

American
Horticulturist



Volume 52 Number 1 Spring 1973

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As the sun rises from among the fishes to gild the horns of the ram we know that it is spring. Life responds, each part of creation in its own way. Birds stir, and move northward, ghostly, high-flying flocks we know of only when they are silhouetted against the moon. In the North, hibernating animals rouse and hunt for their first meal in months and New England experts drain the watery juices from apparently sleeping maples to enjoy an all day—all night orgy of cooking down syrup. Gardeners on the Gulf already enjoy their earliest annuals and they know that now is the time to work up beds for those wonderful, summer-flowering bulbs, corms, and tubers brought to our gardens from tropical places. Arizona gardeners think of clearing away the annual flowers that have brightened their gardens through the “winter” months; they will rely on deep rooted, desert trees and shrubs for summer beauty, and the lawn is irrigated daily. We average-type North Temperate gardeners, we can hardly wait. Seedlings are coming on strong in the basement under lights and in the garden in growing frames. Many of us already have planted our hardier spring vegetable crops; lettuces, peas, spinach, cabbages and other cold-loving, frost tolerant sorts, our legacy from our ancestors in cold, clammy, northern Europe.

It's a shame to tell a fellow sitting on the edge of his chair, already to run out and start shoving seeds in the ground when the weather bureau chap says “no more frost (probably)”, to do a little hard thinking. But we gardeners need to take a minute for some hard thinking. Not a generation ago people engaged in plant industries had it all their way. Ours was an agriculturally oriented nation. Many of us had started on a farm, and if we were city bred, we spent the summers in the country with our grandparents. All of a sudden this no longer is true. Ours is a commercial, citified society. Major cities truck a cow, a pig, and a chicken round to each school so horrified children get an idea of the origin of milk, pork chops, and eggs. Because city air has become intolerably choked with filth we hear quite a lot about abused nature, the need for protecting our rapidly diminishing natural sites, and all the rest of it. We are secure in our gardens; we have our homemade islands of greenery, of horticultural beauty. *But we need to realize that our number is proportionately less every year.*

It is axiomatic that man and plants go together. From time

immemorial men have lived with nature, and when conditions permitted, men built beautiful gardens. The history of mankind—at least, the happy part of it—is the history of gardens and of gardening. It may turn out to be axiomatic that man divorced from nature becomes an intolerable brute; the bellicose types spawned by the inner city would seem to indicate the possibility. Do you get the point? We may be happily gardening while a cataclysm is building just across the hedge.

It is hard to sell things of the spirit. Flashy advertising serves to entrap people into buying stuff that is here today, gone tomorrow. But try to sell the average fellow on a Bach fugue, on Swan Lake, or even on a sun-drenched field by van Gogh. It isn't easy. Things of the spirit take some effort; it takes concentration and, perhaps a modicum of brains, to appreciate creative arts. Certainly, it takes a susceptible spirit. A beautiful flower is just as elevating as the finest music or a great piece of sculpture—and far more personal, because anybody can grow his own flower. Given a pot of soil and a seed, anybody can be a Michelangelo. The average man on the street may be a hard sell when it comes to do-it-yourself horticulture (But is he really? Has anybody—any *gardener*—tried to sell him?) but youngsters take to gardening like they take to peppermint candy.

There's our chance. This year, as we begin gardening again, let's sow one more crop. Let's bring on a crop of gardeners. The kids are easy; show them how to spade up a sunny place, how to plant their seeds, and how to tend the plants. And while you are at it, cultivate an adult or two. A flat of surplus petunias handed over the garden fence may lead to better things.

Right now gardening is on the defensive. We are beset with meetings and projects that eat into our gardening hours. They tell us that if the bugs don't get us, the stuff we use to fight 'em will. We have our problems. But we have our pleasures, too. Think of dawn sunlight filtering through the budding trees, with dewdrops sparkling like diamonds, and with birds singing to welcome the tulips as they waken for the day. In the garden there is peace and serenity. And there is satisfaction. We did it. But, no; we and nature did it. We go together. We need to see that every person on earth has a chance to enjoy that age-old partnership. —**J. P. B.**

JOHN PHILIP BAUMGARDT, *Editor*

The American Horticultural Society, *Publisher*
901 North Washington Street/Alexandria, Virginia 22314
O. KEISTER EVANS, *Executive Director*

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.

AMERICAN HORTICULTURIST is the official publication of The American Horticultural Society and is issued in March, June, September, and December of each year. This magazine is included as a benefit of membership in The American Horticultural Society. Individual dues are \$15.00 a year.

Refer editorial matters to:
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American Horticulturist
P. O. Box 7163
Kansas City, Missouri 64113

Refer advertising matters to:
Publisher Services, Inc.
621 Duke Street
Alexandria, Virginia 22314

Address requests for reprints of articles to The American Horticultural Society, Alexandria, Virginia.

AMERICAN HORTICULTURIST is devoted to the dissemination of knowledge in the science and art of growing ornamental plants, fruits, vegetables, and related subjects. Original papers which increase knowledge of plant materials of economic and aesthetic importance are invited. For manuscript specifications please address the Executive Director, 901 North Washington Street, Alexandria, Virginia 22314.

Replacement issues of AMERICAN HORTICULTURIST are available at a cost of \$2.50 per copy, but not beyond twelve months prior to date of current issue.

The opinions expressed in the articles which appear in AMERICAN HORTICULTURIST are those of the authors and are not necessarily those of the Society. They are presented as contributions to contemporary thought.



Second class postage paid at Alexandria, Virginia and at additional mailing offices. Copyright © 1973 by The American Horticultural Society.

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OUR COVER PHOTO—Coventry Patmore writes that the snowdrop hails far distant spring with uplifted spear, a marvelous description of the mid-winter blossom sheath of *Galanthus nivalis*.

1. Creative corsage design makes a person feel important. 2. Garden project instructions are given by Jim Clippard, Director of Horticultural Therapy, Pontiac State Hospital. 3. Sticking plant cuttings is a skill to enjoy and good exercise for arthritic fingers. 4. Patients at Pontiac State Hospital loading up the tractor with plants for the flower beds.

Photo by A. E. Aperauch



Horticultural Therapy

2



3



4



Is IN !

Alice Wessels Burlingame*

Pioneer days are over. Horticultural therapy is a twelve month program for those who are mentally or physically ill, with plants and allied material as "building blocks." Hospital auxiliaries, garden clubs, and occupational therapists direct the therapy schedules in hospitals, schools, prisons, and convalescent homes.

Universities acknowledge this academic training and are giving a degree in the field of horticultural therapy. This training opens up a new potential skill in the field of horticulture. Kansas State University, Manhattan, Kansas, sends externs to the Menninger Clinic, Topeka, Kansas, while Michigan State University, East Lansing, Michigan, is preparing to send externs to Pontiac State University, Pontiac, Michigan. Preliminary training will emphasize horticulture as well as the social sciences. Young people realize that this comparatively new profession qualifies for their concept of helping humanity.

Wayne State University has trained occupational therapy externs for eleven years at Pontiac State Hospital, using scholarships from the Michigan Division of National Farm and Garden Association. Five acres of field laboratories plus two twenty-five hundred square foot greenhouses assure a well rounded experience. Medical lectures and on-the-job exposure to patients crystallizes the concepts of horticultural therapy. This technique of tying in an interest in plants toward rehabilitation can be applied to all types of hospital settings. The volunteer or staff trained worker can increase the motivation of even short time patients. The goal is to fill a package of time with a new interest.

The Institute of Physical Medicine and Rehabilitation, 400 East 34th Street, New York, under the directorship of Dr. Howard Rusk (former International President of World Rehabilitation) regards horticultural therapy as an important tool in physical rehabilitation as practiced in the Institute's greenhouse and on its grounds. Some patients work within the structure, others too ill to participate are refreshed by being a passive part of the greenhouse crew.

An awakening to the joy of seeing plants grow is used in school ecology programs; often a love of nature develops to combat juvenile delinquency and vandalism. The Chicago public school system has found an about face with vandalism on the grounds when gardening has been introduced. The Chicago Horticultural Society now sponsors a program in their town's public schools, a program developed over twelve years. Those benefitting are the physically handicapped children and girls in a correctional school.

In schools for the retarded, horticultural therapy is well received because of the monotony of some garden tasks which gives the retarded a feeling of security. Grounds maintenance is the perfect training for these special people as they welcome repetition. Prisons and reform schools find that new taught skills with plants result in new interests for prisoners upon discharge. Most prisoners are from the ghetto where beauty can find a niche. Jackson State Prison (the largest prison in the world) has a renowned horticultural rehabilitation program, called Bootstraps.

Quite often emotionally disturbed people, regardless of age, respond to an indoor or outdoor gardening program because it fills a void; they realize that something needs them. A level of achievement with recognition is mental nourishment for those who feel rejected or forgotten. The challenge is for the technician, whether staff or volunteer, to develop an exciting program.

All schools, all children, benefit from incorporating horticulture in their many disciplines; English, history, art, social sciences and so on. This spade work provides a base of stability and appreciation for future community living; the youngsters are armed with a tool to meet life's obstacles.

Our country is peppered with convalescent homes. Better cooperation, more artistic grounds for patient strolling, and new interests, are the dividends for directors who plan on horticultural therapy as a part of their activities program.

Gardening is willing and ready to lend its power to benefit people. ❖

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In the garage where temperatures never fall below freezing, industrial light fixtures (adjustable to various heights) hold fluorescent tubes. Light period is timer controlled. Tender terrace ornamentals over winter nicely and house plants are brought into mid-winter bloom.

Gardening Under Lights

George A. Elbert*

The marvel of gardening indoors under lights (light gardening) is the opportunity to bring life and color into the home as never before. No unused space is unsuitable; cellar, attic, darkened wall space, underneath tables, in bathrooms, and in kitchens. Everywhere there can be lights, a tray, and plants—foliage plants or gay flowering plants to bring joy and beauty indoors. The equipment is simple. A couple of fluorescent tubes with a reflector, hung from a shelf or suspended, a tray, saucers and pots of plants. You have a light garden.

The culture of plants under arti-

ficial light is not merely the latest horticultural fad. Living in an age of continuous technological breakthroughs, we easily lose sight of the significance of this relative late-comer. Its potential impact on our civilization is comparable in importance to other revolutionary techniques deriving from the basic discovery of electricity. Its application is by no means confined to ornamental horticulture. Future generations may depend on the method for food production. However, for ornamental horticulture, it represents a great innovation for we are no longer dependent on sunlight to

*George A. Elbert, 801 West End Avenue, New York, N. Y., 10025, president of the Indoor Light Gardening Society of America, speaks for a growing segment of horticulture.

grow and bloom ornamental plants.

Artificial light allows us to grow plants in our home where natural sunlight is insufficient. In the far north and south gardening can go on during the dark winter months. In desert regions where outdoor conditions are severe the garden can be grown indoors with the additional advantage of an economical use of water. Gardening under lights is a boon to the aged, to shut-ins, to hospitals, and other therapeutic institutions. It is ideal for the classroom, especially at the grammar school level for children confined to the city. It offers year round gardening to plant lovers in the temperate zones.

The introduction of new plants from the tropics that seem especially suited to light gardening has resulted in the development of truly ever-blooming plants. Although the method is still in its infancy, amateur horticulturists already have a growing list of spectacular flowering plants (not yet well known to the general public) which is rapidly augmented by exploration, selection, and hybridization. Most foliage exotics no longer present a problem under artificial light.

The potential of light gardening was suspected long before the discovery of fluorescent light and the marketing of the lamps which took place about 1938. Since then this economical and efficient lamp has been used widely for residential indoor gardening and even to augment natural light during winter months in commercial greenhouses.

Light Gardening Equipment

Equipment for light gardening gradually is improving. Some time ago research was carried out at the U.S.D.A. Plant Research Center at Beltsville, Maryland, on phytochrome, a pigment present in plants which is sensitive to red and far-red light and is important in controlling

plant growth and bloom. It also has been found that blue light is similarly utilized as a source of energy by plants. Thereafter, manufacturers of fluorescent lamps concentrated on designing special tubes that emit light of wave lengths most effective in promoting plant growth and bloom.

Until recently these "growth" tubes have proven very little more efficient than regular illumination tubes, while costing considerably more. The one exception, in my experience, is Sylvania's Gro-Lux Wide Spectrum, which is both economical and effective. Amateurs have learned that by using a combination of household fluorescent tubes they can achieve satisfactory results with their indoor gardening. Most recommended are combinations of Warm White and Daylight or Cool White. In the last few years the manufacturers have increased considerably the output of light per watt from these tubes. Incandescent bulbs, which are strong in the red and far-red spectra, sometimes are used in combination with fluorescent tubes, but their range is small, they are hot, and they protrude from the fixture. Amateurs have been able to do very well without them.

The manufacture and design of light gardens has lagged behind the potential market. Commercial designs of most table-top and multi-tier units are utilitarian and unattractive. When designers and engineer finally get together, we may hope to have units which will match the furniture of our homes. Until that time, we must put up with this equipment in the living room or put it down in the cellar.

Gesneriads Under Lights

Saintpaulias (African-violets) were the first plant to enjoy widespread popularity for indoor light culture. It was discovered that these would grow and bloom even better



Photo courtesy Burpee Seeds

A typical, commercially available indoor light gardening unit filled with flowering plants, seedlings and rooting cuttings.

under artificial light than on a windowsill. As a result explorers have searched the tropics for relatives in the gesneriad family. Within a few years, the number of gesneriad species in cultivation has more than doubled. Hybridization has added hundreds of improved cultivars. But, though the gesneriads continue to be the most important plant family for light gardening, amateurs have been trying all kinds of other exotics which are of a size to fit under the lights. And they have come up with some very interesting results from many families. Of the gesneriads species of *Saintpaulia*, *Columnea*, *Sinningia*, *Episcia*, *Streptocarpus*

and *Gesneria* have been most satisfactory.

