydew. Egg laying and larval development is either outside or inside of the host, depending on the habitat of the host and the braconid species. One or more larvae may feed on one host. Parasitized insect pests will act sluggish, and once the wasp has pupated, the host skin may become a hardened shell (for example, golden aphid mummies), or the host may shrivel up as the parasite(s) emerge and spin cocoons externally. Braconids have been used very successfully in many biological control programs, including control of fern weevil, melon fly, Mediterranean fruit fly and satin moth. Flowers blooming in the garden may attract and keep braconid wasps in your garden.

Brown Lacewings (Hemerobiidae). Both the adults and larvae of brown lacewings eat aphids, mites, thrips, mealybugs, whiteflies, scales and a variety of other insects. The adults appear similar to green lacewings in form, although they often are smaller and are always brown. The voracious larvae have shorter, straighter mandibles than green lacewings. These mandibles are used for piercing a prey insect and sucking it dry. Most species overwinter as immatures or pupae within loosely woven, elliptical cocoons and are active primarily in the spring. Brown lacewings can develop at temperatures near freezing, so they may be useful for early season control of aphids when other kinds of biological control agents are not yet active. Efforts have been made to use brown lacewings in biological control programs involving aphids, scales and caterpillars. *Hemerobius* species have been manipulated with artificial food sprays in artichoke crops to reduce aphids, and some control of the artichoke plume moth also has been obtained.

Chalcid Wasps (Chalcidoidea). This is a broad group of small to tiny ($\frac{1}{32}$ -inch-long) wasps that are often metallic-colored, black or yellow. For this group, the

The authors work at the Division of Biological Control, University of California, Berkeley.

host range is extremely broad, including scales, mealybugs, aphids, moths, butterflies, flies and beetles. Individual species, however, often only parasitize one pest species. Adult wasps generally lay their eggs inside of host eggs or larvae. The adults feed on nectar and honeydew and often provide increased pest control by feeding on hosts. Larvae may occur singly in hosts,

or, in some cases, thousands of wasps may develop in one host. Chalcids are very important natural enemies in the garden and in agriculture. Various tree and bush scale species that have holes in them often have been parasitized by chalcids. The many generations of chalcids produced per year can help control scale insects, mealybugs and white flies. A chalcid species also is

important in controlling woolly apple aphid across the United States and Canada. Aphids parasitized by chalcids become hardened and black, and once the parasites emerge, there is a hole in the aphid's upper surface. Chalcids have been used in biological control projects against many different pests, including sugarcane leafhopper and cabbage butterfly. *Pediobius foveolatus*, a



Ichneumon Wasp



Lady Beetle



Lygaeid Bug



Praying Mantis



Predaceous Wasp



Rove Beetle



Golden Garden Spider



Tachina Fly



Fungi

parasite of the Mexican bean beetle, can be purchased for release and is an effective parasite of the larvae of this pest of garden beans.

Damsel Bugs (Nabidae). These small- to medium-sized true bugs have narrow bodies and front legs enlarged for grasping. All the species are predaceous. Damsel bugs frequent low-growing plants and feed on aphids, mites, leafhoppers, psyllids, plant bugs and caterpillars. *Nabis americanoferus* is a common enemy of the potato psyllid, the sugar beet leafhopper, the red-headed pine sawfly and the meadow plant bug. Damsel bugs commonly are found throughout the United States, Mexico and eastern Canada. They are considered important general predators in cotton fields.

Flower Bugs or Minute Pirate Bugs (Anthracoridae). These are black insects with white markings and are only $\frac{1}{8}$ to $\frac{1}{4}$ inch in length. Adults and immatures of these "true bugs" appear similar, although the immatures do not have wings. The best known predator of this family is the insidious flower bug, *Orius insidiosus*, which sucks the body fluids of a variety of prey including thrips, mites, aphids, leafhoppers, moth and butterfly eggs and other soft-bodied insects and eggs. Its eggs are placed in plant tissue, and the nymphs can consume from 30 to 40 mites per day. This species is a fairly effective predator of corn earworm eggs as well as young caterpillars. It is not unusual to find 15 of these bugs on a single corn plant. Minute pirate bugs are important general predators in any garden.

Green Lacewings (Chrysopidae). Green lacewings prey on many agricultural pests, including scales, mealybugs, aphids, mites, leafhoppers and moth and butterfly eggs. The adults of some common species are not predaceous but feed on honeydew, pollen and nectar. Lacewing eggs, characteristically born on long, slender stalks, are commonly found in groups or singly on foliage. The predaceous larval stages do not resemble adults, instead elongate, mobile larvae are nearly dragon-like with large scimitar-shaped mandibles. Larval stages of some species carry trash over their backs for concealment. Their cocoons are white, nearly spherical in shape and parchment-like. Some species pupate in protected places and others spin cocoons on leaves. The adults are bright green with golden eyes and have four large, lacy wings. Increase the abundance and effectiveness of lacewings by applying supplementary

food in the field. Spraying sucrose solutions can congregate lacewing adults. Adults also can be attracted by spraying yeast products or yeast hydrolysate plus sugar, and this combination stimulates egg production. Scientists have observed increased predation of aphids by green lacewings in cotton, corn, green peppers, potato and alfalfa plots sprayed with food supplements. The eggs of green lacewings are commercially available through biological control companies.

Ground Beetles (Carabidae). A common family of beetles that are mostly predaceous, these insects are moderate to large in size ($\frac{1}{4}$ to 1- $\frac{1}{4}$ inches) usually dark in color and shiny or iridescent. They have a strong head and prominent mandibles. Some species eject an offensive fluid when disturbed. During the day they are commonly found under rocks and debris and they run rapidly on long legs when disturbed. They will seldom fly. These beetles are mainly active at night. Most species are ground dwellers, but others, such as *Lebia* spp. and *Calosoma* spp., are partly arboreal and can be found attacking insects on plants. The larval stages resemble caterpillars. Larvae are predators in the soil, in debris or under bark, and they may feed on different prey than adults. Most ground beetles pupate in the soil, often at a considerable depth. Many members of this family have an annual cycle and pass the winter in the adult stage. Most species are general predators although some species eat only snails, others eat only caterpillars. Voracious appetites and good searching powers make these beetles very important components of natural control. One species, *Calosoma sycophanta*, was imported from Europe to help control the gypsy moth and is now established over a wide part of North America.

