
American
Horticulturist
Volume 51 Number 1

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The following excerpts are from letters received by White Flower Farm the past year. Not only were these letters unsolicited, but permission for use was granted enthusiastically by each correspondent—not one received *anything* of value for permission to use the remarks chosen. Also, none of the excerpts were taken from context and none were embellished.

From Mr. John D. Baum, 97 Parkwood Lane, Oberlin, Ohio: "I thought you might like to see a picture of how well some of the flowers you have sold us over the past few years have done. What you see in the middle distance is a stand of Helenium, with some *Rudbeckia Goldsturm* in front of it. The Rudbeckia has really taken hold and behaves almost like a weed, spreading all over the place—we don't mind, for it is a lovely flower and lasts through most of the summer. In the far background you see some Mid-Century Hybrid Lilies, which are lovely, and come back year after year in increasing profusion. We just planted three more bulbs, and I hope they do as well. Behind the Helenium are a stand of Fraises des Bois which are the first things we ever bought from you and are still producing nicely. In the near-foreground you see mostly annuals. Amongst them there are Hemerocallis, but they are hard to see, though they are doing well. This was a very satisfactory year for our garden, and we have been quite happy with the things you have sent us."

Mrs. H. M. Boggess, 653 Waverly Lane, Bryn Athyn, Pa., writes: "I have been a customer of White Flower Farm for over ten years and always found everything just as represented in your catalogue. I enjoy your NOTES and catalogues very much indeed and keep them all for perusal on winter evenings and am much entertained thereby."

Miss Margaret J. Bolman, 701 Berry St., Falls Church, Va., says: "I have been enchanted by the Fraises des Bois "Charles V" that I planted this Spring! They bloomed within a week, bore fruit 10 days later and, as of this writing, we are still picking berries. They make a lovely border for my rose bed."

From Mrs. Sue Chuongvan, R.D. #3, St. Albans, Vt.: "My garden was started from scratch with stock bought almost exclusively from White Flower Farm, and I want to take the opportunity to tell you that I have always been very *pleased with your service and your plants—I have bought stock in a lot of places but always come back to you. And, I think your* Garden Book *is the greatest!"*

Mr. George W. Conrad, 810 So. College, Neosho, Mo., writes: "Enclosed is a picture of Mrs. Conrad and myself which appeared in the local paper in early July, 1971. The Azalea bed and Mums referred to come from your shop. I thought you might like to know I have learned something from your teachings." (Note: The picture is called "Beauty Spot of the Week.")

Miss Catherine G. Hay, 198 E. Beaver St., Glenfield, Sewickley, Pa., says: I have been an amateur gardener practically all my life and made so many mistakes, and suddenly I see what I have been doing wrong—the detailed instructions in your book and the side comments make it clear. And now in your SPARE time, please find a tomato with real flavor."

From Mr. Frank Kirkpatrick, "The Ridge Farm", R.R.2, De Soto, Wisc.: "The perennials and bulbs were received in good condition, packed as carefully as Tiffany's pack their delightfully delicate little bud vases —a greater compliment I cannot pay you and UPS."

This from Mrs. O. L. Kline, 9416 Holland Court, Bethesda, Md.: "Everything you have sent me was so beautifully packed. The Impatiens last spring were incredibly fresh, and have really gone to town. Unwrapping the root system of Abeliophyllum distichum *was an aesthetic experience."*

From Mrs. A. S. Mendes, 20 Conkling Road, R.D., Flanders, New Jersey: "Thank you for hours of delightful, informative reading, and for sharing your wit and wisdom with me."

"I just wanted you to know your plants arrived and have been taken into a family who appreciates the beauty of fine quality plants. And those plants are rewarding us many times over." Mrs. Donald H. Jones, 4530 Briar Hollow Pl., #114, Houston, Texas.

That tells the story of White Flower Farm far better than we can tell it. Our catalogue, *The Garden Book*, except for its covers, is printed in black-and-white on durable paper. You will find its line drawings charming; its photographs make telling landscape points. It is, indeed, a book—a garden book through which shines the knowledge of the four professional English gardeners who operate this nursery. It costs $2.50. This includes NOTES, a reminder publication issued 3 times a year—if you order now. A credit of $2.00 is good for 12 months. (Please add $1.00 for 1st Class Postage.) The nice part: as an active customer you will receive this unique gardening publication service every year . . . . . without charge.

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For further information contact Mr. James A. Fowler, Director of Education, Greenfield, Village and Henry Ford Museum, Dearborn, Michigan.

Talks on gardening, demonstrations, workshops, films and tours will be featured at both the Symposium and the Forum.

O. Keister Evans, Executive Director

The first issue of the *American Horticulturist* represents a new look of all publications of the American Horticultural Society and portrays a new image of the Society that is apparent in all areas of its involvement.

As the Society notes its fiftieth year of existence, we find AHS prepared to enter its second half-century with a modern set of goals, objectives and programs.

During the past year, the American Horticultural Society has experienced unprecedented growth and expansion. Membership has increased by more than one hundred percent and projections indicate that it will continue at this rate. The Society has received aid through financial grants which, combined with increased membership income, has made possible vast improvements in membership benefits.

The AHS headquarters organization has experienced a year of rapid adjustments in order to serve the current needs of the Society. Professional consultants have been employed to assist with auditing and management of the offices; communications and public relations talent have been engaged to carry out our promotional and public relations needs and the Society has contracted outstanding legal representation. Additional staff and administrative personnel are being trained in a number of new areas of responsibility. These and other expansion steps are all indicative of the Society's ability to effectively fulfill its commitments.

The headquarters offices were moved in February, 1971 from limited surroundings in Washington, D.C. to modern facilities in Alexandria, Virginia. Within a short period of time, we can expect growth so rapid that facilities designed specifically for the needs of the Society will be required. A number of national horticultural organizations have expressed interest in the possibility of joining forces in the development of a national horticultural center. The AHS Officers, Directors and staff are working in this pursuit.

An important objective of the American Horticultural Society is to influence unity in the broad interests of horticulture. With your support and involvement, we will achieve continued success in this direction.

David G. Leach
President

The inaugural issue of *The American Horticulturist* marks both a beginning and an end. A long and honorable history during which the Society was preoccupied with plants solely as plants draws to a close and we launch a new magazine which is devoted to horticulture, a concept with much broader horizons. They include the contributions that horticulture can make for the betterment of an ailing America.

The values that all gardeners cherish are endangered. Visual pollution assaults our urban environment with hammer blows at our sensibilities as the uglification of the cities proceeds through thoughtless destruction and greedy planning. Confucius named flower cultivation as one of the arts of civilized men; a twentieth century philosopher could scarcely fail to broaden the meaning to include the cultivation of the world around us, lest the art perish in a miasma of squalor and monotony.

We are occupied now with the offensive tedium of the cityscape and the contributions that horticulture can make to mitigate it. We want to offer the green and growing to ameliorate the psychological erosion caused by crowding, the loss of privacy, the noise and frenetic anthill activity in even the affluent parts of urbia and suburbia. We propose horticulture as one of the constructive solutions to the problems of the aging with their unaccustomed leisure time.

Transit systems have been among the worst despoilers of visual quality in metropolitan areas. Their slatternly stations, barren parking lots and waste-strewn trackage have been an affront to seeing eyes for generations. As an example of the influence your Society can exert, it is presently preparing model landscaping plans for a typical transit station and its environs, with an instruction manual for the Urban Mass Transit Administration to use in planning its future facilities. The project is financed by a grant of $29,900 from this agency.

The city of Albany, Oregon has passed an ordinance requiring that a minimum of five feet fronting every newly constructed *commercial* building be landscaped. It should be more, but it is a promising start. In California, housing developers can obtain added loans from the Federal Housing Administration if utility lines are placed underground. The idea can be expanded to enticing possibilities. In Atlanta and Miami new municipal ordinances prohibit the felling of any tree over a stated size on land either public or private, without a permit, so the bulldozer has been vanquished at last in at least two cities. Your Society proposes to make available to garden clubs and other motivated groups information which will blueprint the way they can act to obtain benefits such as these in other communities across the nation.

Our intention is not to substitute urban amenity for horticultural skill, but to be concerned with both. Landscape architects are often charged with being expert in design and woefully deficient in knowledge of the plants which are used to implement their ideas. If we are to work for the contributions that horticulture can make toward a humane urban habitat, we must know what to plant and how it should be grown. To that end, your Society has under way a massive survey to determine, for each of the climatic regions of the United States, the low maintenance trees, shrubs and groundcovers that can resist air pollution and the other urban growing stresses. The survey information will be recorded in our computer at Lima, Pa. to be made available to street commissioners, highway departments, city planners, park departments, landscape architects and private gardeners.

A certain guide to the quality of any environment is its diversity: the variety and interest of all of the animate and inanimate things which make up the world we see about us. The American horticultural scene is constantly constricting in its quality as automated nursery conveyors carry endless lines of standardized, familiar, easily grown and profitable plants in containers from asphalted acres to palletized trucks and on to the roadside stand. *American Horticulturist* will buck this trend. By accepting advertising for the first time, it will help to provide a marketplace for the small specialty nursery. Editorially it will support the new and good, the unfamiliar and useful, the rare and beautiful.

The American Horticultural Society is composed of member organizations as well as of individuals and they are vital to the impact that horticulture can make in this country. More than 600,000 people belong to some sort of horticultural association. We are initiating programs, and providing the know-how to carry them out, so that the local and state associations and the plant specialty societies can act effectively if they wish to do so.

By the time you read this message the number of Society members will have trebled in recent months, and be much the highest in its history. *American Horticulturist* will be read for the first time by thousands of new members who have never seen its predecessor publication. This greatly expanded audience will require a more eclectic publication, but basically it will be directed to advanced amateur gardeners. It will also stretch the mind of the intelligent novice. As our membership expands we have been equally fortunate in attracting financial support. In a little over twelve months the Society was awarded grants totaling nearly $300,000.!

Both membership expansion and funding success have followed the broadening of our goals. They demonstrate that cultivators of the soil and their benefactors do want to be involved, that they do want to be a part of the action in opposing the forces that now degrade the spirit, the sensibilities and the moral values of our people.

David G. Leach

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

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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.

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.

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IN THIS ISSUE

OUR COVER PHOTO—An alpine meadow high on Mt. Rainier, Washington, with the ancient Volcano's glacier-clad summit in the background. By Bob and Ira Spring, Photographers.

A Native Woodfern Garden

*William E. Hammitt and Warren H. Wagner, Jr.**

In the rich woods and swamps of eastern North America the most prominent fern genus is that of woodferns, *Dryopteris*. These are large, showy ferns, some of them with deciduous fronds and others with wintergreen fronds that lie flat on the ground during the winter. They are characterized by heavy rootstocks covered with scales, and leaves ranging usually from two to three feet in height. The blades are cut into fine leaflets in some of the species, being twice or three-times compound. In other species the leaflets are only deeply lobed. Habitats of woodferns vary from upland rocky hillsides down to deep wet gorges and swamps. We have long been interested in these striking plants from a cytogenetic standpoint, in connection with trying to determine their evolutionary origins (Wagner, 1971; Wagner, Wagner and Hagenah, 1969). We also have wondered to what extent these plants could be used for making a distinctive native fern garden.

To field botanists the woodferns are notorious for their promiscuous tendency to hybridize. There are only a few basic species, but they combine in so many different ways that we now know some three dozen different types from nature. Some of the hybrids are very attractive and vigorous plants, and we especially wanted to determine how they would behave in a hardy outdoor garden.

Woodferns are not commonly used as garden plants, as indeed are few other ferns. The most commonly used fern in Eastern United States gardens and borders is the ostrich fern, *Matteuccia pensylvanica*. I have seen this species used over a wide area from the western Great Lakes to New England. Wherry (1961) lists a number of ferns which *can* be used in gardens and gives some of their culture conditions, but these, for the most part, are grown mainly by fern hobbyists, and few general gardeners cultivate them. Gordon Foster in his valuable *Gardener's Fern Book* (1964, pp. 203-204) lists five native species in his table of hardy ferns. In Europe the cultivation of peculiar forms and cultivars of their native ferns has been practiced since the last century. Since the number of native woodferns is not as great as in America, the emphasis has been upon one species, the male fern (or "Wurmfarn," so named for its vermifuge properties) and its bizarre varieties (Cf. Schacht, 1950, pp. 96-97). It should be pointed out that many ferns that used to be placed in the genus *Dryopteris* and were so classified in horticultural books have

**Matthaei Botanical Gardens and Department of Botany, The University of Michigan, Ann Arbor, Mich.*

Fig. 1. Below is a planting design of the Dryopteris Garden, based on the genetic relationships of the species and their hybrids.

CAMP = *D. campyloptera*
CAMP X INT = *D. campyloptera X intermedia*
CAMP X MARG = *D. campyloptera X marginalis*
CAMP X SPIN = *D. campyloptera X spinulosa*
CELSA = *D. X celsa*
CELSA X CLINT = *C. celsa X clintoniana*
CELSA X CRIST = *D. celsa X cristata*
CELSA X GOLD = *D. celsa X goldiana*
CELSA X INT = *D. celsa X intermedia*
CELSA X LUD = *D. celsa X ludoviciana*
CELSA X MARG = *D. celsa X marginalis*
CELSA X SPIN = *D. celsa X spinulosa*
CLINT = *D. X clintoniana*
CLINT X CRIST = *D. clintoniana X cristata*
CLINT X GOLD = *D. clintoniana X goldiana*
CLINT X INT = *D. clintoniana X intermedia*
CLINT X MARG = *D. clintoniana X marginalis*
CLINT X SPIN = *D. clintoniana X spinulosa*
CRIST = *D. cristata*
CRIST X INT = *D. cristata X intermedia*

	CLINT	CLINT × SPIN	SPIN				CAMP	CAMP × SPIN	SPIN	CRIST × SPIN	CRIST		CELSA
CELSA	CELSA × SPIN	GOLD × SPIN	DIL × SPIN	MARG × SPIN		CAMP × MARG	CAMP × INT		INT × SPIN			CELSA × LUD	
	GOLD		DIL	DIL × MARG	MARG	DIL	DIL × INT	INT	X	?	X	LUD	X

now been transferred to the genus *Thelypteris*.

It is our feeling that there is a need to diversify the fern species and hybrids used in gardening, and we feel that the woodferns, *Dryopteris,* are prize candidates to be exploited.

The purpose then of this article is to describe how the Matthaei Botanical Gardens of The University of Michigan has attempted to expand to a wider audience the appreciation of these plants. This was done by selecting a representative of every known available *Dryopteris* species and hybrids from their native habitats and growing them in a uniform garden. For references to the species of ferns for this demonstration and the techniques of making a Dryopteris garden, we have found the book by F. Gordon Foster (1964) to be especially useful.

Our plants were obtained from localities ranging all the way from the Upper Peninsula of Michigan to the Southern Appalachians. Some of the most interesting hybrids came from the Huron Mountains, Marquette Co., Michigan, and Mountain Lake, Giles Co., Virginia. Their habitats ranged from wet swamps and marshes to dry rocky hillsides, but the ferns were all brought together into one garden environment, apparently without deleterious effects as will be noted below. (What the requirements are that call for one species of woodfern to occur in one environment and another in another are unknown; perhaps it is the young sexual stages of the plants that are strongly selective, for the adult plants when transplanted into uniform gardens seem to have few difficulties in adjusting to one situation.) Some of the hybrids we grew are exceedingly rare ones, known only from one or two collections.

In all cases the hybrids are intermediate between the parents and they are sterile. Those hybrids that involve certain species, e.g., *D. cristata, D. clintoniana,* especially, which normally reproduce vegetatively have to be watched in case they may spread beyond their alloted space. Others in which both parents tend to be solitary and not to offset are reliable and will "stay in place."

A diagram of the relationships is shown in Figure 1.

There were three major considerations in constructing the garden. In choosing a location, we needed a site that was moist and cool. The second consideration was that of soil. A combination of leaf mold and shredded leaf mulch seemed to duplicate the natural soil conditions of these ferns most ideally. Thirdly, the plants needed to be protected from sun and wind exposure.

CRIST X MARG = *D. cristata X marginalis*
CRIST X SPIN = *D. cristata X spinulosa*
DIL = *D. dilatata*
DIL X INT = *D. dilatata X intermedia*
DIL X MARG = *D. dilatata X marginalis*
DIL X SPIN = *D. dilatata X spinulosa*
F.–M. = *D. filix-mas*
F.–M. X MARG = *D. filix-mas X marginalis*
GOLD = *D. goldiana*
GOLD X INT = *D. goldiana X intermedia*
GOLD X MARG = *D. goldiana X marginalis*
GOLD X SPIN = *D. goldiana X spinulosa*
INT = *D. intermedia*
INT X MARG = *D. intermedia X marginalis*
INT X SPIN = *D. intermedia X spinulosa*
LUD = *D. ludoviciana*
MARG = *D. marginalis*
MARG X SPIN = *D. marginalis X spinulosa*
SPIN = *D. spinulosa*

	CELSA × CRIST	CRIST		CLINT × CRIST		CLINT		CELSA × CLINT		CELSA			F.–M.
CELSA × GOLD	CLINT	CRIST × INT	CRIST × MARG		CLINT × MARG	CLINT × INT	CLINT × GOLD		CELSA × GOLD	CELSA × MARG	CELSA × INT		F.–M.
GOLD		INT	INT × MARG	MARG		INT	GOLD × INT	GOLD	GOLD × MARG	MARG		INT	MARG

Fig. 2. Shade and protection from wind were provided by a redwood lathe structure.