Plants that Bloom Under Lights

Among the orchids outstanding results have been achieved with *Paphiopedilum*, (the slipper orchids) and *Phalaenopsis* (the moth orchids). But out of this enormous family there are many others which are grown successfully. There are so many different kinds of orchids, each with unique cultural requirements, that it will be some time before we are able to sort out the species and cultivars which do best. Exotic begonias grow without difficulty. Bromeliads will bloom in the light garden but are not as popular as they might be because of the large size of some of the favorites. Cacti and succulents still present problems with a few exceptions (the stapelias for instance). Plants such as *Crossandra*, *Thunbergia*, *Exacum*, *Clerodendrum*, *Euphorbia* "Crown of Thorns", *Jacobinia* and *Oxalis* are a few genera from different families that will bloom most of the time. Recently an amateur has reported splendid blooming from hybrid lilies in spite of their height. A number of garden annuals do well such as lantana and portulaca, petunias and marigolds. And all this, we should remember, is only the beginning.

Propagating Plants Indoors

One of the attractive activities connected normally with light gardening, and which seldom is carried on out-of-doors, is propagation. Our exotic plants propagate easily in a bed of moist vermiculite, perlite or other rooting medium from stem cuttings and leaves. This is a year round activity. There are many gardeners who use artificial light mainly to propagate seedlings for the summer garden. Although this is advantageous when compared with the cold frame system, these gardeners overlook the other uses of

light gardening and should realize that when the outdoor summer garden ceases the indoor garden continues.

I should like to mention the effect of light gardening on people who have been totally city oriented. Prior to taking up light gardening some members of our light gardening clubs had never tended a plant in their lives. There are many people in our cities today who are quite unaware that a plant needs water and nutrients. This is due not to stupidity but to a complete ignorance and unconcern regarding nature. However, a remarkable thing happens once these people start growing a plant under lights. The fact that they have had to purchase lighting equipment and install it along with trays, saucers and a timer suddenly focuses attention on the plant and raises it in their estimation. The plant becomes a pet or house guest. Suddenly it is necessary to read up on the subject of indoor horticulture, to attend lectures, and to talk to others with a horticultural interest. In the end such a person may possess more knowledge of horticulture than the average outdoor gardener who knows nothing but sowing seeds and allowing the sun and rain to do the rest.

Unless the world becomes impossibly crowded, light gardening will always play second fiddle to outdoor horticulture. But the number of gardeners with plants under lights grows steadily. Most people seem to have taken to it after reading some article on the subject. Very little has been done in the way of organization up to now and the Indoor Light Gardening Society of America is only beginning to expand its activities. Within the not too distant future, however, organized light gardeners may far exceed in number any other plant society membership except the garden clubs.

It is interesting to note that while

garden club membership is largely feminine and most clubs hold their meetings during the day, the light gardening fraternity is balanced with equal numbers of men and women and light gardening clubs hold their meetings at night to accommodate working people. Furthermore, the I.L.G.S.A. member often is technically and artistically oriented. The proportion of professional people is high. The technical aspects related to effective construction of light gardening units and the use of special



Photo by M. Jean Cox

equipment apparently appeals to white collar types. Designers and artists take to plants and are concerned to see them grown and displayed in the most attractive way.

When light gardening becomes accepted by a significant proportion of our house bound population it may transform our civilization as can any important change in our environment. It seems to me that, in the perhaps exciting but certainly alienating environment which science and technology have created, light gardening can be a first beacon directing us again toward a more balanced and humane life within the evolving framework.❖

A small grouping of house plants—a table top garden—growing under a fluorescent lamp that holds tubes especially engineered for vigorous plant growth.



Arboreta Are For People

A place to walk among outstanding collections of plants; the arboretum is a good place to visit. With this feeling, interest in the plants themselves will develop.

*John E. Bryan**

Deep in his being man fosters a basic need for a place of serene and perfect beauty; a place to contemplate his own personal worth and the world into which providence has set him. A place to walk, to sit, to observe the simple marvels of nature. A place to acknowledge and respond to that call of the elemental force that is in every living thing. Hence, we understand that parks and gardens and the arboretum, as concepts, go as far back in the history of man as does his wonder and appreciation of the natural world.

In the 19th century, in Egypt, there were discovered plans of a garden surrounding a house belonging to an official of the reign of Amenhotep III, circa 1375 B.C. These plans show the use of water and trees planted specifically to give shade as well as to provide fruit for the household. In the temple gardens of ancient Egypt medicinal plants were grown. It is recorded that acacia, aloe,

anise, caraway, coriander, poppies, and dill were cultivated for their curative properties. These were utilized, as Homer writes, "... by priests skilled in medicine more than any humankind".

The ancient world did not always enjoy peace. Wars raged throughout the area which we call the cradle of civilization. Egypt over Assyria. Assyria over Egypt. Greeks battled Persians who, under Alexander, conquered Asia Minor and reached India. The victors in these wars took home not only the spoils of the vanquished but, in many cases, the customs of that land. The hunting parks of the Assyrians were copied by the Persians. Numerous examples of this imitation of life styles can be found as we examine the development of nations.

The Greeks, who admired well-designed buildings, also appreciated the shade provided by the trees and other plantings which were used to

complement the statues of their gods and heroes. The homes of the wealthy were havens of green and plantings which pleased the eye were executed by men especially skilled in this art.

While medicinal and sacred gardens were sometimes separate, they were more often together. Primarily priests and gardeners were concerned with the practical uses of plants rather than with their botanical or decorative ones.

It was during the sparsely recorded centuries of the Middle or Dark Ages that the forerunners of arboreta and botanical gardens began to take form as independent entities, distinct and separate from the development of parks. It was the Christian Church of the Middle Ages and the enclaves of learning and culture which it established that preserved the value and knowledge of plants, as well as of literature and art.

Monasteries and castles had to be self-sustaining. The tumultuous times precluded the gathering of plants from the countryside and walled gardens were the order of the day. Plants were essential for food and herbs were required to heal the sick and succor the wounded. Close to the hospitals of the monasteries were grown plants with medicinal value, known as "plants with virtues". Some kings supervised the growing of these plants. The Emperor Karl the Great (Charlemagne), in 812 A.D., gave instructions to grow sixty useful plants and those with virtues were catalogued by him.

The lore of herbs and their uses and medical values were passed from hand to hand and, after being copied and augmented, eventually were printed. Some are preserved for us today.

During the Renaissance man's efforts no longer were concentrated on war and basic survival. There was an enormous growth in all forms of art, scientific achievement and trade in the known world. The possibility of extensive travel brought with it an increased interest in plants from the countries visited and, in time, the diversity of plants grown in private gardens and estates multiplied. New species were added to the collections of "plants with virtues" and man began to name and



There is no reason why a botanic garden and arboretum can not have common plants in fine display. Here are trials of tulips each kind labeled and planted so that they are seen in full beauty.

Photos by author

Vistas over water, azaleas in flower to frame another walk, these tempt and encourage people to see what else is on display.





Old-style plantings, badly overcrowded, make it impossible to appreciate the form and beauty of each plant. The dark foreground plantings are less inviting than the open plantings beyond.



An arboretum should be a place to visit and walk with friends. If an arboretum has this appeal, interest in the plants will follow.



All plants should be grown to allow full development without overcrowding. Ease of access to the plants which are clearly labeled invites inspection and promotes enjoyment.

classify plants. Consequently, the botanical needs of universities were met by growing, in specific beds, in geometric patterns, plants by their order and classification. In 1447, Pope Nicolas V ordered certain areas of the Vatican gardens to be set aside for medicinal plants and for the instruction of botany, which was then a dominant part of medicine.

The Botanic Garden of Padua was established in 1545 and shortly afterwards the Orto Botanico of Pisa. Botanic gardens also existed in Holland and Germany at this time.

Gradually, the investigation of plants reached distinct levels, still valid today. First came the study of plants with herbarium material, taxonomy classification and nomenclature, separate from the purely medicinal uses. Second was the introduction and establishment of plants which were of economic importance from other countries. These were planted and acclimatized, for the most part, in the colonies. A few examples of plants so treated are: rubber, coffee, tea, chocolate, cotton and hemp. One of the trees of ornamental and economic value which was first cultivated in a botanic garden is *Robina pseudoacacia*, false-acacia or black locust. It was first introduced into the Jardin des Plantes in Paris in 1606 and the stump is still there. Timber from this species provided the pegs much used in ship-building in the 17th and 18th centuries. Finally, there was the study of horticultural practices, as exemplified by the many Italian gardens which were landscaped by experts. It followed that ideas for landscaping and groupings of plants were seen, admired and, most importantly, copied.

In 1650 a Scottish medical student, Robert Sibbald, was furthering his studies at the University of Leyden in Holland. Returning home, he was appalled at the ignorance of the medical students at Edinburgh in the value of medicinal plants. He established a garden consisting primarily of medicinal herbs. As the years passed, gardeners and botanists were placed in charge. They developed special interests in particular plants, for example

rhododendrons or primulas. So, we have a complete turnabout and plants were being cultivated, then, not only for their healing virtues in medicine but their botanical interest as well. This resulted in the further advancement of that special science, botany. Today the study and use of plants takes pride of place in botanic gardens and arboreta.

In America, the great botanic gardens were the results of outstanding private collections of plants grown for their rarity and scientific interest. Henry Shaw's collection, now the Missouri Botanical Garden, the Arnold Arboretum, and Longwood Gardens by Pierre DuPont are examples.

Another very important function of the botanic garden evolved about the late 19th century. Money being available, men with interest in plant hunting were sent to the far corners of the earth in search of new species. E. H. Wilson, from the Arnold Arboretum, was one of these plant hunters. To him we owe thanks for the discovery of the regal lily and many azaleas.

It is exciting to think that from the earliest times there must have been flourishing horticultural societies where men studied the profession and discussed the various problems of growing plants. Our present heritage of parks, gardens and arboreta has indeed an ancient, involved, and fascinating history. As we examine their evolution, we should understand that the purpose of an arboretum in the 20th century is essentially an extension of its original function; to serve the needs of the people who utilize it. It follows, then, when asking the question, what will future generations say about our contributions to the field of horticulture that we should incorporate the present day needs of society into the structure of existing institutions. The world in which we live is undergoing tremendous change, politically, socially, and educationally. The pressures are astounding. The quantities of information to be digested are enormous. Restful vistas and open space are essential in providing a respite from this daily overstimulation. Our environment for the most part has become one of hard surfaces; steel, cement and glass. We



Plants grouped together but with the feeling of space are inviting, and more appreciated and easily enjoyed. This is where home gardeners study and learn.



From many different points there should be views tempting the visitor to explore, to walk among fine plants each having its place in the sun.

need a refuge which embodies all that is tender and vulnerable and part of the earth. We must develop the kind of arboreta which will produce incentives in the layman to become more familiar with the world of growing things. We must encourage appreciation and inquisitiveness, which will result in support.

Bright colors and unusual combinations can be achieved by planting in bold array; lavenders, heathers, rhododendrons, azaleas and rare plants such as *Isoplexis canariensis*, can be grown to complement our botanical treasures and stimulate interest. We can, in this way, attract people who will respond and study plants more



A good library complementing the collection of living plants is an essential part of an arboretum.

completely. It is surely a scientific function of an arboretum to introduce to the public for their investigation new varieties of lilies, tulips, primulas, malasian rhododendrons, and so on.

To achieve this and still maintain gardens in exemplary fashion requires gardeners. Today gardeners do not want to spend hours in routine maintenance because, for the most part, their educational level is higher than in former years. Therefore, we must promote a pride in these men by allowing them more time for skilled and interesting work. We can accomplish this by keeping routine maintenance to a minimum with the use of mulches and the use of ground covers.

The trend in today's methods of education should apply in the arboretum. We must not intimidate the visitor. In labeling, a plant's common name, as well as the Latin, should be used. Supplying additional information regarding the uses of plants will certainly capture the imagination of the visitor. The Indian uses of plants in the Redwood Trail at the Strybing Arboretum in San Francisco is an example. Placement of plants by geographical location sometimes helps the visitor to relate better to them.

We must take advantage of the acceptance and appreciation of the unusual in today's world. This means that beds of ornamental cabbage are found to be attractive. Chard planted in beds with flowers all around and gladioli coming through fit today's patterns in design and stimulate the layman to experimentation in his own garden.

We must fulfill our obligation to educate and to act as a living reference library, not a museum, for the public. While commercial nurserymen help their customers as much as they can, it is becoming more difficult for them to provide expert advice on the wide range of problems and questions put to them. So often people feel awkward asking free advice in a commercial establishment. This, then, is a role the arboretum should play; a source of information on all aspects of the growing of plants. From the history and origin of species to the use of tools.



Primulas and bulbs complement shrubs which are grown for their botanic interest only

Tall growing tree ferns are in themselves attractive, add an underplanting of rhododendrons and other flowers and the area is richer, more rewarding and well worth visiting.





Crab apples in flower with a fountain in the background, a pleasant place to visit. In the spring crocus will erupt from the beds under the trees, adding more interest and enjoyment.

Conifers planted to show off their individual color; add rock plants, winding paths, water and good labels and you have delight for gardeners, botanists and lovers of the outdoors. An arboretum should teach all aspects of plants including the joy of looking at them.



From reference books on landscape architecture to practical demonstrations on correct watering and pruning methods. Would the botanical garden, then, be drastically altered by catering to the more practical? Of course not! We can make arboreta more attractive and more useful to the public and at the same time continue in the established traditions of plant introduction, growing of unusual species, and supplying data together with material for scientific research. In this way we will truly be a vital institution functioning in our time as the indispensable house of horticulture.

The special interest groups, professionals such as the American Association of Nurserymen, the State Association of Nurserymen, the Shade Tree Conference, the Plant Propagators Society, and so on, and, the non-professionals such as garden clubs, the African-violet, Chrysanthemum, Rhododendron, Orchid, Rose, Lily, Bromeliad, Carnation, Daffodil, Iris, Fuschia Societies, should have very close contact and work within the overall operations of a botanic garden.

These various societies should be encouraged to help in the planting of a garden, showing the plants which interest them most in a setting which displays those plants to the best advantage. The result will be a greater appreciation of other plants, the enhancement of their own gardens, a substantial increase in their overall plant knowledge and a place to make use of their expertise in their own special fields.

The advantage of one central location for meeting where ideas from these various sources are channelled to provide wider appreciation and where the members can go to be guided by practical demonstration and lectures is obvious. The arboretum also should be a place where books can be obtained, where exhibits for the professional gardener and nurseryman can be set up and where programs designed to reach different elements of society can be maintained. This is public service in action.