Hover Flies or Flower Flies (Syrphidae). Most common hover flies are slightly larger than house flies and are more slender. They are brightly colored, often with stripes or bands, and are frequently seen hovering, remaining in one place and then darting to another. The adults feed on flower nectar and pollen and lay eggs amongst insect pests. The larval stages are voracious, eating aphids especially, but also leafhoppers, scale insects and mealybugs. The larvae do not look like the adults. They are usually green or grayish in color, soft-bodied, slug-like and taper at one end. They are not very mobile. The most common species in the West, *Eupeodes volucris*, feeds on seven

different species of aphids and completes a life cycle from egg to adult in 22 days. Hover flies that feed on mealybugs and aphids often have five to seven generations per year, thus feeding on pests during a large part of the spring, summer and fall. Home gardens may benefit by having blooming flowers that attract and feed egg-laying, adult hover flies.

Ichneumon Wasps (Ichneumonidae). Closely related to the Braconidae, this large and varied group of wasps also is parasitic on other insects. Its main hosts are caterpillars of moths, butterflies and sawflies. Often a wasp species will parasitize only one or two species of insect. The adult's form and feeding habits are similar to those of the braconid wasps, although ichneumonids are frequently longer than one-half inch. They lay their eggs in, on or near a host. The whitish, legless larval stages do not look at all like the adults. Immature stages of this wasp most frequently develop inside the host, although sometimes development occurs outside. The host often is killed when the immatures are ready to become adults. Metamorphosis usually occurs in a cylindrical cocoon on foliage or in the soil. Many generations may occur per year, so that pest control is efficient since these wasps can multiply quickly. Some species have only a single generation each year. The life cycle of each species usually is correlated with that of the host. Ichneumon wasps have been used extensively for biological control on insect pests, including gypsy moth, European corn borer, European shoot moth and European spruce sawfly. In the garden, ichneumon wasps are helpful enemies of many insect pests where they help decrease pest populations and prevent outbreaks.

Lady Beetles (Coccinellidae). This is the most widely known group of beneficial insects, and a very important family of beetles. Almost all of them are predaceous. They are commonly encountered in a variety of habitats associated with prey. Generally, adults are hemispherical in shape, many are brightly colored and they are small to medium in size ($\frac{1}{16}$ to $\frac{1}{4}$ inch). The predaceous larval stages are very mobile, small, elongate and dark in color. They often have patches of colors and spines. Although some lady beetles feed on a limited variety of prey such as spider mites and scale insects, most are general feeders on any small, soft-bodied insects, especially aphids. Many species have successfully been imported for biological

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control. For example, the Vedalia beetle, *Rodolia cardinalis*, is used against cottony cushion scale on citrus. Another species, commonly called the imported mealybug destroyer, *Cryptolaemus montrouzieri*, has been mass-produced in laboratories and used by the citrus industry to control mealybugs. The convergent lady beetle, *Hippodamia convergens*, can be purchased for release in home gardens. Most of these beetles are collected while they are dormant and when released they will fly away before searching for food, so this is not necessarily an effective way to introduce them to your garden. Lady beetles collected while active and released in your garden are usually reproductively mature and may lay eggs as well as feed on pests.

Lygaeid Bugs (Lygaeidae). Most lygaeid bugs, another family of true bugs, are plant feeders, although some are predators. Nymphs eat the same food and live in the same habitat as the adults. The most common predators in this group are the big-eyed bugs, *Geocoris* species, which feed on mites, aphids, plant bugs and some insect eggs. One big-eyed bug can consume up to 80 red mites per day. *Geocoris* deposits its eggs singly on plant surfaces and the cycle from egg to adult is complete in about 30 days. Some *Geocoris* do considerable plant feeding to complement their diet of insects. Large numbers of *Geocoris* can be found on weedy plants, and these insects are common in many crops such as cotton, corn and soybeans.

Praying Mantids (Mantidae). The praying mantid is a large, elongate, brown or green, rather slow-moving insect when not attacking prey. Its front legs are long and are fitted with strong spines to grasp prey. The head is highly movable. Nymphal stages closely resemble adults, although they cannot fly. Both nymphs and adults are predaceous on all kinds of insects, including other beneficial insects. Usually one generation occurs per year, and the insect overwinters in the egg stage. Eggs are deposited in large packets (200 or more eggs) upon twigs, stems, fences, etc. They are deposited in rows covered by a hardened case. *Stagmomantis carolina*, a native American species of praying mantid, occurs in the southern United States. It is a voracious predator of boll weevil, bollworm moths and other common cotton pests. This species often is found in high bushes and perennial weeds. Two species have been introduced into the United States: *Mantis religiosa* from Europe and *Ten-*

odera aridifolia from China and Japan. These imported insects frequently do not survive the winter, so egg cases can be purchased and affixed to a fence in the garden in spring. Mantids do not assure extensive pest reduction, however, because they may feed on non-pest insects or leave if pests are not abundant.

Predaceous Mites (Phytoseiidae). This is an important family, whose members are mostly predaceous on plant-feeding mites, although some species feed on pollen when prey is unavailable. These mites usually regulate pest mite populations below damaging levels unless interfered with by insecticides. They are small in size (less than 1/16 inch long), generally pear-shaped and shiny. They exhibit rapid motion when searching for prey. Predaceous mites naturally occur in a variety of habitats. They are commonly used, especially in European greenhouses, for control of the two-spotted spider mite. These mites also can be purchased for release in the home garden. Currently work is being done to produce insecticide-resistant strains.

