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45 TEXT-FIGURES

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until sunset; Sundays, 10:00 a. m. until sunset. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah car line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

ENTERING THE VICTORY GARDEN HARVEST SHOW

Missouri Botanical Garden Bulletin

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FIFTY-FOURTH ANNUAL REPORT OF THE DIRECTOR

To the Board of Trustees:

The Director of the Garden has the honor to submit his report for the year ending December 31, 1942.

Two outstanding events of the year require special mention. One is the gift of Mrs. Oscar Johnson and Mr. Fairfax Funsten of a tract of land near St. Albans. This was described in detail in the November Bulletin, but its importance can not be too strongly emphasized. Together with the wild-flower reservation being developed at the Arboretum, it places the Garden in the forefront of institutions cooperating to preserve in perpetuity the native flora of a particular region. Few botanical gardens have such an unique opportunity to contribute to the conservation of wild life, and as the years go by the two areas now controlled by the Missouri Botanical Garden will be of increasing value and interest.

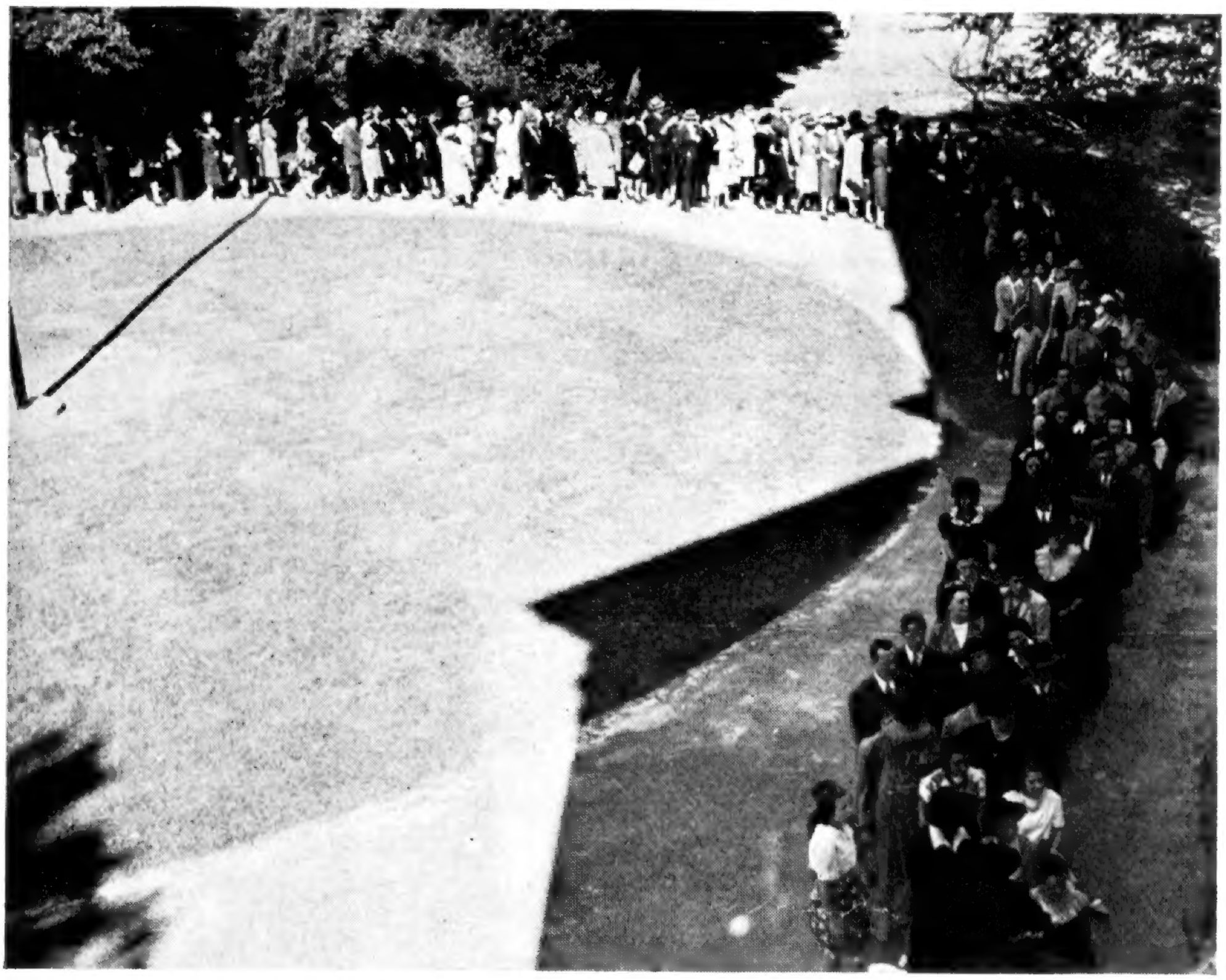
The other was the holding of a Victory Garden Harvest Show on October 2, 3 and 4, for the benefit of the Army and Navy Relief. For the first time in the history of the Garden, a small admission fee was charged and visitors were glad to have the opportunity of contributing to such a worthy cause. The varied character of the numerous exhibits attracted such favorable comment that it probably will be desirable to repeat this show each year, at least for the duration of the war.

The following account of the major displays is copied, with slight alterations, from the November number of *Garden Life,* the publication of the St. Louis Horticultural Society.

> "As one entered the bunting- and flag-decorated main gate the visitor was greeted by the flags of the South American Republics. This was the first time in St. Louis that they had all been displayed in such a manner. Turning to the right, one passed the Victory Garden Demonstration with its valuable lessons and on to the display house for the floral portion of the show. The frost of the week before had effectually disposed of the dahlias as well as many other things, so the riotous color display of previous years was not seen. However, there were fall flowers and some dahlias, plus an excellent group of decorative arrangements.
>
> "From here the visitor passed into the lower display house past a large alcove of orchids to the center where the famous annual Veiled Prophet's

Queen's bouquet was found. This regal orchid bouquet contained over four hundred blooms in perfect condition. It was displayed in a huge shadow box lined with black to set off the beauty of this floral masterpiece. From here one went on to another alcove filled with more orchids, and also a handsome display of Anthuriums. Also there was a banyan tree tapped with the herringbone pattern of cuts to allow the latex (rubber) to flow, which showed how the sap was collected.

"From this house the path led back past the central entrance of the garden southward to the Mausoleum area. Near here a tent had been erected to house the Victory Garden entries. This was easily the main feature of the show in the eyes of the visitors.



CROWD STANDING IN LINE TO ENTER SHAW'S OLD RESIDENCE
DURING VICTORY GARDEN HARVEST SHOW

"A complete line of fall vegetables was on display, together with canned fruits, vegetables, jellies, and preserves of all types. Some 500 exhibitors participated. It would be difficult to call attention to every worthwhile exhibit shown in this tent. However, there were several of particular importance. The Greater St. Louis Association of Gardeners had very excellent displays in the tent and also in the flower house. The University City Garden Club also produced an outstanding display.

"The exhibit of dehydrated foods with a dehydrator that could be made at home attracted great attention. This exhibit was really a most important one and gave to many people a completely new concept of this method of food storage and preservation. There were also educational

MANTELPIECE IN DRAWING-ROOM OF SHAW'S OLD RESIDENCE

LOOKING INTO THE DRAWING-ROOM OF SHAW'S OLD RESIDENCE
FROM THE DINING-ROOM

exhibits placed by the various state and government agencies, all being of great value. The exhibit in the tent was unquestionably of such interest that it should be repeated as an annual feature of our show.

"The old Shaw Residence, now nearly one hundred years old, was opened and some of the rooms furnished with original pieces owned by Mr. Shaw. Visitors were thus able to gather a true picture of these rooms as they were originally used. Young members of the Junior League were on hand effectively showing the costumes of that day. The entire display was quite good and was greatly appreciated.

"In the old museum building the Morton May flower pictures were shown, together with some of the original arrangements by Mrs. Vane Deal from which the pictures were made. In this hall there were also rubber-producing and fiber plants, which were particularly interesting in view of the present war situation, and an excellent display of herbs, together with the fittings and materials of an old apothecary's shop, which introduced many to herbs in general.

"In the experimental greenhouse many different types of house plants were shown, including a great many rarities. A complete exhibit of orchid culture was arranged so that the visitor could see the various steps in the production of these plants. From the minute seed planted in flasks to the final potting of small plants, and eventually leading up to the mature blooming plant, every major step was shown in detail. This display was one that could only have been produced by the Garden.

"The library in the Administration Building put out some of its best and rarest books to show to those interested. The oldest book bore a 1487 date mark. Another showed colored engravings by the famous Redouté.

"On the whole the show was a tremendous success . The Coast Guard Band and the Ft. Leonard Wood Band played for the visitors each day and their efforts were greatly appreciated. The new flag pole was in service and the daily ceremony at the flag added color to the occasion. We may not be able to have another such show on this scale. There is no question that all who participated and who attended felt well repaid for their efforts."