The arboretum can branch out into the community. Volunteers equipped



Paths of simple construction, here logs with a six inch deep layer of sawdust between, are inviting and let the visitor walk through the plants and feel a kinship with nature.



A collection of plants need not be uninteresting even to people not interested in plants. All can enjoy the form, texture and color if planted for this effect.

with a plantmobile could work with school children. It is difficult to obtain funds for enlarging school facilities; a greenhouse, potting bench, soils, and the necessary equipment would be expensive and not fully used. A truck converted into a mobile potting shed, with all the standard tools, and staffed by interested, well-trained workers would bring joy and fulfillment to many and it would educate children in the rich world of growing plants.

Such projects must exist under authorized direction to obtain the cooperation of the schools and to establish long range goals and continuity as ongoing programs. The staff of an arboretum should provide the continuance of direction which cannot and, indeed, should not be expected elsewhere. An arboretum should be the

central location in which to look for verification and example and the information presented must be absolutely correct.

Arboretum personnel together with people from other branches of horticulture, must unite to influence standards and procedures in city planning, park design and highway beautification. We can be completely free to advise without the stigma of bias due to any special interests inherent in so many other groups.

The most popular collections are native plants, plants from around the world, and demonstration gardens.

How can we use these statistics?

Most people would spend an hour or more in the arboretum. Therefore, we should have a variety of trails or walks available to hold the interest for that length of time and to encourage either a longer stay or a return visit. Surprisingly, many people would pay to see an arboretum. This fact alone is very encouraging in testing public support.

It is most distressing to hear of arboreta closing or of staffs being reduced for lack of funds. However, if the arboretum was truly serving the public such action would be taken with great reluctance. The politicians must come to realize the importance of the arboretum, but the arboretum must first become so much a part of the community, so necessary to a great majority of its citizens, and such a productive institution, that it will forever be recognized as essential for the growth of the area which it serves. ☼

How is an actual visit to an arboretum spent? How much interest is there in arboreta? These are the results of a Strybing Arboretum survey based on 150 questionnaires:

Number of first visits to an arboretum	60
Number of repeat visits	90
Chance visit	59
Visited other arboreta in California	55
In U.S.A.	101
In Europe	47
Attended Horticultural lectures	Yes 36
..... No 118	
Would they attend	Yes 81
..... No 61	
Would they pay to visit an arboretum	Yes 121
..... No 38	
How much? ... 76 would pay 25¢ .. 36 would pay 50¢ .. 9 would pay \$1.00	
How long would they spend?	120 would spend one hour or more
.....	28 would spend ½ hour
.....	2 would spend ¼ hour.

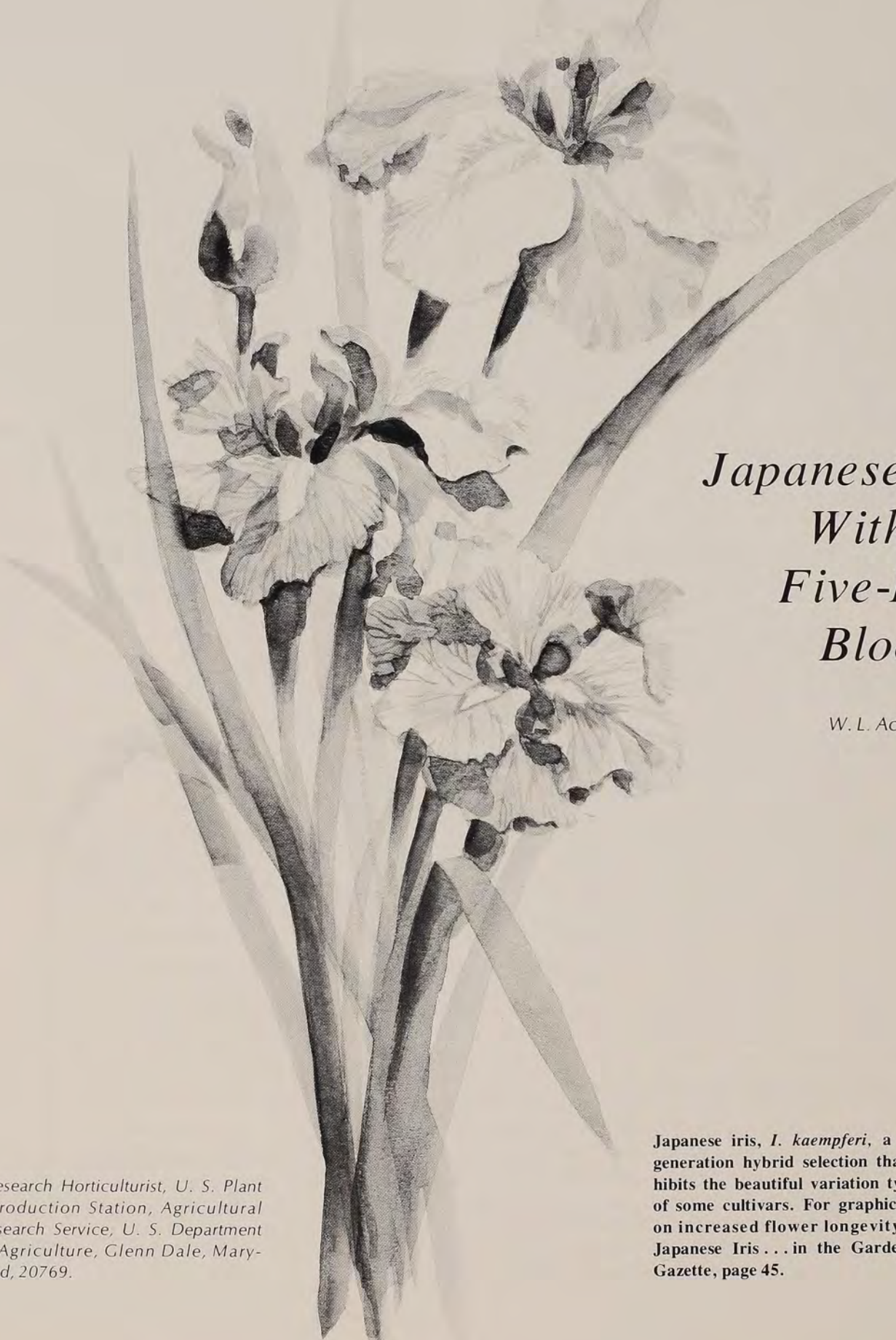


FREEZE HARDINESS EFFECT IN AGAVES

Several plants of *Agave macroacantha*, a medium sized species, have grown in my Texas garden for about ten years. In the Houston area, this species repeatedly proved to be among the more susceptible of tropical agaves to outright destruction by freezing temperatures. Four potted specimens of *A. macroacantha* and one of the similarly tender *A. decipiens* overwintered outdoors in my garden in San Antonio in the winter of 1970-1971. This winter was characterized by an occasional freeze of only a few hours duration to a minimum of 25° F., and but one more severe temperature drop to about 22° F. The city was in the grip of a drought which had begun in early fall; no appreciable amount of precipitation had fallen for several months. Throughout this period the agaves were not watered and I noticed that until the time of the most severe freeze (through several rather mild freezes) all of the agaves survived without apparent damage although fully exposed. About a week before the most severe freeze, I watered three pots of *A. macroacantha* thoroughly but one pot of this species and the pot of *A. decipiens* were not watered due to their being then at a different place. Following the night of the most severe freeze, when all five of the agave plants were fully exposed in the garden and were grouped all together, the three *A. macroacantha* which had been watered were found to have been destroyed, yet neither the unwatered *A. macroacantha* nor *A. decipiens* exhibited any apparent damage. Concurrently, *Cassia alata* and bananas were frozen to the ground by the first light freeze, while *Passiflora coerulea*, *Clematis texensis* and *Vinca rosea* endured all of the light freezes, but were frozen to the ground by the most severe one; all of these planted in the ground and unwatered.☒

Robert C. MacEwan*

*Mr. Robert C. MacEwan, 8040 Fredericksburgh Road, San Antonio, Texas, 78229, writes to share his observation on the survival of watered and dehydrated plants following a freeze.



*Japanese Iris
With
Five-Day
Blooms*

W. L. Ackerman*

*Research Horticulturist, U. S. Plant Introduction Station, Agricultural Research Service, U. S. Department of Agriculture, Glenn Dale, Maryland, 20769.

Japanese iris, *I. kaempferi*, a first-generation hybrid selection that exhibits the beautiful variation typical of some cultivars. For graphic data on increased flower longevity, see Japanese Iris . . . in the Gardener's Gazette, page 45.

Through a program of breeding, selecting, and analyzing the flower longevity of seedlings, U.S.D.A. plant breeders have found a way to provide gardeners with Japanese iris with flowers that are long-lasting.

The Japanese iris *Iris kaempferi* Sieb., commonly called the saucer iris, has many virtues as a showy garden flower, yet it occupies a minor role in American plantings compared with the German iris (tall-bearded iris). A summer flower, the Japanese iris begins to blossom in Maryland during the latter part of June, shortly after the bearded iris are gone, and continues through July. Colors range from white to pale pink through lavender to blue and deep purple. The flowers are single or double and occur in solid colors and in many intricate patterns, some with contrasting dark-colored veins. Flower texture varies from light and filmy to heavy and velvet-like. Size varies from four to more than ten inches across, depending on the cultivar and cultural treatment. Through a program of breeding, selecting, and analyzing the flower longevity of seedlings, U.S.D.A. plant breeders have found a way to provide gardeners with Japanese iris with flowers that are long lasting.

Japanese iris generally are hardy throughout the United States, with the possible exception of the coldest areas of the Middle West and mountain states. Like that of the Siberian iris, the foliage dies down to the crown each autumn and remains dormant during the winter. Japanese iris begin growth quite late in the spring. The plants thrive with high moisture conditions during the growth period and are intolerant of neutral or alkaline soil. While they may grow quite satisfactorily in ordinary garden beds, the huge plate-size flowers for which these iris are famous are seldom seen except under very moist conditions.

A disadvantage of the Japanese iris, which may in part affect its popularity in this country, is the short life span of the individual blossoms. This averages two to three days, compared to three to six days for the German bearded iris. Increased floral longevity would perhaps induce more gardeners to plant Japanese iris.

Seeds from hand-pollinated choice garden hybrids of the Kumamoto strain were obtained in 1956 by Dr. J. L. Creech, Agricultural Explorer, Agricultural Research Service, U.S.D.A., from the Seiko-en Nursery, Kanemoru, Hiroshima-ken, Japan. Introduced as P.I. 235584 to the U. S. Plant Introduction Station, Glenn Dale, Maryland, they were grown for test and evaluation. The seeds were germinated in flats of milled sphagnum moss, transplanted to three-inch pots, and grown in a greenhouse for the first season. The plants were grown in a cold frame for the second season and then transferred to a moist field plot next to an irrigation pond. A total of 395 seedling plants were established in the first generation planting.

Floral descriptive records showed the color range to be typical for the species and present in both solid colors and in veination patterns. Floral longevity studies were made by tagging each individual flower as it began to show color. Daily flower sequence data were recorded on each tag, beginning with full bud and extending through four stages of development to the fading of the flowers. A minimum of ten flowers were tagged for each clone.

The range of distribution for the average life span of flowers on individual clones varied from one to five days, with the greatest number lasting from two to three days. Thirty-nine clones of good floral quality with average life spans of four to five days were selected. Their crowns were divided in half and transplanted as two replications to a new location. Clones in the new planting were allowed to cross-pollinate, and seeds were gathered for a second-generation planting. Floral descriptions and longevity data were recorded for the second-generation seedlings.

The range of distribution for the average life span of flowers on second-generation clones varied from two and one-half to five days, with the greatest number lasting from three to four days. Thus, the average floral longevity was advanced by one day in the second-generation compared to that of the original seedlings. No flower from either seedling population lasted more than five days, which appears to be the limit of floral longevity, at least for the Kumamoto strain used in this study, and possibly may be the limitation for the species.

A nucleus of eighteen clones with an average floral longevity of five days has been acquired in the two generations. Selective breeding among these clones would appear to present distinct possibilities for the development of long-blooming Japanese iris with desirable floral qualities.❖

PIERIS



Emily Brown *

The woody plant genus *Pieris* belongs to the family Ericaceae, which takes its name from the genus *Erica*. *Erica*, *Calluna* and *Daboecia* are the heaths and heathers. Other well known members of the family are *Arbutus*, *Arctostaphylos* Manzanita, *Gaultheria*, *Ilex*, *Kalmia* and *Rhododendron*. The flowers of many members, with the notable exception of the last mentioned, look alike—they are more or less bell or urn-shaped—the shape that people think of in connection with the lily-of-the-valley. Most ericaceous plants come from areas, in whatever hemisphere, where there is moisture in the air and acidity in the soil and, therefore, they flourish in a similar garden situation. This is a large family of more than seventy genera; it is called the "heath" family and its members are spoken of as ericaceous plants.

Pieris as a genus has no common name (though "andromeda" is used regionally); the names of certain species are modified by a common adjective to designate country of origin, as in Chinese *Pieris* or are assigned individual epithets. The botanical name should be retained, in any case, since it has a connotation of beauty, coming as it does from "Pierides", a group name for the muses. As to pronunciation, py-EE-ris is most commonly accepted.

Pieris species are shrubby, sometimes a small tree, evergreen, with firm, leathery leaves, often shiny. Flowers usually are creamy-white, growing in terminal panicles and opening through late winter and early spring. In warmer climates, the buds show some color through the winter.