Predaceous Wasps (Sphecidae and Vespidae). These wasps are small to large in size and usually black, often with yellow or white markings. Wasp predators can be very important in the garden. Paper-nest wasps and potter wasps (in the family Vespidae) prey on caterpillars, using their stingers to paralyze their prey. These wasps carry their prey (whole or chewed) to a nest to provide food for their larvae. Adults often eat pollen and nectar. Vespids are social wasps that build community nests inhabited by several castes. Artificial nests made of wood or bamboo have proven to increase caterpillar predation when provided in cotton, corn and tobacco fields. The solitary wasps (Sphecidae) frequently make their nests in the soil where adults supply food for offspring. Sphecid prey preferences are varied and include grasshoppers, beetles, caterpillars, flies, cockroaches and many others, but individual species usually are specific regarding their prey. The solitary wasp, *Larra americana*, was introduced into Puerto Rico and successfully controls mole crickets in sugar cane fields. The presence of weeds and providing flower nectar for adult wasps helped these wasps become established.

Rove Beetles (Staphylinidae). This is a large, common family of beetles with many predaceous and a few parasitic members. Flat, long-bodied adults with forewings covering only a part of the abdomen are

characteristic. They are mostly dull black and moderate in size (1/4 to 1 1/4 inches). They commonly curl their abdomen up and over their body when disturbed, and some can excrete an offensive fluid. These beetles are active hunters that rapidly move over foliage or ground in search of food. Caterpillar-like larvae are predators in the same habitats as adults. Rove beetles feed on a wide variety of prey. Some exclusively eat mites, others eat snails or slugs, but most eat soft-bodied insects. These beetles can be important pest control agents in the garden since they are so common. One rove beetle species, *Coprochara bilineata*, is an important enemy of the cabbage maggot. It tunnels through the soil and parasitizes maggot pupae. Another species, *Somatium oviformis*, is an efficient predator of red spider mites on citrus trees in California.

Spiders (Araneida). This extremely large and diverse group of predators is poorly studied partially due to the bad image it has in the public eye. The few studies of their habits have proven them to be extremely important in the natural control

of many insects pests. Spiders are not insects, since they have eight legs and a body divided into two main parts. Spider eggs are laid in masses covered with silk and often are attached to vegetation. Spiderlings often climb foliage upon emerging, let out a silken thread and are carried by the wind to another area. They are usually general feeders, eating what they catch. The better known spiders, the web spinners, passively wait for prey, eating only food that they catch in their webs. Other spiders actively hunt for their prey. The wolf spiders, Lycosidae, and the jumping spiders, Salticidae, both actively hunt their prey, some at night and some in the daylight hours.

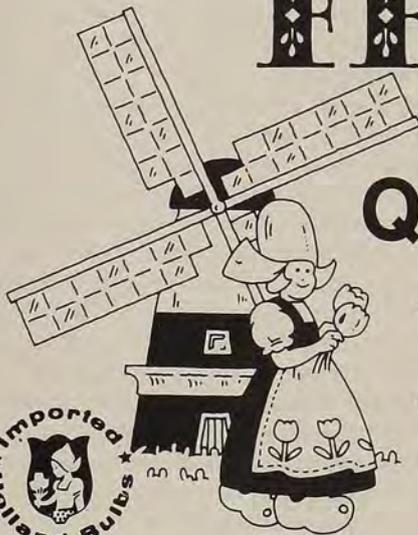
Tachina Flies (Tachinidae). This is an important family of parasitic flies, and some of its members are quite common. They most often attack caterpillars and immature and adult beetles but will sometimes parasitize true bugs, grasshoppers and earwigs. Adults often resemble house flies, are usually moderate-sized, dull-colored and very bristly. Adult tachinids are strong, swift fliers, and they feed on flower nectar,

honeydew and other plant exudates. They lay their eggs either in or on the potential host or on foliage where the eggs can be eaten by a host. Most species hibernate in the pupal stage, and in temperate zones they produce one generation per year. Generally, a tachinid species is associated with only one or a few pest species. Larvae are legless maggots that live inside the host, feed on it and kill it once the maggot is mature. Hosts infested with tachinid larvae may appear sluggish. Although tachinids do not immediately kill their hosts and stop host feeding, they prevent reproduction of pests and check pest outbreaks. Tachinids have proven to be efficient biological control agents. A few common garden pests that may be controlled by tachinids are armyworms, cutworms, Japanese beetles, European corn borers and gypsy moths.

Trichogramma wasps (Trichogrammatidae). These minute wasps are all parasites of insect eggs. Often several individuals will develop in one host egg. The winged adults are very small (hardly visible to the naked eye) and are very effective in their

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INSECT PESTS CONT'D

search for host eggs, since they are able to fit in crevices, between leaves and the like. *Trichogramma* eggs are laid inside host eggs. Once host eggs have been parasitized, they darken, and this is possibly the only sign one may see of these natural enemies since they are so small. The cycle from egg to adult takes seven to 10 days. Generation after generation are produced without interruption as long as suitable host eggs are available and environmental conditions remain favorable. The host range of this group is very broad, although the eggs of moths and butterflies are major hosts. *Trichogramma* are being used extensively in biological control today in a different way than other natural enemies. These wasps are mass-produced and inundatively released to control many agricultural insect pests, including codling moth, corn earworm, spruce budworm and sugarcane borer.

ORGANISMS

Bacteria. Bacteria are unicellular, microscopic organisms that can cause disease in insects after being consumed. They have been used effectively in pest control more than any other insect disease, and they will kill many different kinds of insects, including grasshoppers, white grubs, mosquito larvae, caterpillars and honey bees. They are often quite specific one—one bacteria species affects only a few insect species. The most widely known beneficial bacteria are *Bacillus popilliae*, which cause milky disease in Japanese beetles, and *Bacillus thuringiensis* (BT), which affect a wide range of caterpillars. Caterpillars infected with BT usually stop feeding a few hours after infection and remain on the plant for two to four days before dying. Caterpillars often turn a dark color after death. Predators and parasites in the garden are not directly affected, so this is a control strategy compatible with natural enemy use. BT is commercially available in nurseries and hardware stores under several different brand names. Take care to follow the label instructions and to spray these products on the plant parts or soil where pests are feeding.

