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Editorial

"Thank You"

The officers and directors of the American Horticultural Society wish to thank the following members of the corporate community for their financial support of the programs and activities of the Society:

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America's corporations have long been leaders in supporting our pressing needs in the field of health, education, social welfare, and the arts. More recently this aid has been expanded to include support of our national heritage in the field of historic preservation and the conservation and protection of our natural environment.

There is yet another area where the corporate community is currently turning its attention and support: the American landscape and its related disciplines of gardening and plant science. These concerns comprise a surprisingly important component of national interest and endeavor.

Directing the force of this movement is the American Horticultural Society. Founded in 1922, the Society is in the tradition of serving the needs and interests of more than 35,000 individuals, professionals, ecologists, environmentalists, scientific organizations, educational institutions and commercial enterprises. It is dedicated to the science of horticulture, plant development, cultivation and landscaping. Its impact, however, reaches an impressive segment of a considerably wider audience . . . the average American gardener.

The Society's broad range of activities have had a marked effect on the face of this nation to the extent that it has taken the leadership in disseminating knowledge to a wide segment of the population with topics related to gardening and the horticultural sciences. Its interests and services span a range from technical research in plant development

to amateur gardening—reaching an estimated audience of well over a million.

Currently the Society is implementing a major undertaking of far-reaching educational value—the construction of a National Center for American Horticulture. The Center is being built on the Society's 25-acre headquarters at River Farm. It will offer a unique and significant number of activities designed to serve professional and technical interests in horticulture as well as the concerns of the amateur gardener.

What will the National Center be and do?

- It will offer indoor and outdoor live plant displays tracing the development of horticultural programs in the country from the colonial era to the present.
- It will demonstrate the impact of new plant introductions, the effect of hybridization and technical research on horticulture and gardening over the past twenty decades.
- It will present displays emphasizing not only ornamental horticulture but plants for food and environmental enhancement.
- It will offer audiovisual presentations designed to acquaint the gardening public with all aspects of planting, cultivation and plant maintenance.

Of most significance, the National Center will permit the coordination of staff, office facilities and expense-sharing among other scientific organizations locating their operations at River Farm.

Will the corporate community continue to help? We have every confidence that it will. Companies joining the Society as Corporate Sponsors at \$1,000 or more annually will be making a significant investment in our ability to extend and deepen the Society's services to a greater number of individuals, organizations and educational institutions. We, in turn, offer the participating corporations certain benefits in return for their meaningful support.

For more information concerning the Society's appeal to the corporate community for support and preserving America's landscape, please write Mr. Thomas W. Richards, Executive Vice President, American Horticultural Society, Mt. Vernon, VA 22121.

Mountain Laurel

An American Original

Marcia Bonta
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June is mountain laurel time in central Pennsylvania. Almost everyone who loves the outdoors spends at least a few hours viewing the laurel on foot or from a car window.

Our own Pennsylvania mountaintop farm produces a spectacle nearly every year. A wide jeep trail over a mile and a half long is rimmed on both sides by thousands of laurel bushes. Planted by nature, their beauty rivals any formal garden.

Mountain laurel is one of seven species of the genus *Kalmia*, all of which are purely American. They were named after Peter Kalm, an eighteenth century Swedish naturalist, whose journal contained one of the first detailed accounts of the mountain laurel. "Their beauty rivals that of most of the known trees in nature," he wrote. The Swedes called them "spoon trees" because Indians made spoons and trowels of the wood. But the English named them laurel since the leaves look like their *Laurocerasus*, according to Kalm.

Today, mountain laurel is the state flower of both Connecticut and Pennsylvania, and while its scientific name is *Kalmia latifolia*, it has many local names. Calico-bush, calmoun, and mountain ivy are just a few.



During the early part of this century, laurel foliage was very popular as greenery in bouquets and wreaths. In 1924, one thousand tons of foliage was used in New York City alone. For this reason, quite stringent laws have been passed in many states, forbidding the pruning or digging up of mountain laurel. Luckily, since we own many acres of it, I am able to snip a few branches for bouquets each June. They make splendid cut flowers, lasting well over a week in a vase.

Mountain laurel can be rather easily transplanted, but it does need an acid soil. It grows well in shade and even better in full sunlight. Plants in the sun seem to produce more of the pink-budded varieties, at least that has been our experience.

Until quite recently, very little horticultural research had been done on the mountain laurel. But to my great delight, I discovered *The Laurel Book* by Richard A. Jaynes, published by Haffner Press in 1975. This beautifully done book, with many fine color photographs, is highly readable for the layman, as well as the expert.

It answers many questions I have had about mountain laurel; in particular, why it seems to bloom most spectacularly every other year. According to Jaynes, the seed capsules develop on the flowering clusters after blooming and limit the new shoot growth which is necessary for flower bud setting.

Jaynes also tells of his work with the Connecticut Agricultural Experiment Station, which began a breeding and genetic study of all *Kalmia* species in 1961. This is long, difficult but rewarding work, and has led to the development of new strains such as "Goodrich" and "Shooting Star." He includes a detailed list of available gardens and nurseries throughout the country where these new strains can be seen, and sometimes purchased.

Someday, there may be as many mountain laurel varieties as there are azaleas and rhododendrons. This will not lessen my appreciation of my own mountaintop laurel display, but it will enable me to landscape the home grounds with other beautiful varieties. □

Cephalotus Follicularis: *The Australian Pitcher Plant*

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The expression "carnivorous plant" immediately brings to mind the Venus fly trap (*Dionaea muscipula*), which has long been a source of fascination to plant enthusiasts because of the "steel trap" motion by which its carnivorous leaves capture lured insects. Equally fascinating to the perceptive plant person, however, are the carnivorous pitcher plants, whose leaves form hollow pitfalls structured to trap insects without any associated motion.

Cephalotus follicularis, the Australian pitcher plant, is the smallest and most intricately structured of the pitcher plants. A single species in its own family, the Cephalotaceae, it is endemic to the damp areas of extreme southwestern Australia—the Albany swamps and around the King River.

Unlike other pitcher plants, in which every leaf forms a pitcher, *Cephalotus* produces two types of leaves: foliage leaves and pitcher leaves. Both rarely exceed two inches in length in cultivation. The foliage leaves are produced in the fall to carry on photosynthesis over the frost-free winter, while the pitcher leaves, pale green with attractive reddish markings, develop during the winter to be ready to catch insects in the spring.

The pitchers are equipped with



Photo by Author

Cephalotus follicularis

on the inside and out, which are conducive to the luring, capture, and digestion of insects. A slippery, ridged rim extends around the pitcher orifice. The ridges extend as stationary "teeth" into the pitcher opening. Although it was known that the underside of the protective lid contained nectar glands which lure insects to the pitcher, it was not until the accompanying scanning electron microscope photograph was taken by the author that nectar glands could be seen lining the teeth. These probably play an integral role, together with the slippery nature of the rim, in the capture of insects by this plant. On the outside, three girder-like ridges

strengthen the pitcher and serve as walkways to lead earthbound insects up to the pitcher orifice. Captured insects are digested in a fluid secreted by the pitcher and serve as a source of nutrients.

While the pitcher is similar in structure to those of *Nepenthes* and the Sarraceniaceae, the three families are not related. *Cephalotus* is, in fact, related to roses at the order level, as revealed by flower structure. The flowers, small, buff colored, and supported by a two-foot stalk, are not a significant asset to the decorative nature of the plant, however, and are best removed since they decrease the plant's vigor.

Like other pitcher plants, *Cephalotus* is worthy of cultivation as a miniature ornamental and a collector's item. Although still quite rare in cultivation, it is one of the easiest pitcher plants to grow. It tolerates a comparatively wide range of cultural conditions for temperature, light, watering, humidity, and soil.

Culture

Temperature. *Cephalotus* may be cultivated successfully under intermediate-to-warm growing conditions (night temperature 50–70°F). It will survive a light frost. Temperatures of around 50°F, which would signify the approach of winter in its habitat, favor the production of foliage leaves; while warmer temperatures, indicative of summer, favor pitcher leaf production.

Light. Although *Cephalotus* is found in moist, open areas, the low-growing plants are hidden by an overgrowth of grasses and sedges. Thus, filtered light or semi-shade is recommended for greenhouse or windowsill growing. Equally good results can be obtained under lights by maintaining the plants 6 to 12 inches from the fluorescent tubes.

Soil and Water. Overwatering is not a problem associated with the pitcher plants, but *Cephalotus* prefers to be kept drier than most, without being allowed to dry out. Excessive water may result in the shedding of the pitcher leaves, while the closing of the pitcher lid indicates wilting. Sphagnum moss is an ideal growing medium, for it combines high water retention properties with good aeration. Peat moss or commercial houseplant soils may also be used. The use of clear plastic pots allows soil moisture conditions, as well as root growth, to be monitored. Shallow pots or trays encourage the spreading habit of the plant.

Humidity. A relative humidity of 60–90 percent is ideal. This may be higher than is available for some greenhouses or fluorescent light growing areas, in which case the



Right—*Cephalotus follicularis* flower

Photo courtesy of Longwood Gardens

plants may be grown in terrariums. Good drainage and proper ventilation must be maintained, however. An ideal set-up is to keep the plant in a pot which is placed in a loosely covered terrarium having a layer of moist gravel at the bottom.

Fertilizer. As with all carnivorous plants, captured insects serve as a source of nutrients, especially nitrogen, which may be lacking in the substrate. These nutrients may alternatively be provided by a balanced chemical or organic fertilizer administered to the roots.

Propagation. *Cephalotus* is easily propagated by stem cuttings, which will root in a few weeks under mist and with bottom heat. Leaf cuttings and rhizome divisions are also successful. This obviates any need for the removal of plants from the limited wild stands to accommodate those who may wish to include this striking, but easy-to-grow, plant in their collections.

Acknowledgement

The author wishes to express appreciation to Dr. D. Huttleston, Messrs. P. Nutt and R. Smith, Longwood Gardens, for their critical reviews of the manuscript. □

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Summer Natives Give an Architectural Value to our Woodlands

Mrs. Ralph Cannon
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In the last 25 years, modern farming has reduced many meadow areas once growing summer wild flowers. Road and expressway construction has taken out many more acres. As gardeners, we have a commitment to conserve all the wild plants that we can, and to keep these flora alive and growing.

There are many native plants of architectural value growing in our woodlands which we must conserve and enjoy. These are not rare or endangered plants, but they are interesting and produce great color among the trees. Most of the plants are perennial and herbaceous. They have been planted by nature and occur either in sunny spots or at the outer fringes of the tree branches. Others appear at the edges of shadows where there is light.

Nature generally keeps its planting simple. Single specimens in small patches create restless spots, but plants growing naturally in the wild appear in sweeps or drifts which give a handsome effect. These drifts are of aesthetic importance. They are natural works of art.

Summer plants grow and bloom after spring natives have carpeted or colonized under the trees, giving



Photos by Author

Rudbeckia

to await another rebirth. The delicate tints of the spring flowers are replaced by the stronger hues of summer and fall. The dividing line between spring and summer natives is an arbitrary one. Summer plants with their blooms are eagerly awaited; for they are a bright embroidery on nature's landscape.

In early summer, the ferns on the hillside add dignity and beauty. They are at their best with their different hues of green, all of pleasing texture. For architectural emphasis, two large ones that are favorites are *Dryopteris goldieana*, the golden wood fern, which grows two to three feet in height, and the bold ostrich fern, *Matteuccia pensylvanica*, growing five to six feet in height. The ostrich

ferns are a magnificent sight with their great shuttlecocks rising among the profusion of other ferns, such as *Athyrium filix-femina*, *Dryopteris marginalis*, the *Osmundas* and *Onoclea sensibilis*. They all colonize happily and their foliage is of lasting interest, creating a quiet oasis of green through the growing season.

Besides the ferns, which cannot be surpassed for grace and variation, are the herbaceous plants that give colorful bloom during the summer season.

A slender plant blooming in early summer is *Camassia leichtlinii*. These onion-like bulbous plants are hardy and grow in sunny meadows. Their blooms are star-like, six-parted flowers, (white, in our woods), and



Above—*Echinacea purpurea*

borne on racemes of 15–18 inches in length. The whole blooming stalk grows three to four feet high. The blooms start at the bottom of the raceme and work upward. The leaves are strap shaped, about 12 inches long and one inch wide. They grow happily and will seed themselves to produce a fine group planting. Every summer they charm us with their excellent appearance and are most effective when they become massed.

Veronicastrum virginicum album, a white, starry-flowered form of Culver's root, grows four to five feet high. Its well spaced whorls of slender, finely toothed, lance-shaped leaves are terminated by dense racemes of small white flowers, also in whorls. They like to grow in open areas where daffodils and shooting stars bloomed profusely in the spring. Given the right environment, the root stock will produce a mass of plumes. If not allowed to crowd, they become exciting plants of architectural emphasis and always a lovely sight.

Two beautiful members of the *Compositae* family with rich colors that light up a sunny, shady situation are among the most handsome plants growing in our woods. They have a long season of bloom. Though their colors are many, their form is daisy-like, consisting of a



Thermopsis

single zone surrounded by a mass of petals. Best known, of course, is *Rudbeckia fulgida* with its rough leaves and golden daisy-like flowers with blackish-purple cones.

Another cone flower of decorative value is *Echinacea purpurea*, rising on sturdy stalks three to four feet high. The blooms are a rich, reddish-purple color, adorned with a large dark cone with a flush of orange. They are long-lasting even when cut for the vase. Their leaves are rough, ovate, toothed, and grow alternately. Growing in drifts, they are a great attraction and add gaiety to the open spaces. They continue to flower for weeks. The dried cones can be used for winter decoration.

One planting that will enliven the

woodland wherever it grows is *Cimicifuga racemosa*. The rising torch-like spires drift among the cushions of *Smilacina racemosa*, always vying for supremacy, and present a statue-like appearance. These tall *Cimicifuga* plants of five to eight feet with large compound, toothed, butter-cup-like leaves and wand-like racemes of buds, resemble strings of pearls and always attract attention. When the buds open, the feathery, decorative plumes of small white flowers are a further attraction in their environment. Unfortunately, these flowers have an unpleasant fragrance, but are so conspicuous and beautiful that the odor is not strong enough to be objectionable. Even after the flowers have formed seed heads, the spikes of seed remain an important feature.

Thermopsis caroliniana, fortunately, proves to be one of the most majestic of all the summer bloomers. They brighten up any area and are vigorous in growth;—three to four feet tall—and produce spires of bold, golden, lupine-like flowers, making them ideally suited for the woodland. They have pea-like leaves, three-parted, grayish-green in color. They bloom in July and will grow in sun or dappled light. Their impressive seed heads are interesting and will remain on the plant over winter. They are easily propagated from seed.

The latest seasonal flowers are the native asters and goldenrods. They signal the closing dates for summer activity and greet the turning of the leaves on our maples. The picturesque "New England aster" and the "New York" are just a couple of the many that roam at will and decorate the whole orchard.

Blue *lobelia* and *Phytolacca* are other plants prized for their display of leaves, flowers, and fruits. All of these summer natives, paragons of sturdiness, not only give architectural emphasis to our woodland but join to produce such a pageant of color that we can readily see why nature's art demands all of our admiration.

Fertilizers for Cultivated Plants

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Growth of plants is influenced by four elements—heat, light, food and water. The gardener can do little about light and heat as a rule, but food and water are, to a considerable degree, subject to his control.

