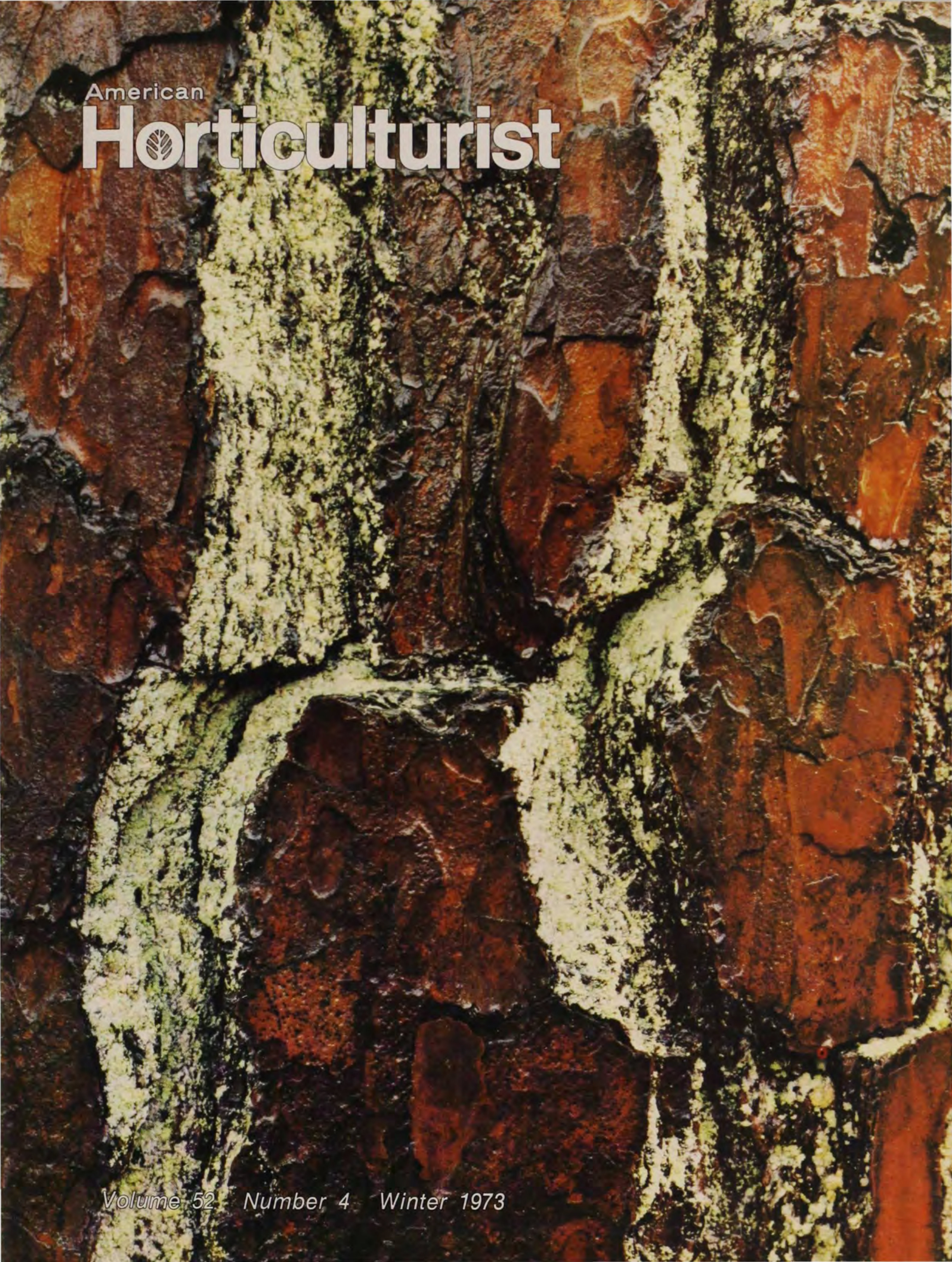
American Horticulturist



Volume 52 Number 4 Winter 1973

"Beauty From Bulbs"

Scheepers' Tuberous Rooted BEGONIAS

American grown bulbs • Shade loving plants • Easy to grow • Flower all Summer long from May to frost • Colorful leaves are added attraction • Our Superior Quality Bulbs will produce Heavy Strong Plants immediately

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So fine were these special types that they were segregated and named. Supply Limited.

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SANTA MONICA. Rose form salmon.
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All colors. **$6.50** for 5; **$12.50** for 10; **$30.00** for 25; **$115.00** for 100.

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an editorial . . . .

Time to Stretch

The art and science of growing vegetables, fruits, flowering and ornamental plants—that's horticulture. In much of the world, horticulture takes place in an organized area called a garden. Gardening is the laying out or care of the garden. Horticulture and gardening go hand in hand. When the gardener is a skillful horticulturist the garden will be at its best.

Gardens, over the centuries, have had one thing in common. They are places where plants are made to grow. It may have been—still may be—roses or herbs or flowers for cutting or display beds and borders or fruits or vegetables. But there is something more. The garden is a place where a human spirit can express itself, can manipulate and arrange living, responding bits of creation to its own liking. There's more to any garden than just a nice view or a pretty bunch of flowers or a basket of something fresh to eat. There's an expression of the gardener.

Do you suppose that every human has buried within him a creative urge? Poets, painters, members of the *corps du ballet,* great singers, and other creative people have found their outlet. Evidence is beginning to gather which indicates that even these artists, already blessed with an expressable art, find an empathy with plants. And so do professional people, working people, retired people and children. Could it be that we all really are gardeners, are horticulturists, at heart? Decades ago German medical .psychiatrists began using the term *Civilizationskrankheit* (civilization-disease), a condition of nervous disorder, hypertension, malaise, and more. The cure was, and is, quiet, organized, almost continuous contact with nature in rural places. Walks through the fields, mountain climbing, a day in the forest plantations, some time in a mountain meadow; these correct or alleviate nervous lesions brought on by city pressures.

The American Horticultural Society is working to discover more about this beneficial thing that happens when people get together with plants. In the spring there will be a symposium at the River Farm funded by a federal grant which is aimed at shaking loose a thread that might lead to the unraveling of the plant-man relationship. We gardeners, you and I, know about this business. We know how easy it is to shuck off hours of aggravation brought on by misunderstandings with other people and their inhuman machines by heading for the garden. Why, just a few minutes with a spade or with the dibble or with the clippers puts people and their wretched machines back into perspective. They may be a necessary part of daily living, but they have no part of *us*. Our reality lies in our self-expression in the garden.

It seems safe to conclude that mental health is related to successful gardening. When the garden is developing well who can be put down by those daily irritations that are bound to occur? Of course, if something goes haywire in the garden, that's another thing! Then there is cause for doing something.

How do you insure success in the art and science of horticulture? In the field of gardening? We have to face the fact that art is art, and you have it or you don't. But sciences are man-made and the techniques of gardening can be learned, so a little application can get you two-thirds of the way toward success. The good gardener, the good horticulturist, is made by study. By practice. That's the whole point of a magazine such as ours. When you have to stretch a little to get the meaning from an article—perhaps use the dictionary a time or two and maybe take a trip to a reference book—you are polishing your techniques and refining your knowledge. The art may come. We who already know the pleasures of gardening need to expand our collection of facts and learn better techniques. We are the people with a key to city problems. We know how to beat the energy crisis by finding pleasure in our gardens. We even can batter at the high cost of food by raising some of our own. But best of all, we can retain our sanity because we have found our outlet; we have felt the thrill of that age-old plant-man relationship.—**J.P.B.**

For United Horticulture . . . the particular objects and business of The American Horticultural Society are to promote and encourage national interest in scientific research and education in horticulture in all of its branches.

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JOHN PHILIP BAUMGARDT, *Editor*

The American Horticultural Society, *Publisher*
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O. KEISTER EVANS, *Executive Director*

IN THIS ISSUE

OUR COVER PHOTO—Lichen (*Cladonia* sp., identified by Mason E. Hale) on bark of Loblolly Pine (*Pinus taeda*), Williamsburg, Virginia, as photographed Spring 1973 after a warm rain by N. Jane Iseley, Colonial Williamsburg, for J. T. Baldwin, Jr.

Giant sunflowers, corn, bushy tomato plants, and squash plus happy children add up to a delightful introduction to the joys of applied horticulture. *All photos by Edwin Strohmaier.*

The gardener does not love to talk,
He makes me keep the gravel walk;
And when he puts his tools away,
He locks the door and takes the key.

Away behind the currant row
Where no one else but cook may go
Far in the plots, I see him dig,
Old and serious, brown and big.

He digs the flowers, green, red and blue,
Nor wishes to be spoken to.
He digs the flowers and cuts the hay,
And never seems to want to play.

Robert Louis Stevenson, "The Gardener"

Mary, Mary, Quite Contrary, Where Does Your Garden Grow?

*Russell A. Beatty**

Children's folklore is full of references to gardens, farms and growing plants. Nursery rhymes, picture books and stories give the strong implication that as soon as a child is able to walk, he ought to be growing his own garden. This fantasy is shattered when the child, like poor Peter Rabbit, is banished from any garden that does exist, lest he pick the radishes or trample the heliotrope.

To be quite frank, children have been rarely ever allowed to become gardeners. The garden is the place for adults. One can only become a gardener through hard work, total commitment and maturity. Only through rigorous training and discipline a child eventually can become a gardener. At a certain age he may be allowed to pull a few weeds for Mom. If he passes that test by not confusing the weeds with the zinnias, he can eventually be trusted with cutting flowers or pulling radishes. After that plateau is reached, the real apprenticeship begins with planting a few seeds of his own. Only those with infinite patience and unbridled perserverence can ever become full-fledged gardeners.

Perhaps this may seem to be slightly exaggerated. Nevertheless from my experience this scenario is truer than one might care to admit. Ironically, however, more young people are interested in gardening today than ever before. I suspect the reasons stem partly from the fact that gardening is a completely new experience to them. In fact numerous young people are really culturally deprived when it comes to gardening. They have been raised in apartments without the benefit of gardens or in suburban homes where the hired gardener or Daddy took care of the chores. A vegetable garden has never been a necessity for today's affluent society. The Victory Garden of the 40's has never again become a requisite to supplement the larder.

Nevertheless, the art and joys of gardening are being rediscovered in schools across the country from grade school to the university. Communal living groups with splendid, productive vegetable and flower gardens are evidence of the resurgence of a renewed interest in gardening, nature and self-determination. The production and sale of gardening books of all kinds is unprecedented. The demand for gardening classes far exceeds their availability. Whatever the reasons for this revolution, the trend is literally like a breath of spring.

Yet there is much that should be done especially with the very young. Children ought to be not only allowed to garden but also consciously encouraged to explore the rich, wonderful joys of growing plants. At what age a child may begin to garden depends primarily on how the opportunities are presented to him. If he is made to pull weeds or accomplish chores too tedious or too difficult, he will become frustrated quickly and "turn off". On the other hand if gardening is presented in small doses and in an exciting manner, even a three or four year old can be inspired. The earlier the better for it is in the early years that life-long habits and impressions are made and basic values formed.

At the University of California in Berkeley we have been experimenting with the idea of gardening for children for over three years. Combining the resources of the Department of Landscape Architecture with the leadership and financial backing of a major chemical manufacturing company and the publisher of its garden books, the Children's Adventure Garden has evolved.

Blake Garden, a ten acre estate belonging to the Department, provided a unique setting for the experiment. Initially, the Adventure Garden was developed as a place to photograph young gardeners (ages 5-10) for an annual promotional gardening book. The idea soon exploded into a revolutionary concept of gardens for kids.

At first we knew what we did *not* want. We did not want gardening to be a tedious, disciplined, joyless experience. We did not want the garden to be a microcosm of a migrant worker's truck farm with endless rows of crops. We did not want the kids to be turned off by boredom, tedium and inflexibility.

The children should *want* to play in the garden, to have fun. PLAY! That was the key word. If play could be work and work could be play, the garden could be another type of playground. The concept of the Adventure Playground had been

**Assistant Professor, Department of Landscape Architecture, University of California, Berkeley, California.*

proven infinitely more enriching and exciting compared to the traditional playground with static play equipment. Why not apply this concept to a children's garden?

The result was the Children's Adventure Garden. The essence of an adventure playground was combined with growing vegetables and flowers. Incorporating simple structures like raised beds, bean tents and tunnels, with growing plots laid out in irregular forms, the Adventure Garden began to develop. The selection of plants was based on several criteria: 1) common edible vegetables—carrots, chard, tomatoes, and others, 2) enormous or unusual plants—sunflowers, spaghetti squash, giant pumpkins, and others. The intent was to allow the children to experience the excitement of growing plants of interest to them in the creative atmosphere of a playground.

We wanted a heterogeneous group of children to participate in the Adventure Garden. Fortunately one of Berkeley's recently integrated primary schools provided the mix of children we were seeking—kids of different racial, ethnic and social backgrounds. There were some youngsters who were familiar with plants and gardens and others whose contact with vegetables had been limited to a frozen food package or a supermarket bin. Some kids already knew while others had yet to discover the subtle process of growth, harvest and decay. As it turned out, the children with little prior gardening experience frequently were the most interested and perservering. Indeed, if our experience is indicative, there is at least as much potential support for adventure gardens in inner city neighborhoods as in the suburbs.

Each year a student in Landscape Architecture at the University of California, Berkeley, was hired to coordinate the activities of the Adventure Garden, assist and guide the children, make observations on how the children used the garden and modify the garden accordingly. We adults who originally designed the garden quickly learned that not all our preconceived notions were important to the youngsters. Graduate student Dan Wormhoudt made many design changes after the first year based on the need to provide a balanced mix of private and communal spaces. He also expanded opportunities for free play and experimentation. Certain elements were eliminated and others were added. A cute little bridge between two tiered raised beds was discovered to be unused and an obstacle to the children. The small teepees on which beans were grown were removed and a large Bean House was built that formed an igloo where children could gather. A Mural Wall was added to one side of the garden on which sheets of plywood were attached providing places for self-expression through painting. An elevated platform on a tripod frame was built beneath a nearby plum tree to enable the kids to climb and pick the juicy plums, or simply "get above it all".

One of the problems that occurs is when seed is put into the ground nothing happens right away. Children are impatient and that experience can be very frustrating especially for the little ones. So other projects were initiated to keep the children's interest. In the Blake Garden greenhouse root view boxes similar to the ant farm boxes were built. The children could plant seeds of radishes and carrots and have an ant's eye view of vegetables developing in the "windows" of the boxes. Fast germinating seeds like green beans were pressed into large blocks of florists' 'Oasis' to enable a close-up view of the process of germination. Seeds of plants like cucumber and tomato were planted early in pots or flats to be ready for Spring planting out in the garden.

During the year special events were held to celebrate harvest occasions. Carol Malcolm, a senior in Landscape Architecture, who supervised the second year's garden, relates one of these events. "One of the highlights of our activity . . . occurred in mid-August when the corn was ready to harvest. We organized an evening cookout and a crowd of parents, siblings, and friends turned out to share the harvest and admire the children's progress. I was amused to find that the climactic event aroused some worry in the young gardeners—'Will there be more Blake Gardens?' asked one eight year old anxiously."