The Friends of the Garden continue to make possible, by their gifts, improvements at the Arboretum which otherwise could not be undertaken. The full amount contributed by individuals and Garden Clubs during 1942 was $3,834.58. This fund is being held until labor and machinery and material will again be available to make possible resuming work on the Quarry Road, the last main thoroughfare to be completed. Perhaps by that time enough funds will have accumulated to finish the project.

ARBORETUM

For the first time in several years no new construction work at the Arboretum is reported. However, it has been a busy year and a great number of changes in the landscape have been brought about. The most conspicuous, to the casual visitor, is the clearing of the field south of the West Bridge and of several large fields which had been allowed to grow up into brush. The covering of such fields with an impenetrable growth of small trees shows a commendable attempt of Nature to reforest an area, but the effort is of little consequence—both from the forester's and the esthetic

NORTHWEST CORNER OF DRAWING-ROOM OF SHAW'S OLD RESIDENCE

viewpoint—because no oaks can be found there. The light-winged seeds of elm and maple are carried far by the wind, while the acorns have no such advantage in the race. In time oaks may appear, but certainly not until several generations of other trees have lived and died. From the unhappy appearance of the elms during each dry summer it is evident that very few would ever grow to maturity, and that after each twenty years another generation would be in possession. During the year about 300 acres were cleared, an operation which required 1070 man hours of labor and about 40 hours of tractor operation.

Tractor mowing of the Pinetum, Crabapple Hill and the many other open fields reached a new high of 707 hours. This was made possible by the purchase of a small used tractor, which gives us two tractor-mower units each equipped with a 7-foot sickle bar. Mowing serves several purposes: it stimulates the blue grass and checks unwanted weeds; it reduces the fire hazard, since a mowed field burns less easily and there is less fuel if a fire does start; and, of course, a mowed field is much more attractive. To facilitate mowing some grading was done in the Apple Orchard and along a service road. About six acres in all were smoothed by bullgrader, disced, mulched and sown to blue grass. Since mowing seems likely to increase as more and more of the Arboretum is developed and since it must be carefully timed in order to favor the blue grass and control the weedy growth, it becomes necessary to find ways of "streamlining" this operation. This can be done, in part, by grading in ditches and removing brushy patches which require much turning about while mowing. Thus more acreage can be covered in the limited time available with no increase in equipment.

The harvesting of blue grass seed, an important activity in past seasons, was far below expectation. The very rainy weather of late June and July made it impossible to get into the fields when the seed was ripe and made it even more difficult to cure what seed was collected. Over a ton of rough seed was shipped to the plant of Ed. F. Mangelsdorf & Bro. Seed Co., at Atchison, Kans., who threshed it free of charge; this yielded 602 pounds of cleaned seed. Later it was found that not only was the crop short but also the germination was discouragingly low. It is planned to use a combine, at least experimentally, in future harvests of blue grass.

A small International Combine was purchased late in the summer which will be used to harvest wheat, soybeans, grass seed and perhaps castor-beans. Its value was demonstrated when early frost cut short the growth of all soybeans and a planting of selected castor beans. Without this machine a promising variety of soybeans would have disappeared, since it would not have been possible to gather enough seed by hand to begin anew next year. The combine also showed great promise in harvesting the castor-beans.

The seeds were not filled out, but the machine removed the hulls without breaking the seed-coats.

A saw-mill which was purchased last year was set up in January and produced 5,866 board feet of lumber, consisting of black walnut, elm, etc. Most of this was used for stagings in the orchid houses where wooden platforms are needed to hold the potted plants above the water-filled benches. In addition, a shed over the mill and a lumber shed were built largely out of timber sawn from the logs remaining from the Trail House roof. Previously, when it became necessary to remove a tree, the only possible utilization was in cordwood. Now the entire tree can be used. The upper branches are reduced to cordwood, while larger parts are hauled to the mill and sawed into lumber during the winter. This assures an ample supply of rough lumber for cold-frames, greenhouse stagings and other work where specifications are not too exacting.

The trucks were operated 1268 hours during the year, requiring 1446 gallons of gasoline at the rate of 4½ miles per gallon. The use of trucks is rather expensive, but it must be remembered that it simplifies many operations and makes others possible. As an example, a truck may be used to take a crew of men and tools a distance of two miles in the morning; it may be parked all day and used again for the return trip that night. The same truck may later be one of many hauling gravel. In this case it leaves the river bar with a 125 per cent overload, pulls through 1¾ miles of mud road and climbs a steep hill for another mile before it can be operated above extra low gear. Moreover, neither performance will be exceptional.

It has been the practice in past years to store sufficient coal for an entire season. This has taxed the capacity of the coal bunker and caused some bulging of the walls. To overcome this, reinforced concrete buttresses were poured at proper intervals around the building. About one ton of steel and 250 sacks of cement were used. All of this work was done by our own men.

On the whole, the past season was satisfactory for the growth of trees and shrubs. About 8,000 gallons of water were hauled for irrigation purposes, most of which was used during the transplanting period. Experimental fertilization with disposal-plant sludge was continued, and 13,000 gallons were hauled by tank truck for use on grass, evergreens, crabapples and azaleas. Indications are that it is a worth-while fertilizer.

Some years ago varieties of pecans and walnuts were planted in a section along Brush Creek which was then used as a nursery. Later the nursery was discontinued. During the past year everything except the nut trees, of which there are over 100 of bearing size some over 30 feet tall, was removed from this area. A foot trail has now been cut through this orchard to

facilitate inspection and study. In time the nut trees should prove worthwhile from both a practical and scientific viewpoint.

During the past year nearly 20,000 plants, ranging from small propagations to large trees, were set out in the nursery and in permanent locations. The greater part of the material in the Main Nursery was dug up and planted out. It is proposed to "rest" this land for several years, an additional three acres to the east having been prepared for nursery use in the meantime. A large garage was moved from a former building site and placed on a concrete foundation to serve as a nursery tool-shed. The area about this building was planted with a number of evergreens which would not grow in a more exposed locality. A small section was set aside near this shed to be used as an "observation ground" for plants of which we have only a single specimen and which have especially exacting requirements. A partial list of plants and the number established in the permanent collections during the year follows: azalea, 5,602; boxwood in variety, 200; yew (Taxus) in variety, 655; dogwood *(Cornus florida)*, 3,000; magnolia *(Magnolia Soulangeana)*, 132; short-leaf pine *(Pinus echinata)*, 1,000; Virginia pine *(Pinus virginiana)*, 1,000; cypress *(Taxodium distichum)*, 1,000. This does not include some 4,338 of all kinds moved from the nursery to a permanent location.

The planning and supervision of most of the above work has been the responsibility of Mr. A. P. Beilmann, Manager of the Arboretum.

Orchids.—With the exception of a few hundred plants kept in town, the major portion of the orchid collection, comprising some 20,000 plants, is housed at the Arboretum. Cared for by Mr. Fred Wegloener, Orchid Grower, the collection has been greatly improved during the past year both as to general condition and production of flowers. From the Cattleya group, including species and hybrids, 22,977 flowers were produced; sprays such as Cymbidium, Oncidium, Dendrobium, etc., 4,435 (number of flowers per spray varying from 8 to 100); Cypripediums and related genera, 1,942; botanical species, 1,063—a grand total of 30,417 orchid flowers and sprays, many of which were displayed either at the annual orchid show or throughout the year in the alcoves of the Floral Display House. In addition 938 flowers, chiefly Cattleyas, were produced in the city greenhouses.

SUNSHINE RECORD

Nothing so graphically demonstrates the effect of enforcing an adequate smoke elimination ordinance as the change in the comparative amounts of sunshine recorded in the city and at the Arboretum, 35 miles southwest of St. Louis. Previous to the enforcement of the ordinance the excess of sunshine was always in favor of the out-of-town location, some years as much

as 200 hours, with the greatest disproportion in the winter months. In 1941 there were but 34 hours more of sunshine at the Arboretum, while for 1942 St. Louis had only 22.25 hours less sun that the Arboretum. As has been repeatedly pointed out, the critical time for plants, when they need all possible sun, is during the fall and winter months. During the summer there is usually more sunlight than the plant can use. For the six months, January and February and September through December 1942, St. Louis had practically the same amount of sun as the Arboretum, thus emphasizing the fact that the improvement has come at the time of year when smoke was formerly more prevalent in the city. While it may always be expected that there will be differences in the out-of-town and in-town sunshine, there seems to be no satisfactory explanation for the marked change in atmospheric conditions other than the elimination of the winter smoke clouds, to which St. Louis was subjected for so many years.