Probably the best known *Pieris* in cultivation is *P. japonica*, as this species was brought to England in 1870 and distributed widely. It has been called Japanese andromeda and lily-of-the-valley shrub. (This latter common



Pieris japonica 'Wada'



Pieris japonica 'Flamingo'

Photos by Robert L. Ticknor



Pieris japonica 'Valley Rose'

Photo by Fred Calle



Pieris japonica

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Pieris japonica 'Pygmaea'

Photos by Owen Pearce



Pieris japonica 'Variegata'

name is one to be avoided as it has been used for at least two other distinct plants) *P. japonica* is a shrub to ten feet but seldom attains this height in gardens. It is much-branched and compact with many dark leaves masking the structures. To partially expose the trunks is advantageous. Cultivars of *Pieris japonica* are: 'Compacta', a small-leaved clone not exceeding six feet. 'Crispa' with rippled leaf margins and an interesting form. 'Dorothy Wycoff', compact growing, with leaves turning reddish green over winter, flower buds red in winter, pink in spring—flowers a true pink. 'Flamingo', with rich pink flowers that do not fade. 'Pink Bud' buds and flowers bright pink, but flowers soon fade to ivory. 'Pygmaea', dwarf plant with linear leaves less than one inch long. 'Variegata', with leaves smaller than the type, edged with yellowish-white; slower growing than the type. 'Whitecaps', with white flowers in exceptionally long clusters. 'White Cascade' with full clusters of white flowers over a long period. *P. japonica* 'Yakusimanum' is also a dwarf growing at the most to one and one-half feet. The leaves are typical pieris foliage, only somewhat smaller. More cultivars are known.

Pieris floribunda mountain andromeda, is an erect, rounded shrub to six feet. It is indigenous to the Appalachians from Vermont to Georgia but is not cultivated widely beyond the east coast. It is quite hardy and takes hotter, drier air than most *Pieris* species. The clustered flower spikes of *P. floribunda* stand boldly upright. The clone 'Grandiflora', originating in England, has superior flower spikes.

Pieris formosa possibly was so named because it was first noticed in Formosa. The common name is Himalayan andromeda. This species is rangy, growing to ten feet or more. The cultivar 'Wakehurst' has broader, shorter leaves, the new red foliage appears with the spreading panicles of white flowers.

Pieris forrestii originates in China. The "forrest" of this plant refers to the plant hunter, George Forrest who sent this species to Britain in 1910. It is dense in growth; the fiery red of the

new leaves is persistent. To distribute this plant in quantity, growers have propagated it by seed as well as cuttings. The brilliance, therefore, is variable and it is best to select a plant for purchase when the new leaves are young—perhaps during the flowering period and surely directly after. The proper way to propagate for color is by cutting. Summer is the best period. A rooted cutting takes several seasons to become garden size. Flowering might take place in the fourth year. The flowers are only a little less spectacular than the new leaves. Drooping panicles on the ends of many branches are very full, the color almost pure white in April and May. The numerous closed bells (urn-shaped is the descriptive word used in the encyclopedias) are then quite fat and waxy. For several months the buds have looked like tiny, green beads. The terminal leaves in whorl-like clusters are each about six inches long, elliptic-oblong, medium-green in color when mature, somewhat leathery and shiny. The species is not reliably hardy below 10°F.

The cultivar 'Forest Flame' (sometimes Flame of the Forest) is a particularly showy hybrid of *P. japonica* × *P. forrestii*. With brilliant red new shoots and elegant panicles of flowers, 'Forest Flame' is increasing in popularity.

P. nana, the Kamchatka pieris, grows as a low spreading shrub with half-inch long leaves in whorls. This Asian species seldom appears in gardens.

P. taiwanensis, Formosan andromeda, is a very handsome species, to six feet, with a spring display of white flowers. It is less hardy than some others.

Good growing conditions for Pieris have been suggested but need some elaboration. This is a plant for shade or part-shade but most species do well in sun in fog belts or moist climates. It is difficult in a climate too warm or too dry. It has better quality if protected from wind in any area. The soil must be lime-free, a mulch of coniferous bark is advantageous anywhere. Similar to rhododendrons, it likes a cool root-run. Moisture is necessary but good drainage also is critical. Where water is



Pieris formosum

Photos by Owen Pearce



Pieris taiwanensis

high in salts, leaching is indicated. No spraying is necessary. Only very selective pruning is needed; flowers should be dead-headed, however.

Pieris has many decorative uses; in shrubbery groupings with related plants, in oriental-type landscapes, in woodland gardens, as a feature at an entrance, as an accent plant in a shady courtyard, in a rock garden (the dwarf-varieties) and especially as a tub plant. In a container it will flourish for ten years or more. Pieris has year-round quality. ☞

Climbing Plants

David O. Lofgren*

Plants, both herbaceous and woody, that grow more or less vertically and attach themselves to a support, are valuable assets to gardeners. While some long-caned plants such as the various brambles, some roses, and a few other species might be loosely classified as climbers, plants covered in this article are only those that twine or that have mechanical adaptations for support, tendrils, holdfasts, or aerial roots.

Actinidia kolomikta is a good example of a climbing garden ornamental. The plant is not rampant, stems seldom attaining fifteen feet, and its twining tendency is weak. Still it is a vertical-growing plant that requires support. It is a climber.



Actinidia displaying weak twining ability.



Wisteria floribunda showing clockwise rotation.



Clematis petiole shortly after twining about the wire support.



Grape tendrils forming a useless knot.

Photos by author

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Young *Parthenocissis* shoots growing up a wall.

Adaptations for Support

Climbing plants have one or more of three adaptations for climbing. The vertical stems either twine round a vertical support as the plant grows, or the stem produces structures (modified leaves or stems) that physically attach to a vertical support, thus propping up the stems. Various climbing adaptations are:

Twining stems: Stems of plants that twine circle round and round the support, usually, in a specific direction that is peculiar to the plant. Most members of a given climbing genus are either right twining or left twining. Twining is assumed to be the oldest, most common adaptation for vertical support. Some climbers which twine have developed other forms of support as well.

Tendrils: Tendrils are small stems or flower peduncles which may have leaves or flowers, but usually do not. They are specialized stems that support the plant. Seemingly, the tendril has a "sense of touch," because when it encounters an object, it coils around it. If the object is then removed, after a few hours, the tendril will uncoil itself and prepare to attach itself to something else. In fact, no nervous impulse as found in animals is involved. The twining response is a paratonic movement called a tropism, further explained below.

Discs and aerial rootlets: Some climbers cling by ↗



Tendrils of the *Parthenocissis* moving toward a solid surface.



As a holdfast or disc makes contact, other tendrils move toward the supporting surface.



A tendril with discs firmly attached to the support; the tendrils crimp and harden, making the attachment rigid.

fastening themselves to a relatively smooth surface. This is accomplished by a specialized disc on the end of a tendril or a specialized aerial root that emerges from the stem where contact with a solid support occurs. These climbers cling to a surprising variety of surfaces, wood, brick, and occasionally even glass. The clinging parts have amazing tenacity and sometimes they must be pried loose to remove them. Once loosened however, that particular part will never cling again as the organ has the ability to grip a surface only when young.

Plants "grow" in length by the addition of cells at tips of roots and stems and by the enlargement of cells as they take on water and swell. If cells are produced irregularly, more on one side of a shoot than on the other, the shoot will curve as it grows. Or if cells on one side of a shoot elongate faster than those on the other the shoot will curve. When a plant organ moves as a result of external stimulation (heat, light, gravity, or other) the motion is called *paratonic movement*. When the paratonic movement is a curved growth or bending, it is called a *tropism*. When a plant bends toward light, the movement is called positive phototropism; bending away from light is referred to as negative phototropism. Some plants are stimulated to bend by contact with a solid object—thigmotropism. If the response is a bending toward (as a tendril around a wire) the object, it is called positive thigmotropism.*

Specific Methods of Climber Support

It is often said a plant climbs by twining, but what makes it go round and round? *Humulus lupulus* was observed as it broke through the ground. The first two or three internodes were stationary and straight. The third or fourth internodes however, while very young, were seen to bend to one side and travel slowly around toward all points of the compass in a clockwise direction. The average time for each revolution was two hours and eight minutes. This circling movement continues as long as the plant continues to grow. Each internode ceases movement as it grows old. The new internode begins revolving a couple

days before the preceding one quits revolving. One observed internode revolved thirty-six times and stopped half way through the thirty-seventh revolution. At that point it straightened up and became rigid. The internode had revolved both day and night over a period of five days.

The rate of revolution varies with genus, species, temperature, amount of light, health of the plant and age of the internode. *Akebia quinata* may be said to hold the speed record completing a full revolution in one hour and thirty minutes. The revolving movement allows the plant to "search" a fairly considerable area for support and having made contact, the revolving or curving growth permits the plant to cling to and ascend the support.

As mentioned before most species of climbing plants have a characteristic direction of curved growth, clockwise or counter-clockwise. A few plants, however, do not have a particular direction such as *Scyphanthus elegans*. It takes one, two or three turns in one direction and then reverses itself and revolves similarly in the opposite direction. Naturally the ambi-directional habit of growth is not as stable as a continuing spiral ascent and most of the plants which are ambi-directional have other ways of maintaining support as is the case with a number of clematis species which have sensitive petioles.

Some plants that twine in a counter-clockwise direction are: *Actinidia*, *Akebia*, *Aristolochia*, *Asparagus*, *Celastrus*, *Ipomoea*, *Jasminum*, *Menispermum*, *Periploca*, *Wisteria*. Some clockwise twiners are: *Berchemia*, *Dioscorea*, *Humulus*, *Lonicera*, *Schisandra*, *Wisteria*.

As reflected in the list, the majority of twining plants revolve in a counter-clockwise direction. *Wisteria* appears in both lists. This genus has no consistent direction of revolution, but each species has a definite direction to revolve. *Wisteria sinensis* twines counter-clockwise and *W. floribunda* twines clockwise. This difference is a distinguishing characteristic between the two. Many experiments have been made to change a plant's direction of revolution and none have been successful.*

*Footnote. Some useful references are made to plant movements and tropisms in *American Horticulturist*, Vol 51, Number 1, pp 32-40.

*Editors Note: One hears, in England, that a sure way to eliminate bindweed is to untwine the stems and rewind them the wrong direction! No one seems to have researched this delightful proposal for frustrating an intolerable weed.

Tendrils: The majority of the tendril climbers show some ability to twine, indicating perhaps that they once were dependent on twining for support and in some cases still are to some degree. The *Clematis* retains the ability to twine and while it does not have true tendrils it does have sensitive petioles with which it grasps supports. *Clematis* appears to be in the process of developing away from twining to tendril type support.

The sensitivity of *Clematis* petioles varies from species to species, but as a group they generally are quite sensitive. In some cases the sensitivity is extreme. *Clematis flammula* responds to the touch of a thread that weighs one-sixteenth of a grain. This exceeds the sensitivity of human touch as perceived by the finger tips. After *Clematis* has made contact with a support it takes about twelve hours to grasp it firmly. After a petiole has grasped a support it becomes thickened and enlarged. Whereas unattached petioles of the same age are slender and flexible and easily snap when bent, the enlarged, thickened gripping petioles are extraordinarily tough.

Bignonia twines vigorously; it possesses slightly sensitive petioles, but is supported mainly by its tendrils. Some species after fastening themselves to a wood support send out aerial rootlets for even firmer support, thus using four methods of support. When *Bignonia* tendrils grasp a support they thicken and become strong. If they fail to grasp a support they wither and fall off the plant as a leaf falls in autumn. This behavior is unusual as most tendrils coil up tightly whether or not they grasp something.

Bignonia capreolata is adapted to growing on trees coated with mosses and lichens. Only occasionally it grasps a smooth stick. Upon encountering threads and fibers however, it forms resinous discs which have great holding power. The tendrils of this plant always move away from the light. Other plants, e.g. *Ampelopsis* and *Parthenocissus*, also have tendrils which are negatively phototropic, that is, they grow away from light. This adaptation is worth noting because, while most above-ground portions of plants grow toward light, this tendril behavior obviously is highly specialized. It is easy to see that in almost every instance, support will be found in the direction of darkness and not in the direction of the sun.

Actually, two different tropisms are involved here; plant tops generally are positively phototropic, that is, plants respond to light by growing toward it. Tendrils are strongly thigmotropic, that is, they respond to the proximity of solid bodies— positively thigmotropic tendrils grow toward solid objects.

The tendrils of some plants such as the grape are sensitive to any stimulus, even the presence of other grape tendrils. This sometimes leads to the development of a tangled knot with entwined tendrils not supporting the plant. Other climbers as some in the *Cucurbitaceae* have tendrils which are not sensitive to each other or to violent rain; thus the tendrils are free to find support.

Tendrils of various plants have different degrees of sensitivity and rapidity of movement. Some require up to two days to fasten themselves to a support. The passion vine, *Passiflora gracilis* is worth noting here because it exceeds all other vines in the rapidity of its movements. Its tendrils start moving about thirty seconds after they have been stimulated.

A day or two after becoming attached most tendrils commence to form a spiral. Cells in the outer layer of the tendril go on growing while the inner cells do not. The result is a tight elastic spiral. Spiral contraction occurs almost universally among widely divergent species. After a tendril has found support the contraction serves to pull the shoot close to its support. Also, in most cases, the stem has not reached its maximum length before the tendril has gained a hold. Without tendril contraction this increased length would cause the stem to hang slack, not achieving full extension of its growth and being more susceptible to buffeting by the wind. Contraction also often brings other tendrils into contact with the support.

The spiral affords a characteristic elasticity to a relatively unelastic plant organ. This elasticity divides the stress between individual holdfasts in *Parthenocissus* and makes it far stronger as the holdfasts cannot be torn off one by one. Even a single elastic tendril is stronger than a non-elastic one as it is not affected as severely by a sharp snap. It can give without breaking.

Holdfasts and aerial roots: The plants (few in number outside tropical regions) that use these



Aerial rootlets of *Hedera helix* cling tightly to a painted concrete surface.



***Hedera helix* showing juvenile (climbing-form) foliage below and adult (fruiting-form) foliage above.**

methods of support can cling to sheer rock walls and vertical tree trunks. These plants are considered to be the farthest along the road of evolutionary development. Few show any hint of twining and the tendrils have evolved into disc-like holdfasts while the aerial roots, though of stem origin, take on root functions of support and translocation of water and minerals. The two most common north temperate garden representatives of this group are *Parthenocissus tricuspidata* and *Hedera helix*.