An earlier attempt to locate a Dryopteris garden in a natural environment proved to be a failure and thus pointed out possible mistakes to consider when building the present garden. The first garden failure was due primarily to the invasion of native species which out-competed the introduced ferns. The cracking of the flue tiles in which the ferns were planted also contributed to the garden's failure.

The most ideal location for the Dryopteris garden was along the north-facing foundation of the recently constructed reptile house. The area was shaded; water was available; there were few native plants nearby and the available area along the foundation seemed the proper size, 60 feet by 6 feet. Approximately eight to ten inches of the graded fill dirt surrounding the newly constructed building had to be removed. This was replaced with leaf mold, preferably sterilized. A border of cinder blocks was used for containing the leaf mold. The plants were then placed at two-foot intervals into the garden, based on the genetic relationship diagram previously mentioned. A lathe structure over the top and across the west end of the garden was constructed of redwood to protect the plants from sun and wind exposure (Figure 2). A spacing of one and one-half inches between the two and one-half inch width redwood slats provided approximately 60% shade. Landscape plantings of *Populus* and *Juniperus* offer additional shade and wind protection.

During the first summer (1969), the garden was watered with a sprinkler usually twice a week. No leaf mulch was added the first year. We did cover the plants during the winter with straw to prevent winter damage. In the spring, the straw was removed, the old fronds cut off, and two inches of shredded leaf mulch was added as a top dressing. Supplementary fertilizing is not necessary although Foster mentions a light sprinkling of bone meal in the fall may be helpful.

Even though we have been pleased with the success of the second *Dryopteris* garden, there still remain a few problems. Blow-down and breakage is a constant threat even with the protection provided. The fronds are much larger under garden conditions than in nature and therefore conducive to breakage. The constant germination of weed seedlings in the unsterilized leaf mold was a serious maintenance problem, but was solved by adding a top dressing of leaf mulch. A suitable label is also a problem. The 15-inch plastic tree-stakes with ink script will not last for more than a year. We have now gone to the standard engraved laminated plastic label.

Discussion

In our opinion, the horticultural possibilities of at least certain members of the woodfern are very great. Their graceful appearance and vigorous growth make them decorative and reliable. They do not seem to be subject to pests. Some of the larger fronds are brittle and may be broken by loose pets, but this does not seem to cause much problem. They can be grown as a "pure" woodfern garden, as we have described here, or they can be grown in combination with other shade-loving plants.

Of the species and hybrids that we have grown, we have reached at least a preliminary evaluation of their reliability. In the latitude of Ann Arbor, Michigan (42°) the summer temperatures appear to be too hot for at least some stocks of the Lake Superior woodfern known as *Dryopteris dilatata,* the northern spreading woodfern, and we have lost several introductions. In general all of the species are less vigorous than their hybrids, but not all the hybrids are equally vigorous. The most spectacular individual woodfern crosses are clinton's woodfern x fancy fern *(D. clintoniana* x *D. intermedia)* and goldie's woodfern x marginal woodfern *(D. goldiana* x *D. marginalis).* These have consistently been the tallest and most luxuriant of our collection (Figures 3 and 4).

One of the striking conclusions regarding our woodferns is that in spite of very different habitats of origin—marshes, swamps, dry woods, upland rocky hillsides, mountain tops and lowland plains—all can be grown together

successfully in a single garden with a single treatment.

The Dryopteris garden presently serves three primary functions: (1) demonstrating hybridization in plants; (2) teaching of fern biology; and (3) illustrating vigor of certain hybrids. Many of the public school and adult education groups that visit and conduct classes at the Botanical Gardens do not realize that hybridization is such a common phenomenon among plants. It is quite an educational experience to see the two parents and their intermediate hybrid growing side by side where they can easily be contrasted. The garden is also very useful in teaching the role of hybridization in plants and fern biology in general. The initial and most intended use for the garden is to illustrate to a wide audience the vigor, beauty, and possible value of these ferns in horticulture. We hope to distribute to the public and other Botanical Gardens new propagules as they are produced.

Fig. 3. Dryopteris goldiana (left) and its hybrid with D. marginalis (right) are both excellent plants for garden use.

Acknowledgements

We wish to thank all of those who have helped us in this project—especially Dr. Florence S. Wagner for designing the arrangement of the plants and helping in their original collection, the late Mr. Dale J. Hagenah for his unflagging enthusiasm and aid in studying the natural populations and for his many suggestions, and Mr. Kenneth McCulligh and the late Mr. Paul Smith, botanical gardeners, for carrying out many of the procedures necessary to the success of this garden.

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Fig. 4. Dryopteris intermedia grows vigorously and is quite reliable as a garden plant.

The Role of the Los Angeles County Department of Arboreta and Botanic Gardens In Modern Times

*FRANCIS CHING**

The Department of Arboreta and Botanic Gardens objectives for the next ten years will be to completely develop the three main facilities of the Los Angeles State and County Arboretum, Descanso Gardens and South Coast Botanic Garden. The High Desert Arboretum at Lancaster will also be developed since this area is destined to become a center of population. All facilities will be fully landscaped using plants obtained through the Plant Collection and Plant-Introduction Programs.

When we realize that ninety-nine per cent of all plants used in the landscape in Los Angeles are introduced material, it becomes clear that without introduced plant material, Los Angeles could be a virtual desert. With smog and pollution from pesticides becoming more severe, it is imperative that we intensify our efforts to introduce new horticultural material that will withstand, and even absorb, smog and also to introduce new plants that are resistant or tolerant to insects and diseases, thereby precluding the use of pesticides. However, plants, no matter how many, whether exotic or native, or buildings, or pools, or statuary, (no matter how beautiful or costly) do not make an arboretum or botanic garden. People are an integral part of any arboretum and botanic garden and without them there are no values or purposes.

We know that people are no longer taking their environment for granted and are beginning to realize that plant life is the basis for all other life—plants can exist without man but man is totally dependent upon plants for oxygen and food. We know, too, that being aware of problems is not enough and that information is necessary in order to cope effectively with any situation. With this in mind, a newly inaugurated lecture series is designed to help homeowners in their efforts to not only create an esthetically pleasing backyard situation but to also understand the overall situation where what is thought to be normal, acceptable practice could be causing damaging effects in future years.

Publications

Another program designed for the homeowner are articles by staff members published first in *Lasca Leaves* and subsequently in brochures. The first brochure in this series, introduced several months ago dealt with fire retardant and erosion control plants. One thousand copies were printed initially, but following a series of devastating fires, over 15,000 brochures have now been distributed. This brochure currently is being revised to include additional information which will be of direct benefit to all homeowners in hillside residential areas. Other brochures of this series will be "Ground Covers for all Purposes", "Poisonous Plants Around the Home"; "Container Gardening", "Plant Diseases, Prevention and Cure" and others relating to problems of home gardening.

In another effort to bring the Arboreta and Botanic Gardens to the commun-

**Dr. Ching is director of the Los Angeles State and County Arboretum located at 301 North Baldwin Avenue, Arcadia, California.*

Jungle trail is one of the most popular spots in the Arboretum for children as well as grownups. It served as background for many of the early Tarzan movies and is carefully maintained as a natural growing area for plants.

One hundred and seventy five foot tall Eucalyptus globulus *planted in 1858 dwarfs "Queen Anne Cottage" constructed in 1871. "Queen Anne Cottage" is a California State Historical Landmark and served as the center of social activities for "Lucky" Baldwin in the late 1800's.*

Chaparral (California native plants) represents climax vegetation capable of tolerating extreme weather conditions but are highly inflammable during the summer and fall months. The Arboretum has been engaged in an active research program for almost twenty years on developing fire retardant, low fuel volume and erosion control plants for use in hillside residential areas.

Collection of over seventy two juniper taxons used and sold in southern California comprises one of the more recent displays for the general public to view. Junipers comprise one of the largest selling groups of plants in California.

Fourteen year old Youth Education Program fills an important need of the community by offering such classes as Pond Ecology, Plant Science and Vegetable Gardening. Nature Guide with a class are on their way to the upper lagoon to study plant and animal life.

ity, a new effort will be made to make Arbor Day more meaningful than the usual tree-planting ceremonies held at each of the three facilities. As a pilot project for next year the Department will distribute to elementary schools up to 500 trees with packets of information relating to Arbor Day, conservation, ecology and environment. Classes on an individual basis will study about plants, prior to the entire school taking part in planting ceremonies. School officials are enthusiastic over this program as it is a more relevant and direct approach to an understanding of nature and conservation.

Another program soon to be inaugurated will be self-guided ecology tours for school groups and youth organizations. Brochures covering walking tours through the "Chaparral Trail" at Descanso Gardens and "Life in the Lagoon" and "Jungle Growth" at the Arboretum will soon be ready. Another brochure for a walking tour will depict how a rubbish dump, a depository for man's wasteful products is developed from an eyesore into the South Coast Botanic Garden for man's pleasure and enjoyment.

Included on the staff is a horticultural consultant whose main job is to answer letters, telephone and personal inquiries on general horticultural and related matters. An estimated 3500 inquiries are answered by this single person each year, with specific and technical questions referred to twelve other professional staff members. Publications, brochures, lectures, and personal contacts are the master link that connects the Department with the community and the public relations aspect of public service is now more important than ever.

Information Services

The Plant Collection and Plant Introduction programs have been the most important projects of the Department and will continue to receive the main emphasis. At the present time, there are over 7000 taxons (taxonomic groups or entities, i.e., different plants) in the Department's collection. Quality selections within selected genera will now take priority over mass selections and most important, they must serve a purpose. Adaptability, suitability, and horticultural value are considerations which will be given the highest preference. Goals include specialization with eucalyptus, callistemons melaleucas, pittosporums, erythrinas, magnolias, viburnums, flowering trees and shrubs from South America, camellias, roses and palms. At the present time, over forty plants have been introduced to the nursery trade in southern California by the Department with another ten now being propagated by various nurseries for future release. Close contact is maintained with the nursery industry to coordinate the introduction of new plants as well as to provide necessary expertise when necessary.

Research Programs

As the Plant Collection and Plant-Introduction Programs form a basis for our objectives, the Research Program is one of the distinguishing features at an arboretum and botanic garden. Continued investigations into the effects of smog on plants, diseases caused by micro-organisms and virus, and programs in plant breeding with ecological studies on native vegetation all give a greater understanding into the many facets of plant life, and their important relationship to man. Investigations this past year on the effect of smog on plants have produced significant results. It has been found that plants absorb smog out of the air and that some plants exhibit greater efficiency in smog absorption and inhibition. In addition, plants with a relatively high vitamin C content are more tolerant than those with a relatively low vitamin C content. These findings have led to a two year grant from the Environmental Protection Agency to continue these studies.

Pools at Tallac Knoll completed only several months ago appear as if they have been around for many years. Besides being an attractive garden feature, pools serve as aquatic plant garden featuring over twenty-five species of plants.

Demonstration Home Gardens sponsored by Sunset Magazine, the California Arboretum Foundation and the Department of Arboreta and Botanic Gardens were first constructed in 1958 to provide ideas to southern California homeowners. Outdoor living is a way of life the year around and these gardens have proved to be an outstanding attraction.

For almost twenty years, the Department has been active in screening and developing plants that are both fire retardant and effective in controlling erosion. This special and unusual project became necessary since California natives, so well adapted to flourish and survive rugged conditions, are also highly explosive during the dry California summers. Not only do homeowners in hillside areas benefit from this project but likewise all taxpayers as the cost of fighting fires coupled with losses from erosion, landslides and floods can run into the millions of dollars each year.

The Department's Plant Breeding Program was started on a volunteer basis some nine years ago and has recently started to pay dividends. To date three hibiscus have been introduced to the nursery trade. For the immediate future, following an eight year program, four camellias from among twenty thousand seedlings have been selected as being worthy of introduction to the nursery trade.

Other investigations related towards problems of homeowners include studies on the control of oak root rot, a disease that affects over 700 species of plants. To date, three chemicals have been found where under laboratory conditions, they will control the disease at concentrations that are not detrimental to plant growth. The safe use of pesticides through our own eight year old existing program of spraying only for need has been successful beyond expectations. Savings have been in the form of both materials and time at no expense to plant quality and for the 1971/1972 fiscal year, the alloted budget for pesticides has been further reduced by 50%.

At a nearby water reclamation plant over 27,000,000 gallons of raw sewage are treated each day. In a cooperative program now being worked out with the Sanitation Districts of the County of Los Angeles, an investigation will be initiated to determine the possibility of putting this effluent to good use in the growing of ornamental nursery stock, for use in agricultural areas and in maintaining greenbelt areas in the highly inflammable foothills of southern California. High total salt content, as well as other chemicals detrimental to plant growth, are some of the possible problems that will have to be overcome if the use of this water is to be made possible.*

The Herbarium

The Herbarium is unique as it is the only herbarium in the United States that specializes in subtropical, woody, introduced plant material that now comprises 99% of the cultivated landscape material found in this area. Although small in size (10,000 mounted and 20,000 unmounted specimens), the Herbarium contributes significantly to the homeowner as well as to the nursery industry, governmental agencies, universities, and other arboreta, by providing taxonomic identification of horticultural and botanical plants. On many occasions, the taxonomist has been called upon by the Posion Center Information Bureau and the coroner's office to provide expertise in the identification of suspect material.

Education Programs

Besides our Plant Collection, Plant-Introduction, and Research Programs the Education program fills a vital need since many homeowners, (lack or do not desire a botanical education but still desire to become acquainted with all phases of plant life) may gain the necessary information through attending evening classes. In cooperation with school districts, junior colleges and universities, the Adult Education Program is funded with a minimum of cost to the county. Six hundred thirty-five adults were enrolled last year in courses such as: Home Gardening, Home Horticulture, Landscape Design, Plants in the Ecology of Man, Agricultural Chemicals, Plant Identification, Beginning and Advanced

*See page 22 for research study of reuse of waste water.

Bonsai, Flower Arrangement, and California History. Only additional class room space and custodial services keeps this program from doubling in size.

The Youth Education Program also fills a basic need. For many years schools have been spending less and less time and money on courses directly related to plant life. The program offered here is second to none and is consistently oversubscribed. An important need is served here for if we expect our citizens of tomorrow to be able to cope with environmental problems, they must know something of the forces of nature. Last year, with a staff of four at our three facilities, 730 children from the ages of 8 through 15 completed courses in Plant Propagation, Pond Ecology, Art in Nature, Vegetable Growing, etc. In addition, each year some 40,000 students are given guided lectured tours at our three facilities on Plant Science, History and Conservation. Approximately one-half of the students taking guided tours are from the central city area where there is very little opportunity for them to learn, understand or enjoy nature, plants or the luxury of an arboretum or botanic garden. New tours now being developed, as well as old ones being expanded, will be aimed to fill the needs of this special group.

We also fill another basic need by providing displays and demonstrations prepared especially for homeowners. Nowhere else in Los Angeles, in California, and perhaps the United States can so many different displays be found in one area, including the Demonstration Home Gardens, Turfgrass Display and displays of ground covers, vines, flowering trees and shrubs, junipers, begonias, orchids, etc. Besides these, the Department co-sponsors approximately twenty flower shows each year.

Special Features

One of the very newest garden features as well as an educational display is the construction of a series of pools with a 400 foot shoreline although the pools cover no more than 2500 square feet. These pools were constructed so that they would blend with the existing landscape thus taking on a very natural appearance. The special feature of these pools are that they serve as an aquatic garden featuring over 25 species of water plants. No chemicals are used in the water, mosquito fish have been added and an ecological system has already been established.

A relatively unknown fact of the Department is that there are the three buildings on the grounds of the Los Angeles State and County Arboretum that are California State Historical Landmarks; the "Queen Anne Cottage" constructed in 1881, and Coach Barn in 1879, both built by "Lucky" Baldwin and the Hugo Reid Adobe constructed forty years earlier by Hugo Reid with the use of Indian labor. Even before the coming of the white man, these grounds were the home of the Gabrieleno Indians who settled by the natural fresh water lagoon and artesian springs which are still active today. When the nearby Santa Anita railroad station was recently threatened by freeway construction, the citizens of Arcadia chipped in to move the station, brick by brick, to the Arboretum to take its place with the other historical buildings.