Science is now in agreement that at least 15 elements are essential to the growth of green plants—carbon, hydrogen, oxygen, phosphorus, potassium, nitrogen, sulfur, calcium, iron, magnesium, boron, zinc, manganese, iron, copper, and molybdenum.

We do little to control carbon in the open garden. Plants take their supply from the carbon dioxide in air. It is perhaps the most important single element in the amount needed—nearly half the weight of many plants is carbon. Oxygen is liberated as a gas in the process of carbon utilization from water taken up by the roots. This water is the source of the plant's hydrogen needs.

Differences Between Plants and Animals

There are fundamental differences, as well as similarities, between the feeding of garden plants



and the nutrition of animals. They are alike in that all living things, whether a human being, a giant Sequoia, a fungus or a mouse—must have some source of energy foods—sugars or starches that are “burned” by living cells, as fuel, in the process of living.

They differ in that green plants are able to manufacture their own energy foods out of simple carbon dioxide, water and minerals from the soil, whereas animals must depend upon these same starches, manufactured in plants, for their energy.

Animals, including man, have organs capable of ingesting elaborate organic substances, whether of animal or vegetable origin, and by digestion, reducing these into simple compounds, which can circulate through the body and be used.

Plants, on the other hand, have no digestive apparatus (even the so-called carnivorous plants merely allow the flies and other insects they trap to rot where their bodies will permit the simple compounds to reach the plant's vascular system). They are unable to break down elaborate foods and use them directly. Man can eat hamburgers; plants cannot.

What this means is that all complex, organic fertilizers, applied for use by green plants, must be broken down by some agency into simple chemicals, almost into elemental form, before they can be of any use. That agency is the microorganism population of the soil—fungi, bacteria, and similar organisms, which are able to digest organic matter. In this process, they use some of the energy and build nitrogen, phosphorus, potash and other food elements into their own cells.

When these microorganisms die (and their life cycles are usually quite short), the elements are then available to plants, less a certain loss inevitable in the long chain of organism to organism.

Here we have the reason for advantages and disadvantages of natural manures and other organic fertilizers. Obviously, they cannot

begin feeding plants the moment they are applied. Various chains of bacteria are needed to complete the breakdown of protein (the source of nitrogen in organic fertilizers) into a whole series of simpler forms.

Soil organisms are not always predictable in their working. They are fussy about pH, aeration, and about their own food supply. At temperatures below 60 degrees, most of them stop moving and feeding. Because their activity is low at this stage, they live longer, retaining the foods absorbed earlier. This is useful in fall, when unused fertilizer elements in the soil are taken up by bacteria and fungi. They serve as a blotter to absorb these plant foods and conserve them for use the following spring.

The slowness with which organic fertilizers are released depends on how they are "bound up" in the basic material. Dried blood, perhaps the most valuable single fertilizer, is largely available about as soon as water can dissolve it. Unfortunately, it commands such a high price that very little is today available for fertilizer use. It contains every element needed by plants in a form that can be taken up for use almost at once. At the opposite pole is humus, also a highly valuable organic source of nitrogen. Here nitrogen is so tightly bound that at normal pH readings, it will be released at a rate of between 1 percent and 2 percent a *year*. This means that it will remain as a source of fertility for half a century or more. The long "pay-out" of humus means little to the gardener raising a crop of lettuce, but when planting a lawn (which cannot be rolled up to allow him to get at the soil underneath), or a tree (whose roots may not be accessible again in his lifetime), it is the only material that can be used for "permanent" feeding.

All garden soils should contain some organic matter, however, because of its beneficial effect on soil organisms.

Although the use of organic matter is highly recommended in the in-

itial preparation of soils for turf, the old-time practice of applying an organic fertilizer to the lawn in late fall has little to recommend it. For one thing, it does not break down and do much feeding in the cool soils of fall. For another, it feeds certain fungi, which are active at low temperatures and cause the various diseases lumped under the name Snow Mould. This does not mean an outright condemnation of such fertilizers, if they have been used without causing difficulty in the past, but if Snow Mould attacks year after year, avoid all forms of organic fertilizer.

Delayed nitrogen burn is a puzzling condition which often occurs in lawns. It is caused by improper use of organic fertilizers, usually sewage sludge. Because no immediate effect can be seen after applying sludge to turf in early spring, amateurs often figure they have not applied enough fertilizer and put on another dose. If weather conditions change suddenly and temperatures soar into the nineties, soil bacterial action may be so rapid that far more nitrogen is released than either the grass or plants can absorb.

The result is a nitrogen burn, exactly like that caused by application of too much chemical nitrogen, but seldom associated with the fertilizer application because the cause and effect are so widely separated.

Chemical Fertilizers

The difference between chemical and organic fertilizers is largely one of complexity of the latter and the simplicity of the former. In a strict interpretation of the word "Organic", it should be applied to all materials which contain carbon. This, however, makes the fertilizer urea an organic fertilizer, since, while it is made artificially, it does contain carbon and cannot be distinguished in any way from urea extracted from urine.

In general, we consider a fertilizer chemical if it is made of salts or similar materials in simple form, which are either immediately available to

plants, or require only a slight change to make them so, such as sulfate of ammonia.

Although tremendous differences are claimed by organic gardeners favoring so-called "natural" fertilizers, these must all be broken down finally into the same ammonia-nitrite-nitrate products, which are released in much shorter time by chemicals.

Herein lies the advantage of chemicals. They are available to plants almost as soon as applied, and produce rapid responses in growth. It is not unusual to apply a chemical fertilizer to a lawn, and see the grass turn a darker green color in two or three days. Immediate results mean rapid use of the material applied, however. Almost all chemical plant foods must be applied at short intervals where maximum growth is wanted.

Because they are not dependent upon soil bacteria to make them available, they can be absorbed by plants in early spring. This makes them useful on lawns when grass is making rapid growth long before the soil warms up.

Practically all vegetable crops are fed chemically, when grown commercially, because growth can be kept at maximum by regular feeding.

The one disadvantage claimed against chemical plant foods is that of "burning". This occurs if applied at rates higher than recommended, or if applied dry and not sufficiently watered to dissolve all of the salts. The advantages of liquid fertilizers have brought on a rash of claims, which is not substantiated by results: they merely increase costs to exorbitant figures for the amount of actual plant foods they contain. While these are convenient for use on house plants, they are certainly illogical for use on lawns and gardens.

High analysis dry chemicals are available to be mixed with water for application through a hose, which are often more economical than



Textures of our Earth

Nancy Hemenway
1524 30th Street, NW
Washington, DC 20007
©Nancy Hemenway

If you witness a July sunrise at Juniper Point, in the Boothbay Harbor region of Maine, you will be too overwhelmed with the tranquility of the scene to notice a small rowboat heading for Mouse Island. Instead, your interest will be directed toward one of the many lobstermen tending his traps, or a 40-foot motor-sailer rounding Tumbler Island, heading for Monhegan.

I met Nancy Hemenway and her rowboat as a college student. I was employed by her parents as "captain" of the motor launch and reluctant weed-puller in the gardens. Nancy was forever dabbling in oils and water colors, producing interesting and somewhat abstract paintings of fog, waves, trees, and rocks. Hardly a day went by that she did not gather some fresh impression from nature to be reshaped in her mind for specific use in her art. Her proficiency is startling, be it sculpture, tapestry, or oil. Her latest form, "Bayetage", reflects the culmination of her efforts. It brings a new dimension to art. She works in full-bodied, raw wools, rare alpacas, delicate mohair, and exquisite gossamer organdy. All are skillfully blended into tapestries with striking effect. Her inspirations come not only from Maine, but from high in the Andes of Bolivia, the Blue Ridge Mountains, and the white sand beaches of North Carolina.



Photo by M. Keene

Left—Winter Weave (trees)

Above—Nancy Hemenway in her summer studio

In 1977, she produced one of her many exhibitions for the Bowdoin College Museum of Art. The results were breathtaking. She stirred the imagination of all who attended the opening.

I had the good fortune to be aboard Nancy's rowboat, with her two grandchildren, one early July morning in 1977. The destination was Mouse Island, some 600 yards off the coast. She was using the late Harry Emerson Fosdick's studio, which clung precariously to the edge of the eastern shoreline.

I photographed her nature walk with her granddaughters and marveled at her knowledge of native

plants. She appreciated things in nature that I had hardly stopped to contemplate: a delicate insect web surrendering its moisture to the morning sun; the intricate trail of the fiddler crab whose mosaic appeared on the beach at low tide. Upon reaching her studio, I talked with her. The result is recorded below. I hope you don't mind if I share it.

M.K.

"What interests me most in nature? The delicate shadings on a tulip petal, the lace of orb webs on morning grass, and a single feather lying on pine needles are all important to me as an artist. It is often the intricate detail, rather than the expansive view, that absorbs me.

Because I work in embroidery and textiles, I find myself saying, 'How can I capture so much beauty with my medium? What stitches translate the curve of a bird's wing and the floating grace of the dandelion?' There is also the clear knowledge that beauty is everywhere, not just in the forests, or a June garden, but in simple plants poking up through the city pavement.

The open country and tall pine woods of New England were my childhood haunts. Much of the wonder and love of nature that inspires my tapestries comes from memories that go back to the age of four. I still think of forest trees as the most imposing of all the world's sculptures. My tapestries express my feeling of awe. I also remember from my youth blowing dandelion

Continued on page 33 11

Mulches for Gardens and Landscapes

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The gardener who revised this popular nursery rhyme stressed one of the most important features of a good mulch. Horticulturists have long recognized the value of mulches in the garden and in the landscape. A good mulch should help control weeds, reduce the frequency of watering, allow water to percolate through to the soil, and keep the soil cooler in summer and warmer in winter. In the landscape, a mulch should enhance the appearance of the plants and not detract from it.

Mulches have played and continue to play an important role in agriculture. In addition to being used in landscapes, mulches are used in the production of fruits and vegetables. In addition to controlling weeds and preventing the evaporation of water from the soil, mulches help to keep fruits and vegetables clean. What would strawberries be called if it weren't for the straw mulch protecting the berries from lying on the garden soil? Mudberries? Sandberries? Dirtberries?

Although mulches have generally been considered to be loose materials, in recent years they have

taken on a new look, especially in commercial agriculture. Black plastic mulches are being used in the production of strawberries, cut flowers and vegetables. Reflective mulches, such as aluminized plastics and aluminized paper, have added a new dimension to mulches. In addition to controlling weeds and conserving soil moisture, reflective mulches repel insects, reducing the need for pesticides. They are being used in many areas for growing squash, cucumbers and other vine crops. To help farmers harvest muskmellons earlier, clear plastic mulch over sterilized soil is being tested in several eastern states. Soils under the clear plastic mulches warm quickly and the plants grow more rapidly, especially in early summer.

In most home gardens, mulches generally consist of wood chips, pine bark, shredded bark, pine needles, straw, peat moss, aged sawdust, tan bark or garden compost. In recent years, there has been an increase in the use of pea stones, marble chips, granite chips, ground tires, plastic films, newspapers, and fiberglass sheets. Some of these newer mulching materials are compatible with the landscape design and the kinds of plants being mulched.

Marble chip mulch have become popular in many areas because they are attractive and provide contrasting color and texture to the landscape. In general, most plants respond well to being mulched with marble chips, and in some instances improved plant growth has been observed. However, in several cases marble chip mulches have caused a severe decline in plant vigor and death of certain species, especially ericaceous plants. Azaleas, rhododendrons, andromedas, mountain laurel, and other related plants frequently lose their vigor within one year after marble chip have been applied over their roots. Freshly crushed marble and smaller size stones appear to be more damaging than larger stones or stones that have been weathering for a long period of time. Since marble consists primarily of calcium carbonate,

soil beneath the marble chip mulch becomes less acid with each irrigation, and the availability of iron in the soil is reduced. The plant symptoms generally appear as iron chlorosis of the new foliage and eventual die-back of the branches.

Shredded bark, bark nuggets, and wood chips from tree chippers are currently the most popular mulches used by home gardeners. Their popularity is primarily due to their availability, low cost, persistence, and appearance. They generally contain all of the attributes of good mulch, especially if they have been composted. However, many home gardeners are overusing these mulches and losing many plantings as a result.

There is a tendency among many home gardeners to apply a fresh layer of mulch in the spring, whether or not the plants need it. In many instances, yearly applications of bark mulches result in a gradual buildup of organic matter around the stems of plants, often covering the stems of lower branches. Some plants can tolerate this gradual buildup while others cannot. Overmulched azaleas, rhododendrons, andromedas, yews, and hollies frequently stop growing and begin to decline in vigor. Symptoms of decline generally appear as limited new growth, small leaves, iron chlorosis, and sporadic die-back of branches throughout the plant. If the plants are unable to initiate new roots higher up the stem and into the upper layer of mulch, they generally die. If the plants can initiate new roots higher up the stem, frequently observed in over-mulched Japanese hollies, privet, and forsythia, the plants will survive but new growth will frequently be limited. However, the roots growing in the upper layer of mulch are more susceptible to drought and winter injury than the original roots growing in the soil. Over-mulching, combined with the coldest winter in 40 years, is one of the main reasons why many hollies, Japanese privet and boxwood plantings in the

Washington, D.C. and Baltimore areas died last winter. Close examination of many dead plants revealed that the original root systems of the winter-killed plants had died one or two years previously, and minimum winter temperatures had killed the new roots growing in the mulch.

To avoid over-mulching, inspect the plant carefully, using a garden rake or fork to loosen the existing mulch. If 1 to 2 inches of undecomposed mulch remains, delay applying any new mulch until next year. To derive the maximum benefits from an organic mulch, delay applying the mulch until fall. Mulches applied in the fall delay freezing of the ground, because a loose mulch has a higher insulating value than a mulch that is compressed. If mulch is needed, apply only a 1 to 2 inch layer.

Composted bark, wood chips, and shavings are better than fresh materials. To compost, simply mix approximately 4 oz. of ammonium nitrate, or urea, or 10 oz. of 10-6-4 fertilizer with every bushel of fresh mulch. Thoroughly moisten the mulch and cover with a sheet of clear plastic. Twice each month, mix the compost and moisten if needed. Within 2 to 3 months the composted mulch is ready to use. Wood chips from trimming, collected when the plants are in full foliage, compost quickly without any additional fertilizers. Composting will not only improve the mulching properties of the bark, wood chips or shavings, but will also improve the appearance of the mulch. If the mulch cannot be composted, simply apply the 1 to 2 inch layer of mulch uniformly over the area and broadcast the recommended amount of fertilizer over the mulch, and water thoroughly.

There is a tendency among beginning home gardeners to use peat moss as a mulch. The common horticultural grades of peat moss sold locally are undesirable mulches. The particles are generally too fine and are easily blown away by wind unless watered down immediately.

Because it is light, weeds can easily push their way up through the mulch. As the sun bakes the wet peat moss, it forms a hard crust which sheds water like asphalt. Crusting is also a problem when sawdust or grass clippings are used as mulches. Although companies have attempted to market coarse grades of peat moss, as they disintegrate with time they form a water-shedding crust. A good mulch should not shed water away from the roots of plants. Peat moss is an excellent soil conditioner and the major ingredient in many potting mixes. Its uses should be limited to those and not to mulching.