Fungi. Fungi are a group of microorganisms that feed on other organisms or decaying matter. Some fungi specialize in feeding on insects. Normally, fungi gain entry through contact with the insect's skin. Infected insects may become hard and cheese-like after death. Sometimes fine, white fungal strands may protrude from a dead insect's skin. Some fungi affect many

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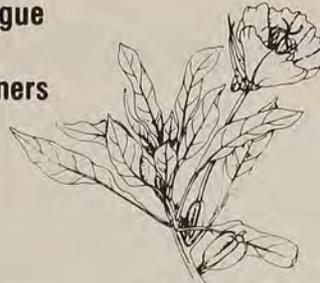
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hosts, like the white muscardine fungus, *Beauveria bassiana*, which infects over 70 insect species. Others are more specific, like *Aspergillus flavus*, which infects only house fly maggots. Fungi that attack insects occur naturally in many areas, however, most fungi have specific temperature and moisture requirements that limit any widespread commercial use for insect control. When conditions are favorable fungi may be quite important in controlling pests. During warm, humid weather, the white muscardine fungus can effectively control chinch bugs, an important pest of cereal crops. Aphid populations can be decimated by fungi during rainy periods in the springtime.

Nematodes. Nematodes, or roundworms, are small, worm-like animals barely visible to the naked eye. Some nematode species feed internally on animals. Insect-attacking nematodes sometimes kill their hosts and can significantly reduce populations of certain groups of insects. Nematodes attack grasshoppers, cockroaches, Colorado potato beetle, codling moth and other insect species. Infected insects are sluggish, and sometimes teeming masses of nematodes are visible inside of them. Nematodes often kill their hosts upon emerging from them, and they also may affect insect pests by transmitting diseases. Although nematodes are not widely used for insect control, some species have been mass produced in the laboratory and sprayed on insect pests such as codling moth, tobacco budworm and Japanese beetle with successful results. The success of such applications may be highly dependent on weather conditions.

Protozoa. Protozoa are a diverse group of tiny, one-celled animals. Many protozoan species are parasites of insects and have a wide range of distribution and specificity as to their host species. Usually protozoa build up slowly in numbers and eventually kill their host. Infected insects often are inactive. They also may change in body size and frequently turn dull and milky-colored, possibly with dark-brown spots. *Nosema* is a common genus of insect-parasitic protozoa infecting many different types of insects. *Nosema locustae* causes a disease of grasshoppers. A distribution of one million spores of *Nosema* per acre has reduced grasshopper populations by 50 percent. Another *Nosema* species has shown promise in field tests against the spruce budworm, an important forest pest. These protozoa form resting

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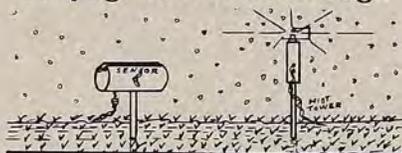
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INSECT PESTS CONT'D

spores in the cells of immature budworms, and the spores then pack the alimentary canal and disrupt food digestion. Some budworms are killed outright, and those that survive produce fewer eggs. The disease also appears to persist into subsequent generations. Protozoa are not widely available to the home gardener, although preparations for grasshopper control are commercially available.

Viruses. Viruses are submicroscopic entities that can only reproduce inside plants or animals. There are over 250 viruses that attack only insects (over 700 species), and they often are lethal. Hosts include many types of caterpillars (cutworms, tent caterpillars, cabbage loopers, tobacco budworms, bollworms, codling moths, corn earworms), fly maggots and sawflies. Most viruses that affect insects are either nuclear polyhedrosis viruses (NPV) or granulosis viruses (GV). Usually viruses attack immature stages, but older larvae are less susceptible than younger ones. Infected insects may show no signs of disease at first, but before death they will stop feeding and become limp. After death they hang from plants, their body tissues disintegrate and the skin becomes a sack holding body fluids. Viruses spread when the skins of dead insects split open and fluids are released, or when infected adults survive and pass the virus on to their eggs. Viruses are most effective at controlling insect pests during pest epidemics. Solutions made of diseased larvae have been sprayed on fields to successfully start viral epidemics of alfalfa caterpillars and cabbage loopers. The pace of research on viruses has increased, and, although no insect viruses are commercially available for home garden use, NPV viruses for gypsy moth and Douglas-fir tussock moth have been registered with the EPA for agricultural and forestry use. ☼

SOURCE LIST FOR INSECTS

The numbers following these pest control agents correspond to the numbers on the list of suppliers below.

- Armyworm parasite, *Chelonus texanus* 14, 17
Bacillus thuringiensis, BT, Biotrol®, Dipel®, Thuricide®, 13, 14, 20
 Fly parasites, *Spalangia endius*, *Muscidifurax raptor*, *Pachycrepoides vindemiae*, *Tachinaephagus zealandicus* 2, 3, 4, 7, 14, 15, 17, 18
 Lacewings, green, *Chrysopa carnea* 3, 7, 14, 15, 17, 19

- Ladybugs, *Hippodamia convergens* 9, 11, 12, 13, 14, 15, 17, 19, 20
 Mealybug destroyer, *Cryptolaemus montrouzieri* 1, 10, 14
 Milky disease spore powder, for control of Japanese beetles, sold as Doom, Milky Spore Powder and Japidemic 10, 16
 Parasitic wasps, *Trichogramma* species 3, 7, 9, 10, 11, 14, 15, 17, 18, 19
 Predatory mites, *Amblyseius californicus*, *A. bibisci*, *Metaseiulus occidentalis*, *Phytoseiulus persimilis* 5, 6, 13, 17
 Praying mantis egg cases 9, 10, 11, 12, 13, 14, 15, 19, 20
 Scale parasites: Black scale, *Metaphycus helvolus* 13, Red scale, *Aphytis melinus*, *Comperiella bifasciata* 8, 14, 17
 Tomato pinworm parasite, *Apanteles scutellaris* 14, 17
 Whitefly parasite, *Encarsia formosa* 5, 14, 17