Top Right. **The Adventure Garden bulletin board keeps young vegetable growers up to snuff. The girls enjoy its shade for a break between chores.**

Bottom Right. **The oakleaf lettuce will make a fine salad for Mom if it survives daily petting. It's *her* lettuce and she loves it.**

Far Right. **Just like grown-ups; half the team does the job and the other half points out how to do it. But no matter—there will be vegetables for everybody.**


CHECK LIST: FRIDAY
PAUL: STAKES AROUND YOUR FLOWER SO THE
DIANE: finish thinning your radishes
ELGIN: ① YOU NEED TO ADD MORE STRING FOR YOUR PEAS
② YOU CAN HARVEST LETTUCE
TROY: PLEASE PUT IN STAKES & STRING FOR YOUR PEAS
CARLA: YOUR PEAS NEED SOME HELP TWINING UP THE STRINGS
JAN: NEWSPAPER SQUARES UNDER YOUR MELONS
YVETTE: WANT TO HELP ME THIN OUT SOME CHARD?
ROSS: PICK ZUCCHINI!
JULIE & DEIDRE ① small stakes for your super peas.
③ YOU NEED TO STAKE + TIE UP YOUR CUCUMBER
④ YOU CAN PICK SOME MORE LETTUCE
CHECK RADISHES!

Indeed there were more "Blake Gardens". Linda Haymaker, the third year coordinator, built on the previous years' experience. Failures were as important as the successes. "One of them," she relates with a smile "was the garden rocket. We couldn't figure out what it was when we planted it. It turned out to be a weed! And when you pulled it up it left a big hole in the ground."

The garden became a combination of the children's personal gardens and larger plantings provided by the Blake Garden staff and the student coordinators. The latter plantings formed an important backdrop to the children's activities. In addition space consuming plants like corn or beans could be planted to provide substantial yields to be gathered for the occasional feasts. Each youngster's own territory, his private plot, was essential. There he could grow what he wanted, make his own mistakes and delight in his successes. A strange flower appearing in one little girl's garden turned out to be a lettuce plant that had bolted in her absence.

One of the most important discoveries evolving from our experiences with the Adventure Garden is that the children need to feel personally involved in its creation and its operation. Through this involvement tremendous enthusiasm emerges. If the children feel that the garden is their place, they tend to develop a keen sense of responsibility towards the garden.

We adults, teachers and parents alike, have a tendency to condescendingly instruct children in the ways of doing things. We do not want them to make obvious mistakes and want to see them achieve constant success. In the Adventure Garden we recognized that the children were the participants and the adults were there to help them explore the fun of gardening for themselves. Major failures were avoided by providing the essential ingredients—good soil, a broad selection of seeds appropriate to the local climate, subtle guidance on the fundamentals of gardening, supplemental care for the garden during periods of absence, and timely suggestions for individual problems. The garden became a process rather than a product. As Carol Malcolm observed: "The size or growth week to week of their *own* plants was more important than the actual take-home produce; pride of possession inspired more care."

The three year experiment has ended. But there can and should be more "Blake Gardens". The Adventure Garden was a prototype that can be adapted to use by children everywhere. The spinoff is great. As a learning experience a multitude of skills beyond those involved in gardening are possible.

Art can be experienced in the sketching of a flower; arithmetic in the counting of seeds, the measuring of plots; music in the singing of songs about gardens; science in the miracle of growth and decay; and literature in the poetry of the garden. Discipline is quickly learned when plants die from lack of care. Cooperation can result when the children share their experience or help tend another's plot. Culture and history can be learned from the use of a gourd as a ladle, the symbolic celebration of an Indian feast, or the creation of corn husk dolls like those made by the pioneers. It is quite possible that a better world could result if the adventure of the experience of gardening could be made available in every child's education. Admittedly our experiment is unique. Few elementary schools have a Blake Garden, a University sponsor and a corporate benefactor at hand for a children's adventure garden. This does not make such a garden impossible. Opportunities exist in virtually every school, neighborhood or community. Resource people are abundant if one seeks them out. Gardens can be made to spring out of the asphalt deserts surrounding our schools.

A vacant lot can be brought to life with flowers and fruits mingled with children's laughter. Dead spaces in housing developments can become focal points of activity for entire families with community gardens.

The folklore fantasies can be brought to life. Jack's beanstalk can become a reality and Mary's garden can be made to grow. We Mr. McGregor's just might learn something about gardens and kids . . . and maybe ourselves.

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Camera Notes From Garden Tours in New Orleans During The 28th A. H. S. Congress

1. An orchid-tree, *Bauhinia blakeana*, spreads its flowering branches over the garden wall to delight passers-by.

2. Some design elements that typify New Orleans courtyard garden architecture; an open stairway, a well-designed pond with fountain, and tubbed plants at the Strachan house courtyard.

3. The fragrant white blossoms and stately stalks of the butterfly-lily, *Hedychium coronarium*, exhibit the plant's relationship to the gingers.

4. In the garden of the Catledge house, water and jasmine cascade down the wall and tubbed tropicals, perennials and camellias provide year-round color.

5. The coralvine, *Antigonon leptopus*, ramps widely in New Orleans gardens where local gardeners decry its vigor and visitors see only its great beauty.

6. The New Orleans sitting garden is a unique blend of elegant furniture and fountains, and a "jungle" density of sub-tropical plants, all blended into a secluded setting.

7. Golden flowers of a tender, shrubby species of *Cassia* bloom out summer-long. Note the almost mature seed pods which have developed from early summer blossoms.

8. Bromeliads, cousins to pineapple and Spanish-moss, grow to perfection in New Orleans' heat and humidity. Mostly epiphytes, these grow in a porous potting mix as terrace plants.

9. Formal garden lines at Longue Vue are enhanced by tubbed, flowering tropical plants that are changed through the season. Fountains delight the eye in the modern garden.

10. Spanish-moss, *Tillandsia usneoides*, is an epiphytic bromeliad relies on high humidity for survival.

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Broken Branch
A branch broken by a child having swung on it. Wind or ice may cause similar twisted breaks. Make a clean cut at the nearest crotch. Leave no stub.

The damaged branch has been removed at the first crotch behind the injury. A double bevel cut leaves no stub. Now the wound is to be painted.

When Catastrophe Strikes!

*Edwin F. Steffek**

Conventional pruning, planned maintenance and training of trees and shrubs, has been the subject of many articles and volumes over the years. It is unplanned pruning, however, the undoing or correction of accidents and other unfortunate circumstances, which often must take precedence along our streets and in our gardens. It is these emergencies that I treat at this time.

Broken Branches

Perhaps the most commonly met emergency pruning problem is that of branches broken by storms or human activities. Even in conventional pruning the rule is that these be taken care of first. If the broken portion is part of a larger branch, merely cut it back to the nearest crotch making the cut as close as possible without weakening the adjoining branch. With no stub left for the callous to have to work its way over the healing is much faster and there is less danger of decay gaining entrance.

If, however, the injured portion is a main structural branch cut it off as closely to the trunk as possible. Wherever a danger of stripping the bark downward with the weight of the branch exists cut the branch back to a short stub first. Then remove the stub. In any case, the very first cut of all must be a protective one on the bottom of the branch to prevent stripping the bark down the trunk.

Stripped Bark

This brings us to the question of what to do, if the bark is already stripped. The only resource, then, is to prevent the entry of decay organisms and to promote as rapid healing as possible. Since a clean-edged wound heals more rapidly than a ragged one, with a heavy, sharp knife remove all ragged edges.

With the knife shape the wound into a

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Tear down
A branch was cut improperly from this locust and its weight tore down a strip of wood and bark leaving a jagged, deep wound.

The tear down has been whittled smooth, shaped to provide continuous drainage. Bark has been beveled. When the cut face is smoothed, tree wound dressing (paint) will be applied and the wound should callous shut quickly with no decay.

narrow, vertical elipse cutting down to clean wood. Next paint the wound and especially the edges of the bark with shellac to make a moisture-proof seal, yet one which will not injure the tender cambium layer beneath the bark. When this is dry coat the entire wound as well as the edges with a good, commercial tree wound dressing. Lacking this, coat it with a good quality oil-based house paint.

Automobile Damage

Although stripped bark, as described above, is usually the result of a broken branch falling and tearing the bark downward, bark torn off is fully as often caused by automobiles hitting the trees. While such wounds are generally much wider, trim the edges back into an elipse, if possible, as above. Then paint in the same fashion. If any of the wood is gouged, also smooth the surface to aid healing before painting. (On a smaller scale lawn mowers are responsible for the same type of injury.)

Winter Injury

In particularly severe winters cherries and other not fully hardy trees may suffer from bark splitting and a peeling away of the bark from the wood especially on the sunny side of the trees. Again, take your knife and cut the bark back to healthy, undamaged wood, still firmly attached to the tree. Then paint the uncovered portion

Car Injury
When an automobile (or the mower) scars a tree trunk the wound is apt to be lacerated. Whittle away all splinters, smooth wood and bark and apply tree wound paint.

The repaired wounds—Bark is evenly beveled to encourage early development of wound callous which eventually will overgrow the injury.

Winter Injury
A successful treatment of winter injury. When young this maple suffered winter sunscald. In spring dead bark was cut away and the wound was sealed. Now callous tissue has covered the exposed wood.

Lightning
Lightning struck this street tree, ripping a spiral gash from tree top to the soil. City employees merely sprayed the ragged, torn, lesion with tree wound dressing. The injury should have been whittled smooth, bark properly beveled, before painting.

A few years back a horseshoe was hung over a small side branch. The branch, bruised, died and was stubbed back badly. Now callous tissue is engulfing stub and horseshoe—an unhealthy situation.

for protection from decay as outlined above. If such injury is fairly common, as in the Mountain and Plains States, and one still insists upon growing the somewhat tender trees, covering the trunks with spiral wrap often helps, especially while the trees are relatively young.

Lightning

While not common, this type of injury does occur, particularly on hilltops or other exposed locations. In these the bark is usually torn off in one or more narrow strips from the top of the tree to the ground. In such cases, treat in the usual way as high as conditions permit working.

Burned Branches

Another type of injury, unfortunately, becoming more common as more and more people take to the outdoors for cooking, is fire or heat-damaged branches. While the damages in any one year may appear only minor, they accumulate. Also, they usually return to haunt the owner in the years to come in the form of weakened and broken branches. The best cure is to not let it happen. Do not cook under the low-hanging branches of a tree. But where the damage has already occurred cut off the injured portions as described under "broken branches". There is no cure.

Overgrown Wires, Nails, and so on

A common practice in some areas is to nail barbed wire or other fencing to living trees—it saves posts. However, this can be particularly harmful to the trees. As they grow, first, the bark covers the wire. Then the wood envelopes it. Of course, the wire tends to rust but this is not enough. The wires interfere with the passage of sap and nutrients up and down within the tree. Also, in the years to come, imbedded wires or nails can do much harm, when one tries to cut the tree for lumber or fireplace wood. They not only spoil the saw but, worse, pieces of the metal may fly off and hit someone.

Wire in a tree
Nailing wire to a tree is a serious error. The tree is sure to be partially girdled. Pull out wire and staples or nails, with a gouge clean the wound, then paint it.

Fire Injury
These branches overreach the barbecue grill. Heat not only has seared the leaves, but branches are scorched below. Note die back from previous injury.

Girdling Roots
A rather young root enwrapping a tree base. As this root and the buttress root it crosses increase in diameter the older root will become strangled.

The girdling root has been severed at one end. Note the groove it already has made. Cut such roots away and paint the severed end. Frequently, girdling roots are below the surface.

The cure—use fence posts not trees to hold up fences and do not drive nails needlessly into trees. However, where the damage has been done and the remains of the fence still show, pull out the pieces, if possible, with heavy duty pliers or a vice wrench. If this is impossible, cut off those portions still protruding so that at least the damage is not compounded.

Girdling Roots

Improper planting often results in one or more roots becoming wound around the others. Then with the passing of the years and the increase in diameter of the roots the encircling ones strangle their neighbors, cutting off the latter's ability to funnel the life-giving moisture and nutrients up and down.

Unfortunately, such situations rarely occur where they may be seen readily. However, if a tree is seriously weakened, shows unthrifty growth or poor color, remove the soil at the base of the tree. If any horizontal, strangling roots appear, saw or chop them out, painting the cut ends with a good tree wound dressing to prevent the entrance of decay. Then replace the soil and feed and water until the tree regains its vigor.

Improper Grading or Changes of Grade

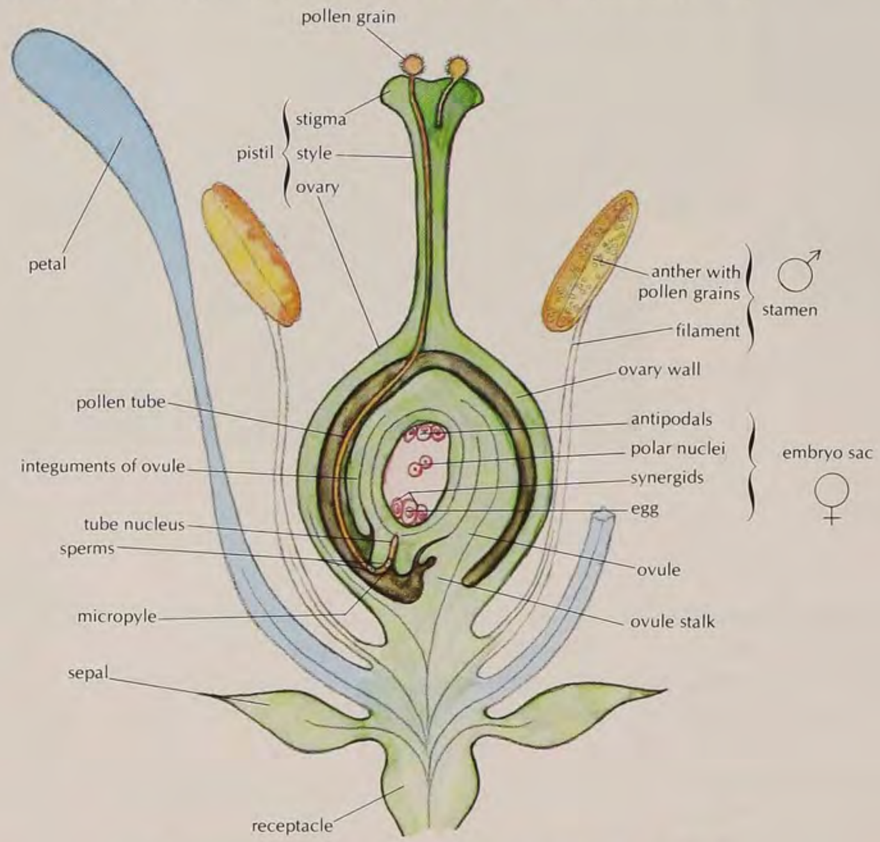
Where damage has occurred due to improper grading the laying of sidewalks or burying of pipes and wires, there really is not much that one can do. Make sure that the roots are cut off smoothly so healing can take place, paint the ends to prevent the entry of decay and feed the tree.

Other than the injuries discussed above, there are, of course, such things as trees beheaded or otherwise butchered due to the activities of lineman, from improper care, cavities, and so on. These however, along with large-scale pruning of shade trees are jobs for the professional aborist or tree surgeon. If the problem is beyond you, do not attempt to fix the tree and harm yourself.

THE MARS/VENUS CAPER

David Goheen Leach

Pollen, transferred from an anther to the stigma of the pistil, produces sperm cells that fertilize egg cells in the ovary of the pistil and from the fertilized egg comes the seed. Nature accomplishes all this easily. But plant lovers like to interfere, pollinating selected pistils with pollen from a selected pollen parent plant. To aid amateurs in organizing their own breeding programs, Dr. David G. Leach, A.H.S. president, notes random thoughts derived from his own experiences as a breeder of fine rhododendron cultivars.



There seem to be no instruction manuals for budding hybridizers. So many would-be amateur plant breeders suffer through the frustration of trial and error experiment that some homely bits and pieces of advice may be helpful. The advice results from thirty years' experience breeding rhododendrons, and it may not invariably be directly applied to the breeding of other plants.