Now that water is fast becoming a scarce commodity in many areas of the country, and many municipalities have issued bans on watering lawns and gardens, more home gardeners should be using mulches to grow beautiful gardens while conserving water. Black plastic mulch and even newspaper mulch are easy to use when planting annual flower or vegetable gardens. To use these mulches, simply prepare the soil as you normally would and rake smooth. Avoid walking on the prepared soil as much as possible to facilitate planting. Spread the black plastic mulch or several layers of newspapers over the prepared soil. If newspapers are used, cover only small sections at one time and soak the paper with a fine mist immediately. Do not walk on the newspapers after they have been laid down; otherwise, you will punch holes through them. If planting through black plastic mulch, cut an X mark 4 to 6 inches wide and plant through the 4 loose flaps of the plastic. If newspapers are used, make a hole sufficiently large to accommodate the plant with your fingers or trowel. Water the plants thoroughly, immediately after planting, and scatter a thin layer of organic mulch over the plastic or newspapers as camouflage.

Mulching is a time-proven horticultural practice. Learn to use it wisely and enjoy gardening more. □ 13

MANGOS

THE APPLES OF THE TROPICS



'Tommy Atkins'

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To the uninitiated, the mango conjures feelings of mystery and fascination, associated with visions of faraway exotic places. However, it needs no introduction to South Floridians, who have relished it for over 80 years. Its delicious flavor and aroma captivate the gustatory senses of local residents during the summer months, some say making the heat and humidity more bearable.

David Fairchild—the great American horticulturist and mangophile—wrote about Florida's mango season in "The World Grows Round My Door": "I sit here sur-

rounded by a riot of flavors, but the English language has invented few names for flavors, and neither I believe, has any other language. And because of that I cannot tell you what my mangos taste like. There is a strange intoxication, a 'mango madness' that comes on us at that season."

There are those, however, who resist new taste experiences and find it difficult to appreciate any unfamiliar flavor. Thus, we have the view of the nescient Englishman who, when first introduced to the mango in India, caricatured the fruit by saying: "A ball of tow soaked in molasses which you have to eat in the bathtub." It is human nature to accept exotic flavors grudgingly, but the fact remains that there are so many widely different types of mango that the inexperienced can quickly form a bad opinion if first confronted with an unimproved fibrous sort with its typical turpentine flavor. However, as with most highly developed fruits, there is a world of difference between the fruit from a wild seedling and that from a grafted superior commercial cultivar.

Mangos are so popular and abundant in warmer latitudes that they have been called the "apple of the tropics." In the Orient, and in India in particular, man has grown mangos for over 4,000 years. The Aryans who invaded the Subcontinent around 1500 B.C. recorded their keen partiality for this fruit in the *Vedas*, the four books which register their complex religious beliefs and practices. Ever since the rise of Indian civilization, the mango has been inextricably associated with their culture and folklore. A sacred tree to the orthodox Hindus, it plays an important role in their mythology and ceremonial rites. Akbar, the great Mughal emperor reportedly planted the famous Lakh Bagh orchard near Darbhanga—in northeast India—which, with 100,000 trees, was perhaps the largest in the world of the 16th century.

The mango is native to Southeast Asia and is believed

to have evolved specifically from the forests of northeast India and northern Burma, where many of the wild forms of *Mangifera indica* L., and other species of *Mangifera*, are so prevalent. We recognize three races or groups of the cultivated mango. The two most prominent—the Indian and the Indochinese—differ from each other in certain well defined characteristics. The Indian race has totally monoembryonic seeds—as do most plants—i.e. their seedlings are subject to genetic segregation and concomitant variability, which leads to the production of fruit entirely different from the mother tree. This group is also known to have, in most cases, a stronger flavor and fragrance, particularly when compared to the Indochinese group, which is generally milder in taste and aroma. This latter group is characterized by being polyembryonic, a condition in which the gametic (zygotic) embryo, if present, seldom if ever develops because it is inhibited by others whose origin is in the nucellus of the fertilized egg. This phenomenon is also referred to

as a form of apomixis. It is significant in that it assures uniformity in seed propagation of the Indochinese mango, since the seedlings are actually a type of clone. The constantly uniform nucellar seedlings make excellent rootstocks because variability in the root is highly undesirable in graftage.

A third, less important group of mangos, is a conglomerate of assorted types most of which are polyembryonic. Many are common in the African and American tropics. Their origin goes back to the dawn of the spice trade, during which they were introduced to the African coasts from the Orient by early Arab traders. More recently, Portuguese and Spanish navigators brought them from India and the Philippine Islands to Brazil, Central America and Mexico. Some polyembryonic varieties (apomicts), such as the 'Manila' of Mexico, have remained largely unchanged since the 16th century. Various polyembryonic forms, generally known in Florida and Central America as "Turpentine" for their



Left—Mangos in flower
Above—'Jubilee' Tree

peculiar flavor, make ideal rootstocks since their large seeds give vigorous seedlings of uniform size.

Under most conditions, the mango is a medium size tree with dense foliage. The leaves are lanceolate, leather-like in texture and dark, dull green when mature. Young leaves can be from pale green to a spectacular burgundy in color, and always glossy. Trees have the peculiarity that their branches seldom flush out in new growth at the same time. Consequently, during the rainy season a tree may have several flushes in various stages of development with different colors, according to the age of the leaves.

Mango trees are sensitive to sudden temperature 15

drops and react unfavorably, sometimes in unpredictable ways. They are very susceptible to frost conditions; thus, temperatures of 25°F for a night are deadly even to large trees. On the other hand, uninterrupted year-around warm weather is ideal for best performance and growth. Consequently, trees are stunted in regions where the nights are cool, even if the days are very warm or hot. For instance, Florida cultivars are commonly dwarfish in southern California, Israel, the Canary Islands and southern Spain, which share an arid, semi-desert climate, with considerable fluctuations between day and night temperatures. Additionally, the newly formed embryo of young fruit has the peculiarity of being even more susceptible to chilly weather than other plant parts. It aborts if the temperature remains in the high thirties or forties for considerable periods of time, and the resulting condition is a seedless, golf ball-sized fruit—commonly referred to as nubbins—which have no commercial value.

Mango growing is confined in the continental U.S. to the southern third of Florida because unfavorable winters elsewhere. Even here, in areas below Lake Okeechobee, the temperature may occasionally drop—as it did in Jan. 19–20, 1977—to a minimum of 26°F which spells disaster for mango orchards. At present, the best protection against these conditions is sprinkler irrigation, since oil burning in heaters is en-

tirely too expensive. An irrigation system with a capacity of ¼ inch per hour will give adequate protection down to a temperature of 20°F, if the wind does not blow at speeds over 5 miles per hour. Water prevents the temperature from going below 32°F, because as it turns to ice it releases a certain amount of heat (heat of fusion), which protects plant tissue from cold injury. Thus, paradoxically the crucial element is to maintain a cover of ice on the foliage, continuously washing it with sufficient water so that the ice does not become super-cooled, damaging the tissues underneath.

Most of the world's modern commercial mango cultivars have originated in South Florida. The farming areas surrounding Miami, Fort Lauderdale and Palm Beach have been veritable melting pots for a great number of mango introductions which started in 1833. That year Henry Perrine brought mango seeds, and seeds of other tropical fruits, from Mexico, but none of these plants prospered. Years later in the 1880's, and continuing after the turn of the century, many choice Indian and Indochinese cultivars were brought from the Orient by private growers and by the U.S. Department of Agriculture. Interestingly enough, none of these introductions proved successful in the humid environment of South Florida, but outstanding varieties began to appear in their progeny as a result of a blending of their best characters. Today, we have a considerable

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number of commercial cultivars which excel by their attractive appearance, tolerance to disease, and productivity—three attributes lacking in old world mangos.

The cultivars most likely to be encountered by the reader in northern and midwestern cities are primarily 'Tommy Atkins' and 'Keitt'. The first is a midseason (mid-July-August) mango which has most of the qualities a grower wants, namely: tolerance to anthracnose disease (caused by the pan-tropic fungus *Colletotrichum gleosporioides*), outstanding production, and a striking reddish color. 'Keitt' is a late (August-mid Sept.) mango, also with good productivity and tolerance to disease, but lacking the attractive appearance of 'T. Atkins'. Its dull, pinkish color and large size is a marked disadvantage in marketing. However, with the possible exception of 'Kent', mango connoisseurs would unhesitatingly put 'Keitt' ahead of most varieties for its flavor, fiberlessness and overall outstanding eating qualities. There is a consensus that 'Kent' has the most delicious, best balanced flavor of the commercial cultivars and 'Irwin' has perhaps the mildest taste with the least fragrance. Other varieties are 'Palmer' and 'Haden', both with the characteristic strong mango flavor which appeals to the experienced taste buds of Floridians. Small quantities of other promising cultivars are also produced; however, they are handicapped by small de-

fects which tend to make them not as profitable to the grower. Good examples of these are 'Sensation', 'Van Dyke', 'Jubilee', and 'Smith', which have proved remarkably better in tropical areas with lower humidity than Florida.

The overriding and most limiting cultural factor of mango production in most warm areas is susceptibility to anthracnose disease. It is particularly relevant in Florida because its humid climate encourages the spread and infectivity of the fungus. Control requires repeated applications of fungicides, which start before the growth of the panicles and usually end before fruit harvest. Spraying is a costly operation, contributing over 40% to the price of the fruit.

Most of the U.S. consumption of this mouth-watering, tropical delicacy comes from Florida. Limited imports of Mexican mangos have to be fumigated against several species of fruit flies which are endemic in that country, and which might otherwise threaten the vast fruit industry of the U.S.

Mango production is increasing by leaps and bounds in many tropical areas, encouraged by modern transportation and fruit handling facilities. Indeed, jet transport—by solving the age old problem of spoilage—is quickly making "the apple of the tropics" a world-wide item of commerce. □

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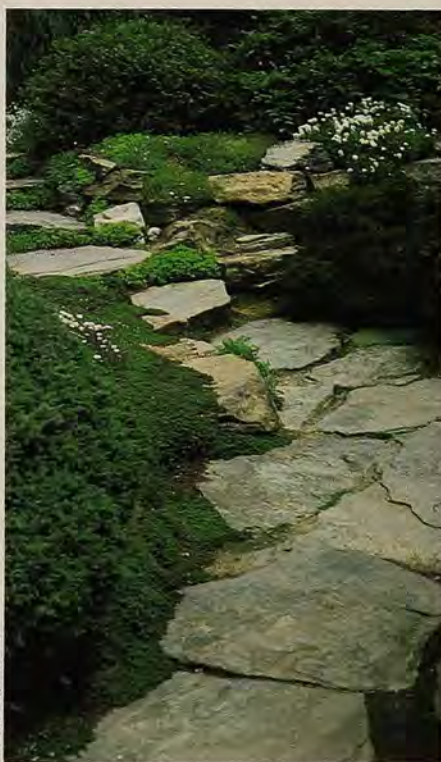
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The presence of rocks does not guarantee the creation of a rock garden. Rocks contribute a variation in form and texture in many landscape settings.

A rock garden features particular types of plants which have a natural association with rocks in their native habitats. A "true" rock garden is frequently confused with another type of garden with rocks, the "rockery". This garden contains mixtures of plants: fruit trees, annuals, highly bred double-flowered perennials, as well as a representation of "rock plants".

"Alpine gardens" and "rock gardens" are terms often used synonymously, but "alpine gardens" represent a special type of garden in which only alpine or mountain flora are grown. Climate frequently limits gardeners in their culture of alpine plants. The alpine garden is often incorporated into a larger rock garden with the specific goal of simulating one of nature's alpine regions, characterized by waterfalls, pools, and conifers.

An exotic garden may also be a part of a rock garden with flora from desert regions. The red, purple, and ochre colors of desert rocks, however, are difficult to use away from their natural setting. The warmth and vibrancy of these colors need the strong sun and crystal blue skies of the desert.



Photos by Author

Rock gardens are thought to have developed in China some centuries B.C. An account of the eighteenth century garden of the Emperor of China in Peking describes a view of "stones and rocks scattered to produce a deceptively wild and rustic effect—to seem truly a work of nature!" Rock gardens were also a part of seventeenth century England, and became increasingly popular in the late eighteen-hundreds through the efforts of William Robinson, an ardent proponent of the naturalistic school of design. He gave to their design a variety and intricate detail, the result of his extensive knowledge of wild flowers and alpine plants.

In the rock garden, rocks and gravel are used in many ways: as a garden path or mulch, or as a scree or moraine, incorporated into the soil. But, most importantly, these materials serve as the structural framework of the garden. How rocks are used is important and should reflect the natural origins of the rock garden, both in types of rock selected and their placement.

The best site for a rock garden is an existing natural rock outcropping. This is a rare situation. Most gardeners will have to select a site and construct from scratch. An appropriate and favorable location is the first prerequisite to a successful garden. An existing slope is a good beginning, particularly one that faces frequently-used, outdoor areas, where one can spend long moments contemplating the delicate textures and intricate patterns of the flowers and foliage of the rock garden plants. A north or northwest orientation is ideal. It helps prevent rapid moisture depletion, which often occurs on southern slopes. The location of the garden calls for a naturalistic surrounding, not one which is formal or architectural in character. Flat areas can be carefully regraded to include a variety of slopes and to recreate nature's areas, where rocks appear emerging through eroded soil. Nature's rock gardens are not always pretty places; they have a starkness and vastness which cannot be easily reproduced. We must apply lessons nature teaches us about using rocks



and placing plants. The first thing to learn is not to use too many rocks. The dominance of stone, except perhaps in a small alpine area, will make a garden harsh. Rocks should not cover more than two-fifths of the area. As plants grow and spread, they should be contained so that at least one-tenth of the area remains rock. In nature's gardens, the exposed surfaces of rocks vary in size and height. Most rocks appear firmly imbedded in the earth. This "iceberg effect" is important. In nature, as soil is eroded the cleavage lines of the rocks become apparent. In alpine regions, calcareous zones exhibit horizontal or only slightly inclined fissures. Siliceous ranges often have vertical fissures, sharply pointed crests, and slopes covered with rubble. In the average garden (approximately two hundred square feet), at least one rock should be large enough to make machine handling necessary. Irregular spacing of various sized rocks sets up a rhythmic and exciting composition. The type of rock selected will vary with the locality. Rocks should be indigenous to the area and have a well-worn appearance. Porous stones, such as limestone and sandstones, are excellent choices because they store water. Granite is hard and gives an acid reaction to the soil. Quartz is generally too conspicuous.

Loose accumulations of gravel and smaller rocks can be used in the garden to simulate a moraine or scree. A moraine is the deposit left by a retreating glacier. These accumulations on slopes of the garden can be effectively combined with a stream to supply a number of new microclimates for plants. Dry streams, containing only rainwater and runoff, can be realistically constructed with gravel and rock. A scree is a deep pile of fragmented stone found at the base of steep slopes or cliffs. The typical scree plant has a deep root to accommodate a normally dry environment. Here, plants are well supplied with water from snow melt or under-

ground springs during a relatively short growing period. In most gardens, there is a need to supply water for longer periods, and to add water-holding humus to all but the top inch of scree material. As large rocks form our garden cliffs with the scree below, dwarf conifers represent forest trees. The scree is the perfect background to exhibit these characteristics. Dwarf conifers can have a value equal with rocks in forming the structural frame of the garden. In a small garden, one specimen may set the theme and scale for the entire design. *Cedrus deodara* 'Pendula' is a graceful, weeping choice. *Picea abies* 'Pendula' is also good.

Rocks and gravel make an effective mulch in nonscree areas until plants spread to fill the spaces between rocks. Large, flat stones are an ideal material for steps and walkways. They last forever and are harmonious. Gravel can be used but requires replacement and is somewhat messy. Rocks and gravel are not only found at the surface of the garden but should also be incorporated into the soil for improved drainage.