The overall function of the Arboreta and Botanic Gardens then is to fill a basic need to the community we live in—to relate directly to the homeowners through the many different services we offer. And while serving such a need we also provide a sanctuary of open space, a depository and museum for past, present and future plants, a sanctuary for birds, a historical site rich in California history and also an oasis in the middle of a metropolis of 7 million where people will always be able to find a spot of quietness, beauty and a bit of nature. ◈

'Roanoke'

Two Showy-Flowered Oak Leaf Hydrangea Cultivars, 'Harmony' and 'Roanoke'

*Joseph C. McDaniel**

Several of the most often cultivated *Hydrangea* species are notable for cultivar forms selected for their greater than typical numbers of showy flowers with large, persistent sepals. The showy-sepaled flowers usually have been called sterile. Actually, they are functionally staminate, and in nearly all cases are included in flower heads with reduced numbers of some smaller, functionally perfect flowers which can set seeds following cross-fertilization. To the well-known showy-flowered cultivars in *H. macrophylla, H. arborescens* and *H. paniculata* are now added two Alabama selections from *H. quercifolia* Bartram, the oak leaf hydrangea. These have been registered with the International Registration Authority of *Hydrangea*, Dr. Elizabeth McClintock, California Academy of Sciences, San Francisco 94118.

History

Bartram first discovered oak leaf hydrangea in western Georgia. It ranges naturally as far north as Hardin County, Tennessee, southward into Florida and westward at least to Baton Rouge, Louisiana. Probably it is most abundant in parts of Alabama, where it can be found in many counties between the Tennessee Valley and the Gulf of Mexico. Wooded hilly areas north of Birmingham have recently furnished many of the *H. quercifolia* seedling plants collected for the nursery trade. Plants from that area often have shown satisfactory hardiness up to Massachusetts and lower Michigan, but seedlings do vary in hardiness. At Urbana, Illinois, where Alabama and Tennessee sources have given hardy plants, some seedlings of a tall and late growing population from Torreya State Park, Florida have frozen back or died out entirely, though the Florida source was satisfactory for cultivation 300 miles southward in Cairo, Illinois.

'Harmony'

New Cultivars

The two cultivars recently registered, 'Harmony' and 'Roanoke' are much showier flowered than the specimens now in Bartram's Garden. Both

**Division of Ornamental Horticulture, University of Illinois, Urbana, Illinois 61801*

came from localities some 75 miles apart in the northeastern quarter of Alabama. Both color well in the fall, and both have superficially similar panicles of mainly showy white flowers, but there are minor characters which serve to distinguish the two clones.

H. q. 'Harmony', from the Coosa River Valley in Etowah County, Alabama, is something of a McDaniel family heirloom. My father, the late Thomas Arthur McDaniel, told me of first discovering it around 1890 in the border of his father's apple orchard, and transplanting it to the home grounds. Much later he helped me collect cuttings for repropagation from bushes in the nearby Old Harmony Church grounds. Cutting-propagated plants now have flowered outdoors at Urbana, Illinois for several years.

'Harmony' grows more slowly than the species average. It bears dense, usually somewhat nodding panicles of largely showy-sepaled white flowers. The four (occasionally 5) flower sepals are orbicular, from about as broad to broader than their length, and overlap from near their points of attachment. The broadly ovate, normally lobed leaf blades diverge at nearly a right angle to the petiole, tapering shortly where they attach. They are of average size, but thicker than in most other clones which have been compared.

H. q. 'Roanoke' probably originated near Roanoke, Randolph County, Alabama, in either the Tallapoosa or the Chattahoochee drainage. There are plants of undetermined age, but old, both in Roanoke and in nearby LaGrange, Georgia. From the latter, wholesale nurseryman Calvin Harman, Stovall, Georgia 30282, took cuttings several years ago. I find his propagation indistinguishable from plants that I rooted from the largest plant now growing at Roanoke. Sara D. Groves, 404 Queen Ann Street, Oxford, Georgia 30267 and Theodore R. Klein, Crestwood, Kentucky 40014, are others who have propagated 'Roanoke', Mr. Klein by grafting.

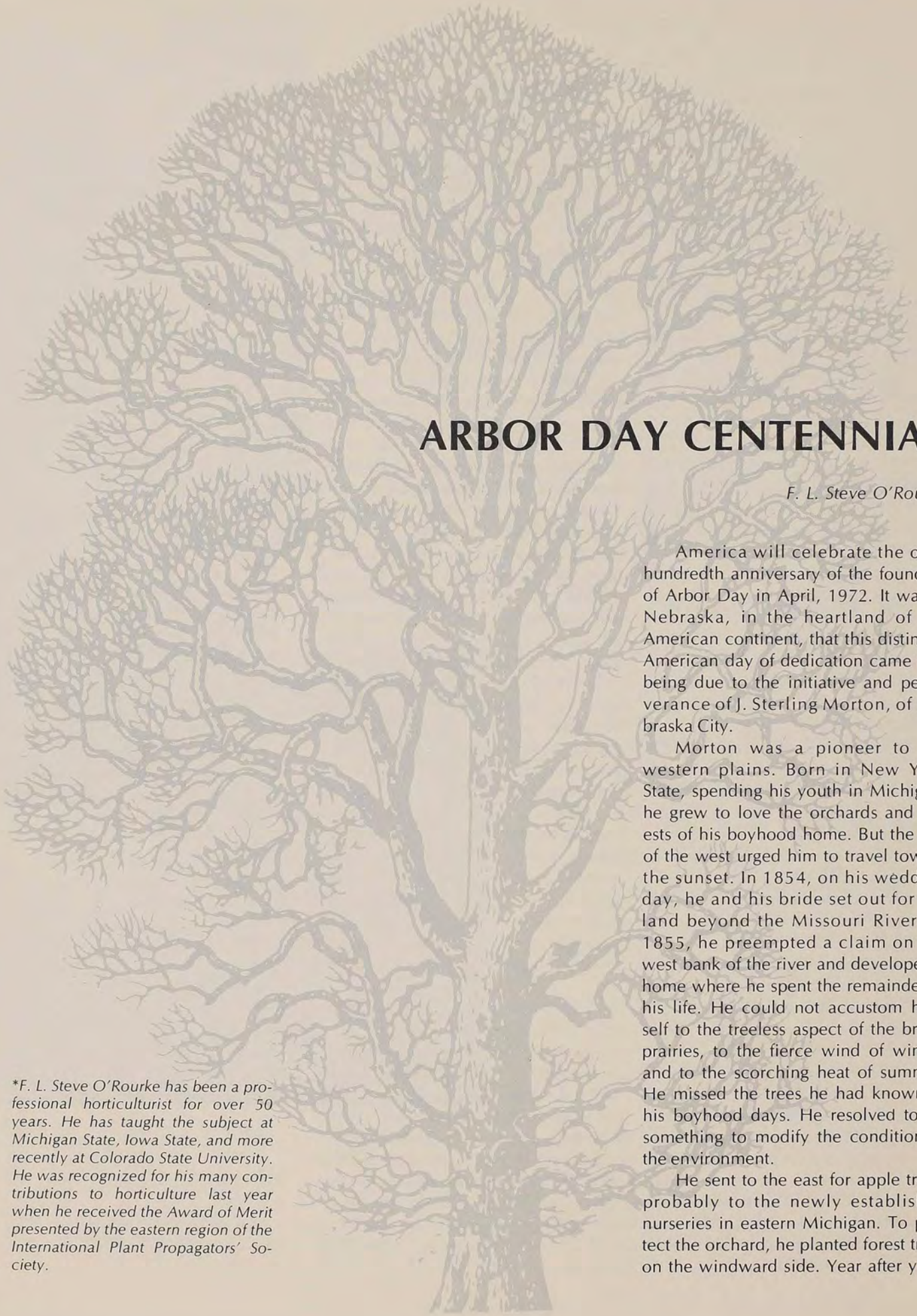
The largely showy-sepaled white flowers of 'Roanoke' are borne upon generally longer peduncles than in the case of 'Harmony', in a slightly looser, more erectly held panicle. Its four to frequently five sepals are generally obovate, somewhat longer than broad, and show little to no overlapping in an individual flower. Leaf blades of 'Roanoke' tend to be shallowly lobed and are usually cuneate where they attach to the petiole. 'Roanoke' is a more vigorous grower than 'Harmony'.

Both of these cultivar clones approximately reverse the normal proportions as well as the positions of showy and non-showy flowers in the panicles. For average seedling *H. quercifolia,* the showy flowers terminate each principal branch of the panicle, while the non-showy, seed-producing flowers are on laterals to such branches. In 'Harmony' and 'Roanoke' the few fully fertile non-showy flowers are on shorter peduncles and are hidden by the showy flowers at anthesis. Both clones, in common with other Hydrangeas I have tested, appear to be self-incompatible, but 'Roanoke' did set fruits to cross-pollination. These were not carried to maturity because of infection by a blight seen commonly in aging panicles of the species. 'Harmony' pollen was used to set fruits on a normal *H. quercifolia* plant, but these also were blighted short of maturity. I plan to use fungicides in connection with further breeding experiments, to determine how the mostly showy-flowered condition in *H. quercifolia* is inherited.

H. quercifolia

Propagation

I have found that plastic-wrapped chip buds allow propagation of *H. quercifolia* on established stocks of *H. quercifolia*. This method is recommended particularly for 'Harmony', to get it up higher on standard stems, where its great flower heads will be displayed to better advantage. For own-root propagation, either dormant hardwood cuttings or leafy summer or late spring cuttings can be started in well-drained beds under intermittent mist.



ARBOR DAY CENTENNIAL

F. L. Steve O'Rourke

America will celebrate the one-hundredth anniversary of the founding of Arbor Day in April, 1972. It was in Nebraska, in the heartland of the American continent, that this distinctly American day of dedication came into being due to the initiative and perseverance of J. Sterling Morton, of Nebraska City.

Morton was a pioneer to the western plains. Born in New York State, spending his youth in Michigan, he grew to love the orchards and forests of his boyhood home. But the call of the west urged him to travel toward the sunset. In 1854, on his wedding day, he and his bride set out for the land beyond the Missouri River. In 1855, he preempted a claim on the west bank of the river and developed a home where he spent the remainder of his life. He could not accustom himself to the treeless aspect of the broad prairies, to the fierce wind of winter, and to the scorching heat of summer. He missed the trees he had known in his boyhood days. He resolved to do something to modify the condition of the environment.

He sent to the east for apple trees, probably to the newly established nurseries in eastern Michigan. To protect the orchard, he planted forest trees on the windward side. Year after year,

**F. L. Steve O'Rourke has been a professional horticulturist for over 50 years. He has taught the subject at Michigan State, Iowa State, and more recently at Colorado State University. He was recognized for his many contributions to horticulture last year when he received the Award of Merit presented by the eastern region of the International Plant Propagators' Society.*

he planted more trees. He had faith in the land, believing that with well-nurtured care, it would produce as good fruit and field crops as those in other regions. He built a spacious home, Arbor Lodge, at Nebraska City and surrounded the mansion with several acres of ornamental and landscape trees which exist to this day. Among these are magnificent specimens of Crimean linden, American chestnut, and Algerian spruce.

Morton was a man of many talents. In addition to farming, he edited the local newspaper, *The Nebraska City News,* and under the administration of President Buchanan, he was appointed Secretary of the Territory of Nebraska. After Nebraska achieved statehood in 1867, Morton ran for several public offices but failed to be elected. In later years, he was appointed as U.S. Secretary of Agriculture in President Cleveland's cabinet.

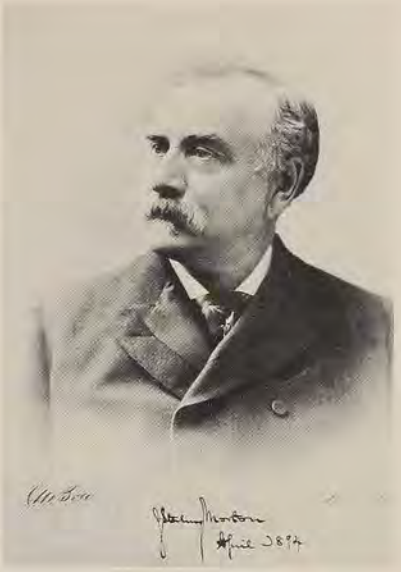
He was instrumental in organizing the Nebraska Board of Agriculture in 1858 and the Nebraska State Horticultural Society in 1869. On January 4, 1872, he presented a resolution to the Nebraska Board of Agriculture proposing that April 10th of that year be set aside as "Arbor Day" for tree planting throughout the state. The resolution was officially adopted and prizes offered for the organization or person planting the greatest number of trees. It is reported that Mr. J. D. Smith, of near Lincoln, planted one tree per second all day long or a total of 35,550 trees on sixty acres. In all probability, these were small seedlings of forest tree species.

Thus, Arbor Day was born, an American concept, originating and developing in mid-America. It became a traditional annual event in Nebraska. Neighboring states soon followed and, before the turn of the century, it was observed in all the states of the Union and in many provinces of Canada.

The founding of Arbor Day marks a change in the history of the public attitude toward trees and forests in America. Imperceptibly, but surely, the era of American conservation was just beginning, and the period of exploitation was nearing its end. Trees were a nuisance to the early colonist on the Atlantic coast, and were an even greater obstacle to the pioneers pouring through the Appalachian gaps into the midwest. The forests were slaughtered, burned, and destroyed to make room for grass and crops. However, by the closing year of the nineteenth century, thinking men throughout the nation sought to stop the reckless plunder of our woody plant heritage and to preserve and replace our nation's trees.

Now, a hundred years later, we are undergoing another change. We have become aware that we must combat pollution and preserve and improve our environment. We know that plants, and particularly trees, are necessary to maintain the gas-oxygen balance of the atmosphere. We know that by planting trees, we aid in the establishment of survival for ourselves and for our children.

The Centennial of Arbor Day furnishes us a wonderful opportunity to make our nation tree conscious. With the publicity which accompanies tree planting ceremonies and with the participation of leading citizens, the public as a whole will become conscious of the great worth of trees in the landscape, on roads and streets, and on the home grounds. All of us who support horticulture in its many aspects should encourage Centennial celebrations and do our utmost to promote the traditional annual observance of Arbor Day. We should enlist the support of the schools, the churches, and the civic and patriotic organizations of our local communities to observe the Centennial in 1972 and to continue their support on each annual Arbor Day thereafter. It may be well to note the improvement in nearly all types of trees since 1872. Even at that time superior fruit trees propagated by budding and grafting were available and certainly the 800 apple trees planted by Morton at Arbor Lodge in 1872 were of such lineage. Now superior clones (cultivars) of most species of landscape trees are available at nurseries so that we may select those which fit the site most suitably



J. Sterling Morton

ARBOR DAY OBSERVANCE AND OFFICIAL STATE TREES

State	Official tree	*Arbor Day first observed	*Now observed
Alabama	southern pine	1887	Second Friday in February
Alaska	Sitka spruce	1966	First Monday in May
Arizona	paloverde	1890	First Friday after Feb. 1 (Friday after April 1 in 5 counties)
Arkansas	pine	1906	First Saturday in December
California	coast redwood, giant sequoia	1886	March 7
Colorado	blue spruce	1885	Third Friday in April
Connecticut	white oak	1886	Last Friday in April
Delaware	American holly	1901	Last Friday in April
District of Columbia	scarlet oak	1920	Third Friday in April
Florida	sabal palm	1886	Third Friday in January
Georgia	live oak	1887	Third Friday in February
Hawaii	candlenut		November
Idaho	western white pine	1886	Last Friday in April
Illinois	native oak	1887	Last Friday in April
Indiana	tulip tree	1884	Last Friday in April
Iowa	oak	1887	Last Friday in April
Kansas	cottonwood	1875	Last Friday in March
Kentucky	yellow poplar (tulip tree)	1886	By proclamation of Governor
Louisiana	bald cypress	1888	Usually in January—designated by State and Parish boards of Education
Maine	eastern white pine	1887	Last Friday in April
Maryland	white oak	1884	Usually the first Friday in April
Massachusetts	American elm	1886	Last Friday in April
Michigan	eastern white pine	1885	Late April
Minnesota	red pine	1876	Last Friday in April
Mississippi	magnolia	1890	Friday after first Monday in December
Missouri	flowering dogwood	1886	Friday after first Tuesday in April
Montana	ponderosa pine	1888	Last Friday in April
Nebraska	American elm	1872	April 22—Legal Holiday
Nevada	single-leaf pinon	1887	Last Friday in April
New Hampshire	white birch	1885	Last Friday in April
New Jersey	red oak	1884	Last Friday in April
New Mexico	pinon pine	1890	Second Friday in March
New York	sugar maple	1889	Last Friday in April
North Carolina	pine	1893	First Friday after March 15
North Dakota	American elm	1882	First Friday in May
Ohio	Ohio buckeye	1892	Last Friday in April
Oklahoma	redbud	1898	Friday after second Monday in March
Oregon	Douglas-fir	1889	Last Friday in April
Pennsylvania	eastern hemlock	1885	Last Friday in April
Rhode Island	red maple	1887	Last Friday in April
South Carolina	palmetto	1898	First Friday in December
South Dakota	Black Hills spruce	1890	Last Friday in April
Tennessee	tulip poplar (tulip tree)	1875	First Friday in March
Texas	pecan	1890	Third Friday in January
Utah	blue spruce		Last Friday in April
Vermont	sugar maple	1885	First Friday in May
Virginia	flowering dogwood	1892	Second Friday in March
Washington	western hemlock	1894	Late April or early May
West Virginia	sugar maple	1883	Last Friday in April
Wisconsin	sugar maple	1892	Last Friday in April
Wyoming	plains cottonwood		Early spring by proclamation of Governor

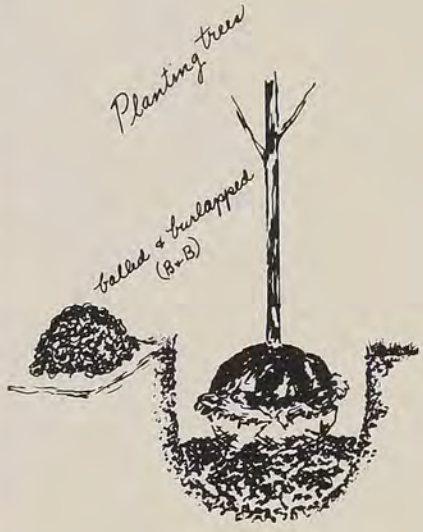
Data from Wyman's Gardening Encyclopedia, *copyright 1971 by Donald Wyman.*

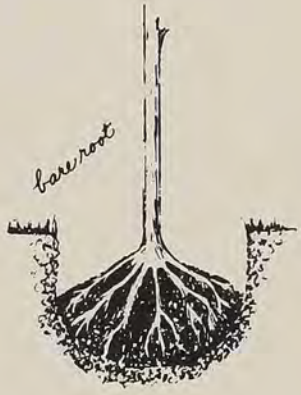
and can be predicted to grow to a uniform size, shape, and color.