The first illustration of *Parthenocissus* shows young shoots growing up a concrete wall. The next illustration shows tendrils of it pointing away from the light and heading root-like toward the relative darkness and solid mass of the wall. Upon touching the surface of the concrete wall the head of the tendril is pushed into a disc shape. When one disc comes in contact with the wall the others quickly follow suit. After touching the surface the discs enlarge and in the course of forty-eight hours glue themselves tightly to the wall with what might be described as contact cement. The discs consist of enlarged cells gorged with fluid and they are green; the cells contain chlorophyll-bearing chloroplasts. Soon after attaching themselves the holdfast discs began to turn red. Ultimately they become woody and apparently lifeless during the following winter, but cling tightly until physically detached. Tendrils ten and fifteen years old have been tested and found to be elastic and the holdfasts resisted detachment until the pull exerted was over two pounds. Unattached tendrils fall off the plant in a week or so. Immersion in oil of peppermint dissolves the cement. Therefore, it is probable that it is a resinous adhesive. The amount of cement is small, but the contact with the surface under the disc is complete.

Hedera helix is thought to secrete the same type of cement from its aerial roots. These aerial roots enable this evergreen ivy to grow up the trunk of a tree or spread out over a vertical wall of nearly any material; wood, concrete, brick, rock, and even glass. In addition to climbing *Hedera* grows satisfactorily on the ground, rambling about in either sun or full shade.

It is interesting to note that *Hedera helix* does not attach itself to horizontal surfaces or even vertical surfaces if it is cascading downward. The end of each branch tips up toward the sun at the critical time that

the aerial roots are active. When growing upward however, the plant hugs the wall and attaches itself very tenaciously. *Hedera* seems to produce less glue than *Parthenocissus*; thus during the attachment period it is essential that it remains immobile. The slightest jar will completely stop the process of attachment.

It is also interesting to note that the juvenile leaves are different from the adult fruiting leaves. The adult leaves are rarely, if ever, produced when the ivy is rambling about on a level surface. After climbing a few feet or even crawling up a bank adult leaves often will appear and flowers and later blue-black berries will be produced. These adult branches come from the main stem and do not climb, but reach out from the wall for light.

Hedera helix is a variable species; over sixty forms have been recognized and named. Curiously however, whether the juvenile leaves are big or small, yellowish, variegated with white or reddish, the adult leaves always look the same, big, glossy and green.

Hydrangea petiolaris climbs by aerial rootlets after the fashion of *Hedera helix*. This plant has the added attraction of showy flowers. Its drawback is that during the winter it loses its leaves and the naked branches are considered to be unsightly by some gardeners though others appreciate the fibrous texture.

Rich Variety in Climbers

If the average gardener is asked to name the climbing plants he knows, grape, ivy, sweet pea, honeysuckle, and morning glory almost invariably will be mentioned. Ignorance of the vast number of species of climbers is almost inexcusable in today's world where space is at a premium and vertical surfaces abound. Here is a list of plants hardy or at least semi-hardy in the Pacific Northwest. Information is given on genus and species, ultimate height of the plant, method of support, whether the plant is deciduous or evergreen and the rate of growth. The list is not exhaustive and shows certain personal preferences, but it does provide an idea of the tremendous variety of vines available and provides a stepping stone to reference books for complete descriptions of the plants.



Hydrangea anomela petiolaris climbing a Douglas-fir at the University of Washington Arboretum.



Aerial rootlets of *Hydrangea anomela petiolaris*.

Climbing Plants

Plant	Height in Ft.	Method of Support	Deciduous (D) Evergreen (E)	Growth	Exposure	Hardiness to
<i>Actinidia arguta</i> Bower Actinidia	25-30	Twines	D	Very Rapid	P. Shade	10°F.
<i>A. chinensis</i> Chinese Actinidia	25-30	Twines	D	Rapid	P. Shade	10°F.
<i>A. kolomikta</i> Kolomikta Actinidia	15	Twines	D	Slow	P. Shade	10°F.
<i>A. polygama</i> Silver-vine	15	Twines	D	Slow	P. Shade	10°F.
<i>Akebia lobata</i> (= <i>A. trifoliata</i>) Threelobed Akebia	15-20	Twines	E	Rapid	P. Shade	0°F.
<i>A. quinata</i> Fiveleaf Akebia	15-20	Twines	E	Rapid	P. Shade	15°F.
<i>Ampelopsis aconitifolia</i> Monkshood-vine	30	Tendrils	D	Rapid	Sun/Shade	15°F.
<i>A. arborea</i> Pepper-vine	40	Tendrils	D	Rapid	Sun/Shade	5°F.
<i>A. brevipedunculata</i> Porcelain-vine	10-20	Tendrils	D	Rapid	Sun/Shade	20°F.
<i>A. b.</i> 'Elegans'	3-10	Tendrils	D	Slow	Sun/Shade	10°F.
<i>A. cordata</i>	40	Tendrils	D	Rapid	Sun/Shade	15°F.
<i>A. humulifolia</i> Hop Ampelopsis	10-20	Tendrils	D	Rapid	Sun/Shade	0°F.
<i>A. megalophylla</i>	30	Tendrils	D	Rapid	Sun/Shade	-5°F.
<i>Aristolochia durior</i> Dutchman's Pipe	20-30	Twines	D	Rapid	Sun/Shade	10°F.
<i>Asparagus plumosus</i> Fern Asparagus	10-20	Twines	D	Moderate	Sun/Shade	20°F.
<i>Berchemia racemosa</i> Japanese Supplejack	10-15	Twines	D	Moderate	Sun	0°F.
<i>Bignonia capreolata</i> (= <i>Anisostichus capreolata</i>) Crossvine	50-60	Tendrils	E	Rapid	P. Shade	0°F.
<i>Campsis grandiflora</i> Chinese Trumpet creeper	10-20	Aerial Roots	D	Moderate	Sun	10°F.
<i>C. radicans</i> Trumpet-vine	35-50	Aerial Roots	D	Rapid	Sun	10°F.
<i>C. X tagliabuana</i>	25-30	Aerial Roots	D	Rapid	Sun	-10°F.
<i>Calonyction aculeatum</i> Large Moonflower	10-30	Twines	D	Rapid	Sun	25°F.
<i>Celastrus angulatus</i> Anglestem Bittersweet	20	Twines	D	Rapid	Sun/Shade	0°F.
<i>C. flagellaris</i> Korean Bittersweet	25	Twines	D	Rapid	Sun/Shade	-10°F.
<i>C. orbiculatus</i> Oriental Bittersweet	40	Twines	D	Rapid	Sun/Shade	-10°F.
<i>C. scandens</i> American Bittersweet	10-20	Twines	D	Rapid	Sun/Shade	-40°F.
<i>Cissus incisa</i> Grape-ivy, Ivy-treebine	30	Tendrils	E	Moderate	Sun	15°F.
<i>Clematis</i> species	6-25	Petioles	E & D	Slow/Rapid	Sun/Shade	Variable
<i>Cobaea scandens</i> Cup-and-Saucer Vine	10-20	Tendrils	D	Moderate	Sun	30°F.
<i>Decumaria barbara</i> Southeast Decumaria	50	Aerial Roots	D	Rapid	Sun	15°F.
<i>Dioscorea batatas</i> Cinnamon-vine	15-30	Twines	D	Rapid	Sun/Shade	0°F.
<i>Distictis lactiflora</i>	20-35	Tendrils	E	Rapid	P. Shade	40°F.
<i>Doxantha unguis-cati</i> Cat-claw Vine	25-40	Tendrils	E	Rapid	Sun	25°F.
<i>Euonymus fortunei</i> Wintercreeper	15-35	Holdfasts	E	Moderate	Sun/Shade	-10°F.
<i>E. f.</i> 'Coloratus'	15	Holdfasts	E	Slow	Sun/Shade	-10°F.
<i>E. f.</i> 'Gracilis'	10	Holdfasts	E	Slow	Sun/Shade	0°F.
<i>E. f.</i> 'Kewensis'	3	Holdfasts	E	Slow	Sun/Shade	0°F.
<i>E. f.</i> 'Minimus'	3	None	E	Slow	Sun/Shade	0°F.
<i>E. f.</i> 'Vegetus'	4	Holdfasts	E	Slow	Sun/Shade	-10°F.
<i>Gelsemium sempervirens</i> Carolina Jessamine	20-35	Twines	E	Moderate	P. Shade	10°F.
<i>Hedera canariensis</i> Algerian Ivy	30	Aerial Roots	E	Moderate	Sun/Shade	15°F.
<i>H. colchica</i> Colchis Ivy	50-90	Aerial Roots	E	Rapid	Sun/Shade	0°F.
<i>H. helix</i> (60 varieties) English Ivy	50-90	Aerial Roots	E	Rapid	Sun/Shade	Variable
<i>Hydrangea anomala petiolaris</i> Climbing Hydrangea	30-80	Aerial Roots	D	Rapid	Sun	-10°F.
<i>Kadsura japonica</i> Scarlet Kadura	10-20	Twines	E	Rapid	Sun	20°F.

Climbing Plants

Plant	Height in Ft.	Method of Support	Deciduous (D) Evergreen (E)	Growth	Exposure	Hardiness to
<i>Lathyrus grandiflorus</i> Everlasting Pea	6-7	Tendrils	D	Rapid	Sun	-10°F.
<i>L. latifolius</i> Perennial Pea Vine	8	Tendrils	D	Rapid	Sun	-10°F.
<i>L. odoratus</i> Sweet Pea	6-7	Tendrils	D	Rapid	Sun	Annual
<i>Lonicera caprifolium</i> Sweet Honeysuckle	20	Twines	E	Rapid	Sun	5°F.
<i>L. etrusca</i> Cream Honeysuckle	50	Twines	E	Rapid	Sun	15°F.
<i>L. flava</i> Yellow Honeysuckle	15	Twines	E	Rapid	Sun	0°F.
<i>L. X heckrottii</i> Everblooming Honeysuckle	15	Twines	E	Rapid	Sun	0°F.
<i>L. henryi</i> Henry Honeysuckle	15	Twines	E	Moderate	Sun	0°F.
<i>L. hildebrandtiana</i> Giant Honeysuckle	40-80	Twines	D	Rapid	Sun	32°F.
<i>L. japonica</i> 'Halliana' Hall's Honeysuckle	15-30	Twines	E	Rapid	Sun	-15°F.
<i>L. j.</i> 'Aureo-reticulata' Yellow-net Honeysuckle	15	Twines	D	Moderate	Sun	-10°F.
<i>L. j.</i> 'Chinensis'	15-30	Twines	E	Rapid	Sun	0°F.
<i>L. periclymenum</i> Woodbine Honeysuckle	20	Twines	E	Rapid	Sun	-10°F.
<i>L. sempervirens</i> Trumpet Honeysuckle	15-30	Twines	E	Rapid	Sun	-25°F.
<i>L. X tellmanniana</i> Tellman Honeysuckle	15	Twines	E	Rapid	Sun	0°F.
<i>L. tragophylla</i> Chinese Woodbine	50	Twines	E	Rapid	Sun	0°F.
<i>Lygodium palmatum</i> Hartford fern	2-8	Twines	E	Slow	Shade	0°F.
<i>Muehlenbeckia complexa</i> Wire-vine	15-25	Twines	E	Rapid	Sun	10°F.
<i>Parthenocissus henryana</i> Silver Vein Creeper	20	Holdfasts	D	Rapid	Sun	20°F.
<i>P. quinquefolia</i> Virginia Creeper	30-50	Holdfasts	D	Rapid	Sun	-20°F.
<i>P. tricuspidata</i> Boston-Ivy	50	Holdfasts	D	Rapid	Sun	-10°F.
<i>P. t.</i> 'Lowii'	3-10	Holdfasts	D	Slow	Sun	-10°F.
<i>P. t.</i> 'Purpurea'	3-10	Holdfasts	D	Slow	Sun	-10°F.
<i>P. t.</i> 'Veitchii'	3-10	Holdfasts	D	Slow	Sun	-10°F.
<i>Passiflora</i> species Passion-flower, Granadilla	20-25	Tendrils	E	Slow	Sun	Variable
<i>Periploca graeca</i> Grecian Silkvine	25-40	Twines	D	Very Rapid	Sun	15°F.
<i>Phaseolus caracalla</i> Snail flower	25	Twines	D	Rapid	Sun	40°F.
<i>P. coccineus</i> Scarlet-runner Bean	10-20	Twines	D	Rapid	Sun	Annual
<i>Pileostegia viburnoides</i>	45	Aerial Roots	E	Rapid	Shade	10°F.
<i>Polygonum aubertii</i> Silver-lace (Fleece) Vine	15-30	Twines	D	Rapid	Sun	0°F.
<i>P. baldschuanicum</i> Bakara-vine	20	Twines	D	Rapid	Sun	0°F.
<i>Pueraria lobata</i> Kudzu-vine	40-70	Twines	E & D	Very Rapid	Sun	15°F.
<i>Quamoclit pennata</i> Cypress-vine	10-20	Twines	D	Rapid	Sun	Annual
<i>Q. X sloteri</i> Cardinal-climber	15	Twines	D	Rapid	Sun	Annual
<i>Schisandra chinensis</i> Chinese Magnolia-vine	10-20	Twines	D	Moderate	P. Shade	-10°F.
<i>S. propinqua</i> Himalayan Magnolia-vine	10-20	Twines	E	Moderate	P. Shade	20°F.
<i>Schizophragma hydrangeoides</i> Japanese Hydrangea-vine	20-30	Aerial Roots	D	Moderate	Sun	0°F.
<i>Stauntonia hexaphylla</i> Japanese Staunton Vine	30-40	Twines	E	Moderate	P. Shade	20°F.
<i>Vitis</i> species Grape	30-65	Tendrils	D	Rapid	Sun	Variable
<i>Wisteria floribunda</i> Japanese Wisteria	25-50	Twines	D	Rapid	Sun	-10°F.
<i>W. macrostachya</i> Kentucky Wisteria	30	Twines	D	Rapid	Sun	0°F.
<i>W. sinensis</i> Chinese Wisteria	25-50	Twines	D	Rapid	Sun	0°F.