Your rock garden may require more than one soil type to meet the needs of the variety of plants chosen. Some plants prefer alkaline soils, others prefer acidic conditions, and still others a neutral soil, or have no preference at all. Some rock plants, which occur naturally in limestone areas, do not require lime but merely tolerate it and grow equally well in neutral or acidic soils. It is desirable for each soil type to have its own area in the garden, and each with slopes varying in degree and orientation to create a range of light and temperature conditions for a heterogeneous mixture of plants.

When the rocks are in place and the soil is distributed, the moment of creative artistry with plants begins. Rock garden plants often have foliage which is of value throughout the seasons. Planning and planting for harmony means consideration of

foliage texture and color, as well as of flowers. Most rock garden plants have fine textured foliage. Many exhibit leaves with shades of blue or gray-green. The careful combination of textures and colors throughout the garden in rhythmic patterns can create a beautiful effect. Flowers may not be necessary in the rock garden to produce interest or beauty, but are always enjoyed. Many rock plants have small flowers easily missed unless closely viewed. Others have their small flowers grouped in fairly large, showy clusters. Although spring will be the time for an abundance of bright flower colors, plants can be chosen to provide flowers throughout the summer months as well. Nature plants in large masses, which are repeated across her garden. These masses are punctuated by smaller groupings to provide contrast in unending variety, with all colors displayed in a continuous kaleidoscope. Many rock plants increase in diameter year by year with the production of rosette-shaped offsets, such as *Heuchera* or *Semprevivum* species. Others increase in size because of increasing stem length, as with *Gypsophila repens*. A rule of thumb for the average garden is to use plants one foot in height or less. This keeps them in proportion with the size of rocks used and with the space occupied by the garden.

Several very low plants are excellent choices for spaces between stepping stones, to provide a soft continuity. *Thymus serpyllum* is an evergreen plant with tiny, dark green, shiny leaves. The cultivar 'Vulgaris' is of particular value because its leaves release a pleasant, lemony fragrance. Most thymes have purple flowers and are a good selection for any location in the garden. In moist, sandy areas, *Arenaria verna caespitosa* (Irish moss) forms a fine textured, green carpet with tiny, star-like, white flowers through the summer.

The list of rock plants is extensive. A group which must have rep-

resentation in every garden is the *Saxifragas*, if only because the name translates to mean "plants that break rocks." This is a large group with a number of irresistible selections for every place in the garden. *Saxifraga sarmentosa*, the strawberry geranium, has lovely, variegated silver and green, rounded leaves. Its rosettes spread rapidly on the more shaded slopes. It is evergreen and blooms in spring with open panicles of many small, delicate, white flowers. Another *Saxifrage* is *Heuchera sanguinea* (Coralbells), which usually has long racemes of coral, bell-shaped flowers in late spring and through the summer. It is also available in pinks and white, which are a bit easier to combine with other colors than the coral. It is also evergreen with spreading rosettes and leaves with silvery patterns. *Saxifraga aizoon* is a rock plant native to high alpine cliffs. Its leaves are a leathery, grayish-green with a row of ornamental white dots, formed from lime taken from the soil and deposited by evaporation on the leaf edges. There are many cultivars of different flower color which bloom in early summer. 'Lutea' has pale yellow, 'Major' bright yellow, and 'Rosea' pale, rosy-pink flowers.

There are several plants which have been rock garden favorites because they are not only easy to grow, but beautiful. *Iberis sempervirens*, commonly known as candytuft, flowers from April to June, with masses of bright white flowers covering its narrow, dark green, evergreen foliage. It is a good choice for any sunny spot and particularly effective in a scree. *Arabis caucasica* and *Aubrietia deltoidea* are both members of the *Cruciferae* family, both known as rock cress and similar in appearance, with notched leaves forming felty rosettes that spread rapidly to disappear beneath four-petaled, cress-shaped flowers in May. *Arabis* flowers are usually white, although there is a rose colored form. *Aubrietia* varieties extend the color range to include lilac and

violet, in addition to white and rose. *Alyssum saxatile* is considered the "great" rock plant. Its mustard yellow flowers give it the name of "baskets of gold." The cultivar 'Luteum' has soft yellow flowers. Both grow to fifteen inches. There are several alyssums with the same gray foliage, but with very low spreading rosettes. *Alyssum wulfenianum* is one of the easiest to grow.

A plant which is not one of the old favorites, but lovely, is *Armeria maritima*, a native to England's rocky coasts. Its short, grass-like foliage is evergreen in dense mats. Its flowers are tiny and bright pink in compact balls held above the foliage on six-inch stalks in June.

There are no better grass-like plants than the ornamental grasses which make soft-tufted carpets in the rock garden. *Festuca glauca* (Blue Fescue), with its thread-like blue leaves, is a striking addition. The tiny *Poa alpina* is an alpine meadow grass. Both have open, feathery inflorescences—Blue Fescue in spring and *Poa alpina* in summer.

A number of bulbous plants make delicate and colorful contributions to the rock garden, starting in early spring with *Iris reticulata*, a small, rapidly naturalizing plant with large, deep purple flowers. *Oxalis adenophylla* has a mound of many heart-shaped, gray-green leaves with lovely pink flowers in June. Fall blooming, bulbous plants are always surprising and satisfying. *Crocus zonatus* is one of the best fall blooming crocus with fairly long-lasting lilac blossoms. *Sternbergia lutea* contributes its bright yellow flowers at the same time, but without foliage. A low spreading plant, such as *Ajuga reptans* 'Purpurea', can lend its foliage for an effective background.

Rock gardening can be for everyone. Its limitless combinations of plants and its year-round beauty, supplied by intricate patterns of color and texture, make it a rewarding, as well as an appealing, pursuit. □

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Willows for Pleasure and Benefit

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Introduction

Willows are among the earliest known vascular plants; they appear as fossils in Cretaceous Period deposits over 135 million years old. The 300–350 species that have evolved over this time occur almost worldwide, but abundance is greatest in northern North America and Europe and in the mountains of China. They are uncommon in tropical regions where there are a few species and are absent from the Antarctic region and Oceania. In Australia and New Zealand they occur only as introductions.

Willows are distributed by means of their small windblown seeds, by stems and seedlings carried by stream and rivers, and by man who has carried willows throughout the world. Many willows have been successfully moved from one part of the world to another, but some are not readily adaptable to growth in new regions. For example, some dwarf species from cool arctic alpine regions do not tolerate warm or

drier climates or the shorter day length of lower latitudes. However, it is a common misconception that willows require wet conditions for optimal growth. Most species can tolerate wet conditions but few, if any, require it. They are, however, intolerant of shade and will suffer under the shade of grasses or trees. This explains their great success as pioneer species on newly exposed river flood plains, glacial moraines, and waste places and their absence from closed-canopy forests.

It is generally agreed that the taxonomy of willows is confused and the province of the specialist (4), but this is true only in part. Many species are readily recognized, and disagreements among taxonomists are not as great as they once may have been. However, there are problems in the identification of species because of the separation of sexes on different plants; the appearance of flowers before the leaves in some species; and the high degree of variation in leaf form and hairiness, which is sometimes due to environmental factors. Hybridization is another source of confusion that is often overemphasized but does lead to some puzzles. Then these hybrids are sometimes selected for cultivation, and what may have been a rare exception in the wild becomes abundant through extensive cultivation and introduction (2).

Commercial nurseries, and even botanical gardens, are often unreliable sources of properly named willows, and species or cultivars, for example *Salix gracilistyla* Miquel, are

being distributed under a variety of names. The identity of the willow species, varieties, and cultivars discussed in this paper may be confirmed by referring to the numbers that accompany the species names. These numbers correspond with those on specimens deposited in the Herbarium of the National Arboretum, United States Department of Agriculture, Washington, D.C., and in the National Herbarium, The National Museum of Natural Sciences, Ottawa, Canada.

The purpose of this paper is to introduce the reader to the uses of willows, which seem to be less appreciated today than they were in the past, and to discuss a number of distinctive willows that are being grown in America by nursery men or in arboreta and are interesting materials for ornamental cultivation. The authors have long been interested in ornamental willows and have procured for their own plantings various species and cultivars available in North America that have ornamental qualities as shrubs or trees or possess unusual growth habits which lend interest to the landscape. The first two authors have also had an interest in decorative shoot material for floral designs and in distinctive foliage or flowers useful in floral arrangements; the third author has been a student of the classification of willows for twenty years and has published on the taxonomy and biology of North America willows. Most of the species and cultivars discussed here are in the collection of the first two authors and clone material has been

contributed to the United States Department of Agriculture, Plant Materials Center, Beltsville, Maryland 20705 and to the National Arboretum, Washington, D.C. At both locations qualified growers may apply for cuttings or other source of materials. In addition there are a number of willows grown by the Soil Conservation Service, USDA, Beltsville Agricultural Research Center, that are of ornamental value and that are referred to in the text.

willows. A list of medicinal plants prepared in A.D. 64 and used as a valuable reference for 16 centuries reported many species of willow from which were extracted a group of glucosides including pure salicipoide, salicylic acid, and salicin. Thus, men were relieving their pains by chewing willow bark or leaves 2000 years before they had aspirin pills. Also, quite early, a black dye for tanning was obtained from several species. In Scan-

methods used today are much the same as those employed by early Romans. Since female (or pistillate) plants produce more vigorous shoots and larger rods than male plants are chosen for delicate baskets are chosen for delicate basket making. For most needs, the bark is stripped from the rods while still green. When basket making was an important industry, about 20 species of osier willow and clones of some species were selected for special needs and were shipped from one country to others, including America. Growing osier willows for basket making is still an important industry in European countries, including Britain, Belgium, Holland, France, Germany, Poland, and Czechoslovakia and in Argentina.

Several ornamental willows are also used as osier willows in England and Europe. For example, fresh shoots with golden bark from *S. alba* L. cv. Vitellina, are the toughest osiers grown and are used as tie-rods by nurserymen and market gardeners. Other ornamental willows used as osier willows include the bay willow, *S. pentandra* L.; varieties of the purple willow, *S. purpurea* L., which produce the most slender rods for their length; and the goat willow, *S. caprea* L., which is used in making barrel hoops in Holland.

Plastics have almost entirely replaced the demand for osiers in many countries. One may predict that need for osier willows will increase as our present plastic resource materials are exhausted and as the price of these resources increases.

Timber Production

The prime timber commodity of willows in England is the cricket bat and to a lesser extent artificial limbs. The bat willow, *S. alba* L. cv. Coerulea is used exclusively, and only the basal trunk of female trees is acceptable for producing the required standard of timber. About 2-million bat willow trees growing today are progeny, by cuttings, of a



The Fantail Willow

Willows as a Benefactor of Man

Although willows are among the earliest plants used by man, many of their attractive and beneficial qualities are today unknown to the general public and even to many horticulturists.

The genus *Salix* refers to the early recognized medicinal qualities of

dinavia, dried inner willow bark was ground and mixed in oatmeal as food in times of famine; and macerated willow bark fibers have been spun into cloth.

Willows for Osier Production

From time immemorial, willows for osiers have been propagated from cuttings, and the cultural

single female tree selected in 1803 in Suffolk, England.

Also, English farmers make poles for gates and fences by cutting from sprouts on stumps of timber willows every five or six years, and willow boards are used for crating machinery; for veneer for baskets; for containers for fish, fruits, and vegetables; for carvings for toys; for paper pulp; for plywood; and to make fine charcoal for artists. In America, the tough, light wood of the white willow, *S. alba* L., would be suitable for making packing cases, veneer for baskets and boxes, and toys. In Holland, willow is in great demand for making clogs. In Argentina, the natural forests are being augmented by willows grown for packaging, cellulose, and paper pulp. It is not economically feasible to grow willows just for pulp in Europe; but, where they are also useful in soil conservation and are used for veneer, the tops may be profitably disposed of as pulp (6).

Erosion and Environment

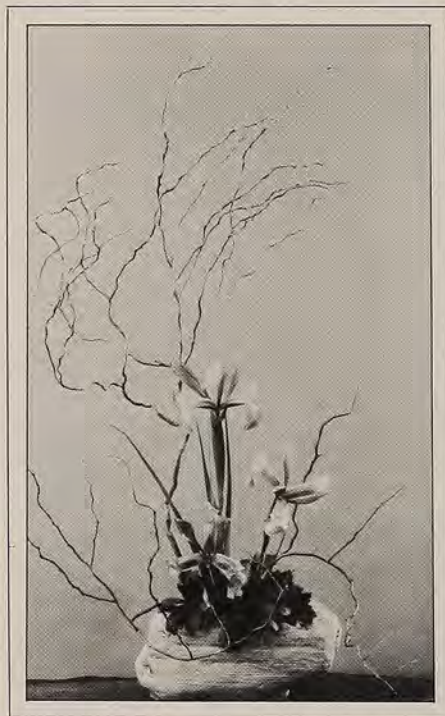
Undoubtedly, the greatest beneficial effect of willows is least known and least appreciated. Nevertheless, throughout their history, native willows have been the first vegetation to cover and protect vast areas of ground laid bare by receding glaciers, by burned-over forests, and by earthquakes, floods, war devastation, gravel pits, and mine wastes. Willows growing naturally along stream banks not only control erosion of valuable lands, but they provide an environment favorable for fish, birds, and other wild life. Willow wood is a favorite food of beavers; willows provide browse for deer, moose, and livestock.

Selected clones of *S. purpurea* are now being propagated and planted by various U.S. government agencies to combat erosion in critical areas (1).

Early Season Pollen and Nectar Sources

Honey bees and other insects visit both the pistillate and staminate flowers of willow for nectar and col-

lect pollen from the staminate flowers. Indeed, ornamental willows are now being planted near apiaries to provide important early season sources of nectar and pollen (3), and a sequence of flowers lasting four to six weeks would be available by planting the species discussed in this paper. For example, bees visit the earliest flowering Japanese and Persian willows in great numbers



Corkscrew willow arrangement with blue iris and pachysandra

on warm days and some even when temperatures are relatively cool. Then the visits become more regular during the warmer periods of later flowering species, each of which is attractive for 8–12 days.

Ornamental Willows

Warren-Wren (7) states that in Great Britain 24 species of willows have colorful or aromatic stems and foliage (catkins) that make them valuable as decorative sprays in winter and spring. Six of these are available in North America and are discussed in this paper. Other species on his list that have unusual catkins differing from those available to us are: *S. daphnoides* Villars with ornamental catkins from large crimson buds and *S. lanata* L., the

woolly willow, considered the most beautiful willow in Sweden because of its silver leaves and brilliant catkins and also valued for its high yield of nectar.

Warren-Wren also states that ornamental willows are used much more extensively in the United States and Scandinavia than in Great Britain. This comment is surprising to us. Willows seem not to be fully appreciated in North America though they can add much to the enjoyment of our gardens (including outdoor bonsai specimens), roadsides, and park plantings, and especially to the floral decorations in our homes. In the following sections, some available ornamental willows are grouped according to their special uses. The number in parentheses following the scientific name refers to the number of the Soil Conservation Service of the USDA for that particular clone.

Willows for Forcing Catkins and Arrangements

The Persian willow, *S. aegyptiaca* L. (*S. medemii* Boiss.) (13663, 14876) is an upright shrub 12 m tall with stout, slightly pubescent branches and black winter bud scales that open into an abundance of bright yellow catkins 3.5 cm long. It is one of the earliest to bloom and lasts for 8–12 days.