'Tow Head.' A dwarf yellow flowered rock garden or dooryard rhododendron. The first hybrid of *R. ludlowii* ever recorded. The other parent was the Carolina rhododendron, *R. carolinianum*.

Home-Made Desiccator

Nearly every beginning hybridist struggles with the manipulation of pollen so that it can be preserved for use on plants that bloom at another season. Pollen decays in storage under exactly the same conditions as do seeds; moisture and warmth. A simple way to preserve it for several weeks is to use a commercial peanut butter jar as a home-made desiccator. An inch and a half of inexpensive four-mesh anhydrous calcium chloride, ordered from a pharmacist, is covered with perforated cardboard to hold it in

Rhododendron Photos from Dr. Leach's Breeding Garden.

Photos by author

Unnamed. A startling break (to a rhododendron buff) in color pattern.

'Virginia Leach.' The garden effect is orange, though the close-up may not convey more than a totally unfamiliar flower color for cold climates. Low growing, in scale for modern single story houses and small gardens.

Unnamed. A rhododendron with a dramatic contrasting blotch previously known only in mild climates.

place. The lid should seal tightly. Calcium chloride absorbs the moisture from anthers containing pollen, or from free pollen so that viability is prolonged. If the pollen is to be stored more than three weeks, the desiccator should be placed in a refrigerator, ideally at 34°F. The period of preservation can thus be extended two months or more.

Long Term Storage

If pollen of a late blooming plant is to be saved for use on one which blooms at an earlier season, it can be frozen in a deepfreeze at about 0°F. It still will be viable for making the cross the following year.

Most breeders use gelatin capsules with ribbon-like paper strips inserted which identify the pollen they contain. Small glassine coin envelopes also provide visibility of the contents. They are just as satisfactory and far more convenient.

Pollen Manipulation

Anthers do not always readily yield their pollen. If the group of stamens is held in one hand and the heel of the hand is then struck sharply against the knuckle of the other, sufficient pollen may be jarred out to make a cross with a cultivar which is presumed not to produce pollen at all.

Anthers with only traces of pollen which have been in a desiccator so that they are thoroughly dry can be macerated with tweezers on the palm of the hand and the entire mixture of pulverized anthers and pollen can often be used successfully to make a cross which would otherwise be impossible. Enough pollen germinates on the stigma to produce seeds, although their number is usually reduced.

Seeds; Harvesting and Labels

Seeds of rhododendrons, at least, mature long before the capsules appear to be ready for harvesting, and they can be sown much sooner for accelerated growth if they are gathered early. In 1971, for example, I gathered seeds from the early blooming little blue flowered alpine, *R. fastigiatum* on July 25th that would ordinarily not have been harvested before mid-October. They germinated perfectly.

An exceptionally convenient identification for crosses are the featherweight anodized aluminum Hartley Shrub Labels, imported and sold by Connoisseur Garden & Home Company, 2815 Alaskan Way, Seattle, Washington 98121. They can be attached quickly at the site of the cross, and pencil parentage records on them last for years. The same label can identify the contents of the seed envelope and later the resulting seedlings in the flat, so the possibility of error is reduced.

In addition to a label of whatever sort, each flat should be marked on its side with an identifying number. The first two digits show the year the cross was made; the second set of digits indicates the parentage as recorded in a written list of crosses to which each has been assigned a number. A Magic Marker felt tip pen produces waterproof ink which is very durable. Every experienced breeder has lost labels in flats to playful chipmunks, acquisitive blue jays or the chubby hands of tiny tots. A second means of identification spares many an apoplectic incident.

Unnamed. A salmon "art shade" without precedent in completely hardy rhododendrons.

Parent Selection

Beginners at plant breeding often pose a question which brings a harried look to those with the best of technical backgrounds: does it make a difference, if a choice is available, which of the two parents produces the seed?

Usually not. But then the backyard hybridist, perversely, is invariably seeking the unusual.

I have made my fair share of reciprocal crosses, as have most hybridizers, and perhaps three per cent have shown differences when the same parent which produces the pollen is also used as the seed parent. The differences are not usually very large, but again amateur breeders tend to be long-shot artists.

'Small Wonder.' The first hardy *R. forrestii* hybrid, semi-dwarf, with scarlet flowers devoid of blue. There are no semi-dwarf reds in commerce and those of conventional size have flowers badly flawed and muddied by the blue admixture.

The existence of maternal inheritance, in which the seed parent exerts an undue influence upon the characteristics of the progeny, was observed with puzzled dismay by geneticists for many years. The assumption had always been that all traits are invariably controlled by the genes within the cell nuclei of the parents. Then, not too long ago, in an ingenious experiment with corn, it was demonstrated that the cytoplasm surrounding the cell nucleus of the female parent also influences the traits of the offspring, an abhorrent thought in classic genetics. The evidence was clear, however, and the extra-nuclear determiners were called plasmagenes. They are usually responsible when, in reciprocal crosses, the offspring are different. The inference is that there is a long-shot mathematical advantage in choosing as the seed parent the plant which exhibits to the more marked extent the characteristics most sought in the progeny.

'Peach Parfait.' A color hitherto unknown in rhododendrons grown in cold climates.

Protecting the Pod Parent Blossom

It is not necessary to place protective coverings over emasculated flowers to prevent bee-carried pollen from contaminating crosses in many genera, if the corolla and stamens are removed, providing the local conditions are first tested. A few flowers should be emasculated without later fertilizing them. If no seeds form, the breeder is reasonably safe in assuming that insects are not making natural crosses with unwanted parents. In western Pennsylvania, where bumble bees visit rhododendron flowers in huge numbers almost to the exclusion of other insects, no precautions other than emasculation are needed. In northeastern Ohio, where honey bees are conspicuous in rhododendron plantings, emasculated test flowers regularly produce some seeds. Presumably the smaller, more agile honey bees roam over the receptive stigmas.

Unnamed. An uprecedent yellow and pink combination for the Northeast.

Germinating Medium and Seedling Management

For slow growing seedlings of woody plants, and especially the Ericaceae, milled sphagnum moss is the preferred germinating medium for all but the most sophisticated of growers. It is offered by Mosser Lee, Millston, Wisconsin, if no local source is available. Sphagnum moss contains an inbuilt anti-fungicidal agent which virtually eliminates the ever-threatening scourge of damping-off roots rots, *Phytophthora* and *Pythium*. Dr. H. M. Cathey and his colleagues at the U.S.D.A. Agricultural Research Service have evidence that sphagnum moss inhibits growth to some degree, but most old-time breeders will swap this modest disadvantage for seedlings free of disease.

The most common mistake of novice breeders in pricking out seedlings is to choose those that are the strongest and sturdiest. Instead, they should be taken just as they occur in the germinating medium, whether they are weak, average or of exceptional vigor. The desired combinations of ornamental characteristics are often not associated with vigor. They may be associated with average stature or even with a slow rate of growth.

'Peking.' The first hardy, truly yellow rhododendron for the eastern United States.

Unnamed. A novel color for the East. I included this one because I like the lighting and the suggestion in the developing buds of the color phases. All but the one floret were deliberately diffused.

Insect and Disease Control

Sooner or later small seedlings of most genera will be attacked by fungus disease or insect pests. Once established, the most common diseases are extremely difficult to control. The sensible precaution is to start spraying the seedlings when they produce their first set of true leaves in the germinating medium, and to repeat every two weeks throughout the first growing season. The best prophylaxis I have discovered is a spray solution composed of one tablespoon of Captan, one and one half teaspoons of Benlate, two tablespoons of Isotox and fifteen drops of Du Pont spreader-sticker, in a gallon of water.

Supplementary Light

At the end of the first season, rhododendron seedlings which have had supplemental fluorescent light to produce a sixteen-hour growing day, are about two and one half times larger than those which have had a natural dawn-to-dusk day of growth following germination.

I wish to emphasize that in producing this article at the Editor's request, I intended not to suggest the possibility of slavish application to other genera of all methods which have proved convenient and successful with rhododendrons. The hope is to offer an array of ideas some which may be adapted to help solve the problem of the thousands of backyard breeders who produce most of our new hybrid cultivars.◇

PHILAFLORA '76

It really is going to happen! At long last the United States is to see one of those great horticultural extravaganzas that Europeans have come to take almost for granted. For decades American plant lovers have made pilgrimages to the Floriade, to the Bundesgartenshau, to the International Horticultural Exhibition. Now it will take a shorter trip. Philadelphia is the place. The Pennsylvania Horticultural Society is the creative spirit.

What is all this? It works this way. An enlightened city makes available a tract of ground—usually a downtown area of considerable dimension. A capable sponsoring organization calls in experts and develops a concept of gardens, buildings, and related construction, aimed at getting people and plants together under the most enjoyable, the most educational, the most thrilling circumstances.

Always there are gardens; often these are specialized gardens to show the unique, the unfamiliar, the exotic plant, grown to perfection, in the best possible setting. People are stunned! Often there are special buildings for exhibits of special plants, of cut flowers, or of displays assembled for educational purposes. That might be an array of plants which supply rare medicines or plants artificially created by specialized breeding techniques. But always the layout is geared to the layman. The gardens and the exhibits speak to everybody. A non-gardening viewer may not comprehend the chromosome charts in the lily breeding display, but his heart leaps when he sees the lily. It will all be there, in Philadelphia.

The concept is total. There will be pleasure for the children (a carrousel? a ferris wheel?), a concert for everybody, a trade fair to stimulate gardening at every level, and even nourishment for the body—restaurants and snack bars.

Fairmount Park, site of the 1876 Centennial, is the location for Philaflora. Forty acres have been set aside for the gardens. Parking—lots of parking—is extra.

Philaflora will be opened officially in April of 1976 with a massive display of spring flowers in the gardens and exotic flowers on display in the halls. A kaleidoscopic change will continue. After the tulips, the spring perennials; then the summer annuals, the roses, and the displays of new cultivars. The season ends with dahlias and chrysanthemums, but before they fade everyone will have enjoyed the rock garden collections, the flowering shrubberies, the bonsai specimens, and the exhibits and programs in the halls. The season will close in October.

What a job, just to celebrate the Bicentennial! But it is not "just". It goes on. Remember where Rotterdam had the first Floriade, now those grounds are more beautiful each year, as happened with the Anlagen Garten a Bundesgartenshau site in Stuttgart, or with Donaupark, an International Garden Exhibition site in Vienna. So with Philaflora. It begins, as part of the Bicentennial celebration in 1976. It will go on as a cultural feature of Philadelphia forever.

Who did it? The Pennsylvania Horticultural Society dreamed up Philaflora and prepared a proposal. Progressive, far-sighted citizens bought it, and the sponsorship lies with P.H.S., collaborating with the Greater Philadelphia Cultural Alliance, the Fairmount Park Commission, and Philadelphia '76. But it's for everybody. See you in Philadelphia in 1976!

Preliminary Plant Material for Mass Effects at Philaflora '76

In formal beds near the entrance:

Earliest bloom: April to early May

Pansies
Violas
Primroses
Single Early tulips
Double Early tulips
Hyacinths
English-daisies
Forget-me-nots
Wallflowers

Second bloom: Mid to late May

May-flowering tulips with pansies, primroses, forget-me-nots and dwarf wallflowers.

Late May to first half of June:

Sweet William, Canterbury bells and foxglove.

Third bloom:

Ageratum
Alyssum
Begonia semperflorens
Celosia
Centaurea candidissima
Cineraria maritima 'Diamond' } for silver-grey foliage
Cineraria maritima 'Silverdust' } for silver-grey foliage
Coleus
Dahlia—Coltness and Unwin Hybrids
Dahlia—special dwarf ones from Holland
Geranium
Impatiens
Marigold
Petunia
Salvia farinacea, 'Catima' and 'Regal Purple'
Salvia splendens and cultivars
Snapdragon
Vinca

Last bloom:

Chrysanthemums

In Shrub Beds:

Phlox divaricata used as a ground cover and interplanted with late blooming varieties of daffodils.

Borders of primroses and/or pansies.

Scilla campanulata and *Camassia* to add extra color in late May or June.

Groups of daylilies to face down the shrubs for summer color while *Sedum spectabilis* and its new cultivars and *Sedum telephium* 'Indian Chief' to do the same for September.

The following trees and shrubs will give the best mass display of color and bloom in the months indicated.

Trees

April:
- Magnolia denudata
- Magnolia kobus
- Magnolia stellata
- Prunus serrulata cultivars

May:
- Cercis canadensis
- Cornus florida
- Cornus florida 'Rubra'
- Cornus florida 'Pluribracteata'
- Crataegus in variety
- Halesia carolina
- Halesia monticola
- Laburnum species
- Magnolia x soulangeana and forms
- Malus—many species and named cultivars
- Prunus serrulata cultivars (late flowering)

June:
- Cornus kousa
- Magnolia virginiana
- Styrax japonica
- Styrax obassia

July:
- Oxydendrum arboreum
- Sophora japonica
- Stewartia koreana
- Stewartia monadelpha
- Stewartia ovata
- Stewartia pseudo-camellia

August:
- Franklinia alatamaha
- Koelreuteria paniculata

Shrubs

April:
- Cytisus praecox
- Forsythia
- Rhododendron mucronulatum and "Azaleas"

May:
- Cercis chinensis
- Deutzia gracilis
- Deutzia x lemoinei
- Fothergilla major
- Fothergilla monticola
- Pyracantha coccinea 'Lalandi'
- Pyracantha crenulata 'Flava'
- Pyracantha crenulata 'Rogersiana'
- Syringa persica
- Syringa vulgaris and cultivars
- Rhododendron species and cultivars

June:
- Deutzia scabra 'Candidissima'
- Kalmia latifolia
- Kolkwitzia amabilis
- Philadelphus species and cultivars
- Rosa rugosa
- Viburnum sieboldi
- Viburnum tomentosum 'Mariesi'

July:
- Abelia grandiflora
- Clethra alnifolia
- Hydrangea macrophylla 'Hortensis'
- Hypericum species and cultivars
- Vitus agnus-castus

August:
- Abelia grandiflora
- Hibiscus syriacus
- Lagerstroemia indica

September:
- Camellia sasanqua

Louisiana iris 'Charlie's Felicia'.

Photos by author.

LOUISIANA IRISES

*Charles W. Arny, Jr.**

Flower lovers, particularly iris enthusiasts, are overlooking wonderful opportunities for landscape beauty and flower arranging found in the group of iris species and their hybrids referred to as Louisiana irises.

Today most Louisiana iris cultivars are hybrids. For the most part these cultivars were created from four species referred to as *Iris fulva, I. giganticaerulea, I. brevicaulis* and a giant "fulva" now known as *I. nelsonii.*

The fulva iris has many small flowers borne on rather straight 30-inch stems usually small, rusty red or copper colored with all floral parts drooping.

Iris giganticaerulea is the giant of the Louisiana family of iris, sometimes five feet high; large flowers, with five to seven inch spread, usually blue and white. These flowers have sepals or falls held horizontally with the petals or standards vertical.

Iris brevicaulis is dwarf or the baby of the group. The flowers are of medium size, three or four inches across with a great deal of substance and are usually colored blue and white. The flowers are borne on zigzag stems just below upper level of the plants foliage.

Iris nelsonii is characterized by thick, leathery, overlapping floral parts which form a rather flat, full flower. Sepals and petals are held out vertically or slightly drooping.

The newer cultivars or varieties have large flower size, wider floral parts, much firmer flowers with a great deal more substance, improvement in texture, superior color shades and tones, increased branching of flower stems and smaller rhizomes than those of earlier varieties.