Photos by author

Rhododendron nakaharai And Some North Tisbury Hybrids

*Mrs. Julian W. Hill**

The village of North Tisbury lies two to four miles between the north and south coast lines of the island of Martha's Vineyard, Massachusetts. There, at Barnard's Inn Farm, since 1957, I have been growing a number of Japanese azaleas. The seed to produce my plants was imported through the kindness of Dr. Tsuneshige Rokujo of Tokyo, who hybridized and collected for me. He made the appropriate crosses to meet my objectives, namely to produce prostrate, hardy, evergreen forms to be used as ground covers. In addition to the tailor-made seeds he sent me a few choice species and hybrids as rooted cuttings, both named and unnamed, through the usual import channels sanctioned by the U.S.D.A. Only those hybrids raised by me from seed at Barnard's



Rhododendron 'Marilee'

Rhododendron 'Wintergreen'



Inn Farm are given the covering name of North Tisbury hybrids.

To achieve the prostrate and evergreen character the species *R. nakaharai* was largely used. To achieve a variety of flower forms and colors other garden azaleas were used in the crosses. Fifteen years of attrition of the tender, weak, and otherwise undesirable have left me with a number of plants well suited to this area and to the designated objectives. Further testing in other areas is in progress.

Rhododendron nakaharai, native to Taiwan and long grown in Japanese gardens, is an evergreen species too little known in this country. It is so flat on the ground that two to five inches covers its height after ten years. The twiggy mat with small, dark green, hairy, pointed leaves and brick red twin flowers make it a little gem for rockeries or intimate borders. The hybrids of *R. nakaharai* have an even greater hardiness than the species. The many branches spread vigorously in a horizontal manner and gradually mound to ten to fifteen inches with a spread of thirty to forty inches in ten years. They make a serviceable, fine textured, and distinguished ground cover, flowering late in the season, in June and July, depending on the climate. In my experience, open pollinated progeny of *R. nakaharai* give evidence of ready promiscuity, for only one out of fifteen plants exhibit all the characteristics of the true species. The others have nodal extension, cold hardiness, extra flower size, and color variations from light pure red to deep orange red. I have yet to see any purple or crimson toning in a *R. nakaharai* species or hybrid. Most of them are in the 5R sheet of the Munsell color fan. All the colors are bright and carry well at a distance.

A very special plant of *R. nakaharai* has come to me through a rather romantic story. Mrs. Ann Fielder, whose husband was in the service in Vietnam, decided to take

her five children to Taiwan for a few years to be near him. I asked her if she would like a project. (As though five children were not enough.) So I gave her a few branches of my open pollinated plant as a sample and suggested she find the real thing in the wild, possibly on Mt. Morrison. Later I suggested she contact the Botany Dept. of the Tai Da University in Taipei for specifics.

Many searching expeditions and many months later her teen-aged son, somersaulting down Mt. Seven Star on a picnic, landed in a bush and said, "I have found it". Indeed he had. Not too long after I received a small envelope from Prof. C. S. Kuo of Tai Da University containing a pinch of dust. Under the microscope I estimated there were about forty seeds in all. They were gathered at 800 meters on Mt. Seven Star on November 16, 1969. I planted them the 10th of December. On January 10, 1970, two seeds germinated and ultimately one lived. That one plant wintered under lath in my nursery at North Tisbury in 1972 and grew and blossomed last summer (1972) at a time when all the Fielders, united in the U.S.A. were again on Martha's Vineyard and could see it.

The little *R. nakaharai* from Mt. Seven Star has the finest form of any *R. nakaharai* I have yet seen. It is low and dense in growth, its leaves are furrier with longer red hairs, its flowers are larger than others of the species and of a most deeply saturated red, (5 R 5/13 vivid red). It will be carefully observed in the years to come.

North Tisbury hybrids include a variety of crosses. My *R. nakaharai* Open Pollinated Seedling #1 is named *R. 'Marilee'*, and my #2 is named *R. 'Wintergreen'*. These are both low dense plants of vigor and class. The flower color of *R. 'Marilee'* (2.5 R 7/8 to 6/11 blotched on three lobes 4/10) has excellent carrying power and blooms later than any of its siblings into the first half of July. The winter leaf color is

**Amateur plant breeder, Mrs. Julian W. Hill, has been awarded the A. H. S. Silver medal for her work with azaleas. Though some cultivars of the North Tisbury hybrid azaleas presently are being increased for distribution to growers, plants are not available. American Horticulturist will carry an announcement when these are on the retail market.*



Rhododendron 'W. Leith' × *R. nakaharai* #1



Rhododendron nakaharai × *R.* 'W. Leith' #4



Rhododendron 'Alexander'

smoky purplish where exposed to direct sun. *R.* 'Wintergreen' makes a perfectly circular mound with a specially fresh green color all winter. The five-lobed blossoms of *R.* 'Wintergreen' are 6½ cm. wide and 5 cm. long (2.5 R 7/8 to 6/11 blotched 5/12) a light red or deep pink. Once established they do not seem to mind temperatures down to minus 4° F.

The satsuki azalea *R.* 'Chinyeyi', which is white, crossed with pollen from *R. nakaharai*, has yielded some sparkling light pinks with open frilly flowers. This sturdy and twiggy plant is also low and mounded in habit. *R.* 'Michael' is the #1 of this cross. The flowers are 6½ cm. wide and 5 cm. long, the color is a bright pink (10 RP 7/8 to 6/12 blotched 4/12).

R. nakaharai crossed with *R. kaempferi* yields a compact but upright plant of dependable hardiness,

full evergreen habit and a gaudy solid red color display, in late May and early June. The two parents are about equally evident in the progeny. The open up-reaching habit of *R. kaempferi* is dwarfed by the cross making a compactly branched but vertical plant, about one meter high by one meter wide in ten years. It blooms at the same time as Gable's *R. kaempferi* hybrids but holds green leaves all winter. The flowers are massed in shades of 5 R.

Dr. Rokujo admires an English azalea named *R.* 'W. Leith' for its red flowers and fine habit and has made reciprocal crosses with *R. nakaharai*. The plants I raised from these seeds have produced a very hardy and handsome group of azaleas. *R.* 'W. Leith' × *R. nakaharai* #1 has a dark green leaf, very low wide spreading habit and brilliant red flowers which occasionally produce petaloids. This gives the effect of bright red roses standing out among the green foliage. These flower buds are not always as winter hardy as some other selections. One sibling of this cross is taller, to forty-two centimeters and ninety centimeters wide, but with a tight billowy habit that is particularly handsome. The reciprocal cross has produced much the same variation in habit. It is possible to single out one or two outstanding individuals. The brilliant flowers are 5 R 6/11 to 5/13.



Rhododendron 'Louisa'



Rhododendron 'Andante'

R. nakaharai × *R. 'kin-no-sai'* #1 is the hardiest plant of all the North Tisbury hybrids. Bright red flowers come through the toughest situations of sun, wind and drought on prostrate, lightly billowed plants, fine textured in leaf, dark green in summer, and purply grey green to bronze in winter. I have named this one *R. 'Alexander'*. This plant would curve down over a bank or wall as well as hug the ground.

A North Tisbury hybrid not involving the species *R. nakaharai* is *R. 'chinyeyi'* × *R. 'W. Leith'*. The #5 is a lovely fresh pale pink I have named *R. 'Louisa'*. It takes several years in my climate to become established and flower, as it is not so hardy in small sizes as the *R. nakaharai* hybrids. The flower color is 10 RP 6/12 to 7/8, 5 cm. broad X 5 cm. long, the leaf is very narrow, the plant habit low and suitable for ground cover.

There are three North Tisbury hybrid selections that do not appear to include the species *R. nakaharai* in their immediate parentage. These three I call the Music Street Trio, named for the principal residential street of West Tisbury. They are *R. 'Andante'* pink, *R. 'Trill'* red, and *R. 'Hot Line'* crimson. Dr. Rokujo wrote on the seed envelope, "selections from dwarf new Gumpos". The seeds were gathered in 1962 from one of the finest collections of these

Gumpos, or Satsukis, in Tokyo. My plants are compact but not prostrate, the flowers are large and ruffled. The hardiest is *R. 'Hot Line'*, but all three are less hardy than the *R. nakaharai* hybrid selections. In fact, they compare with the average Satsuki azalea in general adaptability and would grow better in the Washington, D.C. area further south. *R. 'Hot Line'* is purply red, not unlike *R. 'Glamour'* in color, of good compact, but not prostrate, habit. *R. 'Trill'* is a medium red and ruffled, also compact. *R. 'Andante'* is a large flowered pink and ruffled, but with a definitely upright habit. *R. 'Andante'* and *R. 'Louisa'* would be two good pinks to grow together with *R. 'Andante'* planted to the rear.

The North Tisbury hybrids that have been propagated from summer cuttings all seem to root easily, and, of course, their habit of lying low on the ground makes layering appropriate and successful. Like most of the Japanese azaleas these plants need plenty of light to bloom well. They tolerate sun better than they do wind. Perfect drainage and a good mulch are essential. If rabbits are a local pest the plants will need protection from September until June.

It is regrettable, that even in our northern latitude, the wet spring of 1972 encouraged petal blight on a wide range of species and hybrids, including the North Tisbury hybrids◊



Rhododendron 'Trill'



Rhododendron 'Hot Line'



Plants from Seeds and Cuttings

*C. Gordon Tyrrell**

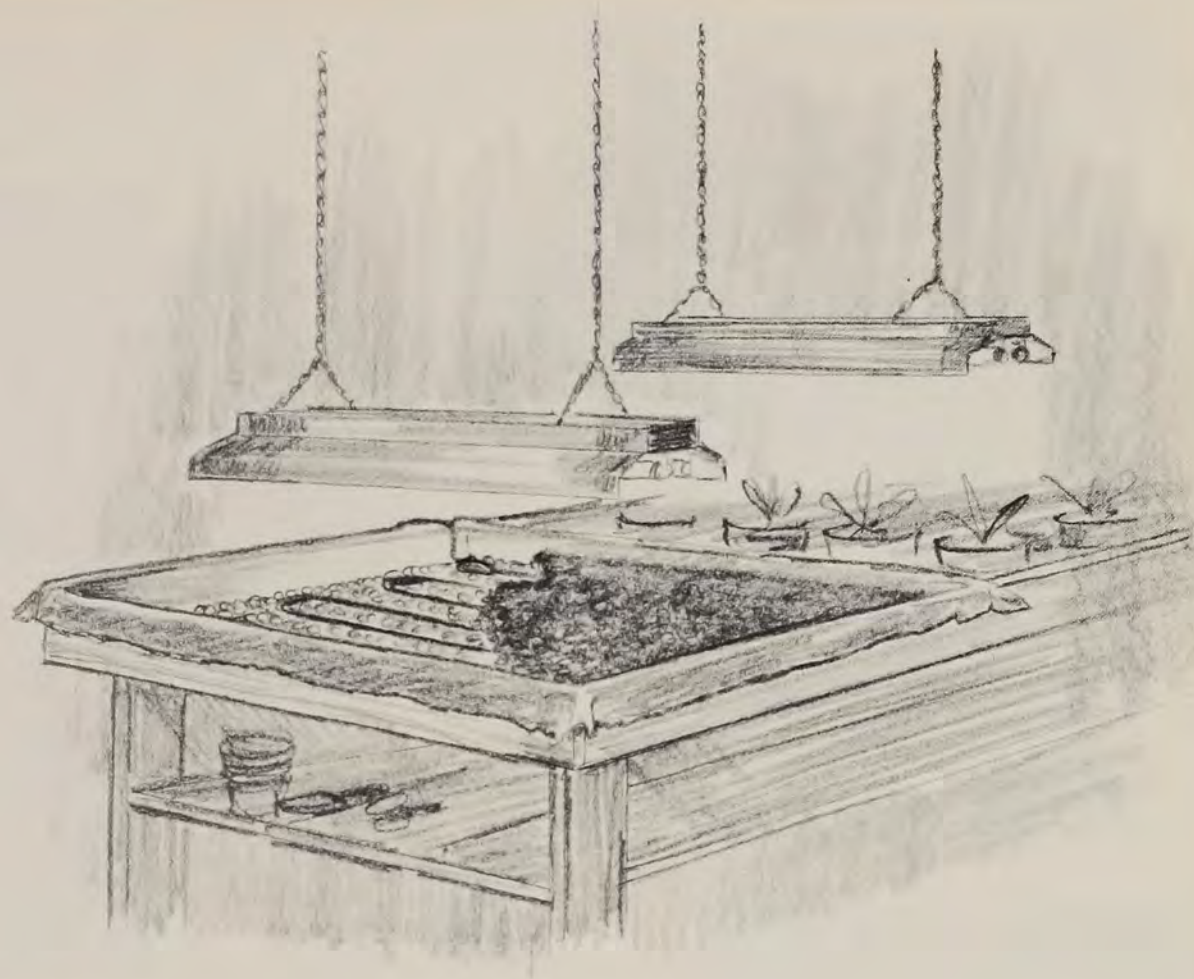
In this day and age when everyone is "doing his own thing", why not make your thing the propagating and raising of plants, for an enjoyable and rewarding hobby? It is not necessary to buy a lot of expensive or sophisticated equipment. Using material found in the home, let's see what can be done.

Raising annuals is very easy with a quart milk carton as a container. Turn the carton on its side and remove the top panel, and now you have a seed container. Punch a few holes in the bottom with a pencil to allow for drainage. This can be dispensed with if more care is used in watering. Put a thin layer of gravel in the bottom and then fill the milk carton to within one-half inch of the top with soil made up of two parts garden soil (loam), one part leafmold or peat, and one part sharp (coarse) sand. For seed sowing, this mixture should go through a one-quarter inch sieve. Firm the soil in the carton with your finger tips, making sure the surface is level. Now all is ready and the seeds should be sown sparsely and evenly. Do not try to sow the seed directly from the package. Instead put some seed in the palm of your hand and then take a pinch of this seed between the first finger and thumb of the other hand and by a gentle rubbing motion drop the seeds on the top of the soil in the desired place. Cover the seed its own depth with soil; use a small kitchen sieve for this operation. Label with name of seed and date.

Now water in the seed using a light spray (maybe from a mist spray or clothes dampening bottle). Place in a window with good light; the kitchen window is ideal because of the extra humidity there. Keep the soil moist, but not wet, and wait for germination, and then make sure the seedlings have plenty of light to keep them short and stocky. When the seedlings are large enough to



**Assistant Director of Horticulture, Callaway Gardens, Pine Mountain, Georgia; an expert plant propagator writes for the home gardener.*



handle or when they have their first pair of true leaves, prick them off into small individual containers.