1. Associates Insectary, PO Box 969, Santa Paula, CA 93060
2. Beneficial Biosystems, 1523 63rd Street, Emeryville, CA 94608
3. Beneficial Insects, Ltd., PO Box 154, Banta, CA 95304
4. Beneficial Insectary, 2544 B First Avenue, San Bernardino, CA 92495
5. Better Yield Insects, Mrs. Pat Reeves, 13310 Riverside Drive, Tecumseh, Ontario, Canada N8N 1B2
6. Biotactics, 22412 Pico Street, Colton, CA 92324
7. California Green Lacewings, PO Box 2495, Merced, CA 95340
8. Foothill Agricultural Research, Inc., 510 W. Chase Drive, Corona, CA 91720
9. Gurney Seed and Nursery Company, 2nd and Capital, Yankton, SD 57078
10. King Labs, Box 69-G, Limerick, PA 19468
11. Mellinger's Nursery, 2310 W. South Range Road, North Lima, OH 44452
12. Natural Pest Control, 9397 Premier Way, Sacramento, CA 95826
13. Orcon Organic Control, Inc., 5132 Venice Boulevard, Los Angeles, CA 90010
14. Peaceful Valley Farms, Route 1, Box 319, Nevada City, CA 95959
15. Pyramid Nursery, 4640 Attawa Avenue, Sacramento, CA 95822
16. Reuter Laboratories, Inc., 2405 James Madison Highway, Haymarket, VA 22069
17. Rincon Vitoya Insectaries, Inc., PO Box 95, Oakview, CA 93022
18. Spalding Laboratories, Route 2, Box 737, Arroyo Grande, CA 93520
19. Unique Nursery, PO Box 22245, Sacramento, CA 95822
20. W. Atlee Burpee Company, Inc., Warminster, PA 18991

Photos of insect pests courtesy of: Oregon State University Extension Service and Barbara W. Ellis.

PHOTOGRAPHING PLANTS CONT'D

Continued from page 13

magnification at a working distance of about 18 inches, but systems using a 50mm lens require a working distance of about two inches to achieve the same result. This extra distance allows for much greater freedom of composition, since you don't have to be concerned about shadows from your equipment falling on the subject and can therefore shoot from just the right angle.

My own rule of thumb for selecting film is "the slower the better." The fine grain of a film like Kodachrome is ideal for capturing the subtle detail so important in successful close-ups. However, I must often

sacrifice this luxury when shooting on windy days (when my subjects are rarely stationary for long) and when using my macro lens handheld. Experimenting with different kinds of film under a variety of conditions will lead you to the choices that best suit your own style.

I hope this information will get you started in the fascinating world of flower photography. The season for enjoying flowers outdoors is all too short. With a little practice, you will be able to begin building a library of your favorite blossoms that will be a constant source of enjoyment throughout the year. ☉

Comparison of Magnification & Working Ranges*

Lens/Accessories	Magnification Range (Subject Width)**	Working Range***
Standard 50mm	Inf.-0.14x (Inf.-9.5")	Inf.-13.5"
Std. 5mm, +1 Diopter Supplementary Lens	0.05 × -0.19 × (28.0"-7.25")	40.0"-10.0"
Std. 50mm, +2 Diopter Supplementary Lens	0.010 × -0.27 × (13.25"-5.5")	19.0"-8.0"
Std. 50mm, +4 Diopter Supplementary Lens	0.20 × -0.34 × (6.75"-4.0")	10.0"-5.75"
Std. 50mm, 12mm Extension Tube	0.23 × -0.36 × (6.0"-3.75")	8.5"-5.25"
Std. 50mm, 20mm Extension Tube	0.36 × -0.51 × (3.75"-2.63")	5.25"-3.5"
Std. 50mm, 12 & 20mm Extension Tubes	0.6 × -0.77 × (2.25"-1.75")	3.0"-2.5"
Std. 50mm, 36mm Extension Tube	0.68 × -0.83 × (2.0"-1.63")	2.75"-2.25"
Std. 50mm, 12 & 36mm Extension Tubes	0.9 × -1.0 × (1.5"-1.25")	2.0"-1.75"
Std. 50mm, 12,20 & 36mm Extension Tubes	1.4 × -2.14 × (1.0"-0.63")	1.25"-1.0"
50mm Macro Lens	Inf.-0.5 × (Inf.-2.75")	Inf.-4.0"
50mm Macro Lens, 25mm Extension Tube	0.5 × -1.0 × (2.75"-1.38")	4.5"-2.25"
Std. 50mm + Extension Bellows	0.67 × -3.6 × (2.0"-0.38")	2.5"-0.25"
Std. 100mm + Extension Bellows	0.37 × -2.0 × (3.6"-0.69")	14.5"-6.0"
Std. 200mm + Extension Bellows	0.19 × -1.0 × (7.25"-1.38")	52.0"-17.5"

*All measurements are approximate and may vary slightly depending on the specific equipment used.

**"Subject Width" refers to the size of a subject that will fill the width of the frame when the camera is held horizontally.

***"Working Range", or Working Distance, is measured from the front of the lens to the subject.

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PRONUNCIATION GUIDE

Guide to Botanical Names in This Issue

The accent, or emphasis, falls on the syllable that appears in capital letters. The vowels that you see standing alone are pronounced as follows:

i—short sound; sounds like i in “hit”
o—long sound; sounds like o in “snow”
a—long sound; sounds like a in “hay”.

Agave ah-GAH-vee
Aloe polyphylla AL-oh-ee pol-ee-FILL-ah
Arisaema sikokianum
air-iss-SEE-ma si-ko-kee-A-num
Athyrium goeringianum
ah-THIGH-ree-um gair-ring-ee-A-num
Capsicum annuum CAPS-i-kum AN-you-um
C. frutescens c. fru-TESS-enz
Clematis viticella
CLEM-ah-tiss vy-ti-SELL-ah
Cycas circinalis SY-kas sir-sin-AL-iss
Cypripedium calceolus var. *parviflorum*
sip-ri-PEE-dee-um cal-see-O-lus
par-vi-FLOR-um
C. candidum
c. can-DEE-dum/CAN-did-um
C. speciosum c. spee-see-O-sum
Dicentra peregrina
dy-SEN-tra pair-eh-GRY-na
D. spectabilis d. speck-TAB-i-lis