**University of Southwestern Louisiana, Lafayette, Louisiana 70501.*

Chromosomes and Breeding

Practically all of today's Louisiana iris species and hybrids are diploids; that is, their cells contain two sets of chromosomes. Studies of Louisiana iris reveal that the Louisiana iris species have the following number of chromosomes in each set, *Iris fulva,* 21, 22 for *Iris giganticaerulea,* and 21 or 22 for *Iris brevicaulis.*

In view of the fact that these chromosomes, and the number of chromosome sets, determine the characteristics of irises, hybridizers recognize the opportunities for changing the features of the Louisiana iris by making new combinations of chromosomes and chromosomes sets. In other plants where the number of chromosome sets have been increased to three (triploid) or to four (tetraploid), improvement in many plant characteristics has been noted.

Louisiana iris 'E. E. Caradine'.

Since originally there were no known tetraploid Louisiana irises one means of improvement was to artificially create tetraploids. Louisiana iris fans are fortunate to have a man with the foresight, skill, perserverance, and interest to develop two tetraploids Louisiana irises and a number of chimeras or incomplete tetraploids. As a result of Jr. Joseph K. Mertzweiller's accomplishment the future prospects for further improvement in new iris cultivars are very promising.

Growing Conditions

With the principal geographical habitat of Louisiana irises located in south Louisiana a gardener might conclude that these irises had very limited adaptability throughout the United States to say nothing of the world. It appears logical that Louisiana iris cultivars would require a long warm growing season, mild winters, an abundance of moisture, and slightly acid, rich soils. In many parts of America these conditions are not found and people have concluded that Louisiana irises cannot be grown in northern areas.

Reports from persons in midwestern states and in the New England area, for example, prove that these irises do rather well and are nearly as carefree as other irises. These Louisiana iris cultivars have been subjected to below 0° F. temperatures with top soil and rhizomes remaining frozen for some days at a time and survived to produce beautiful bloom. Any tendency not to bloom may be attributed at least in part to a shorter growing season. This problem can, in many cases, be overcome by stimulating early growth and development of the rhizomes by fertilizing and with proper soil management.

Popular Interest Develops

Interest in growing Louisiana irises is increasing and will continue to flourish as more people learn about them, and as new, improved cultivars become available. A number of factors contribute to this new interest; some of the more important are: relative ease of growing, ability to flower in both full sun or semi-shade, and excellent value as cut flowers. Louisiana irises provide flower arrangers with variations of color, and offer a variety of flower form and texture. These irises are suited to the perennial flower bed or border, and they are comparatively

Louisiana iris 'Marie Caillet'.

Louisiana iris 'Ila Nunn'.

free of insect pests and from diseases. They offer tremendous challenges to the breeder.

Cultural Notes

The culture of Louisiana irises is not too difficult if gardeners supply the conditions favorable for good growth. Keep in mind these irises are heavy feeders; they thrive on organic matter, and they need plenty of moisture particularly in the fall and in the spring at blooming. The rhizomes should not be planted too deeply and they should be protected from the direct rays of the sun on hot summer days. While a slightly acid soil usually is best, it is not so much the soil reaction as it is the availability of plant food elements that determines success. It is not necessary to plant these irises in a pond or bog.

The ideal exposure for Louisiana iris is at least half-day sun preferably in the morning, with semi-shade in the afternoon, and protection from strong winds.

A soil mixture made up of peat or pine bark, leafmold, manure (preferably poultry droppings), and good garden soil (top soil), in about equal proportions, gives good results. Apply eight to ten pounds of a half and half mixture of balanced fertilizer (such as 12-12-12) and cottonseed meal to each 100 square feet of bed surface, and mix it thoroughly through the soil. In areas where soil and water are alkaline the use of agricultural sulphur (at a rate of ten pounds per 100 square feet) helps to assure the acidity desirable for Louisiana irises. Prepare the bed ahead of time to allow it to settle for two weeks before planting.

The best time for transplanting and reworking the beds is in the late summer and early fall. Outside the Gulf Coast Region early spring planting may be the most desirable time to plant.

Plant iris rhizomes so the terminal shoots face the direction in which plants are to grow. Set rhizomes deep enough to be covered with no more than one and one-half inches of soil after the bed has settled. Space rhizomes ten to eighteen inches apart if they are to remain undivided for more than one year. Newly established plantings should be heavily mulched soon after planting. Mulch is desirable in the fall and spring to conserve moisture and to control weeds and grass; it is essential after the plants become dormant in the summer. Rhizomes

Louisiana iris 'Anne Caradine'.

Louisiana iris 'Mrs. I. Nelson'.

continually exposed to the sun during the summer months will be killed and rot away. Materials suitable for mulching are sugar cane bagasse, rice hulls, cottonseed hulls, oak leaves, rotten sawdust, pine straw and pine bark.

Depending upon the amount of growth and development of the rhizomes, additional fertilizing thirty days before blooming and following blooming may be desirable. Follow all fertilizing with a thorough watering.

Selections For The Garden

Gardeners have different preferences with respect to color tones, flower form, texture and other flower features of the Louisiana irises. Accordingly selection of cultivars to include in a planting may be quite a chore. One basis for selection could be official plant society awards, or popularity polls, or experience of friends. My choice of iris cultivars of red color tones are 'Chuck,' 'F.A.C. McCulla,' 'Ira Nelson' and 'Walter Dupree III.' These red irises have varying flower form, texture and signal or crest patterns.

A number of blue-toned Louisiana irises make a real contribution to the landscape and please the flower lover. Among the darker shades are 'Blue Duke,' 'Marie Caillet,' 'Clyde Redmond,' 'New Offering,' 'Mark Fontenot' and 'Lake Maumelle.' For lighter blues 'Blue Chip,' 'Eolian,' 'Gulf Surf,' 'Mr. Mac' and 'Ellene Rockwell' are good bloomers and provide color over an extended period or time.

Some of the exceptional purple-toned irises in the Louisiana group are 'Violet Ray,' 'Royal Velour,' 'Pam Truscott,' 'King Calcasieu' and 'Crescent City.'

For something different from yellow to brown consider varieties such as 'Theresa Dorlores,' 'Bayou Comus,' 'Dean Lee,' 'G. W. Holleyman,' 'Tressie Cook' and 'Uptight'.

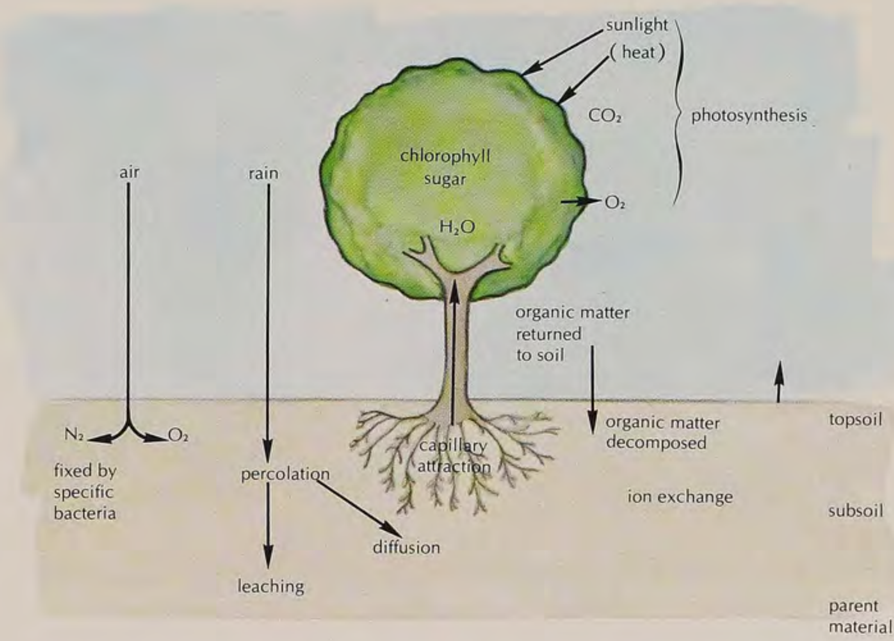
In pink, rose and lavender colors the choice may be made from: 'Treecie,' 'Faenelia Hicks,' 'Mrs. Ira Nelson,' 'Charlie's Michele,' 'Charlie's Ginny,' Dr. Dorman' and 'Carolyn Lapoint.'

The outstanding white or cream colored irises include such cultivars as 'Queen O Queens,' 'Ila Nunn,' and 'Inez Conger.'

For those who like bitones recommendations would include 'Counterpoise,' 'Katherine Cornay,' 'Charlie's Felicia,' 'Myra Arny,' 'Charlie's Marie' and 'Captain Bill.'

The Chemistry of Soils for Gardeners

A. Garnett Richardson*



Various living processes of a plant, and related natural phenomena. Carbon dioxide and water combine in chlorophyll-bearing cells using sunlight energy to produce sugar. The reverse of this reaction, when sugar combines with oxygen to release energy and carbon dioxide, is respiration.

Everyone interested in horticulture is aware of the dependence of plants upon soil conditions for optimum growth and development. It is not necessary to take a course in chemistry in order to acquire skill in horticulture, but a working understanding of the basic principles of soil chemistry can be helpful.

Since the composition of soil varies with depth and location on the earth's surface for purposes of this discussion we shall consider only average soil suitable for growing plants, which limits the depth to that reached by the roots of most plants and excludes deserts and rocky outcroppings. Soil has been defined as a mixture of inorganic and organic compounds, dead and living plant and animal material, colloids, water and gases, in variable but balanced proportions. Its composition is the result of degradation of igneous, metamorphic, and sedimentary rocks, vegetation previously grown upon it, climate, topography, and the time of interaction of these factors.

The most abundant elements in soil are oxygen, silicon, and aluminum, and they make up about seventy-five per cent of the total elemental composition of soil. Iron, calcium, sodium, potassium, magnesium, and titanium account for another twenty per cent, and all the remaining elements make up the other five per cent. Eighteen elements have been established as es-

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sential to plant nutrition. These are carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, sulfur, calcium, iron, magnesium, manganese, copper, boron, zinc, cobalt, molybdenum, chlorine and sodium, but many of these are required only in trace amounts, and any appreciable excess can be toxic to plants.

Nitrogen and Nitrate Fertilizers

The organic component of soil consists of fresh and decomposed plant and animal material and a large number of live microorganisms. Even though the weight percentage of the latter is small their number in a single ounce of fertile garden soil is greater than the entire human population of the earth. Microorganisms have a very important function in plant nutrition in that they are chiefly responsible for the breakdown of dead plant and animal material to a soluble form which can be used by plants. Certain species of bacteria also convert atmospheric nitrogen, which penetrates the soil, into soluble nitrogen compounds.

Organic compounds were so named because originally the only way they could be obtained was from material derived from live organisms, but now thousands of new organic compounds are made artificially every year. Carbon is the element common to all of them, and usually it is found combined with hydrogen and oxygen. For the formation of proteins nitrogen also is required. This element is a gas under normal conditions, and as such it comprises about eighty per cent of the earth's atmosphere, but except for certain legumes plants cannot use it in this elemental state. It first must be converted to soluble nitrogen compounds by the nitrogen-fixing bacteria.

When plants are repeatedly harvested from the same soil the nitrogen becomes depleted, because the atmospheric source is insufficient. Soil nitrogen can be replenished by organic material, such as

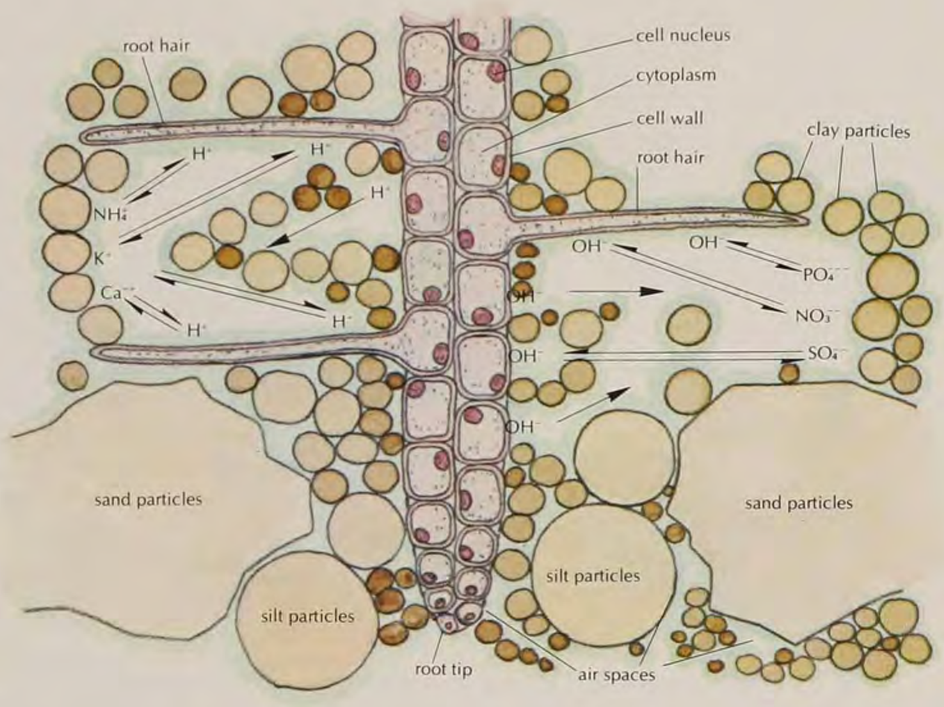


Diagram of a root tip extending through mineral soil and showing patterns of ion exchanges which result in nutritive ion uptake by the root.

manures or compost, or by inorganic nitrogen salts. Natural organic material in soil decomposes slowly so that plants receive a prolonged supply of nitrogen. The decomposition process consists in progressive break-down of complex molecules into simpler ones until eventually the carbon, along with some of the oxygen, end up as carbon dioxide. Some of the nitrogen and hydrogen produce ammonia; nitrogen and oxygen combine with basic elements to produce nitrogen salts, and the balance of hydrogen and oxygen form water.

Soluble nitrogen salts are taken up by plant roots within a very short time, but the quantity of any nutrient material which a plant can absorb at one time is limited. A moderate excess of soluble nitrogen can combine with other soil constituents, but these reactions are easily reversible, so any considerable excess will be wasted either by leaching or by oxidation to volatile oxides of nitrogen. Chemical analysis of fairly fertile soil shows that nearly all of the nitrogen is in organic form. The amount of inorganic nitrogen immediately available to plants usually is less than one per cent. For this reason inorganic nitrogen fertilizers are more advantageously applied in frequent small doses.

Since the supply of natural fertilizer material is becoming scarcer due to the increasing urbanization of our society fertilizer manufacturers have been seeking methods of producing slow-release nitrogen compounds. The most successful of these is ureaform, compounded from urea and formaldehyde. In soil it decomposes slowly releasing ammonia and carbon dioxide. Ureaform is considered by some gardeners to be useful as a fertilizer for lawn grasses where a constant supply of nitrogen is needed throughout the growing season.

In addition to nitrogen, phosphorus and potassium are required in relatively large amounts, and consequently they are also likely to be depleted from soil by repeated harvesting. Therefore nitrogen, phosphorus, and potassium are the common ingredients of most fertilizers, and the three numbers seen on many fertilizer labels specify the content of these elements. For example: 20-10-5 means that the fertilizer contains twenty per cent nitrogen, ten per cent phosphorus pentoxide, and five per cent potassium oxide. However, the ingredients will not consist of these actual substances which are gaseous or caustic but will be the equivalent quantities of their respective salts.