COMPARATIVE HOURS OF CITY AND COUNTRY SUNSHINE

Month	*City Garden Hours*	*Arboretum Hours*
January	161	167.25
February	112	108
March	161	168.50
April	167.50	228.50
May	204	235.50
June	201	191.50
July	283.50	278
August	262.50	233
September	241.25	213
October	182.25	160
November	119.75	128
December	75.25	82.50
	2171.50	2193.75
		2171.50
Excess of sunshine hours at Arboretum		22.25

CITY GARDEN CONSTRUCTION AND MAINTENANCE

The importance of maintaining the central heating plant at its highest efficiency need not be emphasized. Since the original installation was some thirty years ago, it is necessary that the entire system be carefully gone over during the summer months to anticipate, as far as possible, weaknesses that might develop during the heating season. This summer the 10-inch main supplying the upper Garden was overhauled. One flange had to be cut out and a new piece welded in, while several old gaskets were replaced. Fourteen steam traps were repaired and 268 thermostatic traps were dismantled,

cleaned and repaired. All valves, expansion joints, etc., were repacked and new pipe installed from main feed water-line to the three boilers. The tubes and drums of the boilers were cleaned and the brick work under each was repaired. Much additional repair and replacement work was accomplished, such as installing new heating pipes in the Experimental Greenhouse, replacing 2-inch pipe in the sprinkling system of the Italian Garden, resetting heating coils in the water-lily propagating bench, supplying new angle-iron frames in the Bromeliad and Plant Curiosities houses, rebuilding with concrete the steps at the Engineer's house and those at the west and south exits from the Main Conservatory, as well as the fountain in the Italian Garden, erecting a 50-foot permanent flag-pole south of the Old Residence, and placing 80 new directional signs in the main garden.

Painting.—In addition to routine painting of iron work, greenhouse roofs, etc., which never stops, the interior of the Old Residence and the Cleveland Ave. Gate House were cleaned and painted and the exterior of the Director's residence was painted.

Planting.—A long-contemplated improvement was started this year in replanting the Knolls in the Main Garden. Many of the trees had outgrown their location and the older shrubs needed to be replaced with better varieties. The entire east knoll has now been cleared and replanted, and it is hoped the west knoll may be similarly treated during the coming year.

CITY GARDENS

Each year various agricultural crops have been grown in the demonstration plots in the south section of the Economic Garden, some of the more important being cotton, rice, tobacco and sugar-cane. The war has forced emphasis on home-grown vegetables which have become scarce and very expensive (as much as 25 cents for a head of lettuce or a stalk of celery in December), and while there were some home gardens in 1942 doubtless there will be many more in the next few years. To aid the government effort in food production, 38 beds in the Economic Garden, comprising an area of almost a quarter of an acre, were planted with vegetables to demonstrate proper growing methods. Although only 36 kinds were grown, there were 142 varieties—for instance, 4 varieties of beets, 9 of carrots, and 11 of tomatoes. Valuable information on the growth of vegetables in the St. Louis area was obtained with reference to the spacing of plants; the elapsed time between seed sowing and germination; the number of days required to mature a crop; the superiority of some varieties; the difference between spring and fall crops; the average yield per plant, as in tomatoes; and insect and disease troubles. During the summer the harvest of beets, cabbage, carrots, egg-plants, onions, parsnips, squash, sweet-potatoes and tomatoes

were delivered to the Day Nursery at the Patrick Henry School.

In another year the iris garden will reflect the generosity of iris fanciers and growers who contributed 91 new varieties to the Garden's collection. Local donations were received from Miss Mae Winningham and Mr. Frederick Pitzman. The following iris dealers generously responded to an appeal for new varieties: Fairmount Gardens, Lowell, Massachusetts; Longfield Iris Farm, Bluffton, Indiana; Over-the-Garden-Wall, North Granby, Connecticut; Mr. Carl Salbach, Berkeley, California; Mr. Hans P. Sass, Elkhorn, Nebraska; and Schreiner's Iris Gardens, St. Paul, Minn.

For the first time in years, all the plants in the rose garden received an application of cow manure, which, with copious spring rains, benefited them materially. The central circle was entirely replanted with Pfitzer's junipers, polyantha roses and a border of Teucrium. Jackson & Perkins, of Newark, New York, contributed two climbing roses of the variety STEPHEN FOSTER.

During October 14 large beds, with a total area of one-fifth of an acre, in the Linnean Garden, were entirely replanted after the soil had been fertilized and spaded. All the old bearded iris were replaced with improved ones. Twenty-eight new varieties of Siberian iris and 6 hemerocallis were purchased for this garden.

As their contribution towards the Victory Garden Harvest Show the Landscape and Nurserymen's Association gave and planted 54 evergreens just south of the Grove. These, together with the 19 species of evergreens donated by the McGovern Nursery of Kirkwood, Missouri, will be used as an experiment to determine the improvement in growth of evergreens in the city since the reduction of the smoke evil. The A. H. Hummert Seed Company of St. Louis contributed 150 narcissus and 300 tulips.

The growing of ornamental vegetables, such as cherry tomatoes and rhubarb chard, in some of the beds in the Main Garden was an innovation which attracted a great deal of attention. Due to popular demand it will be repeated in 1943, with all of the beds in this area planted with vegetables instead of bedding plants.

INDOOR FLORAL DISPLAYS

The orchid show opened on January 18 and continued until March 15. For the annual flower sermon at Christ Church Cathedral, on February 1, the Garden sent four dozen plants. An azalea garden was installed at the Arena for the Greater St. Louis Flower and Garden Show, March 14 to 22. Azaleas and cinerarias were exhibited in the Floral Display House on March 19, later being replaced with other spring flowers. The St. Louis Horticultural Society held its flower show on May 16 and 17, which was followed by a display of hydrangeas, beginning May 24. The summer exhibit of

fancy-leaved caladiums and fuchsias opened on June 14. The dahlia show of the St. Louis Horticultural Society was held October 2 to 4, and chrysanthemums were on exhibition from November 8 to 29. As in previous years, the Book and Flower Guild distributed the chrysanthemums at the close of the show to the various hospitals and institutions throughout the city. The poinsettia or Christmas show opened on December 6.

All of the floral displays are designed and executed by Mr. Paul A. Kohl, Floriculturist, who is also in charge of the major portion of the outdoor gardens.

MAIN CONSERVATORIES AND EXOTIC RANGES

During 1942 no extensive improvements have been made in the Main Conservatories, although new plant material has been added on an even larger scale than in previous years.

The Palm House particularly has done remarkably well and now the plants are beginning to show natural jungle growth which was expected after the alteration of the original layout a few years ago. When the Main Conservatories were completed in 1914 the Palm House was one of the first to be planted. Exotic palms were the especial attraction, with the golden club-moss, *Selaginella denticulata*, used as a ground cover. After twenty-five years many of the palms assumed such proportions, particularly those in the side beds, that a great number of them had to be cut down. Other plants, mostly aroids, were gradually moved in to cover up the bare spots. The palms still retain the prominent positions but the undercover is now a mass of exotic foliage plants, including Aglaonemas, Anthuriums, Calatheas, Codiaeums, Dracaenas, Dieffenbachias, Heliconias, and Marantas.

In the Economic House several large trees, particularly of the genus Ficus, were removed, continuing the "weeding out" begun the previous year. With the exception of two or three tall trees this process is now complete. Several vines have been planted, mostly as an experiment, but they show great promise. Among them are *Abrus precatorius* (rosary pea), *Allamanda cathartica* var. *Hendersoni*, *Ipomoea cathartica* (purple morning-glory), *Kennedia rubicunda*, *Prestonia mollis*, and *Stigmaphyllon ciliatum* (Amazon vine). The textile-producing plants (Sansevierias) were moved from the bed and planted as a screen in front of the steam pipes. The mango tree, *Mangifera indica*, flowered in early spring and later bore a number of edible fruits.

The Garden's collection of sago plants was enhanced by the addition of *Cycas Rumphii*, a medium-sized Malayan species, which was planted in the center bed of the Cycad House. This house contains some outstanding and rare forms. Biology classes visit this collection for the express purpose of

studying these beautiful cone-bearing plants whose ancestors flourished during the Coal Age.

Since the cacti and succulents form such an important part of the Garden's collections it is necessary to devote much time to their care. The attention thus given results in plants that make vigorous growth, give an abundance of bloom, and present a healthy appearance throughout the year. The night-blooming Cerei particularly put on a dazzling exhibition of floral splendour and in cool weather often stay open until 9 or 10 o'clock in the morning. The most profuse bloomers seem to be *Monvillea Cavendishii*, *Hylocereus costaricensis*, *H. undatus*, *Selenicereus Macdonaldiae*, *Harrisia Martinii*, *H. Bonplandii* and *H. tortuosa*. Xerophytes other than succulents, such as the desert trumpet-bush *(Tecoma Stans* var. *angustatum)*, desert matrimony bush *(Lycium brevipes)*, and the scarlet plume *(Euphorbia fulgens)*, likewise make a vivid display with their respective yellow, lavender and scarlet blooms. The six-year old *Euphorbia pulcherrima* is another free bloomer and flowers twice during the year, beginning in late November and ending about the end of February, and again in April and May. Many visitors, being acquainted only with potted specimens of the Christmas poinsettia, do not realize that this popular flower may grow into a large tree such as is seen in the Cactus House.