The Japanese pussy willow, *S. gracilistyla* Miquel (23460), is a broad, upright shrub 3 m tall. Young branches are gray, and the long winter bud scales are grayish purple. This willow is one of the first to bloom and produces long branches bearing masses of large catkins that are 3.5 cm long and change from red to golden yellow and age as silky gray (Fig. 1). Branches can be forced to open in January, sometimes December. This willow has been called the "rose-gold" pussy willow, also the "big catkin" willow (Fig. 1-A). An unusual variety, *melanostachys* (Mah.) C. K. Schn. (22487), has blackish catkins and red anthers that open to bright yellow.

The French pussy willow or goat willow, *S. caprea* L. (23467), originated in Europe and northern Asia and is probably the most common home garden pussy willow in the United States. The upright branches and winter buds on this 10 m shrub are glabrous brown and lustrous. The plant flowers about 2–3 weeks later than *S. gracilistyla*. The male catkins with dense stamens becoming 3.5 cm long are conspicuously yellow. The female *S. caprea* produces large, cottony catkins in great profusion.

The American pussy willow, *S. discolor* Muhl. (22962♀, 22966♂) is found as an upright, oval shrub or small tree 7 m tall from British Columbia to Newfoundland and south to Pennsylvania and Indiana. The jet black winter buds, a discerning character for *S. discolor*, on glabrous mahogany brown shoots and the expanding gray, young catkins produce a striking effect. The male catkins, less compact than *S. caprea* and opening about one week later, reach 3.5 cm long; the dark green female catkins with contrasting black bracts become 7 cm long and persist for 2–3 weeks. This willow has merit as an open growing ornamental shrub for forcing and for decoration. Unfortunately, all willows that we purchased as *S. discolor* from several nurseries proved to be one of several other species.

Wimmer's willow, sometimes referred to as *S. X wimmeriana* Gren. & Godr. (*S. aurita* L. X *S. purpurea* L.) (12360), originating in Europe and cultivated for over 100 years, is an attractive, broadly oval shrub to 5 m tall with numerous slender, dark mahogany stems and large numbers of small catkins that open 3–6 weeks later than the earliest ornamental willows. This plant is excellent for flower arrangements and is highly productive for cutting or forcing branches even when it is not pruned back each year. It would be suitable as specimen shrubs or for broad hedges and screens, and requires minimum pruning.

Salix miyabeana V. Seem. (20355),

from Japan, is a handsome shrub or small tree to 5 m tall. The conspicuous yellow catkins that reach 3.5 cm long are a late-season source of flowering branches for flower arrangements.

Salix gilgiana Seem. (13604), a native of Japan, is a dense shrub to 5 m tall with green glabrous branches. The coloration of its immature male catkins is useful in making interesting flower arrangements. Great numbers of cylindrical catkins produced on every branch are silky brown to purple when young and then become conspicuously yellow as they open.

The prairie willow, *S. humilis* Marsh. (23464♂, 23465♀), grows to 3 m tall and is found from Newfoundland to Manitoba and south to Minnesota and South Carolina. Its staminate catkins, 1.5 cm long, are at first red but become conspicuously yellow on opening. It is an interesting native willow that grows in poor wasteland soil and in dry, sandy forests. It is a late season source of arrangement material.

Willows with Distinctive Branches or Foliage

The fantail willow, *S. udensis* Trautv. & Mey. cv. Sekka (*S. sachalinensis* Fr. Schmidt cv. Sekka) (23461), is a Japanese shrub 4 m tall on which strong new shoots develop extreme fasciation, with curling and curves. The name "Sekka" means fasciation in Japanese. Less vigorous shoots are normal, and severe pruning enhances the fasciated condition. The stems are green and winter buds are brown, but after they are cut and dried, the surfaces become a rich, glistening mahogany brown as if varnished. The fasciated shoots are superb for creating unusual effects in flower arrangements and the normal shoots are used for their catkins. Both fasciated shoots and the less vigorous, normal shoots produce an abundance of catkins that sometimes almost conceal the branches; thus the whole male bush becomes a mass of yellow. This willow, which flowers

about 10 days after *S. caprea*, is grown commercially for its curved shoots as well as for its normal shoots with catkins.

The corkscrew willow or dragon-claw willow, *S. matsudana* Koid. cv. Tortuosa (23469), is an upright growing, narrow, oval tree to 10 m tall. Its twisted and contorted branches and smooth, olive-green bark provide useful material for distinctive floral arrangements. The tree is also an interesting landscape plant in summer with its narrow, twisted leaves and displays an interesting silhouette in winter. The plants produce vigorous, contorted new growth after cutting back and could also serve as a narrow hedge.

The bay willow, *S. pentandra* L. (23740), native of Europe, grows to a tree 20 m tall. It is highly ornamental because of its shining, dark green, aromatic foliage, the golden male catkins that are produced after the leaves appear, and the lustrous, brownish-green bark on young branches and twigs in winter.

The white willow, *Salix alba* L., which has been long cultivated as a timber tree, has several variations with highly colored branches including *S. alba* L. cv. Chrysostella (13652), with coral red branches and *S. alba* L. cv. Tristis (23468) with bright yellow pendulous branches sometimes called the yolk-of-egg willow. These willows lend interest to the landscape and provide cut branches for winter floral decorations. Although they grow into 20 m trees if unpruned, they can be cut back annually and maintained as highly colorful, low shrubs.

The sage willow, *S. elaeagnos* Scop. (13603, 20336), is a handsome shrub or small tree to 15 m tall that originated in Europe and Asia Minor. Its leaves are linear, narrow, densely hairy, and 5 cm long. The grayish, feathery, summer foliage, useful for its effect in flower arrangements, turns yellow in the fall.

Two similar clones of distinctly columnar, purple willows, *S. purpurea* L. cv. Eugenei (20362) and *S.*

Continued on page 32

Hearts O' Flowers

Frances C. Cox
1571 DeAnza Way
San Jose, CA 95125

The visual effect of a colorful garden is very pleasing; bright flowers always catch the eye. We marvel at the massed beauty of flower beds in city parks, landscaped areas and private yards, but we often miss the greater beauty found within each individual blossom. The next time you pass a garden of colorful flowers, take the time to look closer. You'll find interesting designs in the rich colors as shown in these photos. □



26 Camellia, 'Glen-40'



Morning Glory



A *Gazania* blossom



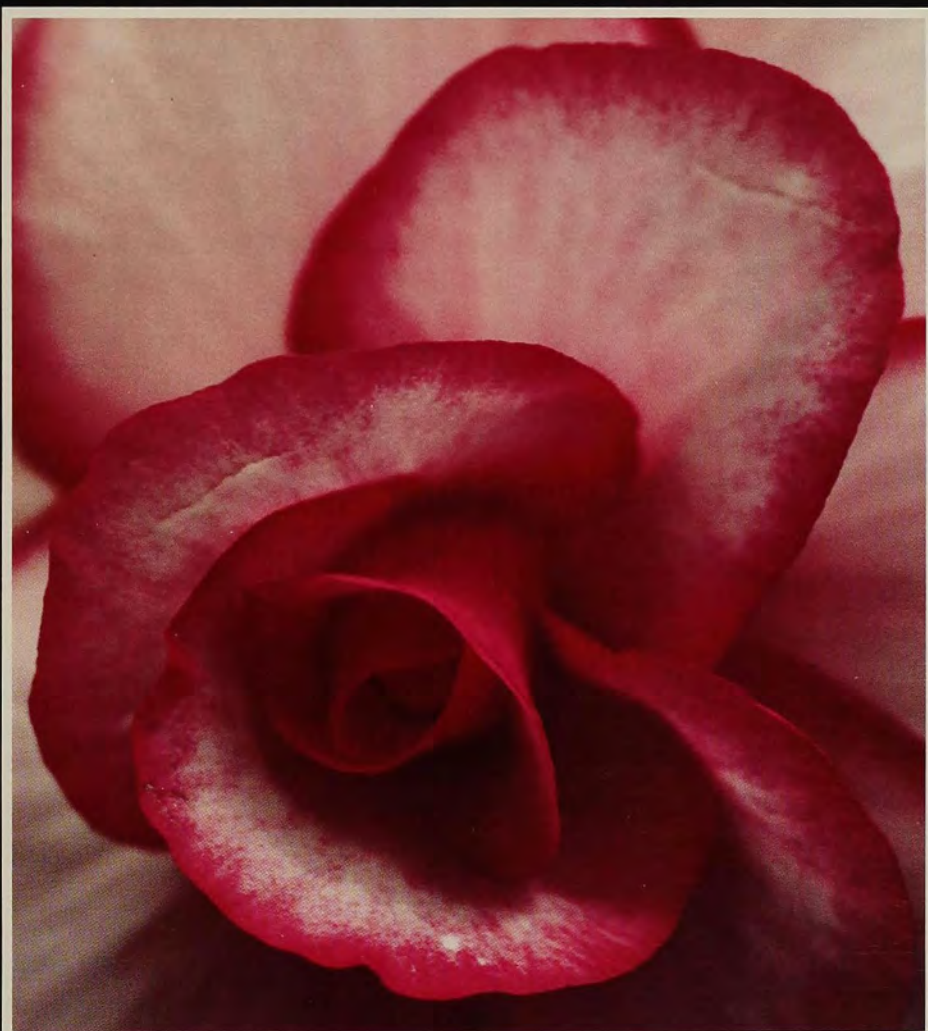
A cactus blossom



Pansy



Tall bearded Iris, 'Classic Touch'



Tuberous Begonia

Fertilizers

Continued from page 9

conventional garden fertilizers. Since these are pure plant food, with no added fillers or carriers, shipping costs per unit of fertilizer are lowered. This reduces cost to the user.

Light Weight Lawn Fertilizers

Because of high shipping costs, and as a convenience to gardeners who cannot handle 50-pound bags, light weight lawn fertilizers have been developed. Practically all of these analyze about 20 percent nitrogen, 10 percent phosphorus, and 5 percent potash, and are sold in bags weighing between 20 and 22 pounds.

Ureaform Nitrogen

In an attempt to solve the problem of applying large amounts of ni-

trogen at one time, yet feeding plants over a long growing season, several methods of slowing down nitrogen release have been developed. A chemical in regular commercial use at present is called a ureaform. It is a soft plastic made by reacting urea and formaldehyde. This plastic breaks down slowly and releases the nitrogen it contains at about the rate grass can absorb it. The breakdown is slightly affected by soil chemicals and moisture, but is largely caused by bacterial action. As a result, ureaform fertilizer alone is slow to act in spring and does not release in late fall, but does an outstanding job of feeding during warm weather. Newer plastic fertilizers have been introduced recently which have similar qualities.

Ureaforms, of course, supply only nitrogen and are not complete turf fertilizers. They are at their best as ingredients in mixed fertilizers; but to be sure of their long-feeding advantages, at least 50 percent of the mixture should be ureaform. Some quickly-available type of nitrogen should be used for early feeding before soils warm up.

Straight ureaform is a particularly valuable ingredient to be used when planting nursery stock. The critical period for newly planted trees and shrubs is usually the first two years of growth. If well fed with nitrogen, they are usually able to survive and thrive whatever conditions occur later. Many nurserymen add a mixture of half sewerage sludge and half ureaform nitrogen to the soil used in covering roots of newly planted stock.

Foliar Feeding

Completely soluble plant foods are often applied in solution to the leaves of plants. These are absorbed and are almost instantly available to the plant. This is one reason why many liquid fertilizers gain such a reputation for stimulating growth. However, costly liquids are not necessary. Most dry, completely soluble fertilizers can be used in this manner.

One defect in this method of feeding is that the effect is gone about as fast as it has taken place. Only a limited amount of plant food can be applied to a leaf. For this reason, foliar feeding is largely a device for quick stimulation; but as a supplement to regular soil fertilization, it has its place.

Fertilizer Formulas

In order to use fertilizers properly, we must know how to read an analysis and figure out how much of each element a given product actually contains. Since nitrogen is the most costly ingredient and is the element most often in short supply, the usual practice is to figure for this element and take the others for granted.

A great deal of fuss is made about ratios, most of it unnecessary. About the only place where ratio is really important is when low-phosphorus lawn fertilizers are essential to the proper functioning of pre-emergence crab grass controls containing calcium arsenate. In practically every other place where fertilizers are used, no such thing as a perfect-ratio general fertilizer exists. This may sound like heresy to rose enthusiasts, who have been known to spend an entire evening session of a rose club arguing the merits of formula "A" versus formula "B".

True, a fertilizer to exactly fit the needs of a specialty crop, such as roses, could be devised for a given soil under given cultural methods. About the only effect of such a perfect ratio would be to avoid the waste of a minuscule amount of one or more nutrient elements.

Much of the pother about analysis arises out of the fact that farmers, when planting a field of 50 to 100 acres to a single crop, do find this factor of importance. By omitting or including a certain element in exactly the right amounts, savings of several hundreds of dollars can be effected.

True, fertilizers *can* be overused. Most experienced gardeners have



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seen lawns burned by too much nitrogen. This, however, would be the result whether the lawn fertilizer used had 12 percent phosphorus instead of 5 percent; or 8 percent potash instead of 4 percent. It is the excess that does the damage, not the analysis.

What is not appreciated is that plant roots are selective. So long as enough of each element is available to meet normal needs, and provided any excess can be buffered or absorbed in the soil, plants will thrive.

Since nitrogen is the most costly element, let's see how to figure for it. The formula usually includes only three elements—Nitrogen, Phosphorus and Potash. These are the elements which all states insist must appear on the bag. This usually appears as 10-10-10 or 4-12-4. The first number stands for nitrogen, the second for phosphorus and the third for potash. The figures given are percentages. In order to reduce them to pounds, consider them as decimals. That is, if we are dealing with a 10-8-6, we multiply the weight of the bag (say 50 pounds) by .10 to give us nitrogen, (a total of 5 pounds); by .08 to give us phosphorus, (a total of 4 pounds); and by .06 to give us potash, (a total of 3 pounds).

Although you should consider what form of fertilizer you are buying (chemical, organic, ureaform, mixed ureaform), in general, you can figure that a pound of nitrogen in one form does the same work as a pound of nitrogen in another. Dividing the cost of a bag by the number of pounds of nitrogen it contains is a simple way of figuring out whether you are getting your money's worth.

For example, a 50-pound bag of sewage sludge at \$4 looks like a tremendous bargain against a 25-pound bag of ureaform at \$8, but when the former is figured out as costing \$1.33 a pound for nitrogen and the latter at \$0.64, the reverse is true.

Using Fertilizers

Although fertilizer bags always give specific directions for applying the products they contain, these are of little use, except as a rough guide to safe limits. Usually, they err on the side of conservatism to avoid claims of injury caused by overuse. In most instances, these can be doubled with safety on most soils.

In the case of lawn fertilizers, overstating coverage is a survival of the day when one pound of actual nitrogen was considered a good application for 1,000 square feet of turf for an entire growing season. Today, from four to eight times that amount is considered desirable where maximum luxury growth is wanted.

In general, heavy clay soils and those high in organic matter can absorb and store anywhere from two to ten times rates recommended on bags with safety. Poor, thin soils cannot be fed as heavily with safety to plants. Because they need more nutrient elements, and because they lose these faster than heavier soils, plants must be fed often and in lighter doses, usually at the recommended rates.