Enkianthus campanulatus var. *palibinii*
enk-i-AN-thuss cam-pan-you-LAY-tuss
pal-i-BIN-ee-eye
E. cernuus var. *rubens*
e. SIR-new-us REW-benz
E. perulatus e. pair-you-LAY-tuss
Epimedium X youngianum
ep-i-MEAD-ee-um yung-ee-A-num
Ficus benghalensis
FY-kus ben-gal-EN-sis
Franklinia alatamaha
frank-LIN-ee-ah ah-la-ta-MA-ha
Hakonechloa macra
ha-ko-nee-KLO-ah MACK-ra
Hedyotis michauxii
head-ee-O-tiss mish-O-ee-eye
H. serpyllifolia h. sir-pill-i-FO-lee-ah
Houstonia hew-STONE-ee-ah
Hydrangea anomala subsp. *petiolaris*
hy-DRAN-gee-ah an-NOM-ah-la
pet-ee-o-LAIR-iss
Iris cristata EYE-riss cris-TAY-ta
Juniperus chinensis var. *procumbens*
jew-NIP-er-us chi-NEN-sis pro-KUM-benz
J. rigida j. RIDGE-i-da
Lycopersicon lycopersicum var. *cerasiforme*
ly-ko-PER-si-kon ly-ko-PER-si-kum
sir-ass-i-FOR-me
L. lycopersicum var. *commune*
l. ly-ko-PER-si-kum ko-MEW-nee
L. lycopersicum var. *pyriforme*
l. ly-ko-PER-si-kum py-ri-FOR-me
Maianthemum canadense
my-AN-the-mum can-a-DEN-see
Menziesia purpurea
men-ZEES-ee-ah poor-poor-E-ah
Microbiota decussata
my-kro-by-O-ta dee-ku-SA-ta
Piper nigrum PY-per NY-grum
Polygonatum falcatum
po-lig-o-NAY-tum fal-KAY-tum
P. japonicum p. ja-PON-i-kum
P. pumile p. PEW-mil-ee
Primula acaulis PRIM-yew-la a-KAW-liss
P. alpicola p. al-pi-KO-la
P. auricula p. aw-RICK-you-la
P. clarkei p. CLARK-eye
P. denticulata p. den-tick-you-LAY-ta
P. elatior p. ee-LAY-tee-or
P. florindae p. flor-IN-dee
P. japonica p. ja-PON-i-ka
P. juliae p. JEW-lee-ee
P. marginata p. mar-gin-A-ta
P. X polyantha p. pol-ee-AN-tha
P. pubescens p. pew-BES-enz
P. rosea p. ROSE-ee-ah
P. rubra p. REW-bra

P. sieboldii p. see-BOLD-ee-eye
P. sikkimensis p. see-kim-EN-sis
P. veris p. VER-iss
P. viscosa p. vis-KO-sa
P. vulgaris p. vul-GAY-riss
Rhododendron carolinianum
ro-do-DEN-dron ca-ro-lin-ee-A-num
R. kiusianum r. key-use-i-A-num
R. prinophyllum r. prin-o-FILL-um
R. racemosum r. ray-see-MO-sum
R. radicans r. RAD-i-kanz
Saxifraga stolonifera
sacks-i-FRAYGE-ah sto-lo-NIFF-er-ah
S. sarmentosa s. sar-men-TOE-sa
Solanum melongena var. *esculentum*
so-LAN-um mel-on-GEE-na
ess-kew-LENT-um
S. tuberosum s. too-bur-O-sum
Syringa afghanica sa-RING-ga af-GAN-i-ka
S. X chinensis s. chi-NEN-sis
S. emodi s. ee-MO-dee
S. X henryi s. HEN-ree-eye
S. X hyacinthiflora s. hy-ah-sin-thi-FLOR-ah
S. X josiflexa s. jo-si-FLEX-ah
S. josikaea s. jos-SEEK-ee-ah
S. julianae s. jewl-ee-AN-ee
S. komarowii s. KO-mare-o-ee-eye
S. laciniata s. la-sin-ee-A-ta
S. meyeri s. MY-er-eye
S. microphylla s. my-kro-FILL-ah
S. oblata s. ob-LAY-ta
S. oblata var. *dilatata* s. o. dill-i-TAY-ta
S. patula s. PAT-too-la
S. pekinensis s. pee-ki-NEN-sis
S. X persica s. PER-si-ka
S. potaninii s. po-TAN-in-ee-eye
S. X prestoniae s. PRES-ton-ee-ee
S. pubescens s. pew-BES-enz
S. reflexa s. ree-FLEX-ah
S. reticulata s. re-tick-yew-LAY-ta
S. X swegiflexa s. swedge-i-FLEX-ah
S. sweginzowii s. swedge-ins-OW-ee-eye
S. tomentella s. toe-men-TELL-ah
S. villosa s. vill-O-sa
S. vulgaris s. vul-GAY-riss
S. wolfii s. WOLF-ee-eye
S. yunnanensis s. you-nan-NEN-sis
Theobroma cacao tey-o-BRO-ma ka-KAY-o
Tiarella cordifolia
tee-ah-RELL-ah cor-di-FO-lee-ah
Tricyrtis macrantha
try-SIR-tuss ma-KRAN-tha
Trillium grandiflorum
TRILL-ee-um grand-i-FLOR-um
Tsuga canadensis SUE-ga can-ah-DEN-sis
Welwitschia bainesii
well-WITCH-ee-ah BAYNES-ee-eye
Zizyphus jujuba ZIZZ-i-fuss who-WHO-ba

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Continued from page 2

textured, lobed foliage and tiny, pale-lilac, star-like flowers. It makes an excellent accent plant. U.S.D.A. Zone 5.

- *Syringa pubescens*, hairy lilac, is praised as the most fragrant lilac, although its flowers are perhaps not as lovely as the Chinese, Persian or cultivars of the common lilac. It is a six-foot plant with pale-lilac flowers. U.S.D.A. Zone 6.

- *Syringa microphylla*, littleleaf lilac, is a small shrub with three-inch panicles of lilac colored flowers. 'Superba' is a particularly attractive cultivar with deep-pink flowers. U.S.D.A. Zone 4.

- *Syringa patula*, Manchurian lilac, bears 2½ to eight-inch panicles of lilac colored flowers on shrubby, 10-foot plants that are not particularly attractive. U.S.D.A. Zone 4.