In the Exotic Range all the ordinary routine labor has been performed as usual. Of major importance was the work done on the vast bromeliad collection, which will be continued until all the flowering types have been studied and correctly named. The Garden has one of the finest collections of showy Bromels in this country. As in the past, this range is under the care of Mr. Ladislaus Cutak, in charge of Succulents.

EXPERIMENTAL GREENHOUSES

The research work on orchids, under the direction of Dr. D. C. Fairburn, Horticulturist to the Garden, has expanded considerably during the past year. Many thousand hybrid seedlings in various stages of development now occupy about one-half of the bench space in the Experimental Greenhouse. Following are some of the investigations under way: Determination of the optimum amount of sunlight for the growth of orchid plants in Missouri; effect of electric light at night on the growth of young seedlings; carbon dioxide treatments to stimulate rapid growth of young seedlings; correlation of size of seedlings with quality and quantity of flowers produced; supplementary feeding with nutrient solutions to increase rate of growth of seedlings potted in osmunda fibre; effect of various nutrient culture media on the germination of seeds and the growth of the seedlings in the flasks; symbiotic and non-symbiotic methods critically compared; raising

plants by gravel-culture methods, using haydite and nutrient solutions instead of the usual osmunda fibre. Preliminary experiments with gravel culture yielded such favorable results that a 50-ft. bench in the greenhouse has now been equipped for this work. A 150-gallon storage tank for the nutrient solutions has been installed in the greenhouse basement and the solutions are pumped into the gravel-culture bench at regular intervals. The seedlings are transplanted out of the flask directly into gravel cultures instead of to community pots of orchid peat.

A number of hybrid Nepenthes or pitcher plants have been raised from seed. Additional crosses being made from selected varieties in the Garden's large collection should result in greatly increasing the number and variety of these plants.

Considerable time and greenhouse space have been devoted to the propagation of various plants. Over 5,000 cuttings of Balkan ivies were rooted and set out in the Mausoleum as a ground cover. Many kinds of house and garden plants propagated by cuttings are being raised for use in the amateur gardening course. Several thousand more azaleas were started from seed and sent to the Arboretum for group plantings. The usual number of new annuals and perennials was started in the greenhouses and transplanted to the nursery to determine their value as ornamentals in this climate.

The amateur gardening course monopolized a large portion of the experimental range during the late winter and spring. Some 10,000 cuttings and seedlings of many plants were raised by the class members and transplanted to their own gardens.

A new sprinkling system to control humidity and an extra heating unit were installed in one of the greenhouses, providing better growing conditions.

SUPERVISED INSTRUCTION FOR SCHOOL CHILDREN

Under the guidance of Miss Clara M. Heising, the special teacher provided through the cooperation of the Board of Education, more than 11,000 pupils from elementary and high schools came to the Garden for nature study work this year. After school hours groups of Girl Scouts and Brownies with their leaders came for field and merit-badge work.

As in the past, early morning bird walks were conducted in the spring and fall, a total of 91 species of birds being observed. More than 700 adults and children attended these walks, and Science and Bird Clubs came at odd times for field work in their particular subject. As a result many pupils, as well as teachers, have become "nature-conscious" and are developing worth-while hobbies for leisure hours.

The program for the school-children varies with their age and grade, the particular interests of the group, the season and the weather. Regardless

of what had been planned any unusual phenomenon is always stressed. Plants of all kinds, trees, birds, insects, etc., are observed, followed by questions calculated to stimulate the child's interest. Whenever possible the lessons are correlated with the work in geography and history in order that a clear idea might be obtained of the natural flora and fauna of a particular country or region studied.

After a visit to the Garden many teachers were able to correlate the nature work with art and language lessons, particularly composition, letter-writing and public speaking. When possible, plant material from the Garden was given to classes for project work, thus affording an opportunity for developing the pupils' initiation and cooperation.

The following list will give some idea of the scope of the work: general field trips, wild flowers, study of plant life, pollination, seed dispersal, propagation, plants' preparation for winter, adaptation of parts of plants, vernation of different types of leaves, study of buds and leaves, tolerance among plants, competition among plants and their parts, tree study, accommodation of trees and other plants to their neighbors, appreciation of autumn coloring in leaves, climbing methods of certain vines, conservation of trees and wild flowers, Nature's method of healing wounds in trees, study of insect-eating plants; general study of insects, beneficial and injurious insects, cooperation of ants and aphids and of ants and mealy bugs, insects' preparation for winter, inter-relation and cooperation of plant, insect and bird life; bird study, particularly during migration periods; the spider as an engineer, as an aviator; squirrels' and toads' preparation for winter.

RESEARCH AND INSTRUCTION

Dr. Henry N. Andrews, formerly Instructor in Botany in the Henry Shaw School of Botany, was promoted to Assistant Professor and appointed as Paleobotanist to the Missouri Botanical Garden. Dr. Robert W. Schery, formerly Assistant in Botany, was made Instructor in the Henry Shaw School of Botany and Research Assistant at the Missouri Botanical Garden. Anheuser-Busch Inc. has established a special fellowship in the Henry Shaw School of Botany for the study of the genetics of yeast. Under this fellowship, Dr. Carl Lindegren has been appointed Senior Fellow, and Gertrude Lindegren Research Assistant.

Dr. J. M. Greenman, Curator of the Herbarium and Professor in the Henry Shaw School of Botany of Washington University, has continued to devote the greater part of his time and efforts to the regular but increasing routine curatorial duties in the herbarium. He has also continued to direct the work of graduate students majoring in taxonomy of higher plants in the Shaw School of Botany of Washington University.

Dr. Greenman, in the limited time available, has continued to pursue research on various groups of flowering plants and to further monographic and floristic studies on which he has long been engaged.

Dr. C. W. Dodge, Mycologist to the Garden and Professor in the Henry Shaw School of Botany of Washington University, on leave of absence during the first eight months of the year, served as exchange professor in the Department of State under the terms of the Buenos Aires Convention. During that time he lectured in the Facultad de Ciencias Naturales y Farmacia de la Universidad Nacional de Guatemala and served as dermatologist in the clinic of Sanidad Publica. In vacations and holidays, he collected a large number of Guatemalan lichens, visiting most of the accessible parts of the republic except Petén Dept. He completed a short paper on a very serious Helminthosporium disease of citronella and lemon grass and studied a serious disease of coffee in San Marcos. At a convocation of the Universidad Nacional on August 1, he received an honorary degree and gave the principal address on the relation of the four freedoms to Guatemalan agricultural and educational problems. Returning by train through Mexico, he visited various laboratories and made a small collection of lichens at the Desierto de los Leones near Mexico City.

During the autumn most of his time has been occupied in completing the study of lichens from Antarctica and the subantarctic islands of the Indian Ocean. The usual courses of instruction have been given. Dr. Grant D. Darker gave the course in general bacteriology in University College during the past academic year and in both summer sessions of Washington University. Dr. Carl Lindegren is giving this course during the present academic year in University College. Routine determinations of various human and plant pathogenic fungi have been made as various cultures were received.

Dr. Edgar Anderson, Geneticist to the Garden and Engelmann Professor in the Henry Shaw School of Botany of Washington University, spent eleven weeks during the summer as guest investigator at the Blandy Experimental Farm of the University of Virginia, at Boyce, Virginia. During the year the major portion of his time was spent in continuing the studies of maize described in some detail in last year's report. In the ANNALS for April he published jointly with Dr. Hugh C. Cutler the first of a series of papers on "Races of *Zea Mays*." Others are in the press or in preparation, several of them to appear as appendixes to archaeological or ethnological monographs by other investigators.

Dr. Robert E. Woodson, Jr., Assistant Curator of the Herbarium and Associate Professor in the Henry Shaw School of Botany of Washington University, has continued his teaching duties at the University. His re-

search has been concerned chiefly with various problems relating to the projected *Flora of Panama* of which he and Dr. Schery are editors. The *Flora* is scheduled to begin publication in the February, 1943, number of the ANNALS OF THE MISSOURI BOTANICAL GARDEN, and will be divided into fascicles appearing at intervals for several years. This work will contain all available information regarding the higher plants of Panama, and is the first comprehensive account of that kind to be attempted. In addition to these activities, Dr. Woodson has continued his studies of Apocynaceae and Asclepiadaceae.

Degrees.—The following students in the Henry Shaw School of Botany received advanced degrees at the Washington University commencement in June: Doctor of Philosophy—Robert W. Schery, A.B. and M.S., Washington University (Taxonomy and Morphology); Master of Science—Eloise Pannell, B.Ed., Southern Illinois State Normal University, Carbondale (Morphology); Rev. Robert R. Brinker, O.F.M., A.B., St. Joseph's College, Westmont, Ill., Graduate of Theology, St. Joseph's Seminary (Taxonomy).