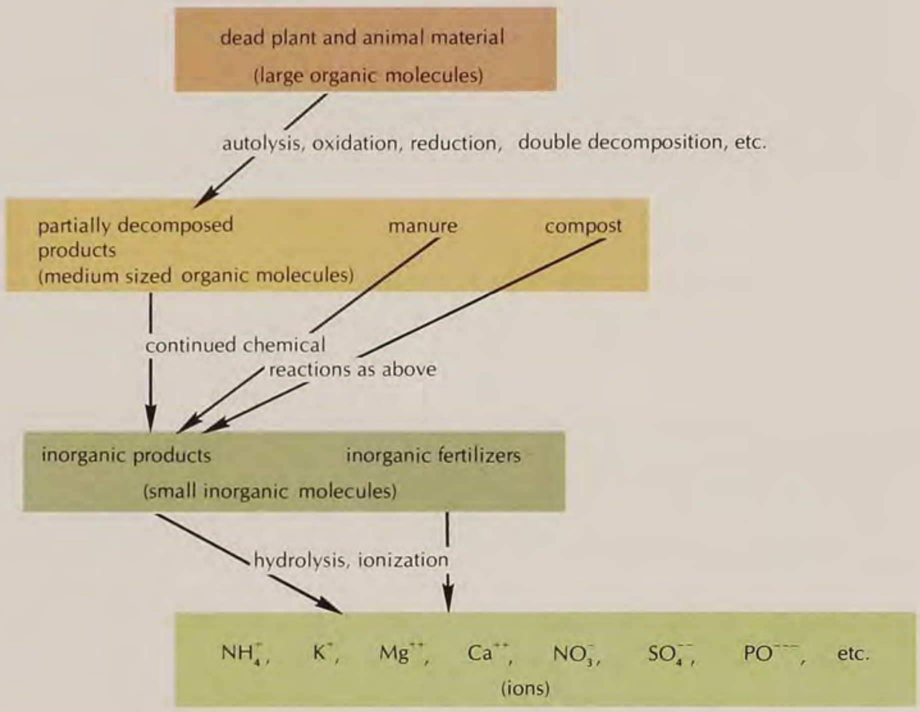
Ionization and Ion Exchange

Most elements are not available to plants in the free state, or even combined with other elements in compounds. Usually they must be in ionic form dissolved in soil water, in order to be taken up by plant roots. An element becomes an ion either by gaining or losing an electron in its outer atomic shell. If an electron is gained the atom becomes a negative ion and if one is lost the atom becomes a positive ion. In either case the electrically neutral atom becomes a charged particle. A salt is a compound containing an acidic negative portion and a basic positive portion. The portions may consist either of single atoms or groups of atoms. In the dry state salts are electrically neutral, because their positive and negative portions balance each other, but when the salts are dissolved in water their positive and negative portions separate as ions and migrate separately through the solution. For example, the salt potassium phosphate dissociates in water as positive potassium ions and negative phosphate ions. Each of the latter consists of a single phosphorus atom combined with four oxygen atoms. Some elements have the ability to form a part of either a positive or negative ion, depending on the characteristics of the elements with which they are combined. The salt ammonium nitrate dissociates into positive ammonium ions (one nitrogen atom with four hydrogen atoms) and negative nitrate ions (one nitrogen atom with three oxygen atoms).

Ions are attracted to other ions when their charge signs are different and repelled from each other when their charge signs are similar. Therefore ions lying upon a root surface can capture oppositely charged ions of nutrient materials. One might ask why migrating ions do not join their original partners. Some of them do, but ions vary in the strength of their charges, and a strongly charged ion can displace a weaker one bearing a similar charge sign and take its position in a compound. This is called ion exchange. The exchange of ions on root surfaces with those in soil substances and the attraction of oppositely charged ions by root-surface ions are the principal mechanisms for the uptake of nutrient materials by plants.

Since most of the plant's food is absorbed from moist soil in the form of ions it is well to consider the principles of solubility and ionization. When a soluble solid comes in contact with water the molecules of the solid dissolve and distribute themselves uniformly among the water molecules as solute molecules. At the same time some of the solute molecules come back out of solution and precipitate on the solid. It is a dynamic condition. However, more molecules of solid will dissolve than precipitate until the equilibrium point is reached. At this point the number of molecules dissolving will exactly equal the number precipitating, and the solution is said to be saturated. If the solid is one which ionizes it will dissolve as positive and negative ions instead of solute molecules, and these ions will re-join upon precipation, but other conditions will remain the same.

If we take a dozen different ionizable compounds, some of which have either acidic or basic groups in common, and dissolve them together in water, then evaporate



Flow chart showing the course of degradation of organic residues to soluble ions. Energy is released at each step in digestion.

Material	Particle size (mm.)	Soil type Clay loam	Sandy loam	Silt loam
Clay	Smaller than 0.002	% 35-50	% 10-20	% 10-15
Silt	0.002 to 0.05	25-30	18-22	55-60
Sand	0.05 to 2.0	20-30	60-70	25-30
Pebbles	Larger than 2.0	(Pebbles not considered)		

Table of soil "Separates" which are the rock particles of various sizes that combine to make up the mineral fraction of soil.

Material	Per cent by weight	Per cent by volume
Mineral matter (density 2.7)	83	38
Organic matter (density 0.5)	5	12
Water (density 1.0)	12	15 to 35*
Air	—	35 to 15

**When the water content falls below 15% ion migration is retarded. When it rises above 35% root cells begin to suffocate from lack of oxygen.*

Percentages and volumes of various components of soil. The mineral matter includes all separates identified in the Table of Soil Separates; organic matter includes living microorganisms and organic residues from dead organisms; Mineral ions and soluble organic residues are dissolved in the soil water; some of the soil "air" also is dissolved in the soil solution, and water vapor is one of the atmospheric gasses found in the air fraction.

some of the water until solid matter begins to precipitate the first compound to appear will be that formed by the pair of positive and negative ions whose concentrations, in the quantity of water remaining at that time, multiplied together will have the lowest value. This value is known as the solubility product for that particular pair of ions, and it will always be constant at a specific temperature. The first compound to precipitate may be different from any of those originally dissolved, in which case the positive portion came from one of the original compounds and the negative portion from another. As more water is evaporated other oppositely charged ions will pair up, precipitate successively in the order of increasing solubility products. When all of the water has evaporated the total weight of material recovered will be the same as that originally dissolved, but some or all of the compounds may differ from the original ones. These facts are important in plant nutrition because a substance must be in solution before it can be absorbed by plant roots.

Compounds differ in the extent to which they ionize in water. Salts ionize completely, some organic acids and bases ionize partially, but most organic compounds do not ionize at all. Soluble compounds of the latter type merely become solute molecules in water. For a compound which ionizes partially in solution the proportion which ionizes at a specific temperature is called the ionization constant of that compound.

Very few elements exist alone. Nearly all of them are found combined with other elements. The two most plentiful elements, oxygen and silicon, combine to form silicon oxide, or quartz. Sand is about ninety-nine per cent silicon oxide, the rest being a mixture of oxides of other elements. Sand consists of coarse, hard particles which water does not penetrate. Sand is chemically inert except under very drastic conditions. Its chief value in soil is in promoting drainage and aeration, but too much permits leaching of nutrient material and rapid drying of the soil.

Clay Colloids

The largest component of the average soil consists of the clays, of which there are many different types. Practically all of them contain silicon, aluminum, and oxygen. In addition some clays contain one or more of the elements magnesium, iron or titanium. A common property of clays is very small particle size and the ability to absorb water. Sometimes the particles are so tiny that they are classed as colloids. The particles of a true colloid have such small mass that they do not settle in water but remain suspended by the water molecules against the force of gravity. When the amount of water is small in proportion to the amount of clay the clay swells, forming a sticky gel. Clay particles usually bear either positive or negative charges. This can be caused by collection of a preponderance of ions of either kind on the particles' surfaces, or to imbalance of atomic charges within the crystal lattice of the compound. The net charge usually is negative if the soil is alkaline and positive if the soil is acidic. In either case the charge signs can be altered by adding acidic or alkaline substances to the soil. From this it is easy to understand how the clays play such an important role in the storage of soil nutrients and also how changes in soil acidity or alkalinity can alter the availability of certain nutrients to plants.

Soil Acidity

In chemistry the degree of acidity or alkalinity is expressed by the symbol pH followed by a number ranging from 0 to 14. The neutral point is pH 7. Acidity increases as the numbers become lower than 7, and alkalinity increases as they become greater than 7. The range of soil pH for growing nearly all plants lies between pH 4- pH 9, and for the majority of plants the optimum is pH 6 to 7. However some plants, such as azaleas for example, grow best in soil of pH 4 to 5, whereas lilacs prefer soil of pH 8 or 9. The reason is that the availability of certain nutrient ions required by these plants is highest in the pH ranges specified.

Water and gases also were stated to be components of soil. Without water plants dry up and die. Not only do root cells require water to live but in the absence of water the formation, migration and exchange of ions becomes impossible. In fact many plants can be grown in water without soil if they are supported upright and the necessary chemicals are periodically added to the water.

Soil gases are essentially the same as those of the atmosphere, namely nitrogen and oxygen in proportions of about four to one. About one-half per cent carbon dioxide also is normally present, but in cases of poor aeration this can increase to five per cent or more at the expense of oxygen. It is necessary for air to penetrate the soil in order to supply oxygen to the living cells of the plant roots. Oxygen is needed also for many chemical reactions continually taking place in soil. Atmospheric nitrogen must be present in soil in order to be acted upon by the nitrogen-fixing bacteria.

On a volume bases the average soil contains about thirty-eight per cent mineral matter and about twelve per cent organic material. The remaining fifty per cent is mostly air and water, varying between fifteen and thirty-five per cent of each. When water is lost by drainage or is taken up by plants it is replaced by the same volume of air. Then when water is added an equal volume of air is driven out, and the proportions change accordingly.

In discussing this very complex subject of soil chemistry I have avoided the use of technical language as much as possible, and I had to omit many details for the sake of brevity. But the main principles are covered. If additional information is desired on a particular point it can be found readily in any library.

Micronutrients and Plant Nutrition

Photos courtesy of CIBA-GEIGY Corporation.

Copper deficiency of corn.

*Fred R. Davis***

Plants require several mineral elements for normal growth. Some elements, such as nitrogen, phosphorous, potassium, calcium and sulfur are needed in relatively large amounts and these are called the "major" elements, while the elements, such as iron, boron, magnesium, manganese, zinc, molybdenum and copper are needed in very small amounts and are called "micronutrients".

Some people may be skeptical about micronutrient supplements in plant nutrition, saying "their effect is rather unimportant and not measurable". Research scientists long have had evidence, both laboratory and field testing, to show that micronutrients are beneficial to plant growth and reproduction. My own experience in growing rhododendrons has borne out the need for micronutrients to correct the chlorotic (yellowing) condition that sometimes exists. The purpose of this article is to discuss the functions and deficiency symptoms of several of the micronutrients.

Magnesium and Its Functions

Some consider this element to be one of the major elements, but I will discuss its role as a micronutrient. Magnesium plays two very essential roles in the processes of photosynthesis and carbohydrate metabolism. Magnesium is the metal atom in the chlorophyll molecule without which photosynthesis would not occur. Magnesium also serves as an activator in carbohydrate metabolism, e.g. glucose + ATP* $\xrightarrow{Mg^{++}}$ glucose-6-P. Magnesium serves as an activator for those enzymes involved in the synthesis of the nucleic acids (RNA, DNA*) from nucleotide polyphosphates. Magnesium also may be involved in protein synthesis serving as a binding agent in the microsomal particles.

Magnesium Deficiency Symptoms

Magnesium deficiencies show up as extensive chlorisis between the veins of the leaves. Chlorisis is followed by the appearance of anthocyanin pigments in the leaves such as the oranges, reds and purples. Whenever a severe deficiency exists, necrotic spotting (small patches of dead tissues) may be observed. This deficiency is best corrected by using a soluble magnesium salt, e.g. magnesium sulfate.

Iron and Its Functions

Iron serves a number of important functions in the overall metabolism of the plant. Chemists say that iron is frequently taken up in the trivalent state (Fe^{+++}), but is generally accepted in the divalent state (Fe^{++}) as the metabolically active form of iron in the plant. Its chemical role both in the synthesis and degradation of chlorophyll is still uncertain. Several researchers feel that iron functions in the synthesis of chloroplastic protein and thus may interfere with chlorophyll synthesis.

*ATP = Adenosine Triphosphate
RNA = Ribonucleic Acid
DNA = Desoxyribonucleic Acid

***Physical Chemist, Kent, Ohio.*

Magnesium deficiency of corn.

Manganese deficiency of corn.

Iron has been identified as a component in the metalloflavoproteins which are active as enzymes in certain biological oxidations. Iron has been found in the iron-porphyrin proteins; the cytochromes belong to this enzyme class.

Iron Deficiency Symptoms

Iron deficiencies of plant leaves appear as extensive chlorosis in the foliage. The new foliage is generally most affected, although I have seen both old and new foliage affected to about the same extent on rhododendron. Iron-induced chlorosis will show up in the interveinal structure of the leaf and the surface of the leaf usually shows a grid network of green veins between the chlorotic areas.

There appears to be some correlation between iron deficiency and chlorophyll content, but there is other evidence that chlorotic leaves may contain as much or even more iron than their green counterparts. It has been proposed that the lack of iron may inhibit the formation of chlorophyll through inhibition of protein synthesis.

Iron deficiencies in many plants can be corrected by the use of chelated iron compounds. Some of the early work with ornamentals was done using the iron salts of ethylenediamine tetraacetic acid. My own experience with these types of compounds for rhododendron has shown a favorable response to correcting chlorosis and producing increased bud set. It is important to realize here that these metal chelates can be toxic to the plant if used indiscriminately. Toxic doses produce withered and curled leaves with browning at the edges. The toxicity is probably related to electrolyte disturbance or unbalance and enzyme inhitibion.

Manganese and Its Function

Manganese seems to be an essential ion in the respiration and nitrogen metabolism where it functions as an enzyme activator. In some cases, especially with reactions in respiration, manganese can be replaced by other divalent cations, such as Mg^{++}, Zn^{++} and Fe^{++}.

Manganese functions in nitrate reduction where it acts as an activator for the enzymes nitrite reductase and hydroxylamine reductase. The preference of amonia over nitrate as a nitrogen source by manganese deficient cells supports the above mentioned role of manganese. Manganese is also thought to be involved in the destruction or oxidation of indole-3-acetic acid.

Manganese Deficiency Symptoms

Manganese deficiency is characterized by chlorotic and nectrotic areas in the portions of the leaf between the veins. This symptom appears on the young leaves of rhododendron, rather than the older leaves. I find that symptoms of manganese deficiency often are difficult to distinguish from symptoms of iron deficiency. In

Iron deficiency of rose.

Iron deficiency of soybean.

Iron deficiency of corn.

some areas of the U.S., grapes suffer from a manganese deficiency. This deficiency is best corrected by using one of the soluble manganese chelates.

Copper and Its Function

Copper acts as a component of phenolases and ascorbic acid oxidose (enzymes), and its role as a part of these enzymes probably represents the most important function of copper in plants. Research suggests that copper may function in photosynthesis. For example, it was found that the chloroplasts of clover contain most of the copper of the plant. Most plants are very sensitive to the concentration of copper irons, so one must be careful in its use.

Copper Deficiency Symptoms

Copper deficiency usually results in shriveling or malformation of the leaves along with tip burn. The most easily recognized symptoms of copper deficiency are those in a disease of fruit trees called "exanthema". A copper deficiency in almonds may result in roughening of the bark, gummosis and shriveling of the kernels. Copper deficiencies are corrected by using soluble copper chelates, e.g., copper ethylenediamine tetraacetate.