Soils also benefit from the elements added by organic materials. Such material improves conditions for the vital microorganisms. At least one fertilizer application during the year should be an organic material such as sludge, well-rotted compost or animal manures. If these are not readily available, substitute peat moss and add a chemical fertilizer. Application during the summer months is best.

No two soils are alike. Every garden owner must run his own tests of responses to added plant foods. The one important thing to keep in mind is that if a fertilizer is complete, containing all the minor or trace elements, as well as the "Big Three" of Nitrogen, Phosphorus and Potash, plants will take what they need. If the pH reading of the soil is kept between 6.0 and 6.9, all these elements should stay in available form. □



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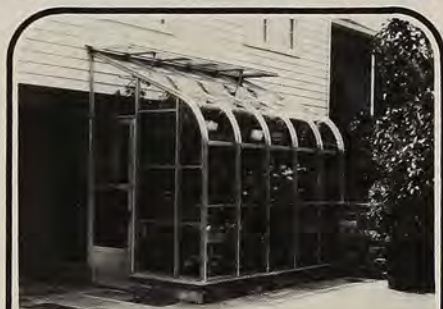
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Ground Covers as Shady Aristocrats

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Established gardens often present two major problems for gardeners. One is scattered plantings of large trees and shrubs which have little visual or spatial unity. The second problem, imposing greater limitations, is varying degrees of shade, which inhibits the growth of understory plants, and results from existing plantings, shade cast by walls, fences, and overhead structures. One landscape element which offers a solution for both issues is ground covers. These plants add the finishing touch to the landscape by visually tying together separate elements into one cohesive design.

In plant selection, it becomes crucial to consider the limitations imposed by shade and seek plants tolerant of this environment. Shade-tolerant species occur naturally as understory plants in woodland areas. Here, centuries of natural selection pressures have adapted a wide range of woody and herbaceous species to optimum growth under the stress of low light levels, as well as the competition for water and nutrients, imposed by the roots of large trees and shrubs.

Ground covers highly successful in considerable shade are *Vinca minor*, *Pachysandra terminalis*, *Convallaria majalis*, *Ajuga reptans* and the various forms of *Hedera helix* and *Euonymus fortunei*. Because these plants are tough, competitive and easy to care for, they have been subject to overuse in the landscape. But many people never look beyond these fine plants to the exciting range of possibilities which exist for the gardener lucky enough to have shade. Here are some additional suggestions:

Creeping Lilyturf (*Liriope spicata*) is a grass like plant which grows six inches tall and spreads rapidly by rhizomes. Lilyturf (*Liriope muscari*) is a taller version, varying from twelve to eighteen inches in height, and growing in slowly spreading, tufted clumps. Both

species eventually form a dense, dark green turf. While *Liriope spicata* is fairly uniform in appearance, *Liriope muscari* displays a considerable variation in height, floral color, foliage and vigor, depending on the cultivar selected. Flowers occur in short spikes in late summer and vary in color from white through rose to purple, again depending on the variety. The *Liriope*s' greatest attributes are that they are evergreen, tolerant of poor soils, drought, dense shade and intense root competition. Hardiness is not reliable below approximately 10°F. The visual monotony of a large expanse of *Liriope* can be relieved by interplanting with *Hosta* or *Hemerocallis* to create textural patterns.

Yellow Archangel (*Lamiastrum galeobdolon* 'Variegatum') is a relative newcomer when used as a ground cover. This plant grows rapidly by sending out long shoots which creep across the soil and root at each leaf joint. The plant is deciduous but growth begins early in spring, and during May the plant is adorned with small, yellow flowers. Its greatest attribute is the silvery-white leaf markings which add a brightening effect to the gloom of dark areas. In its great enthusiasm to spread, Yellow Archangel can become invasive; however, best growth occurs in soils high in organic matter. *Lamiastrum*, previously known as *Lamium galeobdolon*, is attractive blended with masses of *Hosta* or tall-growing ferns for textural, color, and height contrast.

The Bishophats (*Epimedium* sp.) are among the most persistent and dependable ground covers over time. They form dense colonies which grow eight to twelve inches tall and spread in ever-increasing clumps by underground stems. The green leaves are heart-shaped, and especially beautiful in texture and subtle coloration as they unfurl in the spring. Flowers appear with or just after the new leaves have expanded, and in a few instances are hidden in the foliage. In most, the flowers are visible as finely branched clusters of white, yellow, pink or red flowers. These plants tolerate dense shade with best growth occurring in moist, organic soils.

Vancouveria (*Vancouveria hexandra*) is an American native with a growth habit similar to the *Epimedium*s.



Growing six to twelve inches tall, it spreads outward by underground stems and sends up thin, wiry stems terminated by graceful, fine textured, light green leaves. It is slow to reestablish upon transplanting, but eventually forms a dense, persistent carpet, tolerant of poor soil conditions. Flowering occurs in June with delicate, fine textured panicles of white flowers.

Sweetwoodruff (*Galium odoratum*) is an old garden plant of delicacy and charm, lacking in many garden schemes. This deciduous plant with light green foliage forms a dense carpet six to eight inches tall. *Galium* bears tiny, white star-shaped flowers in May, which remain attractive for several weeks. Best growth occurs in moist, organic soils; however, this plant, at its best, is rampant and can quickly take over an area.

Recently, this author has seen *Galium* used in combi-



Left—*Eudonymus fortunei*

Above—*Liriope muscari*

nation with *Asarum europaeum*, which has bold, shiny, dark green leaves six to eight inches in height. The textural and color contrast between the two plants was dramatic and highly ornamental. You might also consider mixing *Galium* with occasional drifts of Lily-of-the-Valley (*Convallaria majalis*) for contrast of height, leaf color and texture. However, the Lily-of-the-Valley is so enthusiastic in its growth that it needs to be thinned out occasionally. Another companion plant is *Corydalis lutea*, with blue-green, fine-cut foliage. It grows nine to twelve inches tall and bears yellow flowers throughout the summer. Once established by seed, this plant can also become invasive and will charmingly invade neglected corners of the garden.

Creeping Forget-Me-Not (*Omphalodes verna*) is a plant of prostrate trailing habit, which spreads rapidly by stolons. Its striking ornamental feature is the small, white-eyed, brilliant blue flowers, which appear in early spring. This plant is intolerant of drought and full sun, so best growth occurs in shade and moist, organic soils. Consider creating drifts of *Astilbe* within a mass of Creeping Forget-Me-Not to add visual relief and extend

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Willows

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purpurea L. X *Silesiaca* Willd. (20369), in the Soil Conservation Service collection from Czechoslovakia have grown to 5 m tall and 1 m wide after five years. These could be used as a substitute for Lombardy poplar, *Populus nigra* L. var. *italica* Muenchh., in narrow hedges or for accent plants in order to avoid the poplar canker problem.

Weeping Willows

In America, the best known and most widely planted weeping willow is *S. babylonica* L. (23466). It was brought from China to Europe and England in 1692. On the island of St. Helena, Napoleon's favorite tree was this weeping willow, and such great numbers of cuttings from it were distributed in Europe and America that many willows in this country may trace their ancestry to this tree. This willow grows 12–20 m tall and its long, green branches may touch the ground. Other weeping willows are available in nurseries including the Wisconsin weeping willow, *S. X blanda* Anderss. (*S. babylonica* X *fragilis*). However, the long, pendulous branches of this variety are brittle and litter the lawn more than those of other willows. The Thurlow weeping willow, *S. X blanda* cv. *Elegantissima*, also is a highly ornamental tree with long, green, pendulous branches. The identity of these three willows is often confused.

The golden weeping willow, *S. alba* cv. *Tristis* (23468), with bright yellow, pendulous branches is highly ornamental in the winter landscape.

Dwarf Willows for Rock Gardens and Bonsai

Warren-Wren (7) discusses 48 willows that grow as dwarf shrubs or trailing plants in rocky or gravelly areas in the Arctic or alpine regions of Eurasia and America. Some of these are native to the mountain regions of the United States and

Canada. They are readily grown outdoors in small containers where light is adequate. Their naturally dwarf growth habits and gnarled branches make them suitable for bonsai specimens or for growing in the rock garden. Among native species growing in the rocky alpine areas of America are *S. herbacea* L., found in New Hampshire and northward; *S. rotundifolia* Trautv. ssp. *dodgerana* (Rydb.) Argus, one of the smallest "trees" in the world, grows on calcareous alpine slopes from Alaska to western Northwest Territories with a disjunct population in Montana and Wyoming; *S. reticulata* L., the wrinkled willow, an unusually attractive plant grows from Alaska to Labrador; and *S. uva-ursi* Pursh., the bearberry willow found from Alaska to Labrador and south to New York. These and other species of dwarf willows may be available from nurseries or arboreta in this country. However, we should discourage the collection of these species in their native alpine habitat because of the difficulty of transplanting them and also because of their scarcity in nature.

Propagation, Transplanting and Culture

Dormant cuttings of willows in 15 cm lengths are readily rooted under mist when they are placed in peat pellets or pots containing a rooting medium. A rooting hormone hastens rooting. After two to four weeks when roots have formed, the plants are set in 10 cm pots and grown on in the greenhouse or cold frame until they are planted in the field. Willow cuttings can be rooted in water or in benches or boxes of sand or perlite and then transplanted to pots; but they may die if the brittle roots are broken. Willows may also be propagated in outdoor beds or fields by planting 30-cm dormant cuttings in a vertical position and leaving no more than five to seven cm of the top end exposed.

Bare roots of dormant plants are easily damaged in transplanting so for best results, willows should be

dug with a root ball or established in containers during the dormant season. When willows are transplanted in leaf, the foliage wilts or turns yellow and drops off; the new foliage gradually replaces it. By stripping off most of the leaves at transplanting time, the few remaining leaves retain turgidity and the plants recover more easily from their transplanting shock as they develop a new set of leaves.

Ornamental willows require well drained, fertile soil; an annual application of fertilizer; and pruning back of the older growth in early spring after flowering to stimulate strong new shoots and buds for maximum production of catkins. Severe pruning of the fantail willow is essential for production of the desired fasciated, curled, and curved shoots.

Willows for commercial forcing are cut back in March or April before growth starts to three or four buds on the strongest shoots of the previous year in order to stimulate maximum shoot growth with catkins for the next crop. The coloration of yellow or red barked willows is most intense on the stems of the previous year's growth. Annual fertilization and hard pruning, even to the ground, will enhance the beauty of these trees the next year.

Preparing Decorative Material

Willow branches are used in decorations when the catkins are partly expanded, preferably before the anthers open and shed pollen. To bring them into proper condition, the dormant shoots should be held in vessels of water at cool temperature (15°C.). Occasional spraying of the shoots with water to maintain high humidity insures against dehydration.

The corkscrew willow shoots may be used for floral design work while dormant or they may be forced until the new leaflets appear that add to their interest in arrangements.

Pests

Insects attack some willows more severely than others, but in most

cases, the plants do not need spraying to prevent damage to next season's growth. The copper blue imported willow leaf beetle, *Plagioderma versicolor* (Laicharting), and Japanese beetles, *Popillia japonica* Newman, may have to be sprayed if they appear. If the willow beaked-gall midge, *Mayetiola rigidae* (Osten-Sacken), attacks susceptible willows such as *S. caprea*, the galls should be cut and destroyed by March 1 or before the adults emerge (5), but most willows discussed in this article are either immune or little damaged by this pest. One of several species of borers may attack branches and lower stems of willows. Cut and destroy infested parts promptly to prevent extensive damage.

Watermark, a disease caused by the bacteria, *Erwinia salicis* (Day) Chester, causes wilting and death of willows in several European countries. It is not known to occur in America. Any imported willows should be observed under strict quarantine before release. □

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Textures

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and milkweed pods against October wind.

Now that I have grandchildren, I want to share with them the sensitive and exuberant world of bud, blossom and seed. For that is what our own lives are. The children are learning to step lightly in the grass, compare the colors of moss, and see the configuration of lichen. This is the wide-open secret I have to share. As they discover each new plant, as we test together the spiny sea urchin, or marvel at the fritillary, our world expands.

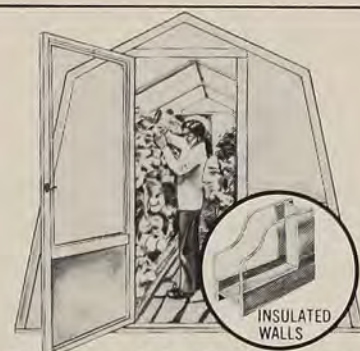
That same expansion finds its way into my tapestries. Nearly all my designs are large. A Murex hanging of organdy is seven feet high. Embroidered in wool on organdy, it hangs, suspended, to catch the light. Other organdy hangings, embroidered on both sides, of dandelion, nautilus, marsh grass, all magnify the exquisite structure of their natural forms. Where windows look out on barren city scenes, I have my transparent tapestries to form a world of light and beauty.

Sometimes I spend hours examining the curve of blossom and leaf of a single plant. I have watched the patterns of rain with a magnifying glass. All of this intimate knowledge is part of my preparation for each tapestry.

These impressions are then translated into embroidery on handwoven wool or organdy. My materials come from countries as remote as Bolivia and Southwest Africa. I prefer natural colors and the staining colors of wild plants.

With my tapestries, I often find that I write poems to help establish the rhythm for the final design. All my good hangings have rhythm. I think this is because I come from the edge of the sea where the motion of wind and water is so compelling.

In my art form I try to capture the strength and tenderness that I find in nature." □



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THE CARY ARBORETUM OF THE NEW YORK BOTANICAL GARDEN

*Willard W. Payne, Director
Millbrook, NY 12545*

The Cary Arboretum was established as a division of the New York Botanical Garden in 1971, through a gift of land and funds from the Mary Flagler Cary Charitable Trust. The heart of the nearly 2,000 acre property is a pair of small mountains, known as the Canoe Hills, the highest of which is the site of Mrs. Cary's summer house, the Tea House, with a breathtaking view west across the Hudson River valley to the distant Catskill Mountains. Spreading from the west slopes is a large tract of relatively flat bottomland, sinuously cut by the East Branch of Wappinger's Creek, flowing toward the Hudson River fifteen miles away. The lowland marshes are flanked by meadows, filled in autumn with wildflowers—deep blue gentians, purple bergamot, gold and yellow black-eyed Susans and goldenrod, and blazing masses of lythrum, accented by white flashes of meadow rue and boneset.

North and south, rolling, upland farms give way to forests and deep ravines. In the east, Wappinger's Creek dances through a massive gorge, dark beneath dense stands of virgin hemlock, but enlivened by occasional sun shards that glint from riffles and rustling falls. In quiet pools, sleek, brown trout inspect the passing possibilities. Many different soil types, exposures, slopes and drainage conditions produce a rich array of habitats and species, and offer a wealth of environmental situations for ecological study and experimentation.

The programs of education, research, and horticulture being developed here are concentrated in four basic areas, emphasizing living systems, and are designed to complement the programs of systematic botany, biochemical research, and horticulture, for which the New York Botanical Garden in the Bronx is so well known. The core of the instructional program is use of the Arboretum as a resource center for ecological and evolutionary studies at college and graduate levels, in cooperation with several area colleges. Doctoral training is conducted through a special affiliation with the State University of the New York College of Environmental Science and Forestry at Syracuse. A number of adult education courses are offered to area residents, and these are facilitated by classrooms and laboratories in the Gifford House, an early nineteenth-century Federalist country home that, after extensive remodeling, now serves as the Arboretum's Education and Visitor Center. Here also is a gift shop, a special activities room for the Friends of the Cary Arboretum, and an instructional resource center that includes facilities where visiting area teachers can find resources to be used in their own classrooms. The Arboretum works with the Garden in the Bronx to broaden the learning experiences of horticulture students enrolled in the State-certified horticulture program; and students studying for the certificate spend at least one semester



working with the Arboretum staff in settings and on projects that are not possible in the urban environment and more fully developed campus of the Bronx.