Graduates and Fellows.—Because of the war very few appointments were made in the Henry Shaw School of Botany for the year 1942-1943. Two senior students at Washington University, Charles Bixler Heiser, Jr. and Elisabeth Hamilton, were appointed as student assistants.

Van Blarcom Scholarship: Dorothy Marie Gaebler, B.A., Washington University (Mycology).

Independent student: Jean Catherine Loeffel, A.B., University of Missouri (Taxonomy).

Published Articles.—

Anderson, Edgar: The Missouri Botanical Garden Arboretum, a Laboratory for the Week-end Gardener. Mo. Bot. Gard. Bull. March, 1942. (Reprinted from Bull. Gard Club Amer. Ser. 7, No. 19:94-98. January, 1942); Narcissi at the Missouri Botanical Garden Arboretum. Mo. Bot. Gard. Bull. March, 1942; Reflections on Evolution. [Review of Willis, J. C. The Course of Evolution]. Jour. Hered. **33**:67-68. February, 1942; Vegetable Gardening in St. Louis. Garden Life. February, 1942; *Veronica hederaefolia* in Missouri. Mo. Bot. Gard. Bull. May, 1942; with Cutler, Hugh C.: Races of *Zea Mays:* I Their Recognition and Classification. Ann. Mo. Bot. Gard. **29**:69-88. April, 1942.

Andrews, Henry N.: Contributions to Our Knowledge of American Carboniferous Floras. I. Scleropteris, gen. nov., Mesoxylon and Amyelon. Ann. Mo. Bot. Gard. **29**:1-18. February, 1942; Contributions V. Heterangium. Ann. Mo. Bot. Gard. **29**:275-282. November, 1942; with Pannell, Eloise: Contributions II. Lepidocarpon. Ann. Mo. Bot. Gard. **29**:19-34. Feb-

ruary, 1942; A Fossil Araucarian Wood from Western Wyoming. Ann. Mo. Bot. Gard. **29**:283-286. November, 1942.

Beilmann, A. P.: The Mechanized Equipment of a Botanical Garden. Mo. Bot. Gard. Bull. September, 1942; New or Noteworthy Plants for St. Louis Gardens. XIV. The Vetch-leaf Sophora. Mo. Bot. Gard. Bull. November, 1942; with Pring, George H.: A Report on the Serbian Spruce. Mo. Bot. Gard. Bull. November, 1942.

Brenner, Louis G.: The Environmental Variables of the Missouri Botanical Garden Wildflower Reservation at Gray Summit. Ann. Mo. Bot. Gard. **29**:103-135. April, 1942; with Erickson, Ralph O. and Wraight, Joseph: The Dolomitic Glades of East-central Missouri. Ann. Mo. Bot. Gard. **29**:103-135. April, 1942.

Brinker, Robert R.: Monograph of Schoenocaulon. Ann. Mo. Bot. Gard. **29**:287-314. November, 1942.

Clark, Robert Brown: A Guide to the Hardy Trees and Large Shrubs of the Missouri Botanical Garden. Mo. Bot. Gard. Bull. October, 1942; A Revision of the Genus Bumelia in the United States. Ann. Mo. Bot. Gard. **29**:155-182. September, 1942.

Cutak, Ladislaus: Amateurs Prefer Mammillarias. Garden Life. October, 1942; Cacti Are Ideal House Plants. Garden Life. June, 1942; Cacti as House Plants. Desert Plant Life. May-June, 1942; Courage in War and Courage in Plants. Garden Life. April, 1942 (Reprinted in March Desert Plant Life under the title "Gardening as a Courage Builder"); Desirable Cacti for the Beginner. Garden Life. August, 1942; Down in Seminole Land. Gard. Chron. Amer. January, 1942; Florida Adventure. Jour. Cactus & Succulent Soc. Amer. December, 1941 (Reprinted in American Eagle. February 19, 1942); The Henry Shaw Cactus Club. Jour. Cactus & Succulent Soc. Amer. August, 1942; Introducing the Cactus Family. Garden Life. July, 1942; The Medicinal *Aloe vera*. American Eagle. September 17, 1942; Turks Caps Are Found in America. Mo. Bot. Gard. Bull. May, 1942.

Dodge, Carroll William: Discurso [Algunos Problemas Universitarios y las Cuatro Libertades de Roosevelt]. La Escuela de Farmacia **5**[55-56]: 8-10. 1942; Helminthosporium Spot of Citronella and Lemon Grass in Guatemala. Ann. Mo. Bot. Gard. **29**:137-140. April, 1942; Las Manchas de la Citronella y del Té de Limón por el Helminthosporium. La Escuela de Farmacia **5**[53-54]: 7-9. 1 fig. 1942.

Erickson, Ralph O.: The Type of *Clematis hirsutissima*. Madroño. **6**:259-260. October, 1942; with Brenner, Louis G. and Wraight, Joseph: Dolomitic Glades of East-central Missouri. Ann. Mo. Bot. Gard. **29**:89-101. April, 1942.

Kohl, Paul A.:Continuous Bloom in St. Louis Gardens. Mo. Bot. Gard. Bull. April, 1942; The Horse-chestnut. Mo. Bot. Gard. Bull. November, 1942.

Lenz, L. Wayne: Contributions to Our Knowledge of American Carboniferous Floras. III. Stipitopteris. Ann. Mo. Bot. Gard. **29**:59-68. April, 1942.

Moore, George T.: Orchids at the Missouri Botanical Garden. Mo. Bot. Gard. Bull. February, 1942.

Pring, George H.: Five-fingered Swan-neck Orchid *(Cycnoches pentadactylon)*. Mo. Bot. Gard. Bull. November, 1942; *Nymphaea colorata.* Garden Glories (publication of Garden Club of Illinois). July, 1942; Some Panamanian Oncidiums. Mo. Bot. Gard. Bull. February, 1942; Tropical Water-lilies. Home Gardening. April, 1942 (Reprinted from March, 1941 Garden BULLETIN); Water-lilies, Propagation and Storage. Garden Life. November, 1942; with Beilmann, A. P.: A Report on the Serbian Spruce. Mo. Bot. Gard. Bull. November, 1942.

Pannell, Eloise: Contributions to Our Knowledge of American Carboniferous Floras. IV. A New Species of Lepidodendron. Ann. Mo. Bot. Gard. **29**:245-274. November, 1942; with Andrews, Henry N.: Contributions II. Lepidocarpon. Ann. Mo. Bot. Gard. **29**:19-34. February, 1942; A Fossil Araucarian Wood from Western Wyoming. Ann. Mo. Bot. Gard. **29**:283-286. November, 1942.

Schery, Robert W.: A Few Facts Concerning the Flora of Panama. Chron. Bot. **7**:77-79. March, 1942; Monograph of Malvaviscus. Ann. Mo. Bot. Gard. **29**:183-244. September, 1942; Plants to Meet the War Emergency. Fibers. Mo. Bot. Gard. Bull. June, 1942 (Reprinted in June 30 and July 15 Chemurgic Digest under the title "Fiber Plants to Meet the War Emergency"); with Woodson, Robert E. Jr.: Contributions toward a Flora of Panama, VI. Collections chiefly by H. von Wedel in Bocas del Toro. Ann. Mo. Bot. Gard. **29**:317-378. November, 1942.

Woodson, Robert E. Jr.: Commentary on the North American Genera of Commelinaceae. Ann. Mo. Bot. Gard. **29**:141-154. September, 1942; Plants to Meet the War Emergency. Rubber. Mo. Bot. Gard. Bull. June, 1942; with Schery, Robert W.: Contributions toward a Flora of Panama. VI. Collections chiefly by H. von Wedel in Bocas del Toro. Ann. Mo. Bot. Gard. **29**:317-378. November, 1942.

Scientific and Popular Lectures.—

Dr. Edgar Anderson, Geneticist to the Garden: January 13, before the High School Science Clubs, at Washington University, "Indian Corn"; February 3, before the Ladue Garden Club, "Vegetable Gardening in St. Louis"; February 5, before the Anderson Chapter of the St. Louis Junior

Academy of Science, Southwest High School, "Corn of the Southwestern Indians"; February 17, before the Biological Fraternity of Harris Teachers' College, "Kinds of Corn"; March 6, participated in a garden clinic and panel discussion conducted by Webster Groves Garden Club for the members of the groups in the eighth district of Federated Garden Clubs; May 15, before the genetics seminar at the University of Missouri, "Races of *Zea Mays*"; November 20, before the Webster Groves Nature Study Society, "Experiments with Indian Corn"; November 23, before the Garden Club of Louisiana, Mo., "Indian Corn and the American Way of Life"; December 2, before the St. Louis Wildflower Club, "Plant Identification"; December 8, at the genetics seminar, University of Missouri, Columbia, "A Morphological Analysis of Heterosis in *Zea Mays*."

Mr. A. P. Beilmann, Manager of the Garden Arboretum: February 13, before the Men's Club, at Gray Summit, Mo., "Flowers of Native Trees."