Zinc and Its Function

Zinc plays a role in protein synthesis as evidenced by the accumulation of soluble nitrogen compounds such as amino acids and amides. Zinc participates in the biosynthesis of the plant auxin indole-3-acetic acid. This was proved by observing that the content of tryptophan parallels the content of auxin in the plant, both when zinc is deficient and when it is supplied to deficient plants. It has been concluded that zinc reduces auxin content through its involvement in the synthesis of tryptophan, a precursor of the auxin. Zinc is also involved in the metabolism of plants as an activator of several enzymes. Carbonic anhydrase was the first zinc containing enzyme to be discovered. This enzyme is involved in the catalytic decomposition of carbonic acid to carbon dioxide and water. An accumulation of inorganic phosphorous in zinc deficient tomato plants indicates that zinc could act as an activator for some phosphate transferring enzyme, such as hexose kinase.

Zinc Deficiency Symptoms

Zinc deficiency is sometimes referred to as "rosette" or "little leaf disease". It is most evident in older leaves as chlorosis, necrosis or mottling of the leaves. The interveinal areas turn pale green to yellow; the leaf margins become irregular. The absence of zinc also may have a retarding effect on growth and the development of fruit. The use of soluble zinc chelates as in soil applications or foliar applications will correct the deficiency.

Iron deficiency of sorghum.

Zinc deficiency of corn.

Zinc deficiency soybean, zinc treated plants at right.

Boron and Its Function

Researchers have concluded that boron is involved in carbohydrate transport within the plant. They believe that the borate ion forms a complex with the sugar molecule. They propose that sugar is transported more readily across cell membranes as a borate complex.

The common features of boron deficiency in plants are the death of the stem and root tips and the abscission of flowers. Symptoms of boron deficiency are symptoms of sugar deficiency. The role of boron in sugar translocation has been supported using C^{14} labeled sucrose.

Boron and Its Deficiencies

The first visible sign of boron deficiency is the death of the shoot tip. The leaves may have a thick coppery texture with curling. Generally, flowers do not form and root growth is stunted. In fleshy organs, there is a disintegration of internal tissues resulting in cork formation in apples and water core in turnips. Boron deficiencies can be corrected by using sodium tetraborate or boric acid.

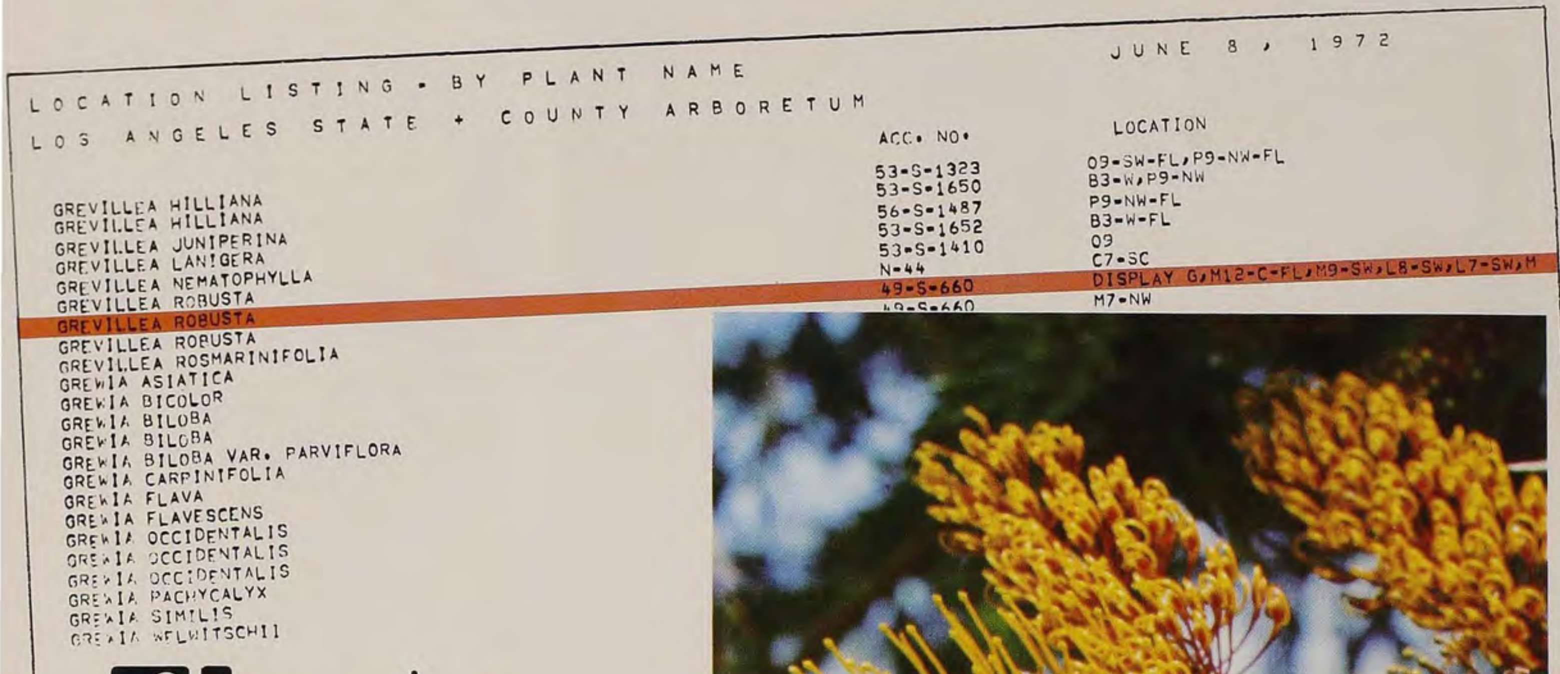
Molybdenum and Its Functions

Molybdenum is involved in the nitrogen fixation and nitrate assimilation. Some investigators have found that molybdenum deficiency leads to a decrease in the concentration of ascorbic acid in the plant. There is some evidence that molybdenum is involved in the phosphorous metabolism of the plant, but the mechanism has not been explained.

Molybdenum Deficiency Symptoms

A condition due to molybdenum deficiency known as "whiptail" occurs in some plants of the cabbage family. The leaves first show an interveinal mottling and leaf margins become brown. The leaf tissues wither, leaving only the midrib and a few small pieces of leaf blade, giving the appearance of a whip or tail. Molybdenum deficiencies can be corrected by using a soluble molybdenum salt, e.g. sodium molybdate.

I conclude with a few words about nutrient translocation. First, let me say that the dynamics of plant nutrition is not completely understood. The mechanism for translocation of the nutrient molecule or iron involve diffusion and the development of osmotic pressure gradients. If one considers diffusion to be the predominate transport process, then the nutrient molecule is trapped at a reactive site. The energy for this process is derived from metabolism. All translocation through the phloem generally involves osmotic pressure gradients developed by concentration field gradients across cell and tissue membranes. It is difficult to predict the response of the plant to the nutrient, because of the lack of a satisfactory translocation mechanism. The pH, geometry and size, charge and solutility of the nutrient molecule all play an important role.


LOCATION LISTING - BY PLANT NAME
LOS ANGELES STATE + COUNTY ARBORETUM
JUNE 8, 1972

	ACC. NO.	LOCATION
GREVILLEA HILLIANA	53-S-1323	09-SW-FL,P9-NW-FL
GREVILLEA HILLIANA	53-S-1650	B3-W,P9-NW
GREVILLEA JUNIPERINA	56-S-1487	P9-NW-FL
GREVILLEA LANIGERA	53-S-1652	B3-W-FL
GREVILLEA NEMATOPHYLLA	53-S-1410	09
GREVILLEA ROBUSTA	N-44	C7-SC
GREVILLEA ROBUSTA	49-S-660	DISPLAY G,M12-C-FL,M9-SW,L8-SW,L7-SW,M
GREVILLEA ROBUSTA	49-S-660	M7-NW
GREVILLEA ROSMARINIFOLIA		
GREWIA ASIATICA		
GREWIA BICOLOR		
GREWIA BILOBA		
GREWIA BILOBA		
GREWIA BILOBA VAR. PARVIFLORA		
GREWIA CARPINIFOLIA		
GREWIA FLAVA		
GREWIA FLAVESCENS		
GREWIA OCCIDENTALIS		
GREWIA OCCIDENTALIS		
GREWIA OCCIDENTALIS		
GREWIA PACHYCALYX		
GREWIA SIMILIS		
GREWIA WELWITSCHII		

Plants In The Computer

Richard A. Brown*

Photo by author.

American Horticultural Society Plant Records Center

In an age when computers are guiding men through space, scrutinizing our income tax returns, analyzing our insurance needs, and even preparing our all-too-frequent bills, it may not be too surprising to learn that a computer is presently being programmed to monitor the ornamental plant resources of North America. There are more than 100 botanic gardens and arboreta within the United States, which, if considered in combination, are likely cultivating over 1,000,000 plant specimens. It is reasonable to assume that, considering this wealth of plant material, a specimen of almost any cultivated plant might be found in one or more of these collections, if one knew where to look.

*Director, The American Horticultural Society Plant Records Center, Mount Vernon, Virginia 22121.

Historical Background

Recognizing the value of these collections and the wealth of information they represent, a feasibility study was initiated in 1966 to consider the concept of an International Plant Records Compilation Center, prompted by a report presented by Robert D. MacDonald* at the XVII International Horticultural Congress. Through the efforts of Dr. Richard A. Howard, Director of the Arnold Arboretum, funds were received for this study from the American Association of Botanical Gardens and Arboreta (A.A.B.G.A.) representing donations from eleven of its member institutions.

While the A.A.B.G.A. was involved in this feasibility study, the Long Range Planning Committee of the American Horticultural Society (A.H.S.) was considering a data processing center as one of its objectives. An effort to coordinate the activities of the A.A.B.G.A. and the plans of the A.H.S. began on January 28, 1967, by Dr. David G. Leach, then Chairman of the Long Range Planning Committee.

The result of these efforts was the formation of a joint A.A.B.G.A.-A.H.S. Plant Records Center Advisory Council in October, 1967. Meeting at Longwood Gardens on December 3rd, of that year, the council decided that a grant proposal would be submitted to Longwood Foundation, Inc. and if accepted, a Plant Records Center Pilot Project would be established under the administration of the A.H.S.

On July 15, 1968, the grant proposal was indeed accepted, and the Plant Records Center Pilot Project became operational. Longwood Foundation provided $90,000 to the A.H.S. to finance the two-year pilot study which would utilize the accession records of Longwood Gardens as its data base.

The two-year pilot project was so successful that, when again approached for financial assistance in 1970, Longwood Foundation agreed to provide $1,835,600 to expand to the functional level, the Plant Records Center (P.R.C.) of the American Horticultural Society, contingent upon acceptable annual reports of progress.

On April 1, 1973, the A.H.S.-P.R.C. concluded its third year of operation, sixth year of existence—after an investment of over $760,000, and after more than 170,000 plant records were processed. With the notable changes achieved during the past twelve months, fiscal year IV (April 1, 1973 through March 31, 1974) promises to be a significant step towards the ultimate success projected for the ten year program, marked by the move of the P.R.C. to its new "home" within the A.H.S. headquarters at Mount Vernon, Virginia. Here, with a new staff of assistants and equipment operators, trained within a frame-work of updated operating policies and principles, the P.R.C. anticipates a growing program of services.

Program Objectives

The P.R.C. has three principle objectives, the first of which focuses on the establishment of a standard system for the recording of information relating to plant accessions. To meet this objective the P.R.C. in its early pilot study stages, reviewed over 100 accession record systems. As a result of this study, a "standard" accession card was developed that would satisfy two design requirements. First, the card was designed to provide for the consistent, uniform entering of information, that was determined to be of principle importance to most institutions.

Second, the card was prepared as a two-part form (original and carbon copy): the original, file copy to be maintained by the institution preparing the record; the carbon copy to be forwarded to the P.R.C. for processing into the data bank. To assist the recorder in the operation of completing the card, the P.R.C. provides an instruction manual which, in detail, describes how the

*Mr. Robert D. MacDonald, then Assistant Professor of Forestry and Director of the Arboretum at the University of Tennessee, became the first Director of the Plant Records Center and served in that capacity through 1972.

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PLANT RECORDS CENTER MASTER DATA FILE

SCIENTIFIC NAME	GARDEN	ACCESSION NO.	SOURCE	FAMILY
GREVILLEA NODOSA	0960	64673		7523
GREVILLEA OBTUSIFOLIA	0955	71.107		7523
GREVILLEA OBTUSIFOLIA	0960	66328		7523
GREVILLEA PANICULATA	0925	69-385	STRYBING ARB	7523
GREVILLEA PUNICEA	0960	65097		7523
GREVILLEA ROBUSTA	0580	49-S-660	BODGER H.	7523
GREVILLEA ROBUSTA	0580	N-44	LASCA	7523
GREVILLEA ROBUSTA	0925	XY-2183	UNKNOWN	7523
GREVILLEA ROBUSTA	0960	PRC 2062		7523
GREVILLEA ROBUSTA	0570	561768	BURNETT	7523
GREVILLEA ROBUSTA	0360	6345	LASCA	7523
GREVILLEA ROBUSTA	0260	65259	TURNERS N FLA	7523
GREVILLEA ROSMARINIFOLIA	0960	PRC 2063		7523
GREVILLEA ROSMARINIFOLIA	0580	65-P-23	UNKNOWN	7523
GREVILLEA ROSMARINIFOLIA	0925	XY-2184	UNKNOWN	7523
GREVILLEA ROSMARINIFOLIA	0925	XY-2185	UNKNOWN	7523
GREVILLEA ROSMARINIFOLIA			E PK N	7523
GREVILLEA SP				7523
GREVILLEA				7523
GREVILLEA				7523
GREVILLEA			WERS N	7523
GREVILLEA				7523
GREVILLEA			PK N	7523
GREVILLEA			LS N	7523
GREVILLEA				7523
GREVILLEA				7523
GREVILLEA				7523
GREVILLEA				7523
GREWIA AS			B	9243
GREWIA AS			4R	9243
GREWIA BIL			N	9243
GREWIA BIL				9243
GREWIA BIL			HNEIDER	9243
GREWIA BIL			3	9243
GREWIA BIL				9243
GREWIA BIL				9243

Accession Card, Side A

Scien. Name	GREVILLEA ROBUSTA
Garden Code	0580
Author	
Accession Number	49-S-660
Family Name Code → Enter Family Name Here	7523 → PROTEACEAE
Common Name	SILK-OAK
Location	M7/NW, M8/NE, L7/SW, M9/SW
Source, Collector	H. BODGER
Year Received (Use 4 Digits)	1949
How Received: Seedling, Scion, etc.	SEED
Country of Origin Code → Enter Country Name Here	009 → AUSTRALIA

0536

12	01	FLOWERED MAY, JUNE 1958; FLOWERS ORANGE
10	01	SEED GERMINATION IN 12 DAYS; PLANTED IN TWO FOUR-INCH POTS.