A movement to have the last Friday in April officially designated as National Arbor Day is now before Congress. Such a bill passed in 1970 but only specified that one year; at the time of this writing another bill, S. J. Res. 152, is still under consideration by the Senate Judiciary Committee but it is hoped it will be brought to a vote and approved before next Arbor Day. The official establishment of a definite Arbor Day will set the date universally throughout the nation as the day to dedicate ourselves to the need, value, preservation, and maintenance of trees.

The actual date for tree planting will necessarily vary according to the region. In the current year "Tree Planting Day" was observed in Hawaii on November 5, in Singapore on November 7, and in Louisiana on January 21. In the northern states however, Arbor Day and Tree Planting Day may frequently be observed on the same date. Some states, notably Michigan, observe a whole week termed Arbor Week, for tree planting. There are several advantages, notably more flexibility in scheduling tree planting ceremonies so as to avoid conflicts in time.

We, as horticulturists, amateur, professional, or otherwise, are concerned with the development of the living world. We seek to enhance its beauty, augment its productivity, and above all, to create and preserve a healthful living environment. We thus have an obligation to ourselves, to society, and to posterity to do all we possibly can to increase tree planting and maintenance. An approaching opportunity in this present year is to observe the Arbor Day Centennial and to remember that "if we haven't room for a tree, we may always plant a shrub."





*** WHAT YOU CAN DO ON ARBOR DAY!**

You can plant trees, and you can encourage your neighbors, your class or your club to plant trees too. Your club or your class might wish to conduct a tree planting and tree appreciation ceremony similar to the following outline:

PROGRAM SUGGESTIONS

Song: "America the Beautiful"

Invocation: By pastor or selected student

Introductory Remarks: By master of ceremonies, including reading of governor's proclamation

Bible Reading: Reading of Scripture passages selected—Genesis 2:8-10, 21:33, Job 14:7, Isaiah 5:24, 44:14, 60:13, Exodus 22:6.

Short Talk: "Why We Keep Arbor Day" by selected students

Poem: By selected students

Song: "America" or "Trees"

Suggested Projects:

1. Tree planting demonstration (let students plant trees)
2. Dedication of trees planted
3. Plant one or more trees on every Arbor Day to landscape school or club grounds
4. Plant a memorial tree to a great statesman or historical leader, a class year tree

**Taken from pamphlet* ARBOR DAY *published by Extension Service, Kansas State University, Manhattan, Kansas.*

THE REUSE OF WASTE WATER

J. C. Lance

Research information shows that land filtration is an effective way to use natural reactions to convert waste water from an environmental hazard into a valuable water resource for plants and man.

Man's increasing need for water makes reuse of municipal waste water inevitable. The natural chemical and biological reactions which occur as waste water moves through the soil can be harnessed to reclaim this water. Reclamation of waste water can be accomplished at a fraction of the cost of comparable tertiary treatment by chemical methods.

Irrigation with waste water has long been an effective way to use land for the disposal of waste water. Because of health hazards, sewage water should not be used to irrigate crops which are consumed raw by humans. Human pathogenic bacteria and cysts and eggs of human and animal parasites can remain viable in the soil and on vegetables irrigated with sewage water for a few days to a few weeks depending upon local conditions, weather, and other environmental factors. Typhoid organisms, for example, have been reported viable twenty to forty days after irrigation. Simple rinsing or dipping vegetables in antiseptic solutions are not effective in removing all of the pathogens. Crops which are mechanically harvested and canned would allow little chance of exposure to pathogens, particularly if the buyer does not know that the product has been irrigated with waste water. For this reason, it is probably better to restrict irrigation with waste water to crops which are adequately processed before sale.

Soil Filtration

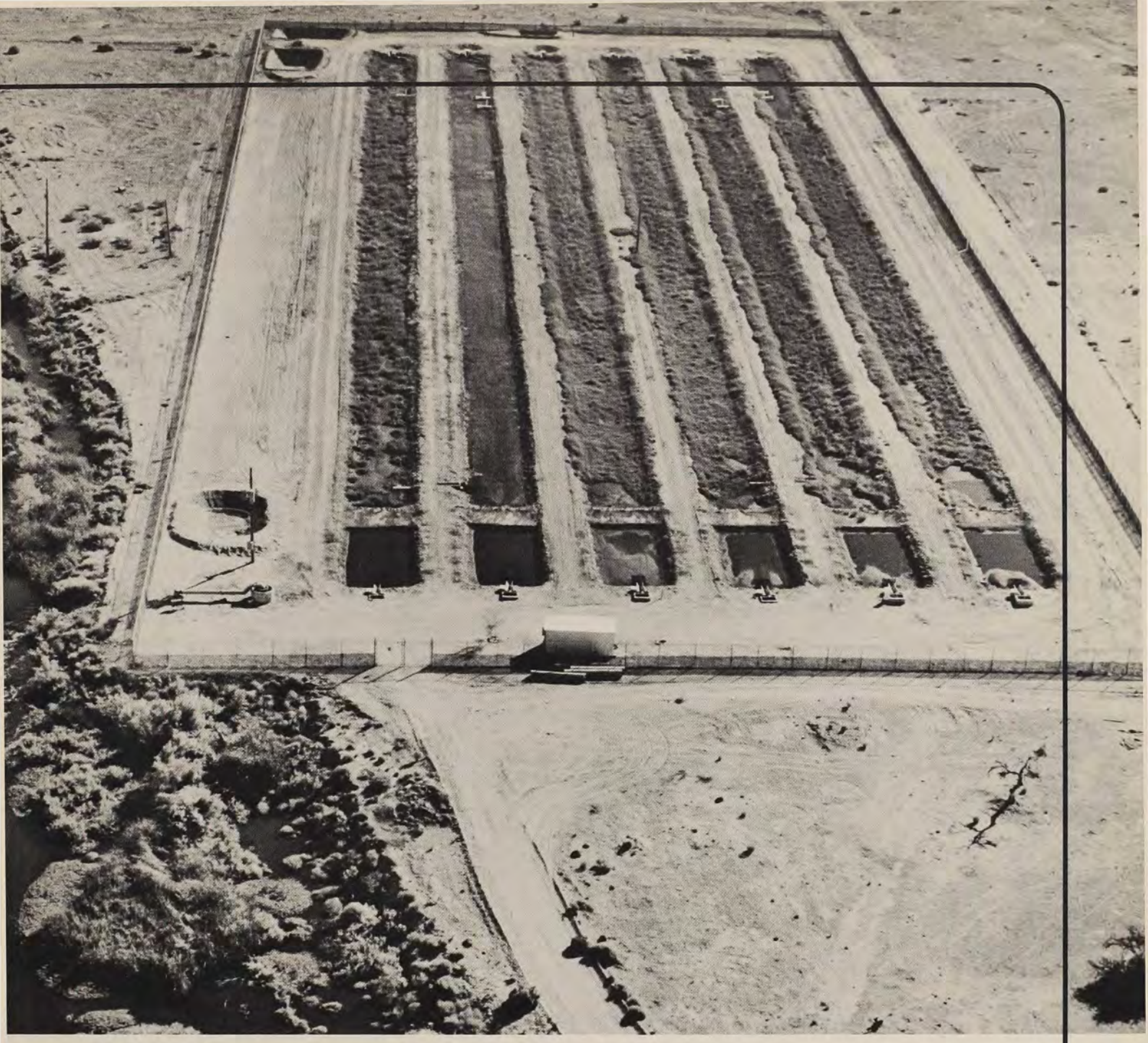
Since direct search for pathogenic microorganisms is too slow and complicated for routine checks of water quality, technicians use index microorganisms such as the coliform and fecal coliform bacteria. Fecal coliforms are much more useful indicators of contamination than total coliforms because some bacteria counted in the total coliform group live and multiply in the soil.

The fecal coliform limit for irrigation water for unrestricted use recommended by the National Technical Advisory Committee on Water Quality Criteria is an arithmetic average of 1,000 coliform organisms per 100 ml of water. Secondary sewage effluent can be chlorinated to reduce the fecal coliform bacteria to this limit, but viruses may survive chlorination. Any waste water used for unrestricted irrigation should receive at least primary and secondary treatment before chlorination. Filtration through soil is another effective way to remove fecal bacteria. Some evidence is available to indicate that viruses are also removed by land filtration, but more research is needed on virus retention by soils.

An effective way to reclaim large volumes of waste water by land filtration is to use a high rate system where purification is the main objective rather than crop production. A plant cover may be used to improve infiltration, but the large volumes of water applied in a high rate system retard plant growth. Waste water can be applied to the land with basins, furrows, or sprinklers, and the reclaimed water can be collected in wells or drains after filtration through the soil. The reclaimed water can then be used for unrestricted irrigation as well as for recreational lakes and possibly even municipal use.

Treatment Sites

Municipal waste water should receive at least primary and preferably secondary treatment before application to an irrigation or land filtration system. An area with favorable hydrogeologic conditions must be selected for a successful land filtration system. A soil in the sand to sandy loam range is needed to provide



Flushing Meadows Project in the dry Salt River Bed, Phoenix, Arizona. Explanation in the text. Photo U. S. Water Conservation Laboratory

high infiltration rates. Level land is better than a sloping area because the water can be more easily ponded on the surface. The depth of the static groundwater table should be at least four or five feet to allow development of a good biological filter. A soil with several feet of sand underlain by a clay layer can be tile drained to provide a land filtration system. The water can then be allowed to move through the soil to the water table and can be collected at some distance away from the recharge area with wells if there are no layers in the soil which restrict water movement.

A land filtration system should be designed to minimize the lateral or vertical movement of reclaimed water from the treatment site. The movement of reclaimed water can be controlled by using tile drains or by regulating the movement of the ground water with a system of wells.

Flushing Meadows Project

The dry Salt River bed which extends through the heart of the Phoenix, Arizona, metropolitan area provided a good site for a land filtration system called the Flushing Meadows project. This pilot project, which was installed in 1967, is a cooperative effort between the U.S. Water Conservation Laboratory and the Salt River Project. Partial support was obtained during the first three years of operation by a grant from the Federal Water Pollution Control Administration. The Flushing Meadows Project (see photo, page 23) consists of six parallel recharge basins, 20 feet x 700 feet, with twenty-foot dikes between them. The soil profile consists of about three feet of loamy sand underlain by a mixture of sand and gravel to a depth of about 250 feet. The water table is located at a depth of ten feet.

Secondary sewage effluent from the activated sludge treatment plant in Phoenix, which is released into a channel in the old river bed, is pumped into these basins. The rate of water flow into each basin is adjusted to fill the basin and maintain a constant water depth with a slight overflow. The amounts of inflow and outflow from each basin are monitored with a critical depth flume. The difference between these two measurements indicates the amount of water which infiltrates into the soil. The basins are operated on alternate wetting and drying cycles because the surface of the soil clogs when the area is continuously flooded. Flooding schedules have ranged from two days wet and three days dry to three weeks wet and three weeks dry. The optimum schedule appears to be one of two weeks wet and one week dry, with longer dry periods during the winter. Studies with different surface covers showed that infiltration rates were increased by grass covers and reduced by a gravel cover. The infiltration rates average about one foot of water per day. More than 300 feet of water per year have been infiltrated into the soil and reclaimed at this rate.

Purity Through Filtration

The samples for chemical and bacterial analysis have been taken from a 30-foot-deep well located in the center of the infiltration area. The samples of reclaimed water can be distinguished from native ground water because the salt content of the reclaimed water is 900-1000 ppm (parts per million) as compared to 2000-4000 ppm in the native ground water. Analysis of these samples has shown that the land filtration process removed almost all of the biodegradable (BOD) material and fecal bacteria from the water. The BOD is reduced from 15 mg/l (milligrams per liter) to 0.3 mg/l. The chemical oxygen demand (COD) is reduced from 50 mg/l to 17 mg/l, which is the same COD as the native ground water of that area. The fecal coliform bacteria count is reduced from about 1 million/100 ml (milliliters) to about 20/100 ml.

The nutrient content of the water is also reduced by land filtration. The phosphorus concentration drops from 13 ppm to 5 ppm. The nitrogen concentration in the reclaimed water depends upon the flooding schedule. The total nitrogen content of the sewage water is 25-30 ppm, with most of the nitrogen in the ammonium form. The nitrate content of the reclaimed water is always high (30-60 ppm) at the beginning of a flooding period due to the oxidation of ammonium to nitrate during the preceding dry period. The nitrate content drops to 0-9 ppm after these nitrates are leached out of the soil. Since the nitrate content of the reclaimed water is always high immediately after a dry period, more low nitrate water can be collected when long flooding periods with few dry periods are used. Almost all of the nitrogen is converted to nitrate and passes through the soil when short, frequent flooding periods with many dry periods are used.

Detailed laboratory studies of nitrogen transformations and net nitrogen removal during filtration have been done. Sewage water was flowed through pipes filled with sand taken from field recharge basins. All of the water and gases were collected from these columns and analyzed. Nitrogen balance studies showed no net nitrogen removal from water collected during short, frequent flooding cycles

(two days wet and five days dry). The nitrate content varied considerably when samples were taken every few hours, but the average total nitrogen content was the same as in the sewage water. However, when longer flooding cycles were used (nine days wet and five days dry), the total nitrogen content of the reclaimed water was sixty-seven percent less than the total nitrogen content of the sewage water.

Laboratory studies indicate that a land filtration system can be managed to retain the nitrogen in water used for crops with a high nitrogen requirement. The opposite result can also be achieved to remove nitrogen from water used for certain vegetable crops whose quality is reduced by high nitrate concentrations and for recreational lakes in which algae growth would be a problem.

Field and laboratory studies have shown that land filtration of waste water is effective in removing most of the biodegradable material and fecal bacteria from the water and in substantially reducing the nutrient content of the water. Under favorable hydrogeologic conditions, this can be accomplished at about one tenth the cost of comparable chemical treatment. Reclaimed water can be released into an irrigation system without contamination of edible crops or deterioration of crop quality due to high applications of nitrogen. Reclaimed water can also be used for recreational lakes.

Treatment of large volumes of waste water by land filtration before it is used for irrigation has the following advantages: (1) Irrigation with water reclaimed by land filtration is safer (even chlorinated secondary effluent may still have live viruses); (2) The nutrient content of the water may be reduced or maintained as needed; (3) Distribution problems are greatly reduced; (4) Relatively small land areas are required for treatment of flow from large cities before distribution and use if permeable soils are available.

It is estimated that 250-300 acres of recharge basins would be sufficient to reclaim all of the sewage water from Phoenix treatment plants which serve a metropolitan area of about one million people.

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POISONOUS PLANTS

John Philip Baumgardt

Numerous plants contain substances that are toxic to people and to domestic and wild animals. These are called "poisonous" plants. Many highly desirable ornamental plants fall into the "poisonous" category; because an ornamental plant contains toxic substances is no reason to forgo growing it. Few gardeners make a practice of munching their way through the perennial border. But, on occasion, newswriters, taking the hysterical approach, lambast the growing of quite useful ornamentals. Then the pot boils, various governmental agencies become involved, and there is an all too real risk of plants we gardeners wish to grow being driven from the market. For example, when was the last time you saw a florist's window filled with the beautiful chinese primrose, *Primula obconica?* The chance of poisoning in the garden probably has increased in recent years, due to the permissive rearing of children. Youngsters are no longer taught not to pop extraneous matter into their mouths—or even, not to touch. Therefore, it seems advisable to know which plants are a potential source of trouble.