Mr. Ladislaus Cutak, in charge of Succulents at the Garden: January 2, before the St. Louis Horticultural Society, "Gardens of Florida"; August 9, before the Henry Shaw Cactus Society of St. Louis, "Introducing the Cactus Family"; October 11, before the Henry Shaw Cactus Society, "Introducing the Succulents"; December 1, before the Business and Professional Women's Group Y. W. C. A., and December 4, before the South End Council No. 791, Royal Arcanum, "Plant Hunting in Mexico."

Dr. Carroll W. Dodge, Mycologist to the Garden: July 1942, address at convocation of the Universidad Nacional de Guatemala, "Algunos Problemas Universitarios y las Cuatro Libertades de Roosevelt." [University Problems in Relation to the Four Freedoms].

Dr. David C. Fairburn, Horticulturist to the Garden: January 2, before the Beta Sigma Phi Sorority, at Hotel Coronado, "Color, Form and Fragrance of Gardens"; March 9, before the Green Thumb Garden Club, Clayton, Mo., "Garden Arrangement and Planting"; March 18, before the Clifton Heights Garden Club, "Seed Planting and Propagation"; May 7, before the Private Duty Section or Special Nurse Group, "The Care of House Plants"; June 2, before the Zeta Beta Chi Sorority, at the Coronado Hotel, "Garden Flowers"; November 12, at the annual convention of Iowa Florists at Iowa State College, Ames, and in the evening at the annual meeting of the Federated Garden Clubs of Iowa, at Iowa State College, "The Romance of the Hybrid Orchid."

Mr. Leslie Hubricht, Research Assistant at the Garden: September 11, before a joint meeting of the entomological section of the St. Louis Academy of Science and the Webster Groves Nature Study Society, "Caves and their Fauna."

Mr. Paul A. Kohl, Floriculturist to the Garden: April 8, before the

Webster Groves Garden Club, and June 9, before the Ladies' Social Room of the Rose Hill Masonic Lodge, "Four Seasons in the Missouri Botanical Garden."

Dr. George T. Moore, Director of the Garden: March 5, before the American Association of University Women, at St. Charles, Mo., "Botanical Gardens—Why and What They Are"; March 9, Men's Round Table, Church of the Holy Communion, "Henry Shaw and His Garden"; April 21, Kiwanis Club of University City, "Gardens and Gardening"; April 22, Southwest Kiwanis Club, "Henry Shaw and His Garden."

Mr. George H. Pring, Superintendent of the Garden: February 4, at Michigan Agricultural College, East Lansing, "The Breeding of Waterlilies"; March 9, Junior Woman's Club of Carondelet, "Flowers and Insects"; March 10, Salem Woman's Club, Salem, Ill., "Planting Victory Gardens"; over Radio Station KMOX, March 14, "New Introductions at the Flower Show", March 16, "The Flower Show", and March 18, "With the School for the Blind at the Flower Show"; "Basic Training in Air-Raid Precautions", March 5, Air-Raid Post Warden's School, at the Wade School, March 18, at the Bryan-Mullanphy School, March 19, Men's Club of Tyler Place Presbyterian Church, and March 27, Post-Warden's School at the Y. M. C. A.; May 4, before the Rotary Club of University City, "The Romance of the Plant World"; June 3, before the 39th Street Business Men's Association, "Basic Training in Air-Raid Control"; "The Greater St. Louis Victory Garden Harvest Show", July 8, before meeting of Air-Raid Wardens of Zone 2, August 3, before Ladue Florists' Club, August 4, before the Greater St. Louis Association of Gardeners, and August 7, before the St. Louis Horticultural Society; November 4, before the Gravois Kiwanis Club of St. Louis County, "The Missouri Botanical Garden", with special emphasis on plants of priority.

HERBARIUM

It is a pleasure to record that the achievements in the herbarium during the year 1942 have been outstanding, particularly in the acquisition of new material, the number of specimens mounted and incorporated, the critical study of special collections, the reorganization of certain families of plants, and in the distribution of duplicates. No herbarium material has been received directly from the Old World; although a few exotic specimens have trickled in through exchanges.

Important collections, however, have been obtained from many parts of the western hemisphere from arctic North America to southern South America. The representation in the Missouri Botanical Garden Herbarium of the flora of America has been greatly augmented, as shown by the following

record of the larger and more significant collections received:

New Accessions.—Paul Allen, 52 plants of Panama; E. Anderson, 81 plants of Virginia, Illinois, Missouri and of horticulture; Arnold Arboretum of Harvard University, 1,969 plants of western United States, South America, etc.; E. B. Babcock, 21 specimens of *Crepis;* F. A. Barkley, 200 plants of Montana; R. W. Baxter, 45 plants of Hawaii; A. A. Beetle, 100 grasses of California; E. C. Berry, 61 plants mostly from Missouri; J. F. Brenckle, 1,273 fungi and other plants mainly from South Dakota; Robert Brinker, 210 plants of Florida and Alabama and 10 photographs of *Schoenocaulon;* California Academy of Sciences, 189 plants of California; Albert Chandler, 43 plants of central United States; M. A. Chrysler, 125 ferns of Costa Rica, Panama, and Jamaica; Ira W. Clokey, 89 plants of Nevada; Mrs. Leighton R. Cornman, 122 lichens, hepatics, and mosses from Panama; Cornell University, 21 plants of New Mexico and Arizona; Arthur Cronquist, 970 plants of Idaho; W. A. Daily, 45 American Myxophyceae; G. D. Darker, 80 fungi from Ontario, Canada, New England, Missouri, etc.; Otto Degener, 474 plants of Hawaii; Delzie Demaree, 1,655 plants chiefly from Arkansas; C. W. Demoise, 25 lichens of Pennsylvania and Maryland; Duke University, 177 plants of southeastern United States; Artheme Dutilly, 221 plants of arctic North America; W. J. Eyerdam, 425 plants of Alaska and the Aleutian Islands, Argentina, Chile, and Uruguay; Field Museum of Natural History, 477 plants of Guatemala, Panama, etc.; Lauretta E. Fox, 47 plants of Louisiana; A. O. Garrett, 21 plants of Wyoming, Utah, and Arizona; H. S. Gentry, 450 plants of Mexico; Gray Herbarium of Harvard University, "Plantae Exsiccatae Grayanae, Cent. XII", and 81 plants from various regions; R. M. Harper, 96 plants of Alabama; Ada Hayden, 23 plants of Iowa; A. A. Heller, 400 plants of Nevada, Arizona, and California; H. Hoogstraal, 717 plants of Mexico; Leslie Hubricht, 244 plants of Illinois, Missouri, Arkansas, Kansas, and Oklahoma; Instituto Miguel Lillo (University of Tucumán), 356 plants of Argentina; Iowa State College, 203 plants of Iowa and Arizona; Leslie James, 36 plants of Alabama; Kansas State College, 120 plants of Michigan and Kansas; Marie Knauz, 235 plants mostly from Mexico; L. W. Lenz, 24 plants of Montana; C. L. Lundell, 361 plants of Texas, Mexico, and British Honduras; E. S. Luttrell, 1,076 lichens of Virginia; G. W. Martin, 43 fungi from the United States and tropical America; Mildred Pladek Mauldin, 51 plants of Texas; R. McVaugh and J. Pyron, 29 lichens of Georgia; Fred G. Meyer, 4,360 plants mostly from Idaho, Washington, Oregon, and California; Thomas Morley, 22 plants of California; C. H. Muller, 200 plants of the United States; Museum of Northern Arizona, 71 plants of Arizona; N. Y. State Museum, 219 plants of New York; Oklahoma A. & M. College, 333 plants of Oklahoma; C. W.

T. Penland, 43 plants of Colorado and Peru; Pomona College, 144 plants of Nevada and California; H. C. Reynolds, 141 plants of Nebraska; William Rhoades, 248 plants from eastern United States; Rocky Mountain Herbarium, 125 plants of western North America; Lewis Samuel Rose, 1,371 plants of California; R. J. Seibert, 54 plants of Florida; L. R. Stanford, 1,112 plants of Mexico; State College of Washington by Marion Ownbey, 661 plants mostly from Rogers' Columbia River Survey; State University of Iowa, 218 plants of Iowa; John W. Thomas, 22 lichens of the United States and Mexico; W. L. Tolstead, 1,137 plants mostly from Iowa and Nebraska; United States National Museum, 338 plants from the United States and South America; University of Michigan, 485 plants of Wyoming, Texas, and Mexico; University of California Herbarium, 725 plants of California; University of California by T. H. Goodspeed, 1,922 plants of South America; University of Kentucky by F. T. McFarland, 223 plants of Kentucky; University of Washington by C. L. Hitchcock, 159 plants of British Columbia; University of Wisconsin, 143 plants mostly from Wisconsin; W. B. Welch, 374 plants of Illinois; U. T. Waterfall, 200 plants of Texas; West Virginia University, 100 plants of Michigan and West Virginia; R. E. Woodson, 4,757 plants of Panama.