- *Syringa potaninii*, Potanin lilac, bears loose, erect panicles of fragrant white to rose-purple flowers on graceful shrubs that can reach a height of 12 feet. U.S.D.A. Zone 6.

- *Syringa meyeri*, Meyer's lilac, has four-inch-long panicles of violet-purple flowers. It is an attractive dwarf shrub. U.S.D.A. Zone 6.

- *Syringa julianae*, the julianna lilac, is distinguished by its fragrant flowers, pubescent leaves and four-inch, purple-lilac panicles of flowers. It is a six-foot shrub, U.S.D.A. Zone 6.

GROUP THREE:

These species bloom on or about June 5 in U.S.D.A. Zone 6.

- *Syringa X josiflexa* (*S. josikaea* X *S. reflexa*), an attractive hybrid with pendulous flowers, is available in several cultivars, including 'Guinevere', with orchid-purple flowers; 'Isabella' with pink flowers; 'Audrey', a phlox-purple and 'Hande', a rose fading to white.

- *Syringa X henryi* (*S. josikaea* X *S. villosa*), Henry lilac, bears large, delicate, lavender to pale-violet-purple plumes that, alas, lack the delightful lilac fragrance.

- *Syringa villosa*, late lilac, bears foot-long terminal panicles of lilac or pinkish-white flowers on 10-foot plants.

- *Syringa josikaea*, Hungarian lilac, is a tough plant with glossy foliage that is able to withstand drastic pruning. Unfortunately, its lilac-violet flowers are not as attractive as some of the other species.

- *Syringa reflexa*, nodding lilac, bears drooping, seven-inch racemes of pinkish flowers that are not considered fragrant.

- *Syringa X sweginzowii* (*S. reflexa* X *S.*

sweginzowii), Sweginzowii lilac, is perhaps better known in Scandinavia. It bears long panicles of fragrant, coral-pink flowers.

- *Syringa emodi*, Himalayan lilac, has six-inch panicles of lilac or whitish flowers.

- *Syringa komarowii*, komarof lilac, bears nodding panicles of lilac colored flowers.

- *Syringa sweginzowii*, Chengtu lilac, bears lilac colored panicles of flowers on plants that can reach a height of 10 feet.

- *Syringa tomentella*, felty lilac, has leaves that are pubescent underneath and bear seven-inch panicles of lilac and whitish flowers.

- *Syringa wolfii*, wolf lilac, bears one-foot panicles of lilac colored flowers.

- *Syringa yunnanensis*, Yunnan lilac, bears pink flowers in six-inch panicles on plants that can reach a height of 10 feet.

GROUP FOUR:

This last group of lilac species blooms around June 15 in U.S.D.A. Zone 6, much later than many people expect to see lilacs in bloom.

- *Syringa pekinensis*, Pekin lilac, bears six-inch panicles of yellowish-white flowers and will reach a height of about 15 feet.

- *Syringa reticulata*, Japanese tree lilac, is a small tree that reaches a height of about 15 feet and bears foot-long panicles of yellowish-white flowers.

SOURCE LIST

Syringa vulgaris, French cultivars only:
Inter-state Nurseries, Hamburg, IA
51644

Gurney's Seed and Nursery Company,
Yankton, SD 57079

J.E. Miller Nurseries, Inc., Canandaigua,
NY 14424

The following sources list several species
and cultivars of *Syringa*.

W. Atlee Burpee Company, Warminster,
PA 18991

Carroll Gardens, P.O. Box 310,
Westminster, MD 21157

Wayside Gardens Company, Hodges, SC
29695, catalogue \$1.00 deductible.

White Flower Farm, Litchfield, CT
06759, catalogue subscription, which
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COLORADO ROCKIES (July 7-17)

Once again we offer this exciting exploration of Colorado. We visit nurseries, the Botanic Garden, and private gardens in Denver. Also see the resort towns of Vail, Aspen, Colorado Springs and Durango; Mesa Verde and Rocky Mountain National Parks. Enjoy an authentic narrow-gauge railroad ride, see Pikes Peak. A local Colorado horticulturist gives us an in-depth view of the local flora.

CHINA AND THE GRAND CANAL (September 7-30)

An unusual adventure to an unusual country. We fly to Tokyo for visits to bonsai nurseries, and on to the People's Republic of China. The formal Chinese garden makes use of courtyards, rocks, and buildings. We see the famous gardens of Soochow and Shanghai, the Great Wall and Ming Tombs near Peking. Western-style Nan-king, and a week cruising on the Grand Canal. Accommodations in China include guest houses usually reserved for foreign dignitaries.

Other horticultural explorations available in 1982 are: **Middle Atlantic States (April 26-May 6)**; **England and Chelsea (May 6-21)**; **New England (May 11-24)**; **Galapagos Cruise and Ecuador (May 26-June 10)**; **Kentucky and Tennessee (October 3-14)**; **Orient (November 1-24)**.

For any of these programs, please write for your free brochure to Mrs. Dorothy Sowerby, American Horticultural Society, Mt. Vernon, VA 22121. OR telephone 1-703-768-5700.

Continued from page 24

Over a moist rock spreads *Saxifraga stolonifera* (formerly *S. sarmentosa*), alias strawberry-geranium and mother-of-thousands, common as a house plant, but few would expect to see it growing out of doors in the New York area. Getting plants in the right place is all-important, which for this specimen means moist shade. One of the prettiest ivies, 'Ivalace', remains undamaged in the Epstein garden, though often defoliated elsewhere in the vicinity, because here it is positioned where winter sun cannot scorch it. Not all the plants grown here are rare; the galaxy of white flowers so effectively displayed against dark rock is foam flower, *Tiarella cordifolia*, a common native woodlander.

At the foot of a great lichen-encrusted boulder, in moist shade, the small, yellow lady's-slipper finds a milieu to its liking. *Cypripedium calceolus* var. *parviflorum* grows about 18 inches high, with ribbed leaves, inflated yellow pouch and brownish, corkscrewed petals. It is one of the most amenable species in a rather wild genus — not "easy," you understand, just less difficult than most. Increase is slow. This day there were 20 flowers, but 40 years have gone by since a single plant was put there.