A slight variation of this method is the use of an egg carton. Fill the individual sections with soil; make a small depression with the blunt end of a pencil and place two or three seeds in each depression. Cover lightly with soil and water in the seeds as before. The lid of the egg carton may then be closed—this creates a moist atmosphere and most seeds do not need light for germination. Lift the lid and air for an hour daily till germination, then remove the lid and give the seedlings plenty of light. Thin seedlings to one per section as soon as true leaves form, and allow this one to grow on till ready to plant. Use divided sections of egg cartons to prick out seedlings grown in milk cartons. Cut apart sections when ready to plant. You can use either fibre or peat pots in a similar manner if you wish.

The next step in home propagation is the rooting of cuttings—start with simple things to root like coleus, begonias, and soft wooded summer cuttings.

Take a rubber or plastic dishpan which is about twelve by fourteen by six inches deep. Put about one-half inch of gravel in the bottom and then about a three inch layer of your favorite rooting media (sand, perlite (horticultural grade), or a peat and perlite mix). Firm, and you are ready to insert your cutting which should be about four inches long. The lower leaves should be removed and a clean straight cut made one-fourth inch below the lowest node (joint), with a sharp knife. When all your cuttings are inserted, water them in, being sure not to over-water as there are no drainage holes in the pan. Place the dishpan inside a large plastic bag (turkey bag). If necessary use hoops made from an old coat



A sterilized flower pot filled with any suitable rooting medium suffices to root a few cuttings. To maintain high humidity cover with a plastic bag. Stretched wire coat hangers keep the bag off the foliage.

Plastic dishpan, a rooting medium such as perlite, some cuttings, water, and a plastic bag to cover, add up to new plants for the garden.



The dishpan propagator at work. The plastic bag maintains a high humidity. The unit is placed in a bright window out of direct sunlight, with cool room temperature, gentle bottom heat if possible.



Photos by author

hanger to keep the plastic bag from touching the top of the cuttings. Close the end of the bag and fasten with a twistem. Place near a sunny window and within a couple of weeks, rooting should have taken place. This method can also be used to root evergreens and such things as yew, holly, pieris, and so on. Insert these in October/November and leave closed all winter with perhaps only one or two waterings. Look for rooting in early spring.

A slightly different procedure, again using a rubber dishpan, is to bore a couple holes (halfway up) on either side of it, using a one-quarter inch drill. Place a six-inch piece of rubber hose vertically in one corner and then fill the holes with coarse perlite. Next cut a piece of screen wire to fit on top of this. Now fill up the rest of the dish pan with the rooting medium (a mixture of peat and perlite). Make cuttings of your choice and insert in the rooting medium. Then fill the dish with water through the hose to the level of the holes. Water should be kept at this level, and then the rooting medium will be kept moist through capillarity. It's as easy as that. Coleus roots in a week by this method! (Try it, you'll like it.)

The Basement Bench

For those who would like to attempt something a little more ambitious, try using fluorescent lighting, perhaps in the basement, to both propagate and grow house plants. Start with a piece of three-quarter inch marine plywood which will be four by eight feet—then, from scrap lumber, build a stand (about three feet tall) to form a table with the plywood. Take six inch roofer (or one by six inch lumber) and nail to the edges of the plywood to form your planting tray. Line the



Many sorts of “flats” are available to gardeners. This unit, formed plastic, is filled with a seed germinating mixture, one or two seeds go in each segment, and a sturdy crop of seedlings soon appears.



When the household dumb-cane (*Dieffenbachia*) gets leggy, fill a clean pot with a washed sharp sand, cut the cane in short lengths allowing the ends to air dry, then half bury the pieces horizontally until roots appear. This technique requires a warm room and close attention to moisture control.

inside with an unbroken sheet of heavy plastic to make the tray waterproof.

Place an inch of gravel in the bottom of the tray carefully, so as not to damage the plastic. On top of this place a soil heating cable. This need not be an expensive one, but should be bought with a built-in thermostat to register between 75° and 80° F. The cable should be spaced in loops four inches apart—a thirty-six foot cable will cover about half of the tray. Why not start with this much space for your propagation, and place another board across the tray half way as a divider. Fill up the portion of the tray above the heating cable with your favorite rooting medium (you may want to try different ones) and you will be ready to put in your cuttings.

Reserve the other half of the tray for growing potted plants, standing the pots directly on the gravel.

This four by eight foot tray will take four forty-inch double fluorescent light fixtures (with good reflectors)—these should be suspended from the ceiling by means of hooks and chains, so they may be raised or lowered as required. This ideal height above the plants is eight to twelve inches. Use fluorescent tubes in the red spectrum range such as Grow-Lux for propagation and those with Cool White for the potted plants. But experiment and see which does best for you. The lights should be on for sixteen hours a day and may be controlled by a time switch. Watering is something you will have to work out from experience, as there are too many variable factors especially in basement conditions—try to keep soils or media moist but not dry or overly wet.

Good luck in your ventures and may you have a Jolly Green Thumb! ❧



An important, often overlooked, aspect of propagation by seeds or cuttings, is labeling. Keep names and dates with all containers.



Photos courtesy Callaway Gar

Elliottia racemosa, the form of the shrub
and a close-up of the flower raceme.



Elliottia...

propagating a rare and beautiful native shrub

Clermont H. Lee*

Mr. Alfred J. Fordham's article, "Elliottia racemosa and its Propagation" was published in *Arnoldia*, Vol. 29, No. 3, April 11, 1969. Mr. Henry Hohman and Mr. Fordham are responsible for discovering a satisfactory way to propagate *Elliottia racemosa* by rooting tip cuttings removed from sprouts on root sections. Newly rooted small plants have been distributed to certain important arboretums and botanical gardens, and hopefully, at a later time plants may be on the market. Transplanting the newly propagated plants has not proven difficult.

For many years, the late Dr. Charles C. Harrold protected *Elliottia racemosa* by purchasing a colony of the plants and preventing their destruction. He tried to distribute a few of these plants, and learned they did not transplant readily from the wild. Since 1958 I have endeavored to preserve known *Elliottia* stations and to rediscover lost colonies. A few new stations have been located, all in Georgia. Nurserymen and plant propagators have been furnished a few plants, many tip cuttings, and most of the available seed for experimental purposes. Established plants have never been moved with much success and tip cuttings from established plants do not root well. Until 1972 poor results were reported with seed germination. Wherever materials have been distributed, instructions on growing have been requested. The purpose of this article is to give propagators and gardeners an understanding of *Elliottia racemosa* in its present native habitats, and some brief pointers which may lead to success in propagating the plant.

Elliottia racemosa, a primitive member of the Ericaceae family, is a deciduous shrub or small tree to thirty-five feet, native to Georgia, and formerly found also in South Carolina. Native *Elliottia* grows where outdoor temperatures range from a high of 100° F. to a low of 10° F. A few plants have survived in Philadelphia area gardens. At Boston, Massachusetts, plants do not withstand outdoor winter temperatures but can be carried over in cold storage units. The average daily temperature range in coastal Georgia is 70° to 95° F. in summer and 35° to 65° F. in winter.

Elliottia thrives in the same type of loose, humus rich ph 4.5 to 5.5 soil in ↗

*Miss Clermont H. Lee, Landscape Architect and Site Planner, 518 East Forty-fifth Street, Savannah, Ga., has been involved for several years in efforts to preserve and introduce to gardeners *Elliottia racemosa*.

The Plant



An old, horizontal root of *Elliottia* showing vigorous shoots that may be taken for cuttings.



Cuttings rooted from juvenile shoots which arose from root sections.

Photos by Alfred J. Fordham

which *Rhododendron canescens* grows. It requires well drained, sandy soil, and will not survive in a bog. It grows and blooms best in full sun or lightly shaded, moist flatwoods, but survives hot, dry sandhill conditions. Plants also survive overcrowding from other trees and full shade.

Elliottia has underground horizontal stems which enable it to spread. At some stations, plants are found on sandhill slopes or crests, and at one station the shrubs are advancing down a sandhill toward lower, moister ground. It appears to me that most *Elliottia* plants dug from the wild have one main root running horizontally one inch below the soil surface. Eventually, the root forks; however, there appear to be few secondary roots. One sandhill plant was selected for digging because it had a small top, and was located about thirty feet from similar plants. Evidently the plant had been browsed or burned over. The root was old; it extended underground horizontally at a shallow depth for seven feet, turned and extended downward for six feet before it forked into several small roots. This indicates that sandhill plants must develop tap roots in order to reach water.

In 1960, Dr. Lindsay S. Olive, a mycologist, formerly at Columbia University confirmed that *Elliottia* roots are symbiotic. The fungus found on the roots has not been isolated, but is of the ectotropic type of mycorrhizal fungus. Dr. Olive believed there was a possibility that *Elliottia* seeds might germinate in the presence of the fungus. Dr. John Couch of the University of North Carolina tried unsuccessfully to germinate *Elliottia* seeds in soil from around *Elliottia* plants and suggested further research to isolate the fungus from the roots and attempt to grow root cuttings in the culture.

There has been evidence of *Elliottia* sprouting vigorously from the bases of stems after tops have been damaged or removed by forest fire, bulldozing, or cutting by a fire plow. Exposure of roots to air and sun seem important in stimulating new top growth. On some sandhills which have been bulldozed, *Elliottia* has resprouted from damaged roots where other wild species have been totally destroyed.

Elliottia racemosa blooms in coastal Georgia in mid-June or early July when temperatures are high and plants use much water. Small sized plants on sandhills bloom abundantly, but usually lack sufficient vigor to develop seeds. It is the older plants in all habitats which develop seed capsules. The oldest sandhill plants, presumably with the deepest roots, bear seed prolifically during years of sufficient rain. It is suspected that the largest capsules and the best seeds are produced at the flatwoods stations. Perhaps the majority of *Elliottia* seeds are sterile. Capsules may be collected around mid-October just before they split open. Upon opening, some seeds are dispersed from the capsules and others are retained.

As an amateur botanist, I have visited most of the *Elliottia* stations, and over a period of fourteen years have never seen young plants which were apparently recently produced from seed. The Charles C. Harrold Nature Preserve, a flatwoods station now owned by The Nature Conservancy, is at present too overgrown and shady for its *Elliottia* seeds to germinate and survive. At the sandhill stations, plants with small new top shoots often have old roots which have been top damaged by browsing, fire, or equipment.

In the Georgia coastal plain, when propagating plants from seed or root cutting indoors or out, some shade is probably desirable—even in a mist house.

Propagation by Seed

Since *Elliottia racemosa* now may be successfully propagated from root cuttings, there is no great need to experiment with germination of seeds except in areas to which roots cannot be shipped without fumigation or other damaging treatment. A Japanese botanist has been interested in raising the species from seed to compare growth processes with those of the related plants, the *Tripe-*

taleia. Of course, any intra- and inter-population genetic studies will require seed germination.

In the wild state, *Elliottia* must germinate from seed because plants appear in colonies miles apart. All presently known natural stations—with the exception of one in the foothills—are on the coastal plain of Georgia. With the exception of the Phillips Station in Tattnall County which is a mile from the Altamaha River, and adjacent to some ponds which were probably a former river delta, all the stations occur within a few hundred feet of fresh water rivers or streams. One would assume that the plants' mature discoid seeds fall to the ground in October and are sometimes floated during periods of high water and deposited on sandy, stream banks where at times past some have germinated under suitable conditions, starting new colonies. Spring freshets have probably been responsible for the natural distribution of *Elliottia*.

Information concerning *Elliottia* germination has been furnished by Dr. Kengo Soma, botanist of Japan. Dr. Soma sent *Elliottia* seeds collected November 2, 1962, to Dr. F. Maekawa of the University of Tokyo. Seeds were planted the usual way by a propagator at Yokohama. (Out of about one hundred planted seeds approximately forty seeds germinated). Half of the seeds were sown in early spring and the other half in late summer. In both cases, the seeds began to germinate at the end of February. Of the forty seeds which germinated, thirty seedlings were albino and they soon died. Two plants survived for five years then one died from the top of the stem. The other plant was a foot high and in a three and one-half inch pot (March 15, 1972). The propagator transplants the surviving *Elliottia* every spring as is customary with weak plants.

Mr. Alfred Fordham reports that fresh *Elliottia* seeds furnished from wild plants and from cultivated Pennsylvania plants were tested by cutting and some were found to be sound. They were put in cold stratification at 40° F. at the end of December, 1971, for three months. All sound seeds from these lots germinated after stratification. Seeds sown March 27, 1972, germinated in about a month and many showed albinism. This mutation was lethal and albino seedlings failed as soon as the food reserves were expended. The balance of the plants continued to develop into fine young seedlings.

Mr. Fordham remarks that he has not noticed symbiosis when working with *Elliottia*. When handling seeds he uses sterilized soil and the seedlings which develop have always gone on to produce healthy plants without mycorrhizal association.

Between 1958 and 1964 *Elliottia* tip cuttings by the hundreds have been taken from mature plants and distributed to ten Georgia and South Carolina propagators. Most cuttings were treated with Hormodin #3; some were placed in *Elliottia* soil; some were given bottom heat; most were given mist in a greenhouse, and a few were given mist outdoors. Evidence indicated that the cuttings usually formed callouses, and would hold their leaves for some time. Reports received indicated that all plants died without rooting. In some cases, plant deaths were due to failures in watering systems.

Plants have been satisfactorily increased from root cuttings grown in a greenhouse, and also outdoors. Root sections are taken during the dormant season just before growth begins—late February or early March in Georgia and late March in Massachusetts. A Maryland grower has had success digging roots in the fall whereas a Georgia grower has had no success with roots taken in late fall or January. Roots one-eighth inch to one-half inch in diameter are recommended; very large roots are not satisfactory. The roots are cut into sections two and one-half inches to six inches or even longer. The root sections can be placed

Propagation by Stem Cuttings

Propagation by Root Cuttings General Information

or scattered on a moss or sand or sawdust flat, and covered one-half inch to three inches with more of the growing medium. Some growers insert the root pieces at an angle with the larger (trunk) end uppermost. Other growers insert the roots horizontally. One individual placed collected roots under sawdust, and new top shoots appeared before he had time to cut roots and insert them in another medium. Half sand - half peat makes a good growing medium.