Dermatitis From Plants

Plants may be poisonous to the touch, or they may contain substances that are toxic when ingested. Plants poisonous to the touch cause a skin irritation, called, generically, a *dermatitis*. This may be a rash, blisters, reddening, swelling, or combinations of these. Most plants that cause dermatitis in man are not bothersome to domestic or wild animals.

The most common plant-induced dermatitis in the United States is caused by poison-ivy, *Rhus radicans,* and its close relative of more limited range, poison-oak, *Rhus toxicodendron*. Two other relatives produce similar symptoms. These are the Japanese lacquer-tree, *Rhus verniciflua* and, native to the eastern United States, poison sumac, *Rhus vernix*. In the southeastern United States poison-wood, *Metopium toxiferum,* causes severe dermatitis. Other plants occurring natively or in a naturalized state that may cause skin irritation include the native lady-slippers, *Cypripedium* species, various spurges, *Euphorbia* species, and Osage-orange, *Maclura pomifera,* the milky juice of which is extremely irritating to sensitive persons.

The list of native and introduced plants that have been isolated as the cause of specific cases of dermatitis includes more than one hundred species. Dermatologists have access to this frequently amended and updated list; the gardener needs only a partial listing of plants that probably cause dermatitis in most people and which may be in his garden.

Aralia spinosa, Hercules club	bark
Arisaema triphyllum, Jack-in-the-pulpit	leaves, corms
Clematis virginiana, Virgin's-bower	leaves
Colchicum autumnale, Autumn-crocus	leaves
Convallaria majalis, Lily-of-the-valley	leaves
Delphinium ajacis, Larkspur	leaves, seeds
Dictamnus albus, Gas-plant	leaves, seed pods
Euphorbia marginata, Snow-on-the-mountain	milky juice
Ginkgo biloba, maidenhair-tree	fruits
Hedera helix, English ivy	leaves
Helleborus niger, Christmas-rose	leaves
Heracleum lanatum, Cow-parsnip	leaves
Hyacinthus orientalis, Common hyacinth	dried bulb scales
Juniperus virginiana, Red-cedar	leaves
Phacelia campanularia, Harebell phacelia	leaves
Primula auricula, Auricula primrose	leaves
Trifolium hybridum, Alsike clover	leaves
Veratrum viride, American false-hellebore	leaves

Plants Poisonous When Eaten

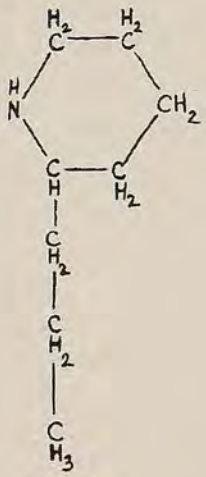
Surprisingly, several plants traditionally grown as food crops or as culinary or medicinal herbs are included in the "dermatitis list", wild-ginger, *Asarum canadense,* borage, *Borago officinalis,* celandine, *Chelidonium majus,* hop, *Humulus lupulus,* and rue, *Ruta graveolens* are on the list; also asparagus, *Asparagus officinalis,* tomato, *Lycopersicum esculentum,* and rhubarb, *Rheum rhaponticum.* Fortunately, almost no one is very sensitive to the latter four species. At least two common garden shrubs appear on lists of plants that cause dermatitis. They are box, *Buxus sempervirens,* and daphne, *Daphne mezereum.* Among the many native plants, aside from those listed above are the notorious nettles, *Urtica* species, and quite a few common woodland plants.

Toxicologists are far more concerned with plants that are poisonous when ingested than they are with those that cause superficial lesions on the skin. Poisonous plants can kill people and animals. In the far west, where grazing is sparse and animals frequently eat plants they would avoid if more palatable forage were plentiful, poisoning of livestock by toxic plants is a serious matter. In cities, the toxicologist at general hospital usually lines up a pharmacognosist with whom to consult, because untrained children gobble up berries, leaves and even flowers that sometimes cause internal reactions.

A handy way to organize plants that may be poisonous when ingested is to group them by the chemical nature and properties of the toxic principle. Of course, a given plant may contain a single toxic substance, several related substances, or toxic elements of widely different characteristics. The result may be some overlapping. Generally speaking, however, a given plant contains *one* substance that quickly expresses its presence with typical symptoms. This allows for quick identification of the cause of poisoning, and the necessary remedies may quickly follow. In North American gardens, most poisonous plants contain toxic substances that fall in the following categories:

Alkaloids

1. Alkaloids. These are drug and drug-related substances of an organic nature. Technically, alkaloids are alkaline, nitrogenous organic substances, i.e., an organic base, with marked physiological action. Usually the term is limited to substances that occur naturally, such as nicotine, quinine, coniine and the like. Alkaloids found frequently in plants of families such as the *Liliaceae,* lily family, *Amaryllidaceae,* amaryllis family, *Papaveraceae,* poppy family, *Ranunculaceae,* the crowfoot or buttercup family, *Leguminosae,* the pulse or pea family, and *Solanaceae,* the nightshade family.



Coniine
(a typical alkaloid)

Some of these are deadly. If you suspect alkaloidal poisoning, (a) call the doctor and specify the emergency; (b) proceed with supportive treatment; (c) make every effort to identify the plant, as treatment varies for different alkaloids. Among the most toxic are monkshood, jimson weed, belladona, henbane and poison-hemlock.

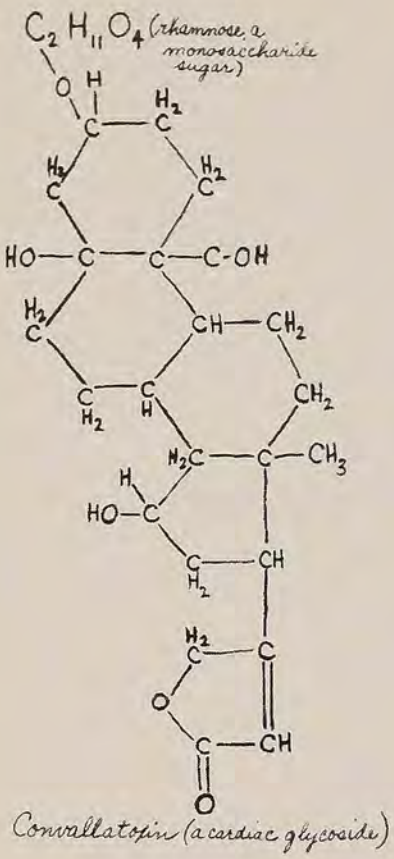
Supportive treatment for alkaloidal poisoning includes immediate percipitation or adsorption of the toxic substance with very strong tea *or* one to two tablespoonsfuls of purified charcoal in a glass of water, followed quickly by an emetic such as warm soapy water. Keep the patient recumbent, apply artificial respiration if needed. While this program may keep the patient alive until the doctor arrives, further specific medical treatment is urgently needed.

Glucosides

2. Glucosides. These are widely varying compounds, either natural or synthetic, which, on hydrolysis, yield a sugar, usually glucose, and one or more other substances. Widely distributed in plants, they generally are white or colorless crystalline compounds, often bitter, optically active and poisonous. These break down readily in the presense of certain enzymes. Some of the most important groups of glucosides concerned in plant poisoning are:

Cyanogenic glucosides: In these, the toxic principle is hydrocyanic or prussic acid. The poisoned condition develops rapidly, and frequently is fatal. Plants involved are in the following genera: *Prunus, Sorghum, Linum,* and *Triglochin.*

Call a doctor, and specify cyanide poisoning. Speed is essential! Break an



amyl nitrate capsule in a handkerchief and hold lightly under the patient's nose for 15 seconds, repeat five times at 15 second intervals. Start and continue artificial respiration at the first sign of difficulty in breathing. If the patient is conscious, or when consciousness returns, induce vomiting by giving one tablespoonful of salt per glass of tepid water; repeat until stomach fluid is clear. *Never* give anything by mouth to an unconscious person.

Saponin glucosides: The poisonous principle acts relatively slowly. Usually these are poisons of grazing animals rather than humans. Nausea, abdominal pains, dizziness and other more specific symptoms characterize the poisoned condition. Cause the patient to vomit with soapy water or salt water as quickly as possible after the plant has been ingested, and rush him to the nearest poison center where treatment will depend on proper identification of the plant.

Solanines: These are the so-called "alkaloidal glucosides" found, most commonly, in some species of the genus *Solanum,* and, under certain conditions, in potatoes and tomatoes. Nausea and vomiting are usual symptoms. Children occasionally are poisoned by eating quantities of berries of woody nightshade, *Solanum dulcamara,* black nightshade, *S. nigrum,* Jerusalem-cherry, *S. pseudo-capsicum* (these fruits contain several toxic principles), bull-nettle, *S. carolinense* and others.

Induce vomiting immediately with soapy water or tepid salt water, and take the patient to the nearest poison center, with a characteristic piece of the plant in hand.

Mustard oil glucosides: Several common species of *Cruciferae,* the mustard family, produce seeds which are rich in mustard oil glucosides. When these are ingested, certain enzymatic activity may release sufficient mustard oil, a strong irritant, to cause a toxic condition. Generally, the plants are involved in livestock poisoning; feeding on considerable quantities of ground seeds may result in chronic enteritis, haemorrhagic diarrhoea, colic, abortion, nephritis with haematuria, apathy, paralysis of the heart and respiration. Gastric lavage, followed by specific medical treatment, is recommended. An emergency treatment for humans is one-half ounce (in half a glass of warm water) of one part scraped burnt toast in two parts very strong tea and one part milk of magnesia.

Resinoids

3. Resinoids. Members of the *Ericaceae,* certain *Cicuta* species and also several species of *Asclepias* contain these poisons. Cicutoxin, found mostly in roots and rootstocks of the several species of *Cicuta* known as water-hemlock (but occurring in above-ground portions of the plants, at least some of the time) is a typical example of this sort of poison. Extracted (the resinoid is soluble in alcohol, chloroform, ether, hot water and alkali hydroxides; insoluble in petroleum ether) the resinoid is an amorphous, viscid mass with an acid reaction. Chemists assign it to the picrotoxin group, and label it very toxic. Frequently it causes death of livestock as the plants containing it sprout up vigorously in very early spring when little other forage is available. One of the great contributions of Linnaeus when, as a young man he was making his Scandinavian collecting tours, has to do with water-hemlock. He informed the residents of an isolated agricultural community that the high spring loss of livestock was due to their having eaten water-hemlock which abounded in the soggy meadows; with the removal of *Cicuta,* the losses ceased. Children and adults have been poisoned by water-hemlock in the United States, apparently mistaking the fleshy roots for parsnips or even Jerusalem-artichokes. The symptoms of cicutoxin in man are stomach pains, nausea with violent vomiting, diarrhoea, dilated pupils, labored breathing, sometimes frothing at the mouth, weak and rapid pulse and violent convulsions. Death frequently occurs, resulting from respiratory failure.

Resinoid poisoning calls for rapid emergency measures; call a doctor, and specify the emergency. Give an emetic to induce vomiting; soapy water or tepid salt water will do. Continue this treatment at fifteen minute intervals until the stomach fluid is clear. Give a cathartic if a doctor is not immediately available.

Unfortunately, in the case of ruminant animals, there is no chance of clearing the stomach; Hypodermic injection of morphia may aid in controlling the convulsions, but usually resinoid poisoning in animals is fatal.

Phytotoxins

4. Phytotoxins. Not very common poisons, the phytotoxins most commonly encountered in a garden situation are found in the foliage and inner bark of black locust, *Robinia pseudoacacia,* and in all parts of the castor-bean plant, *Ricinus communis.* There are several other species with phytotoxin content, but these seldom are encountered. The active principle in black locust is the phytotoxin robin, in castor-bean it is ricin. Abrin, found in the seed coats of jequirity *(Abrus precatorius)*—often the seeds, scarlet with a jet black hylum, are sold, strung, as prayer beads—is another of these phytotoxins. They are technically toxalbumins. Death frequently results from the ingestion of plant material containing the phytotoxins, quickly following symptoms of poisoning, including nausea, perhaps with vomiting, stupor, dullness of vision, depressed heart action and other elements of malaise characteristic of the specific toxalbumin involved.

Proceed with standard emergency measures; call a doctor, preferably at the poison center, specifying the poisonous plant; meanwhile, stimulate vomiting with soapy water or with tepid salt water until stomach fluid is clear. Keep the patient prone and warm; if breathing becomes labored, proceed with artificial respiration until the doctor takes over treatment.

There are two very practical aspects to a popular awareness of phytotoxin poisoning. Suburban residents often keep horses or ponies in relatively small paddocks, where grazing often is sparse. The horses resort to gnawing trees in the fence line (or they reach across the fence for proximal greenery), and all too often the trees are volunteer black locust. Poisoning results. There are records of children watching horses gnaw bark from locust trees, then sampling it themselves, with fatal results. The second point has to do with castor bean plants; these are popular garden ornamentals, tolerant of poor environment and slack cultural methods. All parts of the plant are poisonous, the seed coat, particularly so. In an agricultural situation, avoid growing castor-bean plants where there is a chance of animals feeding on any part of the plant. In the home garden, remove flower shoots to prevent the formation of seeds, as these are attractive to children. A tiny fragment of the brittle seed coat embedded in a finger or eye may cause the loss of the organ!

Oxalates

5. Oxalates. Oxalic acid, combined as sodium or potassium oxalate, occurs in quite a number of plants, but it seldom is present in sufficient quantity to be dangerously toxic. A few plants have, when ingested, caused oxalate poisoning. Apparently certain growing conditions must obtain before this can happen. Plants involved are black greasewood, *Sarcobatus vermiculatus,* various kinds of dock, *Rumex* species, the foliage of certain rhubarbs (including the familiar garden sort) *Rheum* species, and some wood-sorrels, *Oxalis* species. Oxalate poisoning occurs usually when range animals move onto an area where quantities of the oxalate bearing plant are found. For example, black greasewood is a valuable winter and early spring forage plant for sheep; but frequently great numbers of sheep are lost in New Mexico, Nevada and Oregon from eating large quantities of greasewood in a short time. Domestic hogs have been lost from eating common rhubarb leaves, and several cases of human deaths have been reported as due to rhubarb leaf poisoning. The docks, sorrels and wood-sorrels seldom are involved in fatalities, but have caused typical oxalate toxicity symptoms in animals and children. The symptoms include depression, weakness, weak pulse and weak respiration. As oxalates are deadly in very small amounts, if oxalate poisoning is suspected, take emergency steps, immediately.

First, call the physician, specifying the plant. Induce vomiting as quickly as possible (soapy water, *no salt water*) and give quantities of lime water immediately. Keep the patient recumbent and blanket-covered. Use ammonia as an in-

halent, and give strong coffee. In cases of oxalate poisoning, the doctor will know not to use a stomach pump or oral saline solutions (with solium or potassium salts) as these increase the solubility of the poison.

Miscellaneous Compounds

6. Miscellaneous compounds. This is a catch-all category to take care of the rare toxic principle that occurs in just one or two plants. Usually these are problems for the veterinarian.

Milk sickness (trembles) is a typical example. The toxic principle is an unsaturated alcohol, tremetol, found as an aromatic oil in white snakeroot, *Eupatorium rugosum (E. urticaefolium)* and in the rayless goldenrods, *Aplopappus heterophyllus* and *A. fruticosus*. The latter two species sometimes are involved in animal poisoning on the dry plains, grasslands and open woodlands of southern Colorado, western Texas, New Mexico, Arizona and Mexico. In the southwest, frequently the disease is called "alkali disease" but "milk sickness" also is common.

In animals, the first symptoms are depression and inactivity. Constipation, nausea and vomiting, with quickened and labored respiration, weakness and, ultimately, inability to stand, all follow. A noticeable symptom is trembling, particularly in the muscles about the nose and legs.

For years this disease was known in domestic animals, most commonly in the section of the United States east of Kansas and north of Arkansas, where white snakeroot is a familiar meadow margin plant. It was also known that persons ingesting milk from afflicted cows soon developed similar symptoms; weakness, dizziness, loss of appetite, nausea and persistent vomiting, pains in the stomach, thirstiness, swollen and coated tongue, dry skin, constipation, weak pulse, slow respiration, subnormal temperature, weakness and, frequently, collapse. It was not until the second decade of this century that scientists became aware of the chemical behind these symptoms. Studies continued well into the 1930's.

There is every chance for milk sickness to become a problem in public health again, because the present trend in dairy cow management calls for the replacement of weed free pastures with weedy exercising lots; a superficial examination of these modern "milk factories" often reveals quantities of the tough, omnipresent, white snakeroot in the fence rows, the only green forage to be reached by the cattle. Surprisingly, neither the poisonous chemical nor the common names of the disease appear in current poison manuals, or, indeed, in the usual pharmacy reference works.