Tucked in neatly alongside the drive are frames and plunge beds. In a shady corner the Japanese needle juniper, *Juniperus rigida*, displays skeletal branches feathered with fine-needled pendulous branchlets, each with the gangling grace of an Afghan hound.

Across the driveway from the house lies another garden. Originally it was a separate lot, lying wet and low and necessitating the trucking in of many tons of soil before planting could begin. Now shrubs intermingle in island beds and borders. Today the azaleas are at their best. To enter from the driveway, one must duck under an arching branch of small-leaved, purple-panicked *Syringa meyeri*, a species of lilac from China, vying in fragrance with a large flowered form of *Rhododendron prino-phyllum*, formerly *R. roseum* and commonly called Piedmont or Mayflower azalea. The gray sidings of the distant house make a backdrop for the swinging, red-veined bells of *Enkianthus campanulatus* var. *palibinii*. A less familiar species is the compact, white-belled *E. perulatus*, and a third, *E. cernuus* var. *rubens*, with crimson bells serrated at the rim, is seldom seen in American gardens. Rarer still is a related Japanese ericaceous shrub, *Menziesia purpurea*, the flowers rosy-pink, frilly-rimmed

thimbles that are suspended in small bunches on arched, bristle-glistening peduncles. At its base a dark flowered selection of the crested iris, *Iris cristata*, is almost navy-blue in color. Behind this a large clump of double-flowered *Trillium grandiflorum* was white a week ago but is hardly less pretty now with the flowers faded to blush.

In sheltered bays between azaleas grow two more cypripediums. The small white lady's slipper, *Cypripedium candidum*, is exquisite, rare, much-coveted. The pouch is snowy, the flung out, twisted-ribbon petals greenish-yellow. As its place in the wild continues to be usurped by houses and shopping malls its survival may depend on practised plantsmen cherishing it in their gardens.

On a corner is a magnetizing sweep of yellow. *Hakonechloa macra* 'Variegata' ('Aureola') postdates *Hortus Third*, and American gardeners have Harold Epstein to thank that this gorgeous, golden grass is now commercially available. He says he has been asked if he goes out and combs it every morning. He doesn't. The tide-washed appearance, blades all arched in one direction, is natural to this plant.

Arisaema sikokianum is a Japanese Jack-in-the-pulpit. Its spadix resembles a golf ball within a vase-shaped spathe that is snowy within and extends into a tapered hood striped in green and darkest mahogany. The fingered leaves are sometimes all green, but most of the seed-raised plants in the Epstein garden have leaflets with silvery, feathered centers. In one particularly fine seedling, worthy of propagation as a named clone, the central vein is purplish pink, a color echoed by the petals of *Primula sieboldii* with crinkled, bright-green leaves forming a groundcover through which the *Arisaema* grows. Harold holds this primrose in high esteem, as both beautiful and easy to grow. "Unkillable," he says, adding, "and you can quote me," and then, as an afterthought, "only drought can kill it."

The dining room window at the side of the house frames a lovely vista, viewed over a row of sumptuous African violets lining the window sill. Shallow steps, using log risers, add interest to a rising grassy path. It seems a relaxed and sylvan scene, but some of the detail is skillfully contrived. At the foot of the first three steps Kingsville dwarf box makes a hummock of bright green in the paved terrace. Further to the right, with deliberate avoidance

of symmetry, two more were planted side by side to merge into one. At the top of these steps, diagonally across from the mound of box at the bottom and matching it in shape, a white form of the Kyushu azalea, *Rhododendron kiusianum*, is in full bloom. Above a blanket of Cole's prostrate hemlock, gray-green, chartreuse-stippled with young tip growth, rises the shaggy pillar of another hemlock, with tiered, cascading branches. It is Cole's prostrate again, self-supporting now but initially perseveringly trained upright on a metal post. Where its branches skirt the ground a solitary fern has seeded itself—or been put there by intent? In this garden it is not easy to tell what is planned, what fortuitous. The feathered fronds of Japanese painted fern, *Athyrium goeringianum* 'Pictum' are silvery with dark-pink stems and veining.

Just above the terrace a rock path leads off to the left, the paving seams stitched together with moss and *Hedyotis*, formerly *Houstonia*—not the little tufts of the common bluets or Quaker-ladies but the dainty, creeping *Hedyotis michauxii*, (formerly *H. serpyllifolia*), native from Pennsylvania south and just hardy here in suburban New York. Steps lead down to a

sunken path running between the long greenhouse attached inconspicuously to the house and a raised bed housing dwarf plants. The greenhouse, an essential adjunct to the garden, also houses an impressive collection of orchids.

Walk to the end of the vista, turn about to look back and down towards the house, and the scene looks entirely different. Great slabs of gray rock become dominant, the pink and white flowers of tall rhododendrons more conspicuous. What seems, from the house, to be a narrow grassy path between tall rhododendrons and banks of smaller shrubs is now seen to merge into a large sweep of lawn behind a rocky promontory barely visible beneath massed azaleas, *Juniperus chinensis* var. *procumbens* 'Nana', and such rarities as *Microbiota decussata* from Siberia, a Juniper-related low shrub with flattened sprays of evergreen foliage. Through the azaleas (refuting the oft repeated statement that all clematis need lime) rambles the dainty *Clematis viticella* 'Betty Corning', the small, pale-blue flowers campanulate with four reflexed sepals.

From vista to vignette: A slab of grass-surrounded gray granite is cleft down the

center and, seeming to flow down this rill (happenstance, or a master touch?), an enduring and endearing Solomon's-seal.

The vista terminates in a woodland glade. Here there is day-long gloaming when the oaks are in leaf, year-round shade beneath the hemlocks. Few plants appreciate such conditions, but the challenge has been met with such shade tolerant plants as epimediums, hostas, ferns, lily-of-the-valley and *Maianthemum canadense*, commonly called two-leafed Solomon's-seal.

Does Harold have a favorite plant? He says not, but evergreen azaleas figure large among the plantings, with the subtler colors preferred, as in the late flowering, pale-salmon 'Balsaminaeflorum'. And it is a hybrid rhododendron (*R. radicans* X *R. racemosum*) that he chose to honor his wife and companion through all the years of garden making, naming it 'Queen Esta'.

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