Indoor Methods

Flats prepared as mentioned above may be placed in a warm greenhouse or cold-frame and rooting will begin in the spring. As multiple shoots develop on root sections, the sections may be transplanted into pots to develop further growth on a greenhouse bench, or they may be left in the flats. Tip cuttings are taken from the sprouting root sections when shoots are firm and woody. Meanwhile the root pieces are left in place to continue to produce new shoots. If sprouts are not removed during a healthy stage of growth, they will die on their root section. An alternate method where growth can be controlled in a greenhouse is to allow shoots to develop to about eight inches. Remove soft tip cuttings leaving two low buds on the stems attached to roots. From the two buds new shoots can develop to supply additional tip cuttings. Soft tip cuttings are treated with rooting hormones and placed in growing medium with bottom heat control. They should root within three or four weeks at which time they can be potted.

Outdoor Method in Georgia

This is a slow method which anyone can use. When propagating from root sections is done outdoors, root pieces are placed about three inches deep in sandy soil mixed with peat, leaf mold or sawdust. Root cuttings usually produce shoots but no feeder roots. When new shoots are about two inches above the soil, carefully remove the soil on one side of the root to expose base of the shoot. Slice away a little of the callous tissue where the new shoot joins the root section. Apply Hormodin #3 to the wound and replace the soil. New roots will develop at this point and support the new growth. Plants are potted when well rooted; however, they will not survive in the pots unless pots are sunk to rims in a well drained material and perfect drainage is provided, and maintained. Since *Elliottia* in its natural habitats appears to have roots or underground stems running horizontally about an inch below the soil surface, I believe a wide plant container such as is used for azaleas might benefit the plant better than a narrow, more confining pot.

Transplanting Wild *Elliottia*

It is almost impossible to transplant *Elliottia* of any size from the wild into the garden. Small wild plants usually are not available, but have been moved successfully in the past. Some of the original soil should be retained around the roots when repotting or transplanting takes place. Reasons for this are to lower the chance of shock, and to retain beneficial fungi which might be present on the roots. In digging *Elliottia* in the wild I have bare rooted the plants by using a small trowel and broom following the roots from the stem end. I place the root in a moist plastic bag along with soil obtained from the root area. To avoid destruction of natural stands while collecting root sections, I obtain *Elliottia* roots in disturbed areas where the plants are being destroyed for reforestation or construction.

The above information was obtained with kind assistance of the following: Dr. John R. Bozeman, Dr. George A. Rogers, and Mr. Eugene Cline of Georgia; Dr. John Couch and Dr. Lindsay S. Olive of North Carolina; Mr. H. J. Hohman of Maryland; Mr. Alfred J. Fordham and Dr. Carroll E. Wood, Jr. of Massachusetts; and Dr. Kengo Soma of Tokyo, Japan. ☒

Gardener's Gazette

Twenty-Seventh Colonial Williamsburg Garden Symposium in Williamsburg, Virginia April 8-13

The twenty-seventh Symposium was planned by Colonial Williamsburg Foundation experts and a special committee from the American Horticultural Society. The conference with its April 8-13 dates promises an exquisite early spring setting plus an intriguing array of subjects and authorities.

Symposium Highlights

- Garden tours for both the experts and beginners
- The Gardeners' Banquet
- Special tour of Carter's Grove plantation
- Workshops, panels, teas, candlelight concerts, and festive social occasions
- Lectures, demonstrations, and slide presentations
- Winners from the American Horticultural Society's Film Festival
- Outside tour of Richmond private homes and gardens
- Walks for birders and nature lovers
- Colonial Williamsburg's exhibition buildings and craft shops

How To Register

Garden Symposium registration should be made in advance and must be accompanied by a check for \$40.00 per person. This fee covers lectures, tours of Colonial Williamsburg Gardens and exhibition buildings, teas, clinics, and concerts, but not meals or lodging. Send checks, payable to Colonial Williamsburg Foundation, and registration information for "advance mail" to Mrs. T. S. Moyles, Registrar, Goodwin Building, Williamsburg, Virginia 23185.

Hotel Accommodations

Hotel rates include lodging only, Sunday through Friday. The same daily rate applies if registrants stay an extra night. Please give two choices for accommodations, since it is not always possible to reserve first choice. All

accommodations are attractive and every effort is made to give registrants their first choice. A deposit is not necessary to reserve a room.

Speakers:

John Carew—*Chairman of Michigan State University's Department of Horticulture.*

Julia F. Davis—*Colonial Williamsburg Research Associate.*

Joseph A. Ewan—*Ida A. Richardson Professor of Botany at Tulane University.*

William Flemer, III—*Princeton, New Jersey Nurseryman.*

Fred C. Galle—*Callaway Garden's Director of Horticulture.*

John A. Griswold—*Philadelphia Zoological Garden's Curator of Birds.*

Kenneth W. Hunt—*Director of Glen Helen and Antioch College's Professor of Botany.*

Richard Kelly—*Lighting Design Consultant.*

Carlton B. Lees—*Executive Director of the Massachusetts Horticultural Society.*

Richard D. Mahone—*Colonial Williamsburg Director of Landscape Construction and Maintenance.*

Roberta Moffitt—*Flower Arranger.*

W. R. Nelson, Jr.—*Extension Landscape Architect for the University of Illinois.*

Russell J. Seibert—*Director of Longwood Gardens.*

Announcements of Meetings

The California Institute of Technology announces the 1973 Annual Spring Institute (Horticulture) on April 18-19 at the Quality Inn; 616 Convention Way; Anaheim, California 92802. Registration is \$25.00. For information and reservations write to Mr. Ed. McNeil; 1000 Concha Street; Altadena, California 91001.

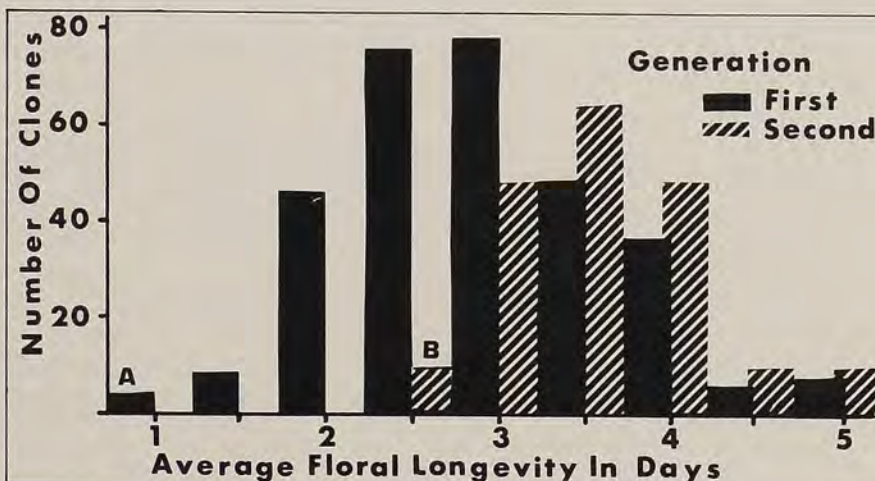
Arboretum Designated National Landmark

Secretary of the Interior Rogers C. B. Morton announced recently that the Arboretum and Nature Reserve of the Missouri Botanical Garden, located at Gray Summit, had been designated a National Environmental Education Landmark. This brings to sixteen the number of such sites which have been recognized as notable outdoor classrooms. The designation of such sites is a project of the National Park Service which serves to assist American education in stimulating environmental learning. The purpose of designating such sites, according to Secretary Morton, is to "encourage the use of outstanding locations—in cooperation with non-Federal organizations—to teach the relationship between man and his environment, an object set for us by President Nixon." The Arboretum, an area of 2,200 acres, is located about thirty-five miles southwest of St. Louis. Education programs are offered year round to students and to the general public.

No More Plastic Landscapes

Following considerable discussion of the plastic plants landscaping project on a Los Angeles County freeway, the following announcement was made after the conclusion of a meeting of the Board of Supervisors.

"On motion of Supervisor Hahn, seconded by Supervisor Dorn, unanimously carried, the Board went on record as opposing further artificial plantings on County highways, and directed the Road Commissioner, Chief Engineer of the Flood Control District, County Engineer, Director of Parks and Recreation, and other appropriate departments to work with the Director of the County Arboretum in developing plans for the use of living grass and plants in landscaping any County road projects where beautification is desirable."



Japanese Iris Longevity Data

Average longevity in days of Japanese iris seedlings; flowers of most first-generation plants fade after three days, while the peak of second-generation flower life is about three and one-half days, with some flowers enduring past five days. The graph bars indicate fading. While some first-generation flowers faded before the end of one day (graph bar A) no flowers of the second-generation faded before two and one-half days (graph bar B).

"Up with Gardens= Up with People!"

This is the theme around which programs and events of the 28th annual American Horticultural Congress are being organized.

The time:

October, 3-7, 1973

The place:

New Orleans, Louisiana
headquartered in the superb
Hotel Fairmont Roosevelt

National and local committees are hard at work setting up programs and speakers of national importance; fascinating exhibits in many of the plant specialties for which New Orleans is famous; and once-in-a-lifetime tours with special guides to New Orleans and area public and private gardens of renown.

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(Details and pre-registration forms will reach you later through
News and Views)

PLAN TO COME!



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(Act of August 12, 1970: Section 3685, Title 39, United States Code.)

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2. Date of filing—September 21, 1972.
3. Frequency of issue—four times a year.
4. Location of known office of publication—901 North Washington St., Alexandria, Va. 22314.
5. Location of the headquarters or general business offices of the publishers—901 North Washington St., Alexandria, Va. 22314.
6. Names and addresses of publisher, editor, and managing editor—Publisher—The American Horticultural Society, 901 N. Washington St., Alexandria, Va. 22314. Editor—John Philip Baumgardt, P.O. Box 7163, Kansas City, Mo. 64113. Managing editor—none.
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(signed) O. Keister Evans

BOOKS

Frequently publishers send copies of recently published books to the American Horticultural Society office. Members of A. H. S. may borrow books from the collection, as from a lending library. The following publications have been received in the past few months.

American Tomato Yearbook. Stanley E. Walker, Editor and publisher, Scotch Plains, N.J. 1972. 44pp. Paperback.

Ferns and Palms for Interior Decoration. Jack Kramer. Charles Scribner's Sons, New York, 1972. 113 pp. Hardback.

The Growth of Bulbs. A. R. Rees. The Academic Press, Inc, London, 1972. 311 pp. (Subtitle, Applied aspects of the physiology of ornamental bulbous crop plants.) Hardback.

Landscape Your Florida Home. Mac Perry. E. A. Seemann Publishing, Inc. Miami, Fla. 1972. 176 pp. Hardback.

The Complete Ecology Fact Book. Edited by Philip Nobile and John Deedy, Doubleday & Co., Inc. 1972. 472 pp. Hardback.

Plants are Like People. Jerry Baker, 1972, Simon & Schuster, Inc., New York, 275 pp. Paperback.

How To Choose Your Tree. A Guide to Park-like Landscaping in Illinois, Indiana and Ohio. Dwight R. McCurdy, William G. Spangenberg and Charles Doty, Southern Illinois University Press, Carbondale, Illinois, 1972, 245 pp. Hardback.

House Plants. Joan Compton, Grosset and Dunlap, 1972. 159 pp. Illustrations in color by Henry Barnett. Hardback.

You CAN Grow Phalaenopsis Orchids. Mary Noble, Jacksonville, Fla., 1971. 148 pp. Paperback.

A Flower Lover's Guide to Mexico. Phil Clark, Minutiae Mexicana, S.A. de C. V., 1972. 126 pp. Paperback.

Common Marsh, Underwater and Floating-Leaved Plants of the U. S. and Canada. Neil Hotchkiss. Dover Publications, Inc. 180 Varick St., N. Y., 1972. 223 pp. Unabridged reprinting of 1967 and 1970 publications in one volume. Paperback.

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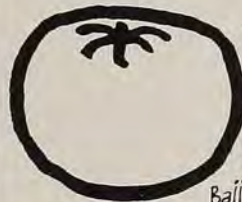
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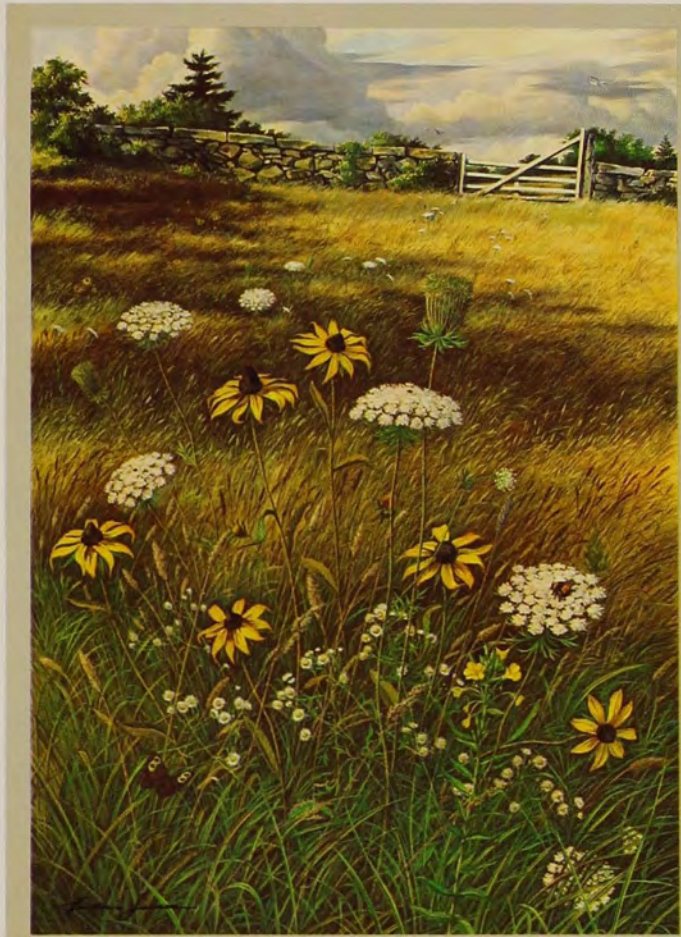
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