Wildlife abounds in the forested regions of southeastern New York, where the Arboretum is located. White-tailed deer, woodchucks, rabbits, and many species of rodents constitute a formidable threat to sensitive plantings of seedlings and sapling trees. For this reason, the Arboretum supports a full program of wildlife study, designed to explore mechanisms for controlling animal populations and reducing plant damage. Wherever possible, fencing is eschewed in favor of natural control measures, including baiting. When necessary, however, innovative fencing techniques seek to combine effectiveness with minimal upkeep and maximum aesthetic acceptability for the landscape.

As with any living plant facility, the Arboretum accumulates ornamental plants that delight visitors and enliven the buildings, offices, and grounds. These are displayed in a formative visitors' program that so far includes twice-weekly tours of the grounds, greenhouses, and other buildings.

The Cary Arboretum also serves as the host institution and organizer for the Russian-American botanical collectors' exchange program. The temperate woody floras of the USSR and the USA are closely related. During the Tertiary Period, many temperate plants had a widespread range, but with the onset of the advancing glaciers, managed to survive only in a few relic areas, such as the Appalachian Mountains in the USA and the Caucasus Mountains in Asia Minor. During the two years of activity, the Arboretum has accumulated seeds of several hundred specimens from the Caucasus Mountains and from Central Asia, many of which have never before been grown in this hemisphere. The program provides opportunity to develop a living genetic bank of natural stocks from throughout Russia, and this will become a central feature of the Cary Arboretum's collections in the years to come. In most instances, seeds collected in Russia, and on forays throughout America to satisfy the needs of Russian scientists visiting here on reciprocal, collecting trips, are available for exchange. They enrich the Cary Arboretum's *Index Seminum* which features seeds of the northeastern United States. This seed list, one of the largest in the United States, is made up almost entirely of seed collected from the wild.

The Horticulture Department, working with the Education Department, is also responsible for planning special educational displays on the grounds. A fern glen is presently being developed with the aid of the American Fern Society that will include the largest and most diverse collection of naturalized, temperate ferns and fern allies to be found in the northeastern United States. Another project is a native tree walk, stretching through

several natural and successional ecosystems, and incorporating a great diversity of the species found in this floristic region.

Ecological and systematic research includes studies of plant-insect co-adaptation as seen in the biology of extra-floral nectaries and nectar, plus investigation of the evolutionary and ecological significance of nectar from floral glands. Other areas of interest include the evolutionary biology of induments and pollen of a variety of taxonomic groups, and of nutrient partitioning among the co-existing species in natural communities. Many of these studies are enhanced by the availability of laboratory, herbarium, and library facilities in the Bronx, and by support from the diverse staff there.

These and other investigations undergird the several research and education programs oriented toward plants and man. In one such program, we are attempting to develop haploid strains of American elm to be used in breeding for resistance to Dutch elm disease. In another, precise investigation of the pollution tolerances of urban trees is being studied. Selected clones and seedling populations are exposed to known concentrations of common atmospheric pollutants, and are then subjected to field trials in circumstances ranging from the heavily polluted streets of central New York City to the relatively pollution-free atmosphere of the Arboretum grounds. The Arboretum supports a program of urban tree study and collaborates with several local communities in investigations of street tree problems and urban forestry. The urban tree work has included preparation of detailed analyses and management plans for the communities involved, including ingenious, key-like mechanisms for finding species or clones especially suitable for the particular circumstances of soil, shade, sidewalk or pavement, height, and growth features that are inherent in considering the desirability of plants for actual urban sites.

The Arboretum also serves as a center for assessment of the likely impact of major economic development projects on the ecosystems and human populations in the tropics. Recent work has been carried out in Bangladesh, Malaysia, Surinam, Brazil, Argentina, Colombia, Nicaragua, and Guatemala, under contract with leading international organizations such as the World Bank. In the United States, Cary staff has also led the way in studying use and development of rights-of-way for power lines as carefully integrated elements, not only of the landscape but of the ecosystem, seeking ways to structure them to provide food and refuge for wildlife and for plant species usually found only at forest clearing ecotones.

As a basic tenet of its philosophy, the Arboretum is committed to energy conservation and to good, environmentally sound, energy management. An educational program in woodlot management is combined with wood production from grounds maintenance to provide fuel for several wood-fired boilers used to heat houses, repair shops, and maintenance sheds. This is part of a growing program that will attempt to study the

conflicts that will arise between technological demands and aesthetic needs, as we increasingly must manage the natural landscape to enable us to exploit it to substitute, at least partially, photosynthate for petroleum products.

Nowhere is the concern for sound energy practices more vividly expressed than in the exciting new Plant Science Building, the administrative and research center that houses the library, plus a variety of laboratories and meeting facilities. This is the largest, privately financed, solar-heated building in the United States. In addition to being heated preponderantly with solar heat (at least 85 percent of the total annual requirement) captured in ranks of collectors on the roof ridges, the building incorporates many energy-saving devices that will provide examples of, and offer opportunities for, energy conservation experimentation. Among the features: the two-story building is sunk in the ground, with the lower story buried and the upper partially encased in soil bermed up around the walls; the masonry walls are unusually massive to provide heat sinks that tend to stabilize the temperature in summer or winter; the exceptionally effective insulation is exterior to the walls and roof elements (rather than within them), providing a protective shell that is unbroken for the entire building; insulated skylights provide general lighting wherever possible, and electric lighting is made most effective as task lighting with illumination concentrated only where work is to be performed; all skylights and windows, including window walls in the library and meeting rooms, can be covered manually at night with insulated panels to reduce heat loss; hands are washed with tepid water heated to appropriate temperatures by the solar system, and not cooled to acceptable temperatures after overheating as in conventional systems; even the restroom lights are on timers, spring wound as one enters the facility, providing frequent reminder of the need for concern for energy use.

Library collections at the Arboretum emphasize energy literature, in addition to serving the biological and horticultural needs of the staff. Daily service brings books to the Arboretum from the Bronx, and weekly trips by the Arboretum librarian enable him to work personally at the main collection in the Bronx on reference requirements of the research personnel. The library is regularly open to the public.

The Cary Arboretum is unique in America today, being a young institution that is committed to development as a major center for plant biology education and research, emphasizing living organisms from this country and abroad that can be grown in the northeastern United States. As an organization now in only its seventh year, the Arboretum is in an active growth phase, with many facets of its work still taking shape. As the grounds and collections mature, so will its programs. We want always, however, to remain youthful in outlook, receptive to change and innovation, continually in cycles of maturity and rejuvenation. □

Ground Covers

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the flowering period of a landscape area. *Omphalodes* is great as an underplanting to face down a border of shrubs.

Strawberry Begonia (*Saxifraga stolonifera*), a trailing plant with runners, is a house plant most gardeners do not consider to be hardy. It is reliable to about 0°F and thrives outdoors in many Philadelphia gardens. The plant bears rounded, fleshy green leaves which are attractive because of their white veins. Wispy-appearing, white flowers occur on tall branched stems during May



Hostas create a bold sweeping mass to visually tie a tree into the larger landscape picture

and June. It thrives outdoors in light shade and a soil rich in organic matter. Rapid soil coverage is achieved by spreading runners, which are easily removed and set into new areas. In severe winters, it does have a tendency to die out in spots and needs to have plants plugged into open spaces. Since this plant tends to be a bit ephemeral, it should be used sparingly.

Astilbes (*Astilbe* × *Arendsii* hybrids) have delicately cut foliage and brilliant flowers in midsummer, but few gardeners consider planting this in spreading masses as a ground cover or in combination with other shade tolerant covers. Height, floral color and bloom sequence

vary according to variety and give the gardener opportunities for design flexibility. Astilbes thrive in low, moist sites and look stunning highlighting the edge of a stream. For the gardener with rich woodsy soil, or willing to supplement the soil with leaf mold or compost, these plants can be used almost anywhere in the shade.

Once established, clumps expand in size and your colony can be rapidly increased by division of existing plants. While not tolerant of drought, plants given adequate moisture are dense, persistent and dependable over time. Astilbes can be used to great advantage in groups of three, five or seven and scattered as drifts among other covers.

One plant which appears to be an overgrown Astilbe is Goatsbeard (*Aruncus dioicus*). This is a plant of yesteryear almost forgotten today. It bears large terminal panicles of creamy-white flowers in early summer and can grow four to seven feet tall. It too, prefers a moist soil and light shade. While it is not a ground cover plant, it can be used to advantage, singly or in small groups, to break large patches of *Pachysandra*, *Vinca* or *Hedera helix*.

Plantain-lily (*Hosta* sp.) is the queen of ground covers for bold sweeping masses. Depending on the species or variety selected, size can vary from six inches tall to approximately three feet. Leaves can be thin and lance shaped to large and ovate; green, blue-green or variegated. Flowers occur on basal spikes in mid to late summer and vary from white to deep purple, with some varieties being quite fragrant. Individually, the plants form dense mounds, but in mass they create a bold, flowing accent which can be used to highlight driveways or walks, or face down shrub borders or the foundations of buildings. Hostas are not fussy about soil type and will thrive almost anywhere; they do wilt under drought conditions. Their greatest disadvantage is that they are not evergreen.

When mentioning Hostas as a ground cover, I am frequently told that they would be great if they weren't so dense, vigorous and invasive. What could be better attributes for a plant which will add beauty and ease of maintenance and last a lifetime?

One problem people have with ground covers for large areas is initial purchase price. All the plants discussed herein are easily increased by division. It becomes possible to buy an affordable quantity, install them into a growing area with well prepared soil, high in organic matter and near a water source. By subjecting the plants to a high level of culture with adequate water and liquid fertilizer applied every two to three weeks, the clumps will increase rapidly. It is surprising how rapidly a good gardener can turn twelve plants into thirty-six. In two years, I have split three clumps of *Astilbe* twice and have managed to get twenty-seven small but healthy plants.

Shady gardens present landscape challenges, but by their very nature give a sense of permanence and stability. If you find yourself with such a growing situation, think of how lucky you are to have the perfect environment to grow shady aristocrats!

Flowers of the Midnight Sun

Kenneth J. Smith
The London Free Press
Ontario, Canada

Summer arrives in the arctic like the crash of cymbals as the ice finally frees the land almost overnight.

To us "southerners" the 21st of June is well into summer with the thoughts of winter long since forgotten. In the vast land of tundra stretching from Baffin Bay to the Beaufort Sea which washes the north shore of Alaska, summer comes and goes in a great rush.

For the visitor flying overhead it is an unbelievable, endless, seemingly uninhabited, barren land, where even the two-month summer cannot dispel the last frozen vestiges of winter. Yet below, almost anywhere one sets down, the rock and tundra are alive with a vast array of arctic flowers jamming everything into this one brief period of "life". Here, an estimated 500 species of flowering plants complete their growth cycles.

All true arctic flowers are perennials, for only this type can survive if a seed crop fails. There are few climbing plants, no plants that sting or poison, nor any that are protected by spines or thorns. Perhaps we can surmise that protection is not needed under the circumstances.

Aside from being cold, the Arctic region is virtually a desert, with some areas getting less than seven inches of annual precipitation. Only



Photo by Author

the perpetually frozen ground prevents the surface water from sinking below the reach of the plant roots. To conserve moisture, many plants fall into the category of xerophytes . . . those that can withstand prolonged periods of drought by having small leathery leaves, often covered with densely matted hairs.

By special adaptation, plants hoard whatever heat can be found. They grow close to the ground, have comparatively large, colorful blooms to trap the solar heat, and often grow closely together to form small warm "forests" of vegetation. A researcher reported that the temperature near the base of a tested plant was 38 degrees Fahrenheit, while the surrounding air temperature was only 10 degrees.

Arctic plants are able to withstand freezing . . . some flowers can be frozen stiff only to thaw and continue their growth cycle.

From the pages of a survival manual we learn that most arctic plants are edible. The leaves of the Labrador tea (*Ledum*) a member of the heath family, and common across the tundra, produces a tasty drink when steeped; the licorice-root, a trailing plant of the muskeg, has a rootstock that is almost tasty raw or boiled. When cooked like spinach, the young flowering stems of the lousewort might be considered a nutritional delicacy.

The area of our particular floral discoveries was limited to the delta region where the mighty McKenzie river meets the Arctic Ocean. Here at Tuktoyaktuk, on a rock outcrop within a hundred feet of the quiet lapping Arctic Ocean shoreline, we found the true arctic rose (*Rosa borealis*). Just three inches high, it had one bud just about to open. Further south near Yellowknife, the capital of the Canadian Northwest Territories, the northern rose grows in greater profusion. It is larger in size than *Rosa borealis* and is excluded from the true arctic variety by its thorny stems.

Strange as it may seem, another "rose" is one of the most common

and widespread of the Arctic plants. In spite of its common name, it is not a rose at all. *Dryas integrifolia*, or Arctic avens, with its clustering nature and oak-like leaves is found throughout the north. It was adopted in 1975 as the floral emblem of the Northwest Territories, and is one of the few arctic plants that will survive in warmer climates. Southern gardeners will need patience, however, as plants raised from seed take several years to flower.

Again near the Arctic shoreline we found *Pedicularis hirsuta*, the hairy lousewort. A strange name for so pretty a flower, but folklore records that some of the 500 odd species in this genus were believed to give cattle lice if they ate them. Though innocuous itself, foxglove, one member of the family has some medicinal properties. Found in most regions of the Arctic, it bears its flowers early and quickly. A tap-rooted plant, it is topped with elongated spikes of pale pink blooms surrounded by a delicate foam-like fuzz that wraps around the stem.

Everywhere among the rocks, the ground pussy willow (*Salix*) pushes its stems of regularly spaced pinkish blooms skyward.

Eighty miles inland near the modern Arctic town of Inuvik is an area of open grassy patches interspersed along the edge of the fading tree line. Here the *Lupinus arcticus* or arctic lupine thrives in luxurious clusters, its light-blue and white flower spikes reaching for the sun.

I visited this area while a University Professor and three of his students were studying a burned section where lightning had started a fire nine years ago. They were attempting to determine how many plants had returned to this tract of rock and tundra.

In an area beside the road not more than one hundred feet square I found 19 different arctic plants. They ranged from one inch specimens to others almost two feet in height. Yet, surveying the area from the road seemed to indicate not

much more than moss, grasses, small evergreens and burned scrub-tree stumps occupied the site.

Three members of the pea family were in evidence on closer inspection. *Astragalus* belonging to the enormous genus of vetch-like herbs, *Hedysarum*, most of whose members are found in the Old World, and *Lathyrus* closely resembling the sweet pea.

There was *Hepatica* from the buttercup family, *Eriophorum*, commonly called cottongrass, an Arctic lily still in tight bud. Also present was *Linum*, one of nearly 100 species from the family *Linaceae*, commonly called flax, and several members of the family *Ericaceae*, including the blueberry and cranberry.

One of the smallest, yet perhaps one of the most beautiful specimens was the *Andromeda*. It comes from a genus comprising only two species of the heath family, and is sometimes called bog rosemary. The one-inch gem taxed my close-up equipment to the limit.