A number of plants have been shown to absorb selenium compounds from the soils of cretaceous or eocene shales in sufficient quantities to make them poisonous to range animals. So-called "alkali disease" a chronic poisoning prevalent in some areas in South Dakota, and "blind staggers", an acute toxic condition predominating in Wyoming, have been widely studied and reported in veterinary and range management literature. Seleniferous plants are found among the asters, the vetches, and species in the genera *Atriplex, Eurotia, Euphorbia, Grindelia, Iva, Mentzelia, Oconopsis, Stanleya, Thermopsis* and *Triglochin*.

Plants have served man well as a source of drugs since the dawnings of civilization. Because some species contain toxic principles, occasionally a hue and cry arises, calling for the cessation of culture of, for example, *Poinsettia, Narcissus* and *Aesculus* (those handsome horse-chestnuts *do* contain a rather numbing glucoside) and it is up to the horticulturist to defend his plants. More and better public education on what plants to eat and, more to the point, what plants *not* to eat, is the thing. Parents need to be reminded to teach their children to eat no plants or plant products until they know they are safe. It seems a minor problem, but sufficient hubbub from an uninformed public could drive any number of desirable species into the same void that absorbed the once popular, and delightful, greenhouse primulas. Gardeners are retiring types that generally shun the limelight; here is a case that calls for public appearances. The story of poisonous plants needs to be told in such a way that both plants and people will be protected.

A NEW ANNUAL ORNAMENTAL— *Solanum nodiflorum*

*W. L. Corley**

A plant introduction from Africa, *Solanum nodiflorum*** Jacq., P.I. 247828, shows promise as a tall-growing bedding plant and for use in floral arrangements. Seeds of this plant were collected in 1958 near Niangara, Democratic Republic of the Congo, by Louis Williams and Norris Gilbert, Plant Explorers, New Crops Research Branch, USDA.

Solanum nodiflorum, P.I. 247828 with petioles clipped to show fruits and stems.

Description

This plant has performed well at this location for six growing seasons. During vegetative growth purple pigmentation is evident in stems and petioles. The flowers are small, inconspicuous, and light violet in color. Dark green immature fruits begin to set during July and then turn scarlet in September. The globose fruits measure approximately one inch in diameter and are borne in cymes along the internodes. Number of fruits per cyme vary from one to eight. Plant height ranges from 30 to 42 inches, depending upon growing conditions. Plant stature is erect and sparsely branched.

Culture

This ornamental accession is readily propagated from seeds. Greenhouse seedlings are vigorous and grow to desirable transplant size in six weeks. Seedlings grow well in greenhouse soil mixes, peat pellets, and artificial soil media. Plants respond to moderate fertilization at transplanting and after initial fruit set. No serious diseases have been observed on any plantings, but Colorado potato beetles, flea beetles, and spider mites, which commonly attack eggplant, *Solanum melongena,* also plague this species. Insecticides recommended for insect control on eggplants have been used with success. Shade tolerance tests indicate that this plant grows best in full sun, but will tolerate light shade conditions.

Uses

This plant shows potential as a tall-growing bedding plant, particularly in early fall when the showy scarlet fruits contrast with the dark purple stems. When plants are harvested before frost, the plant material is well suited for use in fresh and dried floral arrangements. Clipping the petioles from the stems enhances color contrast between fruits and stems. Preliminary tests indicate that the cut plant material dries well at room temperature and fruit color does not begin to fade for several months.

The possible toxicity of fruits has not been determined. Since some members of the Solanaceae family are poisonous, the fruits of this accession should be considered toxic until evidence proves otherwise. Small seed samples are available to plantsmen upon request to the author, Regional Plant Introduction Station, Georgia Station, Experiment, Georgia 30212.

Ass't. Horticulturist, Dept. of Plant introduction, University of Georgia College of Agriculture Experiment Stations, Georgia Station, Experiment, Georgia 30212

***This recently introduced plant is not to be confused with the similar species* Solanum aculeatissimum *commonly grown in southwestern states as "love-apple" or "soda-apple nightshade."*

Diospyros blancoi

. . . The correct botanical name of the Mabolo or Velvet Apple

*Richard A. Howard**

The international code of Botanical Nomenclature does not permit the use of two specific names within one genus which are so similar that they are likely to be confused (Art. 75). When such names exist they are to be treated as homonyms and the last one published must be rejected (Art. 64). This is the case encountered when one seeks the correct name for the tree producing the fruit called mabolo or velvet apple.

The mabolo persimmon is a member of the Ebenaceae (ebony family), and a species of *Diospyros*. It is a native of the Philippine Islands where the common name originated. The tree produces a sub-spherical fruit about four inches in diameter which has an edible white flesh, but is covered with a dense mat of brown velvety hairs. The leaves are dark green and shiny above, but covered below with a silvery pubescence. As an edible fruit and an ornamental tree it was introduced into the Garden of the King in Mauritius in the 18th century and a specimen from this garden was sent to Lamarck in Paris. The plant was first described by Desrousseaux in Lamarck's Encyclopedia in 1792. The plant was widely distributed (possibly from the same garden) and cultivated in the tropics. It was reported in the botanical garden in Calcutta, India, in 1811. John Lindley illustrated one of the two specimens growing in England in the *Botanical Register* in 1828 under the name *Diospyros mabola*. He reported that its introduction was by John Potts from China in 1822. The oldest records of its cultivation in the New World appear to be specimens collected by Belanger from the botanical garden in Martinique in 1858 and by Glaziou from the botanical garden in Rio de Janeiro in 1880.

In 1921 a budded seedling of a nearly seedless variety called 'Manila' was introduced by the U.S. Department of Agriculture from the Lamao Experiment Station in the Philippines. Later introductions recorded by the Bureau of Plant Introduction are from British Guiana, Cuba, and Hawaii. The mabolo is frequently seen in cultivation in Florida at the present time, but the fruit, although attractive in appearance, is not offered commercially and the plant has few advocates except those who appreciate the attractive foliage. Although the plants encountered today have few seeds, the species may be propagated by marcottage** as well as by seeds.

The mabolo was first described by Desrousseaux under the name *Cavanillea philippensis*. That generic name is rejected as it is antedated by a genus of the Malvaceae published five years earlier. In 1806 Willdenow described *Diospyros discolor* citing *Cavanillea philippensis* in synonymy, rendering the epithet *discolor* illegitimate. Lindley committed the same error in publishing the name *Diospyros mabola* in 1828. Gurcke transferred the name *Cavanillea philippensis Desr.* to *Diospyros* in 1891, but in the meantime Alphonse de Candolle had described a timber tree of the Philippine Islands as *Diospyros philippinensis*. The two specific epithets are so similar that confusion will result and a new name should be selected for the mabolo from those available. The earliest name which can be used is *Diospyros blancoi* A. DeCandolle which was published in 1844. This was a new name for a spe-

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**marcottage–air layering, particularly with the rooting medium bound to the plant rather than in a pot.

Mabolo or Velvet Apple (Diospyros blancoi). Closeup of branch; fruit is three to four inches in diameter, brown and hairy.

cies of persimmon from the Philippine Islands which the botanist Blanco had mis-identified as the japanese persimmon *Diospyros kaki* L.

The proper scientific name and the synonymy for the mabolo or velvet apple is:

Diospyros blancoi A. DC. Prodr. 8: 237. 1844.

Cavanillea philippensis Desr. in Lam. Encycl. 3: 663. 1792, t. 454. 1799.

Diospyros discolor Willd. Sp. Pl. 4: 1108. 1806, nom. illeg.

Diospyros mabola Roxb. Hort. Beng. 40. 1814, nom. nud.

Diospyros mabola Lindley, *Bot. Reg.* pl. 1139. 1828, nom. illeg.

Diospyros kaki Blanco, Fl. Filip. 302. 1837, not L.

Diospyros philippensis (Desr.) Gurcke in Engl. & Prantl. Nat. pflanzenfam.IV, 1: 164. 1891 not *Diospyros philippinensis* A. DC. Prodr. 8: 231. 1844.

Editor's Note—Why do plant names change? A better question might be, how do plants get their scientific names. Plants are assigned names to indicate their natural relationships, and for the sake of orderly classification. Common names lead to confusion; "scientific" names, provided they are stable, identify a particular plant. When you and I say "marigold" we mean a plant from the genus *Tagetes;* a plant whose wild ancestors grew in Central America or Mexico. The plant has much divided leaves, needle-like black seeds and a characteristic odor. When Shakespeare said "marigold" he meant the plant we know as *Calendula;* low-growing, with strap-like foliage and a more or less daisy-like head.

A scientific plant name, the latin binomial, consists of two parts. The first portion is the genus name, the second part identifies the species. A *species* is regarded as a group containing all of the individuals of a particular kind of plant that exist now or that existed in the past. The French botanist, de Jussieu, defined a species as *the perennial succession of similar individuals perpetuated by generation.* The concept of "similar individuals" varies greatly among taxonomists (classifiers). It has been said of extremely variable sorts of plants, that "a species is a frame of mind."

Individual plants within specified limits of variation are grouped together to constitute a species. Various species are grouped together to form a genus (plural = genera); a genus is a group or a series of species with particular characteristics in common.

Obviously, a taxonomy specialist has to assign individual plants to the proper genera and species. Sometimes this is done without knowledge that the job had been done earlier. Later workers must give priority to the *first* – assigned name. As you read through Dr. Howard's article, follow the tracing of a particular plant back through its various names and descriptions.

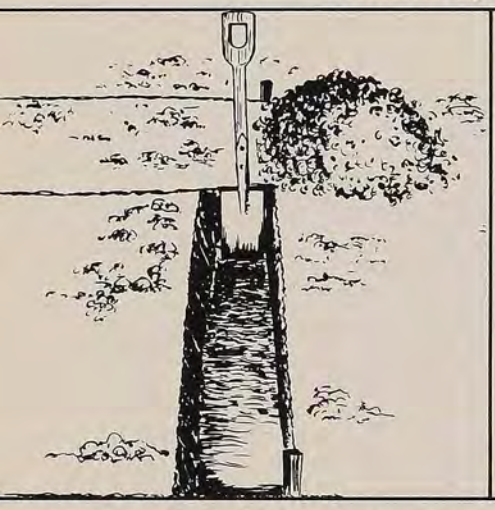
If you become interested in this business of classification, refer to texts on Plant Taxonomy at the library. Also, for the latest rules covering garden plant names, refer to the International Bureau for Plant Taxonomy and Nomenclature publication *International Code of Nomenclature of Cultivated Plants—1969,* available from the A. H. S. office in Alexandria, Va.

SPADING: a basic

Turning soil before setting plants or sowing seed is basic to gardening. Aborigines stir the ground with pointed sticks. Primative peoples still use wooden plows, hand drawn or pulled by oxen. Iron age Europeans prepared their small crofts with the breast plow, a massive, crude iron blade mounted on a weighty wood shaft some seven to ten feet long, and with a knob or plate at the proximal end that the unfortunate ploughsman leaned against as he forced the instrument through the soil. Today plowing (still spelled "ploughing" outside the United States) is scientific; special plowshares have been developed for various types of soils. A great tractor, pulling a gang of eight or ten plows, perfectly turns a wide band of furrows with each pass. The home gardener, not able to use the massive machinery that makes soil preparation a light job on the farm, must rely on smaller power equipment or on hand tools.

Trained gardeners favor the spade for turning soil. Soil scientists tell us that the churning action of rotary tools tend to overaerate the soil, stimulating a population explosion among soil microoganisms, which quickly digest away the important humus fraction of the soil. Furthermore, most soils have a fairly well defined physical structure, the character of which is important to healthy root development. Overlicking the soil pulverizes it, reducing the soil "grain" to powder. There is a place in gardening for the rotary tiller, but it is not the stage of basic preparation for planting. The small garden tractor, with traditional turning plows, it is not powerful enough to achieve any great depth of tillage. We are left with the spade.

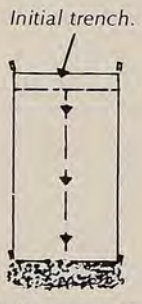
How To Dig



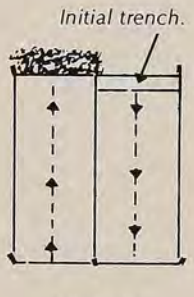
First trench is slightly wider than spade, and to full depth.

Cut off slice (spit) of soil.

Place spade at correct angle.



Small, narrow plot.



Wide plot.

Trained gardeners have brought spading soil to a fine art. Through a knowledge of soil science we now know when the soil is spadeable and when it is not. We know what additives must be turned in, and we plan our spading pattern so these fertilizers and soil conditioners are spread uniformly throughout the bed, and uniformly through the depth of the turned soil. We know, from experience with our crops, from a knowledge of the soil in our bed, and from an awareness of drainage, how deep we should spade.

There are a hundred and one ways of sticking the tool in the soil, lifting out a spit, and dumping it. The degree of refinement you bring to your spading technique will show in the amount of labor it takes to work down the spaded bed prior to planting, and in the uniformity of the crop. The methods presented here probably represent the ultimate in refined spading technique, as practiced by master

art in gardening

Robert P. Wintz *

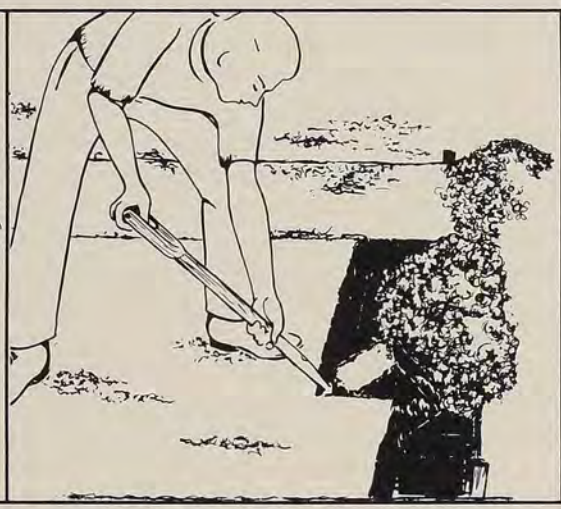
gardeners today. Read over, step by step, these techniques seem tedious and almost pointless. In practice, with time they become automatic—and the result is a perfectly turned bed of soil, uniform in tilth from top to bottom and from end to end. The sort of bed that produces a crop of flower or vegetable plants that are as alike as peas in the pod.

Basic Preparations For Spading

Mark out the plot with stretched lines; if this is a free-form bed, you will have to scratch out the margins and adapt the spading technique. To simplify the story, let us assume that we are dealing with a simple rectangle. If the plot is smallish, dig a trench the full width of the narrow end of the bed; this trench should be a full spade's length deep, and slightly wider than the blade of the spade. The soil from this trench is wheelbarrowed to the far end of the plot where it is windrowed free of the area to be spaded, but accessible to fill the trench that will be left at the end of the plot. If the plot is fairly wide, divide it down the middle. Beginning at one end, dig a trench half way across the bed, windrowing the soil opposite the other half (see diagram). Spade half of the plot, then return from the opposite end to spade the other half, using the soil to fill the final trench.

As you dig, remember to make a clean and thorough job of thrusting the spade vertically into the soil. You can do a cleaner job in most soils if you drive

Spade to full depth for deep working.



Lift full spade of soil.

Reverse soil into trench.

the spade in at right-angles to the trench to cut off the slice (spit) of soil that will be lifted next. If you do not cut off each spadeful in this manner, the soil will crack away loosely and the soil on the spade will crumble as it is lifted.

Digging One Spit Deep

Use this method to break up the soil to the depth of one spade. Take out a trench, as described above, and turn the soil, one spit at a time, into it. Your trench should be about a foot wide and the full depth of your spade. Beginning at one end of the trench, and in the bed, insert the spade vertically along the outer edge of the bed at right angles to the trench. Pull it out. Move over the width of the blade and make another vertical right angle cut. Now, insert the blade vertically at the proximal end of these two cuts to lift out the spit of soil, stepping it in full depth. Lift the freed spit of soil, twist the spade and reverse the soil into the trench, creating a sloping face. After this initial cut, two cuts are recommended for each spit to be turned; the first cut is made at right angles to the trench, the second cut, parallel to the trench, frees the spit for turning. Properly turned soil is inverted. The

* *Executive Director, The Chicago Horticultural Society.*

surface portion lies at the bottom of the trench.

If manure, peat or compost is to be added to the soil, it is a good idea to spread it over the ground to be dug prior to spading to insure equal distribution. But leave the area for the initial trench and the first breadth of spading uncovered. When the trench has been dug and the first row of soil turned, strip up the manure, peat or compost lying on the next row, and lay it evenly on the slowing surface of the turned soil in such a way that none is left above the surface, and so that it is uniformly distributed from side to side and top to bottom. Having coated the face of the turned soil with additive, turn the next strip of soil, burying it.