Many smaller accessions have been obtained during the year. These have been recorded in the current monthly issues of the MISSOURI BOTANICAL GARDEN BULLETIN. The smaller collections often contain material of special interest; and not infrequently important records are based on them.

Mounting and Insertion of Specimens.—The mounting of herbarium specimens has continued uninterruptedly throughout the year. The important work of mounting has been done mainly by Mrs. Nettie A. Bauer and Miss Violet Bauer. The average number of specimens mounted has been somewhat in excess of 2,400 per month. Although 31,929 specimens have been mounted and incorporated in the general herbarium during the year, this number does not include several hundred specimens mounted for the Horticultural Herbarium at Gray Summit. The insertion of all this new material has been done almost entirely by Dr. E. C. Berry, who also has rendered valuable assistance in the routine work of the herbarium. Dr. Berry meanwhile has determined and interpolated many collections of lichens and fungi.

In 1939, when the last block of new steel cases was installed, it was estimated that sufficient case-capacity was provided for a normal growth-period of five years. Already the herbarium is becoming unduly congested in places, so that it has become necessary to put certain groups of plants, namely, ferns, conifers, and grasses, in temporary storage. By judicious shifting, however, it will be possible to care for all new material for at least

one and possibly two years at which time additional herbarium cases will be sorely needed to prevent injury to specimens from over-crowding.

Exchanges.—Special attention has been given again to the distribution of duplicate herbarium material. This has been done for two reasons, *first*, to satisfy our obligations to those scientific institutions and individuals with whom we have maintained for many years exchange relations, and *second*, to free as much storage space as possible in the crowded herbarium. Thus, during the year, 9,379 herbarium specimens have been sent to correspondents. Meanwhile, the herbarium has received 10,656 specimens on the basis of exchange. No exchanges with European herbaria have been effected during the year. A relatively large amount of duplicate material is ready to be shipped overseas when conditions permit.

Field Work.—The pressure of routine duties in the herbarium has been such as to limit field work during the year. Nevertheless, a considerable amount of field work has been done by special collectors, working under the auspices of the Garden, and by members of the staff and graduate students. Particular mention should be made of the discriminating collecting of Dr. E. Anderson and of the excellent series of plants collected by Mr. Leslie Hubricht. Notable also are the field studies and collections of *Clematis* by Mr. Ralph O. Erickson; and of a representative series of plants collected in Florida and Alabama by the Reverend Father Robert Brinker.

Use of the Herbarium.—Although the herbarium has been in constant use by members of the staff, graduate students, and visiting specialists, the number of visiting botanists has been somewhat below the average of the past five years. However, there has been an increasing number of requests for the loan of plant material for critical study by monographers and research students in different American universities. This demand has been met with a fair degree of promptness. Such loans are of mutual advantages to borrower and lender since the specimens concerned are usually annotated by the specialists and thus rendered of greater scientific value for subsequent investigators.

Groups of Plants under Special Investigation and Floristic Studies.—Various groups of plants in the herbarium have received special study during the greater part of the year. Among these are the lichens by Dr. E. C. Berry; fungi by Dr. G. D. Darker; *Schoenocaulon* by Reverend Father Robert Brinker; *Corydalis* by Mr. Gerald B. Ownbey; *Sesbania* by Mr. Ralph Emons; *Actinella* and allied genera by Mr. L. W. Lenz; *Malvaviscus* by R. W. Schery; Apocynaceae and Asclepiadaceae by Dr. R. E. Woodson; Compositae and other special groups by J. M. Greenman. Intensive studies of the Panamanian Flora have been continued by Dr. R. E. Woodson and Dr. R. W. Schery.

Statistical Summary (for the year ending December 31, 1942):

Number of specimens received during 1942:	
By purchase	9,976
By gift	10,673
By exchange	10,656
By transfer	33
By field work	2,443
Total	33,781
Number of specimens mounted and incorporated in 1942	31,929
Number of specimens carried forward from 1941	1,345,892
Total	1,377,821
Number of specimens discarded during 1941	11
Total number of specimens in herbarium	1,377,810

LIBRARY AND PUBLICATIONS

Besides routine matters, the chief library activity during the year has been that of catching-up. When the number of graduate students was large and publications were received in great numbers, the less pressing work had to be deferred. Among such work accomplished during the year was the classifying and cataloguing of an accumulation of old reprints, making numerous cross-references, and re-cataloguing many old publications. Many dilapidated books have now been rebound or mended, including such reference works as Pritzel's "Thesaurus", "Royal Society Catalogue of Scientific Literature", etc. The work of placing all the unbound volumes or pamphlets in dust-proof boxes has been continued, but will not be completed for some time.

The receipt of European publications, which began to dwindle at the outbreak of the war, has been reduced to a mere trickle, and now the shipments from Japanese-controlled countries are stopped. However, we are still receiving British books and periodicals with the accustomed regularity, those from South Africa, Australia and New Zealand more or less regularly, and a little more than formerly is coming in from the countries south of us. The same conditions apply to countries to which we send publications in exchange for the ANNALS except that the Bureau of International Exchanges still accepts shipments to Russia and Portugal. All the periodical cards of such countries as Poland, Greece, Java, etc., have now been removed from the files and a notation made on the cards of the last part sent and received. Since many of the missing sets will probably never be completed, the parts have been catalogued and placed on the shelves. Our foreign bookdealer, of The Hague, is supposedly purchasing the European publications for us and holding them until after the war.

One of the attractions which the Garden offered during the Greater St. Louis Victory Garden and Harvest Show was an exhibit of books from our library. About thirty books selected to show the development of botanical illustrations from the crude wood-cuts of a fifteenth century herbal to the vivid and beautiful flower plates of the eighteenth and nineteenth centuries were displayed in the library folio room. Typewritten labels giving the author, title, date, and the special feature of the book were attached to each volume. It was hoped that the exhibit would be at least interesting to the public but we were unprepared for the enthusiasm with which it was received.

The library is cooperating with the Special Libraries Association in compiling a "Union List of Russian Scientific Periodicals." Since all the Russian works in our library must be looked up and titles translated before they can be listed, the work is moving rather slowly. However, enough headway has been made for us to realize that our holdings are important.

Publications.—Volume XXIX of the quarterly ANNALS and Volume XXX of the monthly BULLETIN were issued during the year. The ANNALS comprises 385 pages, 41 plates, and 64 text-figures; the BULLETIN, 230 pages, 52 plates and 26 text-figures. In December a new "Tour of the Missouri Botanical Garden" was printed, and at the same time 500 copies were run off to form the main feature of the December BULLETIN. In addition to the reading matter and ten illustrations of the former "Tour," thirteen new cuts illustrating flower shows, views of the Garden and plants were made for this issue. The result is an attractive booklet which should appeal to Garden visitors both as a guide and as a souvenir. It will be sold for twenty-five cents at the Main Gate. The BULLETIN seems to have featured guides in 1942, for, besides the Tour, a guide to the narcissi plantings at Gray Summit was published in March and "A guide to the hardy trees and large shrubs of the Missouri Botanical Garden" in October. The June BULLETIN, "Rubber and Fibers to Meet the War Emergency", has been extensively quoted in other magazines.

As in former years, the reprints of ANNALS papers were mailed out in August, 400 having been sent to 152 botanists and institutions. Many important publications are received in exchange.

The total receipts for the ANNALS, BULLETINS, miscellaneous publications and post-cards were $2,293.53. Eighty-six copies of Steyermark's "Flora of Missouri" were sold, and several important Floras were received in exchange for this publication.

Accessions.—Opportunity for purchasing rare botanical works or completing parts of serials was almost non-existent in 1942, for they are usually obtained through catalogues of European bookdealers. A few catalogues

were received from England and Switzerland, but they listed almost none of our *desiderata*. However, a few outstanding works have been purchased, among which was the "first Russian-German botanical dictionary and the first modern dictionary in botanical history" (Botanisches Wörterbuch. Veranstaltet und herausgegeben von der freyen ökonomischen Gesellschaft). It was published in St. Petersburg in 1795, and bears the stamp of the Imperial Library. Another interesting acquisition was the gift of Mr. Arthur C. Hoskins of four parts of Seemann's "The Botany of the Voyage of H.M.S. Herald." Two of these parts are in the original paper covers, which is important from a bibliographical standpoint as they give the exact dates of publication of many first descriptions of plants. Some of the original incorrect pages are also included. A valuable donation was the library of the late Mr. L. P. Jensen, former Manager of the Garden Arboretum. The collection comprised about 255 volumes and included many rare works on horticulture and landscape gardening. The ones duplicated in our library have been placed on deposit at the Arboretum, and the remainder have been incorporated in the Garden library.