The real joy of this expedition was the discovery of a small green clump of plants topped with dainty creamy-white blooms. On the way back to town I asked my learned friends if there were any orchids in the area. The reply was it was doubtful. Upon receipt of my color slide, the Professor agreed that I had indeed found a rare clump of *Habenaria hyperborea*, or arctic green orchids.

For many, a trip into the arctic is too expensive and arduous. Mountain climbing is often easier. Many of the flowers found in the arctic, can also be found growing at various altitudes in the Rocky Mountains in the United States and Canada, where the severe temperatures and sparse growing conditions are similar.

It was a revelation for me to find that many of these same plants . . . the *Ledum*, *Ericaceae*, *Aven* and others, survive the windswept, cold slopes of Mount Washington in New Hampshire, almost the breadth of a continent away. □ 39

Book Reviews

By Tom Stevenson

Cactus and some other succulents are examples of nature's ingenuity in adapting plants to survive in environmental extremes. The deserts of the world contain most of them and they are found also in jungles and on mountain tops.

Imagine them in the home as house plants! Yet, they are becoming more and more popular and more widely used, lovely to look at and easy to grow. Whether enjoyed for their flowers, foliage or form, they are probably the most fascinating group in the entire plant kingdom.

There is another interesting wrinkle: Grow cacti from seed (they are listed in several seed catalogs) and then create oddities of plant forms not found in nature by grafting a part of one onto another.

It isn't difficult and the know-how is provided in a new paperback, "Cactus and Succulents," by the editors of Sunset Books and Sunset Magazine, published by Lane Publishing Co., Menlo Park, CA., 94025, 80 pages, many illustrations, some in full color priced at \$2.95.

Here are two additional recent Sunset paperbacks, both worthwhile: "Sunset Ideas for Small-Space Gardens," 80 pages, beautifully illustrated, \$2.95; and "Landscaping & Garden Remodeling," 80 pages, beautifully illustrated, \$2.95. They can be very useful for the purposes implied by the titles.

There has been a lot of criticism lately of gobbledygook (wordy, legalistic phrases used in documents and other papers), and a growing insistence that language be used which the average American can understand. Some botanists and authors of garden books are almost as guilty as the lawyers and bureaucrats, using complex jargon that isn't easy to read.

William R. Van Dersal in his new book, "Why Does Your Garden Grow? (The Facts of Plant Life)," published by Quadrangle/The New York Times Book Co., 200 pages, well illustrated, \$8.95, provides information useful to every gardener, easy to read, easy to understand.

"It is not a book about how to grow things, except more or less incidentally," he says, but rather a book that attempts to provide some basic knowledge about plants for the benefit of practical gardeners.

There are certain key scientific facts

and ideas that are of direct and practical value in gardening. It is with these ideas that this book is concerned. It can bring about a better understanding of what's going on in the garden.

Van Dersal, a resident of Arlington, VA., was former deputy administrator of the Soil Conservation Service, U.S. Department of Agriculture, and is now dean of the Management College, National Graduate University, in Washington, D.C.

"Most people are aware that we have a great variety of climates in our country. But besides the general climatic and soil conditions, every garden site has a number of little climates of its own," says he.

These are called microclimates by the scientists, and they are very important in gardening. A simple example of a microclimate would be in the shade under a tree or in the shade cast by your house. Because the sun's rays may not reach such an area, it will be a little cooler than elsewhere. Transpiration (loss of moisture by the foliage) won't be quite as fast and the plants there will not require as much water. So there will be a little climate in the shaded area that may enable the gardener to grow plants he could not otherwise.

"A number of scientists have been giving close attention to the control of insect pests and diseases of plants," he says. The results of their work, especially in recent years, are leading plantmen to think a little more carefully about applying poisonous chemicals. It turns out, in fact, that there are ways to deal with plant pests that do not involve some of the hazards and side effects associated with the use of plant poisons.

The use of such chemicals almost always has a number of side effects we really did not intend at all.

Many insects are kept under fair control by parasites—whether other kinds of insects, or fungi, or bacteria of one sort or another. These parasitic forms are pretty useful creatures. If the chemicals we use kill them too, we've lost some helpful allies. We may, indeed, be killing an insect pest already parasitized which means that the parasite, unable to complete its life cycle, goes down the drain along with the insect pest.

Greenhouses are used to control or modify many of the environmental factors affecting plant growth. Tempera-

tures can be regulated with varying degrees of precision; damage from wind and rain is avoided; injury from plant diseases and insects is reduced, but not eliminated. Growing media, moisture content, and fertility levels can be adjusted to meet plant requirements, according to Dr. John W. Mastalerz, professor of floriculture, Pennsylvania State University.

Dr. Mastalerz is the author of a new book, "The Greenhouse Environment—The Effect of Environmental Factors on Flower Crops," published by John Wiley & Sons, New York, N.Y., 625 pages, illustrated, \$18.95.

"This book," he says, "was written for students planning careers in greenhouse management. It is also directed to growers desiring to increase their knowledge of plant growth under greenhouse conditions."

Its purpose is to develop an understanding of the fundamental role that environment plays in the growth of plants. Greenhouse managers who combine a knowledge of plant growth with their judgement of economic factors will have the best opportunity to use their resources effectively.

The greenhouse structure has a distinct effect on several environmental factors, particularly temperature, light, carbon dioxide, and humidity. The changes that occur in these environmental factors, how they can be modified, and what limitations the greenhouse structure and its equipment impose upon the manager's control of the environment are described and evaluated.

After the basic facts about the greenhouse environment have been established, the effects of environmental factors on the growth and development of flower crops are explored in detail. Plant response to specific environmental factors is related to the basic physiological processes that occur in plants and to yield and quality, the goal of plant production in the greenhouse.

"For the student," says Dr. Mastalerz, "basic courses in botany, chemistry, physics, and an introductory course in soils will provide sufficient background for the principles and practices discussed in this book." Some knowledge of plant physiology would be very helpful.

"The Complete Book Of Bulbs," by F. F. Rockwell and Esther C. Grayson (Mrs. Rockwell), published more than 30 years ago, has been one of the best books on bulb flower gardening in the United States. Now there is a new edition, revised and edited by Marjorie J. Dietz, published by J. B. Lippincott Co.,

Philadelphia and New York, 366 pages, well illustrated, \$10.

"All the helpful ingredients of the original reference guide are here," says Dietz, "not only telling the bulb gardener how to succeed with these plants, but showing how, with more than 100 color and black-and-white photographs and many informative line drawings."

"Just how valuable was the original book?" she asks.

"In the course of my research, I had need of an additional copy of the out-of-print original. While talking to one of the country's leading experts on bulbs, I mentioned that I certainly would be happy to have his copy, and indeed would gladly pay him fifteen dollars for it. To which the expert replied: 'That's very interesting! Now if you were able to offer me a thousand dollars, I guess I would consider it.' Perhaps he would have entertained a lower figure, but he did not make me a counter-offer within my budget."

The English supposedly are better gardeners than Americans, the main reason being they've been at it much longer. Be that as it may, occasionally a very good book comes along, originally published in England, which is also worthwhile for gardeners in the U.S.A. Such a one is "Practical Gardening Encyclopedia," made up of contributions by about 50 leading British horticulturists, published by Van Nostrand, Reinhold, New York, N.Y., 350 pages, superbly illustrated, \$19.95.

Among other things, the book covers types of soil, improving the soil, soil testing, climate and its effect on plants, design, and planning of bedding, landscapes, an explanation of how plants grow, all phases of cultivation, propagation, evaluations of ornamental plants, and how to take care of pests and diseases. The index includes more than 2,500 entries.

"This encyclopedia is designed as a work of reference, but the arrangement of the information is thematic rather than alphabetical," says the editor. This is to enable the reader who wants to pursue a subject in greater depth to read through a whole section or group of sections in logical order, while the index should be consulted by a reader with a specific problem or query.

For example, if you are planning a big new project in your garden, perhaps a new vegetable and fruit garden, then you should turn to the section on Edible Plants, where you will find information about how much room fruit and vegetables need, how long you will have to wait for your crops, how much trouble they are, and so on and on. The infor-

mation should help you decide which fruit and vegetables you want to grow and also give you most details of how to grow them.

There are a lot of good suggestions in the book. One such is the recommendation to start sweet corn in the peat pots indoors to plant outdoors when the weather is suitable. This permits you to harvest sweet corn much earlier in the season.



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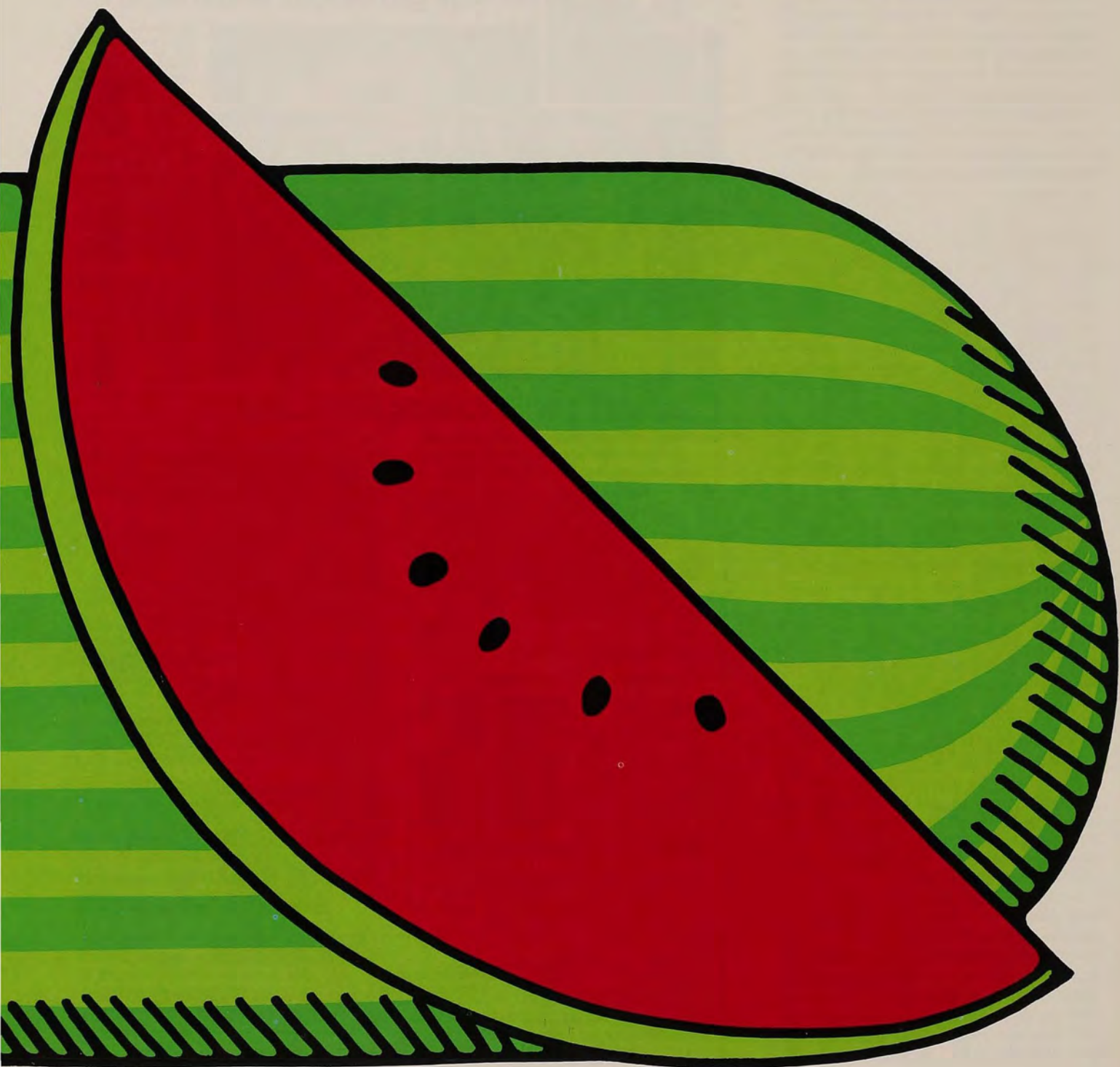
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Growing Melons in the Mountains



R. D. Morse
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Home garden and commercial production of watermelons and muskmelons has traditionally been confined to the areas of the United States having long growing seasons and high temperatures. Recently, researchers at Virginia Polytechnic Institute and State University have shown that, with the use of plastic mulches, melons can be successfully grown in mountainous regions of southwest Virginia.

Two watermelon varieties (Louisiana Queen and Crimson Sweet) and two muskmelon varieties (Harper Hybrid and Burpee Hybrid) were direct seeded and transplanted on bare ground or through black plastic. One direct seeding was made on May 20 with a second direct seeding and setting of transplants on May 27. Standard cultural practices were followed throughout the growing season. Since irrigation was not begun until early July, the improved soil moisture under the black plastic probably contributed to the growth differences prior to this time. Although the plots were cultivated several times, the mulch also reduced competition from weeds.

Early in the summer, the benefits of the plastic mulch became evident. Those melons in the mulched plots grew much more vigorously and began running much earlier than those on bare ground. At harvest time, the increase in earliness was still apparent. In the first 11 days, muskmelon yields were likewise increased 2–3 fold. The effects of the mulch continued through the harvest season, with yields of all but one variety doubled

on black plastic. Marketable yields of muskmelons could have been further improved by a tighter picking schedule. No differences were apparent in any quality parameters such as size, appearance, and flavor.

It has always been assumed that melons must be grown from transplants under southwest Virginia conditions. In this test, the transplants did generally produce a larger early yield, but by the end of the season there was no difference in total yield (Table 1). The earliness response might be increased further by direct seeding a week or two earlier, particularly under hot caps. Compared to the standard method of melon production in Virginia (transplants on bare soil), direct seeding through black plastic

yielded 2.3 times as many marketable fruit/acre (Table 2).

Research from many states has shown that the increased production from the use of black plastic more than compensated for the added initial costs of labor and material. This is certainly true for cooler climates and higher elevations, where melons cannot be grown successfully without it. Since yields in this test well exceeded the national average, it appears that melon production on black plastic mulch is feasible in mountainous regions, at least on a local market basis. Using transplants did not increase yields; therefore, the added convenience and savings derived from direct seeding would benefit both the commercial melon producer and the home gardener.

Table 1.
Effect of Planting Method on Melon Yields.

Variety	Planting method	Planting date	Marketable yield	
			No./A	Lb./A
Harper Hybrid (muskmelon)	Seed	5/20	10,890	13,689
	Seed	5/27	11,230	15,135
	Transplant	5/27	10,039	15,220
Burpee Hybrid (muskmelon)	Seed	5/20	8,848	14,785
	Seed	5/27	8,678	14,583
	Transplant	5/27	9,869	16,190
Louisiana Queen (watermelon)	Seed	5/20	7,147	48,707
	Seed	5/27	6,976	44,028
	Transplant	5/27	7,317	53,889
Crimson Sweet (watermelon)	Seed	5/20	7,657	52,698
	Seed	5/27	6,976	49,499
	Transplant	5/27	5,275	41,706

Table 2.
Effect of Mulching and Planting Method on Number of Melons Harvested.

Mulch	Planting method	Planting date	Melons per acre
Plastic	Seed	May 20	5,445
	Seed	May 27	5,360
	Transplant	May 27	5,785
Bare	Seed	May 20	3,190
	Seed	May 27	3,105
	Transplant	May 27	2,340

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