Inorganic fertilizers work quickly, and seldom are dug into the soil, but are added at the surface latter, to be cultivated in. An exception may be phosphate fertilizers, most of which are not inclined to leach in the soil. If your soil is phosphate deficient, dust the appropriate amount of fertilizer over the face of each row of turned soil before turning the next row.

Double Digging

This technique loosens the soil to a greater depth, improving deep drainage, loosening and aerating soil for greater root penetration, and, in the case of shallow soil, double digging, with appropriate additives, quickly increases the depth of top soil. Take out an initial trench the depth of your spade, and two feet wide, moving the soil to the path or lawn at the far end of the bed. With a sturdy digging fork, break up the soil in the bottom of this trench, working carefully right up to the sides as closely as possible. If manure, peat or compost is to be added (these organics quickly convert heavy subsoil to friable loam) spread it over the bed after the trench is opened, then scrape up a two foot wide strip of it adjacent the trench and spread it over the bottom of the trench before forking. Phosphate fertilizers are possible additives as are other garden fertilizers, particularly organic sorts that stimulate the movement of soil microorganisms down into the fairly sterile subsoil. If the subsoil is heavy, poorly drained clay, consider adding agricultural limestone or gypsum (land-plaster) to the bottom of the trench before spading. These calcium-releasing fertilizers cause the clay colloids to coagulate, giving the soil a porous, more friable texture. Never add fertilizers at the time of liming, as an ammonia-freeing reaction may occur, causing a loss of valuable nitrogen, and, possibly, toxifying the soil temporarily with ammonia gas.

After the soil in the bottom of the trench is broken and aerated by forking, proceed as with digging one spit deep, turning row after row of soil on top of the forked soil. When you have dug to a width of two feet, fork the bottom of this new trench, as before. Double digging is rather tricky. You must adjust your digging so exactly the same amount of soil is turned each time, or the final surface will be quite uneven. Also, you must treat the bottom of each trench identically, and always step in spade or fork absolutely vertically. This is where technique becomes an art. The first time you try double digging, or even simple digging to a depth of one spit, you will swear never again. Eventually you will evolve your own method, based on this outline, and as you prepare soil for your plants, you will have the great satisfaction of knowing that with each passing season your soil gets better and better.

There are more techniques. There is true trenching, where deep soil is brought to the surface and topsoil goes two, even three or four feet down, so that ultimately the bed is rich, friable loam several feet deep. This is the secret behind those magnificent English perennial borders. There is a special way to turn grassland the first time, which involves skimming off the sod as digging proceeds, with the chopped sod ending up on top of the forked subsoil and below the turned top soil. Grit, such as sieved cinder or sand, may be spread through the depth of the soil. Massive amounts of raw manure may be dug in, down deep, with a lesser amount in the upper soil. All of these techniques will come with time.

Practice a little with your spade this spring. This fall, as your beds are cleared of plants, single spade or double dig. Next spring you will have only to lightly fork (or rototill) the spaded bed at planting time. And the loosened soil, acted upon by winter's frosts, will be textured to perfection. ◈

Garden Soil Preparation *is one of a series of Garden Method films coordinated by The Chicago Horticultural Society under the direction 'of Mr. Wintz and may be rented or purchased for showing to schools, colleges, extension services, etc. Further information is available from* Perennial Education, Inc., *P.O. Box 236, 1825 Willow Road, Northfield, Illinois 60093.*

Seattle, City of Parks and Gardens

Host City for the 1972 American Horticultural Society Congress

Horticulturally speaking, the Pacific Northwest is North America's counterpart to England's Surrey County, or Wales and Devonshire. It is a gardener's paradise. The weather is mild; misty and cool in summer, misty and chilly in winter. Not a climate for crape-myrtle and sea-grape, but ideal for all the ericaceous species, for fuchsias, tuberous begonias, ferns and other rain-forest plants. Lawns keep green the year round, throwing back the blaze of color from summer's annuals. In winter, camellias and Ilex species brighten the landscape.

Seattle, queen city of Puget Sound, that great "inland" arm of the Pacific Ocean, lies beautifully situated on Elliott Bay. A hilly town, Seattle looks west to the snow capped Olympic range of mountains across the Sound on the Olympic penninsula and east to the Cascade range, where great volcanic cones such as Mt. Ranier, Mt. Adams and Mt. Baker raise themselves majestically above the coastal ranges. Seattle began as a fur trading base for John J. Astor's company. A great sea port quickly developed, and with it, a major city, well designed with parks and boulevards. Washed by moisture laden, clean ocean air urged inland by the Japanese Current, Seattle seldom knows the smog problems that plague other major cities. Plants thrive in the soft, damp atmosphere. Where much of Seattle stands today, coniferous forests covered the land until the trees were felled to provide lumber for eastern markets. Douglas-fir logs, ten feet and more across the butt, and a hundred feet or more long were moved to the mills; while almost none of the original forest giants survive today, the "second growth" forests dwarf forest tree species as most Americans know them.

Such is the site for the 1972 A. H. S. Congress.

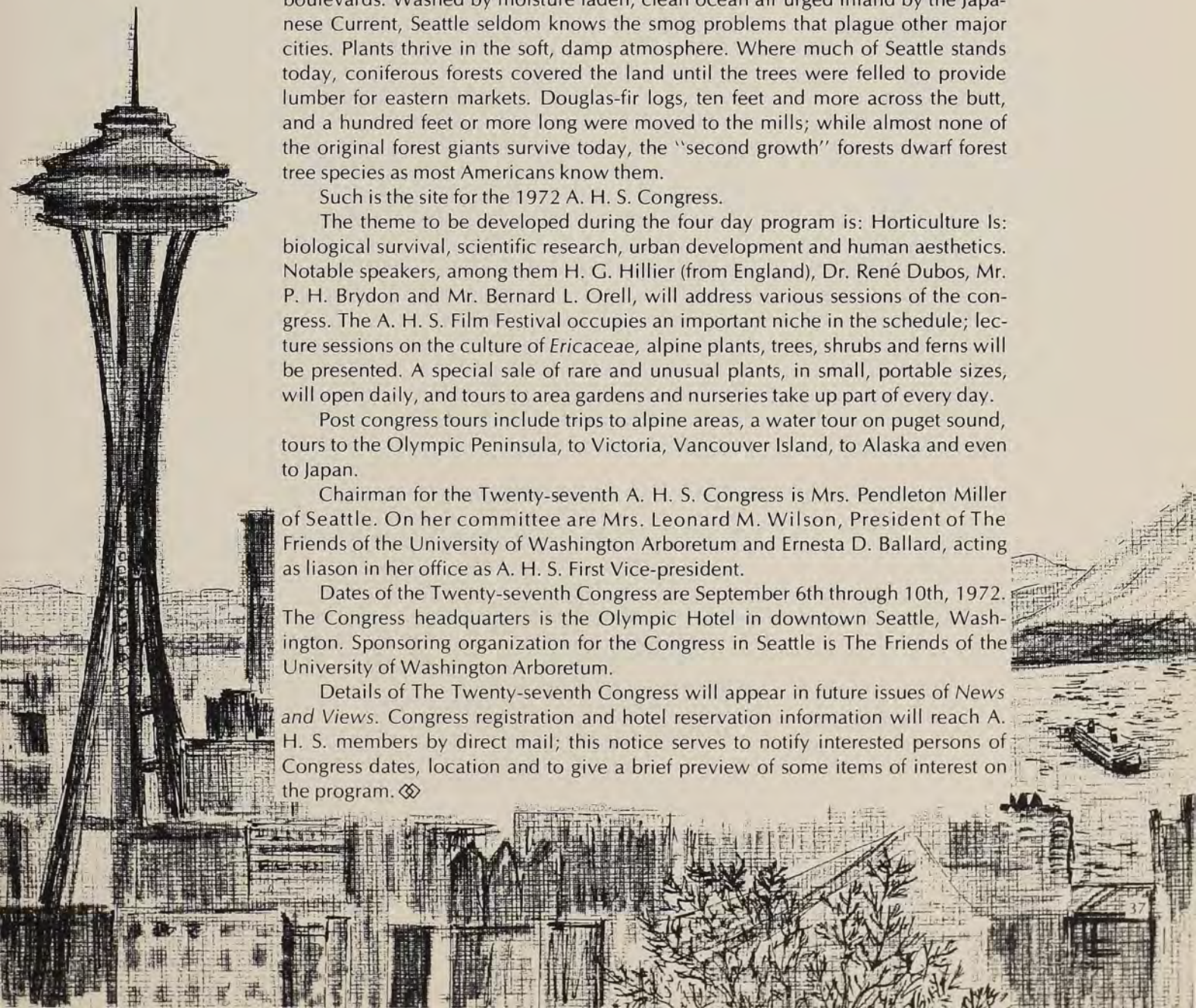
The theme to be developed during the four day program is: Horticulture Is: biological survival, scientific research, urban development and human aesthetics. Notable speakers, among them H. G. Hillier (from England), Dr. René Dubos, Mr. P. H. Brydon and Mr. Bernard L. Orell, will address various sessions of the congress. The A. H. S. Film Festival occupies an important niche in the schedule; lecture sessions on the culture of *Ericaceae,* alpine plants, trees, shrubs and ferns will be presented. A special sale of rare and unusual plants, in small, portable sizes, will open daily, and tours to area gardens and nurseries take up part of every day.

Post congress tours include trips to alpine areas, a water tour on puget sound, tours to the Olympic Peninsula, to Victoria, Vancouver Island, to Alaska and even to Japan.

Chairman for the Twenty-seventh A. H. S. Congress is Mrs. Pendleton Miller of Seattle. On her committee are Mrs. Leonard M. Wilson, President of The Friends of the University of Washington Arboretum and Ernesta D. Ballard, acting as liason in her office as A. H. S. First Vice-president.

Dates of the Twenty-seventh Congress are September 6th through 10th, 1972. The Congress headquarters is the Olympic Hotel in downtown Seattle, Washington. Sponsoring organization for the Congress in Seattle is The Friends of the University of Washington Arboretum.

Details of The Twenty-seventh Congress will appear in future issues of *News and Views.* Congress registration and hotel reservation information will reach A. H. S. members by direct mail; this notice serves to notify interested persons of Congress dates, location and to give a brief preview of some items of interest on the program. ◈



THE TELEGRAPH PLANT

Anthony J. De Blasi

Redrawn from Histoire Naturelle Illustree: Les Plantes *by J. J. Costantin and F. Faideau.*

One of the most exciting experiences I have had with plants has been in connection with *Desmodium gyrans* (telegraph plant, a native of India).

One day my eyes caught the buried paragraph on *Desmodium gyrans* in a garden seed catalog. It described a plant having the remarkable property of visible motion: its leaflets were said to move back and forth in jerky movements during mild, sunny weather. I couldn't believe it, even though I have grown *Mimosa pudica* (sensitive plant) for years and marvelled at the way its leaves fold up when touched. But for a plant to move rapidly of its own accord was too much to take! So I ordered some seeds and tried them.

The designated germination period is ten days; when a month went by and nothing happened in my seed flat I wrote the venture off as a failure but held on to the flat a while longer, just in case. After two more weeks had passed and still no signs of life, I decided to toss the flat out the following day.

Next morning I noticed that a seedling had popped up! The cotyledons had the shape of the seeds I remember planting, so it was not a weed but *Desmodium gyrans* rearing its head.

Several seeds germinated. The seedlings spent their first couple of months in peat pots, outdoors. They were slow to develop at first, but grew with increasing momentum. I stared at them frequently in these days but saw no action. I moved them into all kinds of light and temperature but the leaves stubbornly refused to produce the slightest quiver, except when blown by the wind. I was convinced that there was no such animal as the plant described in the catalog—that the description must have been a perpetuation of a distorted original account, as so often happens when information is passed on from one person to another. But the small plants looked interesting and since they were undemanding I decided to grow them on.

Imagine my surprise when the most advanced plant of the group suddenly began to move! The leaflets were sluggish at first, but as the plant grew, its actions became more spirited. By then the rest of the plants were joining in the nervous, irrational twitching and twirling of their leaflets. Up and down, sideways and diagonally they went, slowly or in fits, followed by pauses. An uncanny sight! A revelation of natural wizardry at its best to all who stood and watched in disbelief!

Desmodium gyrans is a graceful, airy plant, reminiscent of bamboo in miniature. Imagine a clover leaf whose center leaflet is enormously elongated, well beyond the two side leaflets, and the side leaflets narrow and linear, each such leaf cluster alternately arranged around a tall, slender, wiry stem, at the end of a thin, long petiole, and you have a rough picture of *Desmodium gyrans*. It is the small, side leaflets, at the base of the long, central one, that do the "telegraphing." The long ones remain still, except that they droop by night and assume a more horizontal position by day. The plant has a strange, sulking appearance at night, in contrast to its gay, open daytime posture.

The movements are erratic, no two leaflets doing the same thing at the same time, with the movements at a height in bright, warm, still weather and at a minimum in cool, dull, or windy weather. Even at night, though, there is occasional twitching and during midsummer the plants seem to be in constant turmoil. In autumn they slow down. At that time I moved them into the greenhouse to see if I could hold them over into the next season. They were in four-inch pots at this time, and about thirty inches tall. During the

autumn months they continued growing, ever upward, till they brushed the roof. Rather than remove them from the benches and place them on the cold floor, I cut back the tops. Not fazed by this treatment, they branched and resumed their growth but slowed down as the nights grew colder and the temperature of the greenhouse settled to its minimum level of 45°f to 50°f. Then I noticed that the leaf movement ceased. The plants evidently had gone semi-dormant, although they did not lose their leaves. I tested their hardiness by leaving two plants outdoors in the ground; they perished in spite of a mild winter.

The increased warmth and sunshine of the spring months stirred the greenhouse desmodiums into action again and they entered their second year in six-inch pots, standing between two and three feet high after a second trimming. In May I moved the pots outdoors to spend the summer.

All along, the desmodiums have been thriving in a sunny location in pots of coarse sphagnum moss, kept fertile with regular applications of liquid plant food. Except for their uncertain start in life, they have been easy growers and fun to have around.

If you would like to introduce a bit of genuine mystery into your own circle, if you are looking for a sensational conversation piece in the garden—that is a carefree, attractive plant besides—then try the slender, animated *Desmodium gyrans*. I won't guarantee the dramatic experience I had with mine, but I can guarantee constant fascination over one of nature's most remarkable plants.

Leaf of
Desmodium gyrans
after Darwin
JTB *The Power of Movement in Plants*

Editor's Note: *Why Does Desmodium gyrans gyrate?*

The "why" is not easy; even the "how" takes some explaining. A brief review of movement in plants seems to be in order. Every gardener is more or less aware that plants move. Roots and shoots get longer; leaves and flowers unfold; tendrils and stems twine; a house plant becomes one-sided as its leaves all face the window. For the sake of convenience, botanists have classified the various sorts of plant movement, as follows:

I. Autonomic Movements. Those due to internal factors; these movements persist under constant external conditions.

II. Paratonic Movements. Those due to an external stimulus; these movements do not occur at all under constant external conditions.

1. Nastic Movements. Those in which the external stimulus does not determine the direction of the movement.

2. Movements of Orientation. Those in which the external stimulus determines the direction of the movement.

a. Tropisms. Movement is a curvature.

b. Tactic Movements. Movement by locomotion.

The movement of the leaflets of *Desmodium gyrans* is autonomic. We will return to that after a brief review of the paratonic movements.

Paratonic movements are sensitive reactions. An external stimulus is any change or difference in the external conditions (environment) of a plant which causes that plant or any of its organs to react. Paratonic movements of plants are responses to external stimuli. All such stimuli involve differences (changes) of a particular external condition (a) in time, as the diurnal movements of plants that "sleep", that is fold their leaves or petals together or droop at night, as some clover leaves, *Albizia* leaves, tulip flowers, or (b) in space, as when a geranium in the window, lighted largely from one side, bends toward the light.

Nastic movements are responses to an external stimulus which does not determine the direction of movements. For example, the night-blooming cereus opens in the absence of light; the introduction of light from a single source does not deflect the movement of the expanding petals. When plants that "sleep" expand petals or leaves in the presence of light, the movement is outward, not toward the source of light. Nastic movements are further broken down into labeled

categories. In nastic movements, an external stimulus (a change in light or temperature, for example) stimulates the plant's organs to move; the direction of the movement is controlled from within the plant.

Tropisms are plant movements involving a curvature of the plant; the plant, or its organs, bends. Botanists assemble lengthy lists of tropisms, some of which are:

Geotropisms, responses to gravity.

Positive geotropism; the curvature is toward the stimulus (gravity); roots are positively geotropic; they grow downward.

Negative geotropism; the curvature is away from the stimulus. Main stems are negatively geotropic; they grow upward.

Thermotropism; roots and organs of some plants have been shown to grow toward or away from a source of heat.

Chemotropism; the germ tubes of pollen grains may have the direction of their growth determined by the presence (or varying concentrations) of some chemical substance in the surrounding medium.

Thigmotropism; some plant organs (or stems) are stimulated by contact with solid objects of small diameter, resulting in a curving growth; thus, tendrils twine around the object they have made contact with.