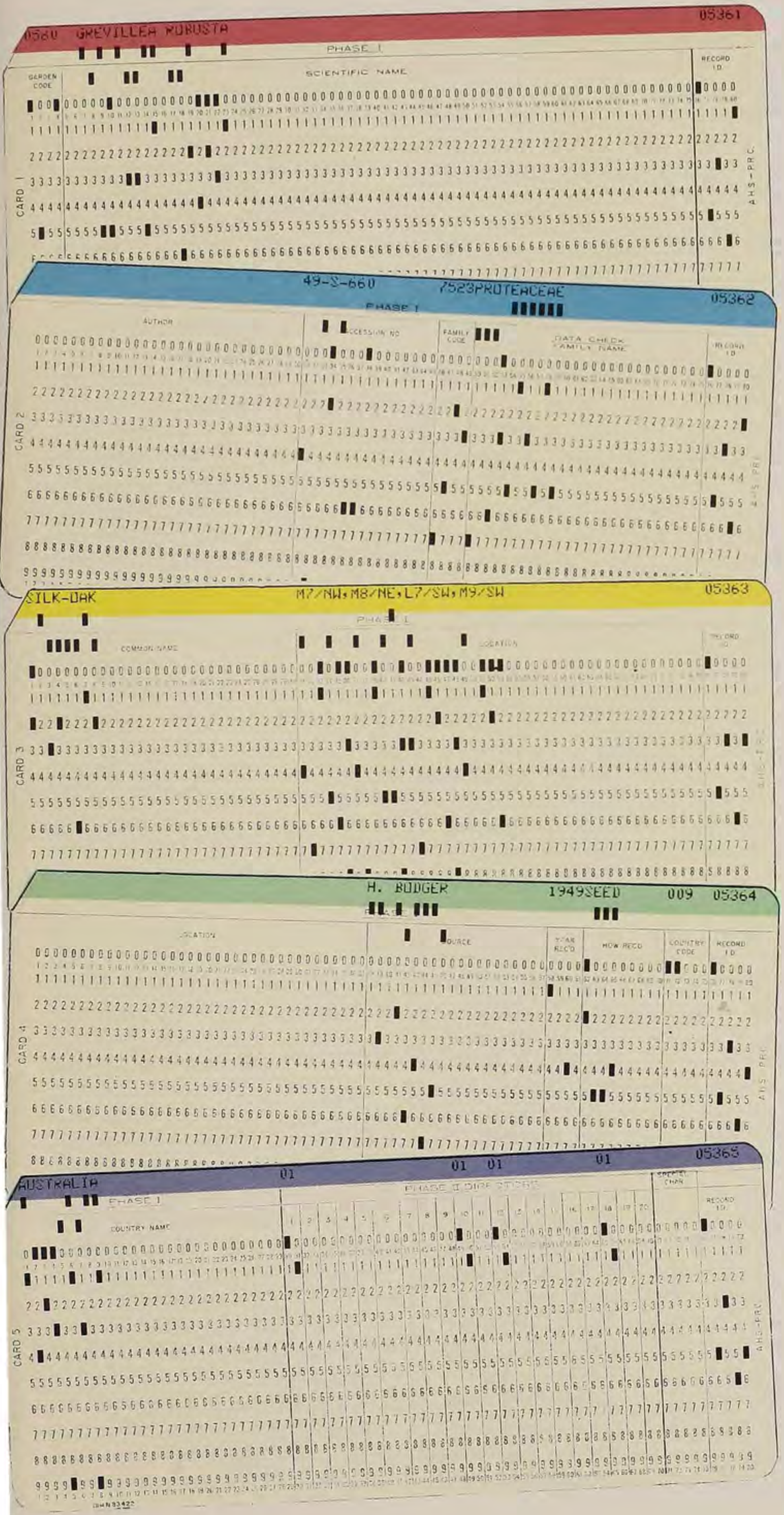
Accession Card, Side B

ADDITIONAL INFORMATION

18 01 Symetrical, pyramidal form when young; becomes tall, narrow, and somewhat open with age. Wood is brittle and will break in high wind. Pruning will help somewhat to reduce breakage. Fine for quick-growing screen or use as temporary filler while more permanent trees develop. Hardy to 25 degrees F.; to about 10 degrees when mature.

Additional Information is available on:

Field	Code	Item	Field	Code	Item	Field	Code	Item	Field	Code	Item
1	01	Nomenclature	8		Herb. Voucher	15		Photographs			
2		Location	9		Lit. Reference	16		How Received			
3		Source	10	01	Propagation	17		Distribution			
4		Habitat	11		Performance	18	01	Other Info.			
5		Range	12	01	Display	19		Fruiting, Seed			
6		Number Rec'd.	13		Genetic Data	20		Mortality			
7		Planting Date	14		Pathogens						



card is to be filled in, and how changes or deletions are to be submitted to the P.R.C. for records previously processed. Currently thirty-four botanic gardens and arboreta are utilizing this accession card system. Using many of the suggestions from these users, the standard accession card has gone through five minor revisions.

The second, and perhaps most obvious, objective of the P.R.C. is to develop a data bank on the cultivated ornamental plants of North America. Currently thirty-four botanic gardens and arboreta are cooperating with the P.R.C. in this program. To date, the P.R.C. has seventeen collections totally processed, representing some 170,000 accession records, with an additional five projects at varying stages of completion representing an additional 10,000 accession records. Generally speaking, the information recorded and processed on any one accession consists of:

- garden (collection) code
- scientific name
- authority
- accession number
- family name
- common name
- source
- location within the collection
- country of origin
- number received
- how received

Frequently, additional information will be reported relating to: number of herbarium vouchers prepared, if any; propagation information; descriptive information; and collection data.

Once processed, any one or more of these items of information may form the basis for the preparation of a computer generated report (data listing or printout) representing one or more collections.

The third objective of the P.R.C. is, perhaps, its most significant one. The P.R.C. through use of its modern equipment and data handling techniques, is establishing an information center designed to service three current requirements.

First, the P.R.C. offers an accession recording and reporting system to botanic garden and arboreta management. As a records-management consulting organization, the P.R.C. offers assistance to meet special record needs. Recently developed computer programs have proven to be valuable tools for garden management by providing detailed reports on the living collection on a timely, economical basis.

Second, the P.R.C. offers special assistance to institutions which require additional services beyond the normal scope of the P.R.C. program. By using available statistical analysis computer programs or other "packaged" computer programs, the P.R.C. can process data files other than plant accession records, and assist in the analysis of special research projects. In this capacity, the P.R.C. offers the benefits of computer processing to any of its cooperators.

Third, the P.R.C. will disseminate information to the scientific, professional, and amateur communities, which draw on the botanical disciplines for information and materials. In this effort, the P.R.C. will prepare and offer checklists and indices to important horticultural plant groups. A directory to plant sources is another objective being considered. Currently, for a nominal fee, the P.R.C. is in a position to handle special requests for botanical information (primarily, sources of plant material) from botanic gardens, arboreta, and research workers.

Outline of Operation

Information is received by the P.R.C. in two ways. One way is through the use of the standardized card as filled in by a garden. Cards are sent to the P.R.C. only when the accessions (plant acquisitions) have achieved a degree of relative permanence in the collection. These cards are sent to the P.R.C. in batches, usually according to prearranged schedules. The second way in which the P.R.C. receives information is by P.R.C. staff going to a garden and microfilming all records pertaining to the living plant collection. After microfilming has been accomplished, the garden begins using the standard P.R.C. accession card for all new accessions and follows the procedure outlined above.

When information is received through the use of the P.R.C. standard accession card, the following steps are taken in the preparation of the information. First, each card is given a sequential P.R.C. identification number. This operation is necessary so that P.R.C. punch cards may be collated by the computer, at a later step in the operation, to form complete records, regardless of the sequence by which the punch cards are submitted to the computer. In addition, this number serves as a convenient reference code so that an original, P.R.C. accession card may be readily located and referenced to any given punch card. Through the use of a mechanical hand stamp, about 10,000 records a day can be numbered by one person.

After numbering, the accession cards are edited by the appropriate P.R.C. staff to insure that all data have been entered correctly. At this point, certain codes are entered on the record to indicate what various kinds of information (other than the required basic information) are present on the record. Next, the edited cards are given to a keypunch operator so that the basic information entered on the records may be keypunched and prepared for processing. After keypunching, the punched cards are key verified—a process performed on special keypunch machines. This second step eliminates over 90% of the errors created during the initial punch card preparation stage. Once keypunched and key verified, the punched cards are "fed" to a card reader attached to the P.R.C. computer terminal (a device, which, through the use of a standard telephone, "communicates" to a computer facility located in New Jersey). The card reader senses the punched holes of the cards, transmits the information to the main terminal hardware where a stored computer program converts the punch-coded information into instructions that guide the P.R.C. line printer (also attached to the terminal) to print listings displaying the information recorded on the punched cards. The terminal, with its attached card reader and line printer, is capable of reading and printing the information on the punched cards at a rate of approximately 300 cards per minute. The listings are then given a cursory edit for any remaining errors.

When a garden's records are microfilmed by the P.R.C., a few additional steps are required. Before microfilming, all appropriate staff members of the garden are interviewed to determine just what records are present at the garden which pertain to the living collection of plants maintained by the garden. Once required records have been selected, each record to be microfilmed is given a sequential P.R.C. identification number assigned for the same purposes as with the standard accession card. Using an automatic camera (which photographs onto two rolls of film simultaneously) with an automatic document feeder, some 15,000 cards an hour may be photographed by one operator with an aide. The camera photographs both sides of the records at the same time, and permits about 6,000 records (5in.× 8in. size) to be recorded on a single roll of film. After filming, each roll of film is mailed for processing. The usual time required to receive the processed film is three days. Upon receipt of the processed film, one roll is filed in a bank safe deposit box, as a safeguard in the event of loss of either the original records or the duplicate roll of film.

Processing of the information on the microfilm begins by giving the film to a keypunch operator for keypunching of data. As with the case of the standard accession cards, each basic plant record requires the use of five different punch cards. Only one type of card is keypunched at a time by a particular keypunch operator. One operator may do only Card 1's, while another operator is working on Card 2's for the records of a particular garden. The operators obtain the necessary information from the garden accession records through the use of microfilm readers, which are positioned beside each keypunch.

After the punch cards have been prepared and edited, the records are ready for final processing through the P.R.C. data terminal. The terminal, once connected to the remotely located computer via standard telephone networks, permits the information that is read from the punched cards by the card reader to be transmitted directly to the computer. The computer, in turn, is programmed to sort and collate the punch card "images" (called transactions), edit the punched information, producing a "Transaction Error Report", and to prepare a new, magnetic tape file for the garden records. Once the file has been prepared, and corrections have been submitted according to the Transaction Error Reports, the file is ready for printing final data listings.

Data Listings

Presently, the P.R.C. has five computer programs which generate reports, inventories or data listings. Four of these programs were designed to produce specific listings which were developed primarily for use by participating gardens as an internal report system. While the information contained in these listings may be of use to other gardens, they are intended primarily to be used as management and research aids by the staff of the garden whose records are reported. The fifth program was developed to handle special reporting needs. This program, which is modified at the time of use, permits an infinite variety of listings to be produced. While this program, like the four others, mainly services the information requirements of cooperating botanic gardens, it is also used to service specific requests for information received from institutions other than botanic gardens and arboreta, and from individual research workers.

Cost of Services

The P.R.C. has established specific schedules of costs for user services, based upon the nature of the services provided. Under the provisions of the Longwood Foundation Grant to the A.H.S. there is no charge for documentation of the living accession records of cooperating, nonprofit, educational, charitable, or governmental botanic gardens and arboreta. This operation includes microfilming all pertinent accession records (when feasible to do so), and preparing them for data processing.

The same services are offered to individuals, gardens, or other institutions which utilize the services of the P.R.C. on a continuing basis but which do not qualify as being governmental, nonprofit, charitable, or educational. For the latter, the P.R.C. does have a fee of from $80 to $100 per 100 records involved.

Cooperation with the P.R.C. requires that the user purchase P.R.C. standard accession cards. The cost of the cards is five dollars per 100 cards, and includes, for new cooperators, the cost for one copy of the Accession Manual. Once a garden's records have been microfilmed, the P.R.C. accession cards serve to supply the P.R.C. with information on subsequent accessions. The Accession Manual, which may be purchased separately at a cost of $20, outlines the use of the accession cards. Revisions or supplements to this manual are provided without charge as the P.R.C. system develops.

The charges for preparing information reports generally depends upon the number of records contained within the file reported, and the number of report copies requested. For most listings, this charge is one cent per record con-

tained within the file, for the first copy. Additional copies of the same listing are charged at the rate of three-tenths of one cent per record within the file. For the institution that requires an additional set of records be prepared, as in the case of loss or replacement, 5 in. × 8 in. accession cards may be prepared through the use of a special computer program, at a cost of from five cents to eight cents per record prepared, depending upon the number of records produced.

Changes to a garden's record file, initiated by the garden, may be chargeable at the rate of fifteen cents for each change. This charge depends upon the nature of the information changed. Chargeable changes generally relate to changes in location data, how received, common name, country of origin, and miscellaneous, nontechnical information. Most other changes are non-chargeable.

Additional services, such as consulting services and researching services for specific information requests, are chargeable at negotiable rates dependent upon the nature of the service(s) and number of P.R.C. staff involved.

Outlook

The P.R.C. like any new system, has had its share of problems during its five years of trial and development. The two-year developmental period at Longwood Gardens, and the past three years of the current program have resolved many problems. However, as the old expression goes, experience is the best teacher. Since April, 1970, when records from many gardens were brought together to be worked on, many interesting problem areas have appeared. Most of these problems have been solved, some however, will likely never be resolved within the operating limits of the P.R.C.

With any new system that has brought together in a short time as many new concepts, practices, and devices as has the P.R.C., system problems surely would be anticipated. Indeed, some have occurred; equipment malfunctions and limitations are an ever present threat to the efficiency of the operation. Utilizing the newest types of equipment coupled to an operationally "fail-soft" system, the effects of system failures are greatly minimized. Effective maintenance procedures, and responsive service facilities keep these problems under control.

Operator errors and faulty procedures represent the biggest threat to the system since data-input labor represents the largest investment. Consequently, there is a continuing review of operation progress and operator problems. From these analyses new, more effective computer programs have been developed to eliminate many relatively minor errors that had previously required correcting by hand. New, more efficient data processing equipment and peripheral devices have been installed to aid in data input and editing time.

Unfortunately, there are just so many machines and devices to be called upon. Ultimately, when all minor mechanical problems within the system have been resolved, that stage of the operation where the operator meets the raw record is reached. At that point problems no longer are found to be within the P.R.C. system, but rather within the botanic garden whose records are being processed. The major problem that the P.R.C. faces each day is general inconsistency in data recorded by the botanical garden. Many times this reflects changes in garden administrations over past years or changes in record requirements. In any case, such inconsistencies are a part of record keeping and, as far as the P.R.C. is concerned, they come with the job. Though it seldom is stressed, the processing, correction and standardization of information contained within a garden's records represent one of the greatest services of the P.R.C. for every garden which cooperates with it.

Hunt Institute for Botanical Documentation

*Abby Levine**

Many scientists disparage the significance of their own work to the history of their science. They mistakenly believe that their correspondence, unpublished research notes, and other personal records are of little value to the history of their discipline and the history of science in general. To the present and future historian of botany and of science, letters, field notes, manuscripts, and journals can be of enormous importance, both in chronicling the development of an aspect of botany and in reconstructing the life of a scientist, the activities of his colleagues, the institutions with which they were associated, and the social and intellectual milieu which both shaped and reflected their work.

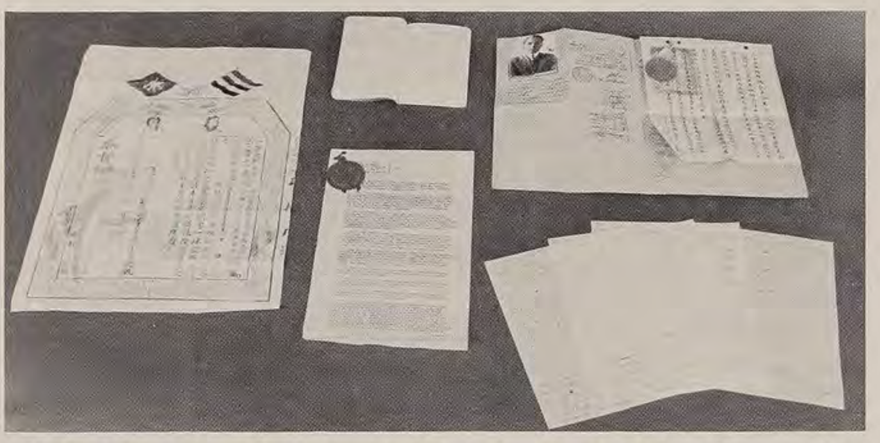
Individuals working in the plant sciences should preserve such archival materials and ultimately insure their deposit in some appropriate repository. The Hunt Institute for Botanical Documentation serves as such an archives and welcomes inquiries from individuals in the plant sciences whose papers might contain material of historical value.