To return to the "telegraphic" movement of *Desmodium gyrans*. This is an autonomic sort of movement. When temperature and light are right, the movement occurs; when the environmental conditions are unfavorable, the movement ceases. In the case of the telegraph plant, each leaflet has, at its base, an organ called a *pulvinus*. Externally, this appears to be a slight bulge of tissue.

A vein of vascular tissue runs through the center of each pulvinus. This strand of conducting cells is surrounded by a cylinder of thin-walled cells separated by large intercellular spaces. When the effect of a stimulus has been transmitted to the pulvinus of the petiole or the stem of the leaflet, water exudes quickly from the cells into the intercellular spaces on the lower side of the pulvinus. The cells involved lose their turgor, while those above retain a turgid condition. The organ beyond the pulvinus bends downward. However, the upper cells also are involved, as are lateral ones. This has been shown by extremely delicate studies of electrostatic currents within these tissues.

The "why" of autonomic movement, is a response to external stimulation; the "how" may be explained, mechanically, by examining the structure of the pulvinus, and, cytochemically, by reviewing the most recent studies of electrochemical impulses within the tissues. The more one probes, the more one is astonished by the intricate complexity of the reaction and of the organs involved. One question remains; what is the point of the whole performance?

Reference Notes:

For persons wishing to pursue the natural distribution of *D. gyrans*, a suitable point of initial reference is: *The Flora of Eastern Himalaya*, The University of Tokyo Press, Japan, 1966.

To research movement in plants, begin with Darwin and come forward.

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OVERCOMING THE FLOWERING PROCESS IN BAMBOO

*Ron Fadem**

The current flowering of the giant Japanese timber bamboo, *Phyllostachys bambusoides,* is an economic event in Japan similar to the corn blight we experienced in the United States during the last two years. The species comprises about eighty percent of the industrial bamboo used in Japan and the clone in flower constitutes a major portion of the crop.

The flowering of a mature grove of bamboo may or may not result in the death of the entire grove, but it reduces the number of usable culms to negligible proportions for many years. In a smaller plant, such as those we find in a garden or nursery, death of the plant is almost a certainty.

This has caused a great deal of concern among gardeners and nurserymen. The gardener must stand by helplessly and watch his prized specimen, a basic part of his landscaping, turn brown and die. The nurseryman can have a hundred saleable plants turn into candidates for the trash pile.

In addition to the economic loss the more decorative cultivars are often lost. *Phyllostachys bambusoides* 'Castillon,' a striking bamboo with striped culms, started flowering about 1960. Seed was obtained but did not come true to type and it appears the cultivar is lost.

Why Bamboo Flowers

Little is known about the cause of flowering in bamboo. Some bamboos flower continuously, others flower on cycles from a few years to 60 years or more, while others have not flowered in over 150 years. The flowering of a clone is usually gregarious, regardless of the size or age of the division, or where in the world it is grown.

Those of us interested in bamboos have hoped that someone would be able to determine the cause of flowering so that measures could be taken to counteract it. Last summer when I was visiting the Hosler Giant Bamboo Nursery, Bob Hosler mentioned to me the theory that a change takes place in the root system of the bamboo which inhibits its ability to absorb nutrients. As a result of this inhibition vegetative growth all but ceases and flowering is initiated.

Treatment of Bamboos in Flower

He showed me a number of *P. bambusoides* in 48-inch boxes, which he had treated with massive doses of fertilizer. The theory was that if the plant was having trouble absorbing nutrients from the soil, excess fertilizer available to the plant would make it possible, even in its restricted position, for the roots to absorb enough food to keep up vegetative growth. Of the treated plants a few flowering culms from last year's growth were evident, however all of this year's growth consisted of normal, non-flowering culms. The heavy fertilization seemed to have reversed the process.

In my own garden there are clones of *P. bambusoides, P. vivax, Sasa disticha, S. graminea, Arundinaria simonii* and *Chimonobambusa falcata* in flower at the present time. I decided to test the theory with my own plants. Some plants were in the ground, others in gallon to twenty gallon containers. I started with a massive dose of liquid fertilizer high in nitrogen (30-10-10 at

Habit sketch of P. bambusoides 'Castillon' flower spray.

*Mr. Fadem is a commercial grower of ornamental bamboos. Pacific Bamboo Gardens, 4754 Vista Lane, San Diego, Calif. 92116

about five times the normal dosage) and followed it with an equally massive dose of 16-4-4. Weekly thereafter I fed the plants in the same manner using the 16-4-4. Within three weeks new, non-flowering, growth started. The *A. simonii* which had been in flower for six years and hadn't a leaf on it started leafing out. Almost without exception the results with all of the species were similar.

Results and Conclusion

The flowering trend appears to have been reversed, the real test of the method will be next spring when the new growth starts. From the results I have observed so far there seems little doubt that the flowering has been overcome and that the plants will survive.

While the theory and the tests could hardly constitute a scientific proof we do have definite empirical evidence that the method works. It will be up to some enterprising botanist to provide the scientific proof, however for those who grow bamboo a solution to the flowering problem seems to have been found.

Phyllostachys nigra 'Henon' in Southeastern Virginia*

Approximately a half-acre grove of this bamboo (identified for me by the late Dr. F. A. McClure) is on the property of Joseph Schmidt about one mile west of Williamsburg on Route 60, James City County, Virginia. The planting consisted of a short hedge-row in 1946. Mr. Schmidt controls the spread of the bamboo by mowing and by kicking off the sprouts, and in recent years various people have collected the young shoots for food.

New shoots are produced in May and June and will reach their maximum height in one month. A plant that I cut down was thirty-nine feet tall and had a diameter of four inches at ground level; I deposited a specimen in the Herbarium of the U.S. National Arboretum (*Baldwin* 17020).

J. T. BALDWIN, JR.
College of William and Mary
Williamsburg, Virginia 23185

*Phyllostachys nigra *'Henon'* is cited as* Phyllostachys henonsis *by Alexander H. Lawson. See A. H. Lawson;* Bamboos, A Gardener's Guide to their Cultivation in Temperate Climates. *Toplinger Publishing Co., New York, 1968.*

Gardener's Gazette

THE GARDEN CENTER OF GREATER CLEVELAND PRESENTATION OF THE DELIA WHITE VAIL MEMORIAL MEDAL TO HERBERT G. MEYER January 18, 1972

On January 18, 1972, The Garden Center of Greater Cleveland paid tribute to Herbert G. Meyer, Directing Supervisor of Horticulture at the Cleveland Board of Education, by presenting him with the Delia White Vail Memorial Medal.

The Delia White Vail Memorial Medal was established in 1957 by Mr. Herman Lansing Vail and members of his family in honor of his wife. Since that date the inscribed gold medal has been awarded to four other individuals and The Garden Club of America.

This is a national award given by The Garden Center of Greater Cleveland for outstanding horticultural achievement. It is awarded to an individual or an organization —a professional or an amateur, who has made an outstanding contribution in the field of horticulture through the hybridizing and growing of new plant varieties, through discovery of causes and cures of plant diseases or for the promotion of horticulture through education.

Mr. Meyer has, over a long span of years, played a leading part in the development of horticultural education in the Cleveland Public Schools.

In 28 years at Harvey Rice School, he saw the children's individual gardens at this school increase from 78 to 460—an adult program increase from 29 students in 1939 to what is now about 800 a year.

German Government bans DDT

The Cabinet has decided to ban the production, import, export, purchase and use of DDT and DDT preparations. A number of DDT preparations will be exempted from the ban until the end of 1975 if they are needed to fight the spread of pests such as fleas, lice and pharaoh ants and if no adequate substitutes are available.

Foodstuffs and cosmetics with more than a certain quantity of DDT deposits will also be withdrawn from circulation.

DDT is a threat to human beings, the government states in defence of the ban. It causes states of irritation in the central nervous system as well as convulsions.

Use of more than a million tons of DDT in the past has resulted in the substance being present today in the air, water, soil, plants, animals and humans.

Professor Ludwig von Manger-Konig, the State Secretary in the Health Ministry, told journalists in Bonn that people's health could be damaged in view of the prevalence of DDT in the environment and the storage of this poison in the human organism.

The DDT ban is viewed by the government as an important step towards the improvement of conservation measures.

—Die Welt, 20 August 1971

Dr. R. C. Allen elected President of the World Federation of Rose Societies

Dr. Raymond C. Allen, Director of Kingwood Center and Vice President of the American Rose Society, was recently elected President of the World Federation of Rose Societies at their first meeting in New Zealand. Dr. Allen will serve until the conclusion of the next international meeting to be held in the United States in 1974.

Dr. Allen received his Bachelor's degree from the University of Massachusetts and his Ph.D. from Cornell University, where, for 12 years, he was in charge of teaching and research work in herbaceous plant materials and supervised the Cornell Test Gardens and research program carried on in outdoor plant culture.

Dr. Allen served nine years as Executive Secretary-Editor of the American Rose Society. During this period, he developed the national rating system for rose cultivars and the system of color classification, proposed and planned the method of training and accrediting rose judges and planned and conducted the first national rose survey. In addition, he was one of the original organizers of the American Rose Foundation, serving as its first secretary and at present is Chairman of the Long Range Planning Committee of the American Rose Society. This Committee is responsible for the development of the site and planning of the new American Rose Society and American Rose Foundation headquarters in Shreveport, Louisiana. He is also Chairman of the Rose Registration Committee.

At press time this additional information on a new H. quercifolia cultivar was submitted by Professor McDaniel. *See page 16.*

'Snowflake', a Third Oak Leaf Hydrangea Cultivar

The most recently named showy *Hydrangea quercifolia* cultivar from Alabama is called 'Snowflake'. It was awarded Plant Patent No. 3,047 on April 20, 1971. The originators are Edgar G. and Loren L. Aldridge, assignors to Aldridge, Inc., a nursery at Birmingham, Alabama.

The Aldridges say its parentage is unknown, and it apparently is not closely related to either 'Harmony' or 'Roanoke'. Its large showy petaloid sepals are multiple, up to forty of them developing successively on each branch of the long panicle. Beneath the showy sepals (which might also be interpreted as bracts) there are inconspicuous flower buds which stop their development well short of anthesis. The clone is thus completely sterile, and unique among all I have observed in the Hydrangea genus.

The 'Snowflake' plant branches extensively, grows to about six feet high, and at Birmingham is in profuse flowering from April to August, with long panicles borne on long, strong peduncles. Its mature sepals, as in other clones, are white, slowly turning to green (sometimes with a rose phase) and ultimately to brown. Leaves are typical for the species, about 20 cm. long by 15 cm wide, turning to a deep wine color in autumn.

I have had 'Snowflake' flowering at Urbana, Illinois. It is expected to be as hardy as most *H. quercifolia* clones from a north Alabama native source.

H. quercifolia has long been valued in cultivation principally for its interesting exfoliating tan bark and its autumn foliage color. The three Alabama cultivars could do much to improve its popularity as a flowering shrub.

F_2 GARDENS

a page for the younger gardeners

Boys and Girls

Let's plan our own small gardens for summer. Even if spring has not yet come we can ask Mom and Dad to help us choose the best place for a garden. We can decide what plants we will grow.

And we can find out about each kind, so we will know how to make it grow as nicely as possible. A garden seed catalog tells about flowers and vegetables.

The best place for your garden is in full sun. Tree roots and roots of nearby bushes take chemicals and water from flowers and vegetables in a garden, so the best place for a garden is away from trees and bushes. Do not make your garden too big. If you never had a garden before, start with a small one. How tall are you? Make your first garden as wide as you are tall, and three times that long. Next year you can make it twice as big.

Plants grow in soil. The plant roots grow down into the earth where they gather up water and minerals to help the plant grow. No plant can grow without water and minerals. If we make the soil loose, so roots can grow through it without too much trouble, the roots will do their job well and our plants will grow better. It is very important to loosen the soil before planting the garden.

The easiest way to loosen the soil in a small garden is with a spade. A spade is a tool related to a shovel, but it is flatter, with no sides, and with a sharp bottom edge. Spading the garden is hard work, especially if you have not practiced. If your garden has never been spaded before, ask Dad to help you do it the first time. There is a story in this magazine on page 34 that tells him just how to do it. But you must learn how to use a spade, yourself. Every good gardener knows how to spade a garden.

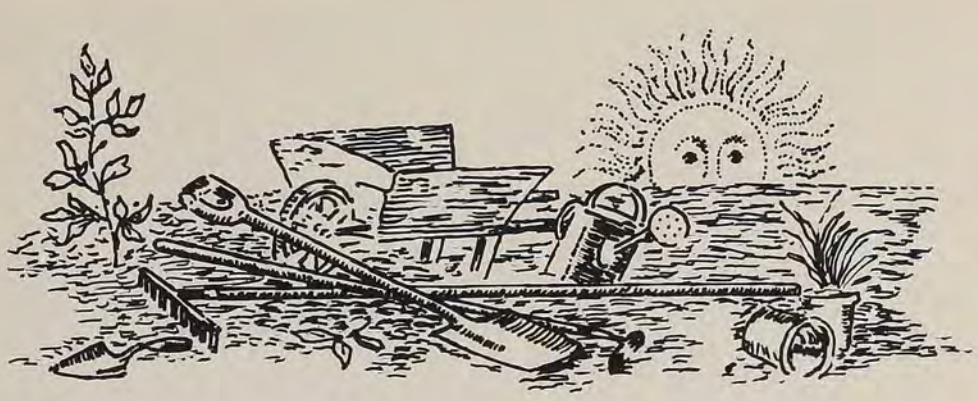
Remember that we talked about minerals that are gathered up by roots to help plants grow? Not all soil has enough minerals to enable plants to grow their best.

We can add extra minerals to the soil, so our plants will be big and healthy. We use fertilizer to add minerals to the soil. In town, we buy our fertilizer at the garden shop. Save a little bit of your spending money so you can buy things you need for your garden. The first thing you should buy is a little bag of fertilizer. Get the kind labeled 5-10-5. That means that the package has the right kinds of chemicals in the right amounts for most garden flowers and vegetables.

Scatter some fertilizer over your garden spot before it is spaded. With a yardstick, measure off one square yard—that is, a square that measures one yard on each side. Borrow a measuring cup from Mother, and scatter one-half cup of 5-10-5 fertilizer over every square yard of your garden.

Now it is time to spade the soil. The soil must be just right when it is spaded. Not too wet. Not too dry. Damp enough to when you pick up a handful of loose soil and squeeze it, it makes a wad, but dry enough so when you tap that wad with your other hand, it crumbles apart, is just right.

After the bed is spaded, with a steel garden rake, rake the soil back and forth until



the garden is level and the soil is in small pieces. Raking is hard work because you have to reach across the garden and then pull. You stretch a lot of muscles. It will make you grow straight and strong.

Now, you can begin to plant your seeds. Get a piece of string that will stretch across your garden, and tie it to two sticks. Allow a little room, a foot or so, at the end of the garden, and stretch the string across the soil, about six inches from the surface. Use this guide to make a straight row.

Dad's garden hoe is a good tool to make a furrow. Do you know what a furrow is? It is a shallow ditch, or trench, made carefully so it is the same depth all along the row. You will put seeds in the furrow, and then cover them with earth. Use one corner of the hoe to make your furrow. For small seeds like bachelor's buttons, larkspur, cock's comb, asters and spider-flower, make the furrow shallow. One inch deep is enough. For larger seeds like zinnias and sunflowers, make the furrow two inches deep.

Read the planting instructions on each package of seeds carefully. If you do not understand what they say, ask Mom or Dad to help you. Every package of seeds will tell you how far apart to make the rows and how far apart to sow your seeds in each row. They will tell you how much soil to put on top of each row of seeds. Do you know what rule the Old Gardener uses? He covers seeds in the one inch deep trench with about a quarter of an inch of soil. That is a layer of soil about as thick as a common wooden pencil. The larger seeds he covers with twice as much soil.

Did you decide to grow some flowers or vegetables with very tiny seeds? Rake a strip where you want to plant these seeds and with your finger tips, scatter the seeds as evenly as possible over the fresh-raked soil. Then pat the soil with your hand or with a small board. Not too hard, just enough so the seeds are tight in the soil.

When you cover your rows, do the same thing. After the soil is on the seeds, pat the row to press the soil down around the seeds.

Did you remember to make a label for every row? The Old Gardener makes his labels before he plants, and then as he makes every furrow, he puts in the label. Save every packet when it is empty. It will tell you about thinning your plants after they come up. It will tell you how soon they should begin to come up. When seeds sprout, we say they have germinated. If your package says your radish seeds will germinate in seven to ten days, that means that you should see little plants in the radish row a week or ten days after you plant the seed.

Do not disturb the garden until your seeds are up. When your rows of seeds have germinated, every day or two rake the soil between the rows. This keeps weeds from growing. Get your garden started when the big tulips bloom. Then you can enjoy working in it for a little while every single day. You will have flowers for your table, and, if you decide to grow them, some fresh vegetables.

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