The archives of the Hunt Institute are open to all researchers and are particularly used by those interested in botanical biography and bibliography, the history of the science, and handwriting identification. Because of the scope of the archival collections and the wide activities of their subjects, there is also much material which could be used by nonbotanical researchers. Topics which have been or could be investigated include travel and exploration in various areas from the 1700s to the present, education in the nineteenth-century United States, United States government-sponsored scientific expeditions, early medicine, social commentary, the sociology of science, and the diffusion of knowledge.

The archives are divided into three parts. The biographical collection currently provides more than 100,000 citations to published and unpublished accounts of botanists, horticulturists, and botanical artists; about 10,000 of the accounts cited are in the institute's collection. The iconographical collection holds the portraits of more than 11,000 such persons. The manuscripts collection contains more than 2000 letters by 900 botanists, horticulturists, and naturalists, mainly of the eighteenth and nineteenth centuries, as well as approximately 180 collections of personal and professional papers of

**Archivist, Hunt Institute for Botanical Documentation (formerly The Hunt Botanical Library), Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213.*

Rock with unidentified native escort, probably Tibetan or Himalayan.



Various items from Rock papers. From the left, clockwise; document in Chinese, probably a visa; Rock's journal; his special passport, 1926, while travelling for the U.S.D.A.; Rock's copy of a letter written from Hong Kong in 1946 to [E. H.] Walker; and an affidavit signed by Rock in Yunnan Province, August 1949, concerning his experiences following the communist takeover.

Photos courtesy of Hunt Institute for Botanical Documentation.

Rock clad in an elaborate native costume in an unspecified place, perhaps Tibet.

eighteenth-, nineteenth-, and twentieth-century plant scientists of various nationalities. Included in this last category are letters, manuscripts, notes, lectures, and other papers of the French botanist Michel Adanson (1727-1806), author of *Familles des Plantes,* and a volume of botanical letters received between 1797 and 1828 by the German botanist Franz Carl Mertens (1764-1831), written by 155 different contemporary botanists of Europe and America. Among the holdings of more recent origin are research notes used in preparation for books, including *Herbals: Their Origin and Evolution,* by the British morphologist, botanical historian, and philosopher Agnes Arber (1879-1960), as well as some of her correspondence, and papers documenting the lives and work of plant explorers William Andrew Archer (1894-1973) and Joseph F. Rock (1884-1962) as well as the early life of mycologist and plant physiologist Benjamin M. Duggar (1872-1956), whose later research resulted in the isolation of aureomycin. In addition, the archives include photocopies of relevant material at a number of European repositories and a series of oral history interviews with botanists.

As an example of Hunt's archival resources we might examine holdings pertaining to Joseph Rock; a few of these items are reproduced in this article. Our biographical collection card catalog indicates that we possess data concerning Rock in our own files and also refers to material located elsewhere. A search of the iconographical collection reveals over 70 Rock photographs, ranging from a portrait of the botanist as a young man aged five, posed in a sailor suit, to pictures taken at many points in his career, in conventional western attire and various eastern costumes, alone and with friends, fellow scientists, and native travelling companions. The manuscripts collection contains Rock papers dating from 1908-1963, consisting mainly of letters written to him, many of which concern the writing and publication of his dictionary of the Na-khi tribe of northwest Yunnan Province, China, and his exploration and plant collecting in Hawaii, China, and the Far East. Also included are many documents—passports, visas, letters of introduction—relating to his travels and copies of two signed affadavits concerning his experiences following the Chinese communist takeover (July 1949) of Liaking, Yunnan Province, where he had worked on and off since the 1920s. In addition are his financial accounts, kept over many decades, brief journal notes in his hand dating from 1960-1962, and an extremely interesting series of letters (copies, 1922-1924) written by Rock in Yunnan Province to David Fairchild at the Bureau of Plant Industry, U.S.D.A.; these refer to collection of Rhododendron and other plants, travel, scenery, the constant threat of brigands, the "base" character of the Yunnan natives, and the general backwardness of the area. In a letter of 1 November 1922 Rock remarks: "The people simply live and die like animals in the woods. They have no idea of time or business nor any conception of truth and honor. If you have any dealings whatsoever with anybody of this province, you must at once take for granted that he is a perverter of the truth and that he will cheat and squeeze to the best of his ability and in that they are most able." He then goes on to discuss a search for chestnuts and the wild pear seeds he is sending.

Pages from Rock's passport showing travel in early 1950.

The manuscripts collection also contains material relating to Rock in the papers of three other persons: T. H. Goodspeed, E. H. Walker, and W. R. Maxon. In this way the holdings of Hunt's archives—biographical, iconographical, and manuscript—fit together to show a man through the eyes of those who wrote about him in published form, through the eyes of his own experience and of correspondents concerned with mutual activities, and through the camera's eye.

In addition to its archival holdings, the institute also has a library of over 19,000 titles, with major strength in works published between 1550 and 1850; conducts extensive bibliographic research on works published in botany and horticulture between 1730 and 1840; has more than 16,000 botanical prints and paintings, which are used for exhibits here and elsewhere; maintains a bindery for the conservation and restoration of books and manuscripts; undertakes publication of a facsimile series and monograph series; and has recently opened its collection of Linnaeana, consisting of all books and papers written and published by the famous Swedish naturalist and physician Carl Linnaeus (1707-1778) in every known edition and translation, and the largest known assemblage of books and material concerning him.

Industry has learned that governmental agencies watch the clock. This fuming emission was photographed on a September weekend in 1973. *Photo by M. Jean Cox.*

Plants, Gardeners, and Air Pollution

*Norman L. Lacasse**

I should like to address myself to two specific aspects of air pollution damage to plants. First, I will review briefly the accomplishments of the past decade; and second, I will offer my analysis of the situation at the present time, what the outlook is, and what remains to be done.

The passage of the Clean Air Act in 1963, was, in a sense, a declaration of war against air pollution, and, as in any other war, Congress mobilized resources to do battle. Prior to the passage of the Act, very few laboratories were actively engaged in air pollution research, and training in the field of air pollution was almost non-existent. Almost overnight new programs mushroomed across the country to fill this vacuum. A crash program was on and, as with any crash program, large sums of money were expended, sometimes unwisely, because of a deficiency of experience at the managerial and administrative levels, to say nothing of the lower ranks. As a consequence, much of the early efforts did not result in tangible effects in the abatement of the air pollution problem. The universities were particularly vulnerable in this respect because they were still enjoying their traditional academic freedom, and much of the research was not what could be classified as mission oriented in the sense of problem solving, but more oriented towards classical departmental lines. All too often a research project will uncover more problems than it solves. This is not necessarily undesirable; it simply emphasizes the fact that most problems, particularly those dealing with ecology, are much more complex than they appear on the surface.

**An address presented during the President's Banquet of the 1971 A.H.S. Congress. Reprinted here for reader evaluation of progress in environmental betterment. Dr. Lacasse is now a pollution control consultant.*

The chaotic ending of the past decade ushered in a new era and along with it a brand new set of rules. The old problems were still with us, to be sure; environmental pollution, the war in Vietnam, inflation, and the heavy burden of taxation, just to name a few. The public then began to lose confidence in institutions of higher learning and in the ability of science to solve present day problems. This came about at the unfortunate time when most universities and colleges were clamoring for increased allocations because of spiraling operating costs and increased enrollments. The principles which have contributed to the strength of our universities were now being challenged. Universities are resistant to change, and, in a sense, this is desirable because of the tendency to respond to fads or to jump on bandwagons. Unfortunately, this is the major factor that has contributed to the inability of universities to respond quickly and effectively to society's needs; included here is a response to the environmental crisis.

Turning now to what is happening at the present time, I think you will see how the events of the day will affect you as gardeners, nurserymen, directors of arboreta, and so on, insofar as air pollution damage to plants is concerned. Universities and colleges will be held accountable for their appropriations more than ever in the past. The day of the blank check is over. This is not in itself altogether undesirable. However, because of the severe financial problems, with which the universities and colleges are now faced, it severely limits their ability to deal with day-to-day problems. For example, several reports of air pollution damage to plants have been brought to our [Penn State University Center for Air Environment Studies] attention this past summer. However, because of travel restrictions, field investigation of these problems was impossible.

A saucer magnolia showing leaf and twig distortion due to a hormone-type weed control chemical emission.

There are two other important developments presently taking place which will seriously affect our ability to deal with the air pollution problem. The first concerns training of personnel; the second sponsored research. Agencies which are responsible for funding training programs are making drastic reductions in the number of programs now in operation. Financial support for doctoral candidates has been eliminated and has been sharply reduced for master's candidates. The reason for this is that these agencies feel we know enough of the effects of air pollution and we should now get on with the task of control. We do indeed know enough to start controlling sources. In fact we could have started long ago! Why should we have to wait until the effects have been documented in 100 different ways before doing something about the problem. However, there is still a great deal to learn about effects. We know pityingly little about synergistic effects—the effects of two or more pollutants acting together. And this is precisely the kind of situation we are faced with in our large industrialized urban areas. We should be training more researchers!

Turning now to government-sponsored research, there is a growing trend for federal agencies to use the services of private research corporations rather than the universities. These agencies feel they can obtain some sort of answers. I fear also, that, if the trend continues, the universities will become more and more emaciated.

Redbud is particularly susceptible to injury caused by hormone-type pollution.

What does all this mean to us? It means that unless we do something to reverse this trend, we will continue to experience serious air pollution damage to our green plants, we will continue not being able to grow certain crops in some areas of this country, and we may have to be satisfied with less enjoyable plants that are resistant to air pollution. Universities will not be in a position to respond to environmental problems to the extent that they could.

What can we do about this situation? I believe we must focus the attention of the public on these very important issues through various media. I think the American Horticulture Society could play a vital role here because of its contact with the public through popular publications, meetings, tours through arboretums, and other channels.

Since environmental issues are likely to dominate in the political arenas during the '70s, an informed public could make a significant contribution.

BOOK REVIEWS

BULBS

THE WORLD OF THE GLADIOLUS

by
North American Gladiolus Council
Edgewood Press, Box A, Edgewood, Maryland 21040
1972
241 pages, $7.50 (direct from publisher)

THE GROWTH OF BULBS

by
A. R. Rees
Academic Press, London and New York
1972
311 pages, $15.00

Edited by enthusiastic hobbyists, *The World of the Gladiolus* covers all aspects of interest to the hobby grower. Twenty-five chapters, written by individual members of the North American Gladiolus Council, provide detailed information on growing, hybridizing and exhibiting their favorite flower. While individual chapters vary considerably in the quality of content and manner of presentation, the overall result is worthwhile for anyone interested in the gladiolus for his garden.

Rees's *The Growth of Bulbs* is an advanced textbook for the plant scientist, commercial grower or serious amateur. A chapter on bulb structure provides useful background information that could be applied to the home gardening situation. Extensive chapters on storage and forcing are, unfortunately, limited essentially to the bulbs of narcissus, tulips and iris.

Gilbert S. Daniels
27 July 1973

TWO MORE FROM JACK KRAMER

THE NATURAL WAY TO PEST-FREE GARDENING

by
Jack Kramer
Charles Scribner's Sons, New York
1972
118 pages, $3.95 paperback or $6.95 hard cover

FERNS AND PALMS FOR INTERIOR DECORATION

by
Jack Kramer
Charles Scribner's Sons, New York
1972
113 pages, $3.95 paperback or $6.95 hard cover

Continuing the series of "how-to-do-it" and "idea" books by Jack Kramer, *Ferns and Palms for Interior Decoration*, lives up to the standard set by the earlier volumes in this series. It has good suggestions for beginners, and excellent illustrations which will not only serve to identify some of the plant material, but also give many ideas to the potential grower. The text is consistently informative throughout. Whether a beginning gardener or an advanced plantsman, there are some ideas for you in this book.

The second Kramer book, *The Natural Way to Pest-free Gardening*, is a considerable disappointment. Although it is as well produced and well illustrated as the other books in this series, the content will be particularly frustrating to the gardener with a pest or disease problem. Chapters on soil preparation, climate, insects and birds do little to contribute to a working knowledge which can be projected to everyday problems. The discussions of predator-prey relationships are drawn from the high school biology classroom and are not applicable for the home gardener. A recommendation for gladiolus thrips to "plant bulbs early in the fall" will almost certainly kill the bulbs as well as the thrips. An appendix giving sources of supply for insect predators and the addresses of the various state agricultural extension services is useful. Unfortunately, the text is inconsistent and the illustrations, while pleasant, will not be of any help with an insect problem. The book would seem to be an unfortunate attempt to get on the ecology bandwagon.

Gilbert S. Daniels
27 July 1973

ORCHID BOOKS

THE NATIVE ORCHIDS OF FLORIDA

by
Carlyle A. Luer
New York Botanical Garden, Bronx, New York
1972
295 pages, $25.00

A HISTORY OF THE ORCHID

by
Merle A. Reinikka
University of Miami Press, Coral Gables, Florida
1972
316 pages, $15.00

THE STRANGE AND BEAUTIFUL WORLD OF ORCHIDS

by
Friedrich Ebel and Otfried Birnbaum
Van Nostrand Rheinhold Company, New York, New York
1972
207 pages, $20.00

The long-standing and wide-spread enthusiasm for growing orchids continues to provide the incentive for the publication of many books on the subject. The first of the books reviewed here—Merle Reinikka's *A History of the Orchid*—provides a background to this enthusiasm, both botanical and horticultural. Divided into two parts, the book first reviews the history of orchidology. While giving only brief discussions of the various aspects of orchids and their culture, it covers the entire field quite adequately for the casual reader. Extensive bibliographies are given with each chapter, for those who wish to learn more. Finally, in the first section, a lengthy bibliography is offered in chronological sequence from 1228-1972 for the major taxonomic and descriptive works of the orchid literature. The second half of the book consists of biographies of major personalities in the field of orchidology, starting with Carl von Linné, who developed the modern scientific system for naming plants and animals, including the orchids, and ending with Louis Knudson, who developed the method of orchid seed germination that subsequently revolutionized the commercial orchid industry. The fifty-one individual biographies cover all aspects of the history of the orchid, including commercial collecting, botany and horticulture.

Luer's *The Native Orchids of Florida* follows in the tradition of *Wild flowers of North America*, also published by the New York Botanical Garden. One hundred and two species and varieties of orchids from 45 genera (out of the 61 genera occurring throughout the 50 states) are described in detail and illustrated in full color, both with floral details and habitat photographs. While the book is specifically devoted to orchids occurring in Florida, distribution maps are given for the complete range of each species. In addition to the excellent descriptions and line drawings of individual flowers and floral parts, identification is aided by the complete keys to genera and species. A further note is offered for each taxon, giving comments upon the ecology, floral development and floral biology. Of special interest is the note that this is the first of two volumes planned to cover all of the native orchids of the United States and Canada.

Unlike the first two books reviewed here, which contribute considerably to the knowledge of the orchid and its history, the third book (Ebel and Birnbaum—*The Strange and Beautiful World of Orchids*) has little to add to the knowledge of anyone who already has any slight familiarity with orchids. Translated from an original German edition, the text is mostly unrelated to the accompanying photographs and both seem to be assembled in a random sequence. The photographs in themselves are of excellent quality, but the work cannot be described as any more than a picture book.

Gilbert S. Daniels
27 July 1973

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