Visitors.—Miss Allen, Assistant in the Herbarium, Cornell University, Ithaca, N. Y.; Dr. A. C. Arny, Associate Agronomist, Agricultural Experiment Station, University of Minnesota, St. Paul; Mr. Raymond Baker, Manager Breeding Department, Pioneer High-bred Corn Breeding Co., Johnston, Iowa; Dr. John Hendley Barnhart, Bibliographer New York Botanical Garden; Dr. G. W. Beadle, Professor of Genetics, Stanford University, Calif.; Lt. Stanley Bettoney, formerly Graduate Student at the Garden; Dr. A. F. Blakeslee, of the Carnegie Institution, Cold Spring Harbor, Long Island, N. Y.; Pvt. Louis G. Brenner, formerly Graduate Student at the Garden; Rev. Robert R. Brinker, O. F. M., Instructor in Biology, Quincy College, Quincy, Ill.; Dr. William L. Brown, formerly Cytogeneticist, U. S. Golf Association, Washington, D. C.; Pvt. (Dr.) Alexander F. Bucholtz, formerly Graduate Student at the Garden; Dr. John T. Buchholz, Professor of Botany, University of Illinois, Urbana; Lt. Robert B. Clark, formerly Graduate Student at the Garden; Mrs. Leighton R. Cornman, Dahlia breeder, of Cardiff-by-the-Sea, Calif.; Dr. Ray J. Davis, Professor of Botany, University of Idaho, Southern Branch, Pocatello; Mr. Otto Degener, author of books and papers on the Hawaiian Flora, of Honolulu, H. I.; Mr. Delzie Demaree, of Arkansas Agricultural and Mechanical College, Monticello; Pvt. Ralph Emons, formerly Graduate Student at the Garden; Dr. Norman C. Fassett, Assistant Professor of Botany, University of Wisconsin, Madison; Mr. Mulford B. Foster, Bromeliad specialist and plant collector, Orlando, Fla.; Dr. A. Fromm, O. F. M., of St. Joseph College, Chicago, Ill.; Dr. Harry J. Fuller, Associate Professor of Botany, University of Illinois, Ur-

bana; Mr. Howard E. Gilkey, Landscape Architect, Oakland, Calif.; Dr. George B. Happ, Assistant Professor of Biology, Principia College, Elsah, Ill.; Dr. H. K. Hayes, Agronomist and Plant Geneticist, Agricultural Experiment Station, University of Minnesota, St. Paul; Mr. P. T. Haynes, Superintendent of Parks, Brownsville, Texas; Mr. Richard Inglis, student in botany, Grinnell College, Grinnell, Ia.; Dr. Alfred C. Kinsey, Professor of Zoology, University of Indiana, Bloomington; Mr. Leonard Jansen, student in botany, Texas Technological College, Lubbock, Texas; Dr. George Neville Jones, Assistant Professor of Botany, University of Illinois, Urbana; Dr. Boris Krukoff, tropical plant explorer; Dr. C. L. Lundell, Research Professor in Botany and Curator of Herbarium, University of Michigan, Ann Arbor; Dr. Mary Maxine Larisey, Assistant Professor of Biology, Judson College, Marion, Ala.; Dr. R. E. Marker, Associate Professor of Chemistry, Pennsylvania State College; Dr. Mildred Mathias (Mrs. Gerald Hassler), of Binghamton, N. Y., formerly Graduate Student at the Garden; Mr. Reid Moran, Graduate Student in Botany, Cornell University, Ithaca, N. Y.; Dr. Norma E. Pfeiffer, Research Morphologist, Boyce Thompson Institute for Plant Research, Yonkers, N. Y.; Mr. Ralph Rawlings, formerly Graduate Student at the Garden; Dr. Frederick D. Richey, formerly Chief U. S. Bureau of Plant Industry, Washington, D. C.; Mr. Charles Denny Rogers III, author of biographies of botanists, of Columbus, Ohio; Dr. George A. L. Sarton, Professor of History of Science, Harvard University; Dr. Henry Schmitz, Dean of the School of Forestry, University of Minnesota, St. Paul; Mr. Russell J. Seibert, Agent Rubber Investigations, U. S. Bureau of Plant Industry, Washington, D. C.; Dr. J. B. Shelmire, Professor of Dermatology, Baylor University College of Medicine, Dallas, Texas; Dr. Christianna Smith, Professor of Biology, Mt. Holyoke College, South Hadley, Mass.; Dr. R. E. Spencer, Professor of Botany, McKendree College, Lebanon, Ill.; Dr. Lewis J. Stadler, Principal Geneticist, U. S. Dept. Agr., University of Missouri, Columbia; Dr. Neil E. Stevens, Head Department of Botany, University of Illinois, Urbana; Dr. A. B. Stout, of the New York Botanical Garden; Dr. Charles Thom, Mycologist, U. S. Bureau of Plant Industry, Washington, D. C.; Mrs. Richard Walker (Helen Bramsch), formerly Graduate Student at the Garden and the University of California, Berkeley; Dr. and Mrs. Roland Walker, Dr. Walker head of the Biology Department, Rensselaer Polytechnic Institute, Troy, N. Y., Mrs. Walker of the Botany Department, Smith College, Northampton, Mass.; Dr. H. K. Wilson, Agronomist, Agricultural Experiment Station, University of Minnesota, St. Paul; Mr. John C. Wister, Director Arthur Hoyt Scott Foundation, Swarthmore College, Swarthmore, Pa.; Prof. T. G. Yuncker, Head Department of Botany, DePauw University, Greencastle, Ind.

The following school groups visited the library during the year: the biology classes of Principia College, Elsah, Ill.; the biology class from the Southern Illinois State Normal University, Carbondale; and the biology classes of Wood River High School, Wood River, Ill., accompanied by Mr. W. C. Hopper, Instructor in Biology.

The library also lends books on the interlibrary loan plan, 102 loans having been made to 27 institutions during the year.

Statistical Information.—There have been donated to the library or received in exchange during the year 490 books valued at $1,156.80, and 2,861 pamphlets valued at $606.84. One hundred and thirty-three books were bought at a cost of $562.69, and 31 pamphlets at a cost of $80.51. Seven books and 128 parts or pamphlets, valued at $57.70, were discarded. The library now contains 55,016 books and 89,114 pamphlets. With the donation of two manuscripts in 1942 there are now 351 manuscripts valued at $1,717.70. The number of index cards now totals 1,086,083, of which 7,588 were added during the year, 1,446 having been written by Garden employees and 6,142 purchased at a cost of $132.53. Three hundred and five books were bound, 32 were rebound or repaired, and 792 magazine-files were purchased.

ANNUAL BEQUESTS

The annual flower sermon "On the wisdom and goodness of God as shown in the growth of flowers, fruits, and other products of the vegetable kingdom," provided for in the will of Henry Shaw, was preached by Dr. Maude Royden, famous woman preacher of England, at Christ Church Cathedral, February 1.

The Gardeners' Banquet Fund was used to provide turkeys for employees at Christmas.

ATTENDANCE FOR 1942

(Not including visitors to Arboretum)

	Week-days	*Sundays*
January	6,400	7,126
February	3,383	4,412
March	6,920	10,687
April	10,874	13,011
May	15,545	16,146
June	13,234	8,879
July	14,256	8,752
August	14,541	13,602
September	10,392	9,864
October	10,890	10,892

November	11,047	13,018
December	2,736	1,597
Total	120,218	117,986
		120,218
Total		238,204

GEORGE T. MOORE,
Director.

STATISTICAL INFORMATION FOR DECEMBER, 1942

GARDEN ATTENDANCE:	
Total number of visitors	4,693
PLANT ACCESSIONS:	
Total number of plants and seed packets received as gifts	6
LIBRARY ACCESSIONS:	
Total number of books bought	9
Total number of books and pamphlets donated	280
HERBARIUM ACCESSIONS:	
By Purchase—	
Waterfall, U. T.—Plants of Texas	200
By Gift—	
Allen, Paul H.—Plants of Panama	3
Darker, G. D.—Cryptogams from various localities	9
Degener, Otto—Plants of Hawaii	180
Demaree, Delzie—Plants of Arkansas	123
Dixon, Royal—*Euphorbia serpens* HBK	1
Hubricht, Leslie—*Polyporus* sp. from Missouri	1
Moldenke, Harold—Plants of Ohio	3
University of Michigan by C. L. Lundell—Plants of Texas	11
Whetzel, H. H.—Fungi of New York, Oregon and Bermuda	4
By Exchange—	
Duke University—Plants of southeastern United States	177
Field Museum of Natural History—Cryptogams from various localities	119
New York State Museum by H. D. House—Plants of New York	219
Ownbey, Marion—Plants of British Columbia and Alberta	169
University of Kentucky by F. T. McFarland—Plants of Kentucky	123
By Field Work—	
Woodson, R. E.—Plants of Panama	277
Total	1,619

STAFF
OF THE MISSOURI BOTANICAL GARDEN

THE GARDEN, 2315 TOWER GROVE AVENUE, ST. LOUIS, MISSOURI

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MISSOURI BOTANICAL GARDEN BULLETIN

Vol. XXXI FEBRUARY, 1943 No. 2

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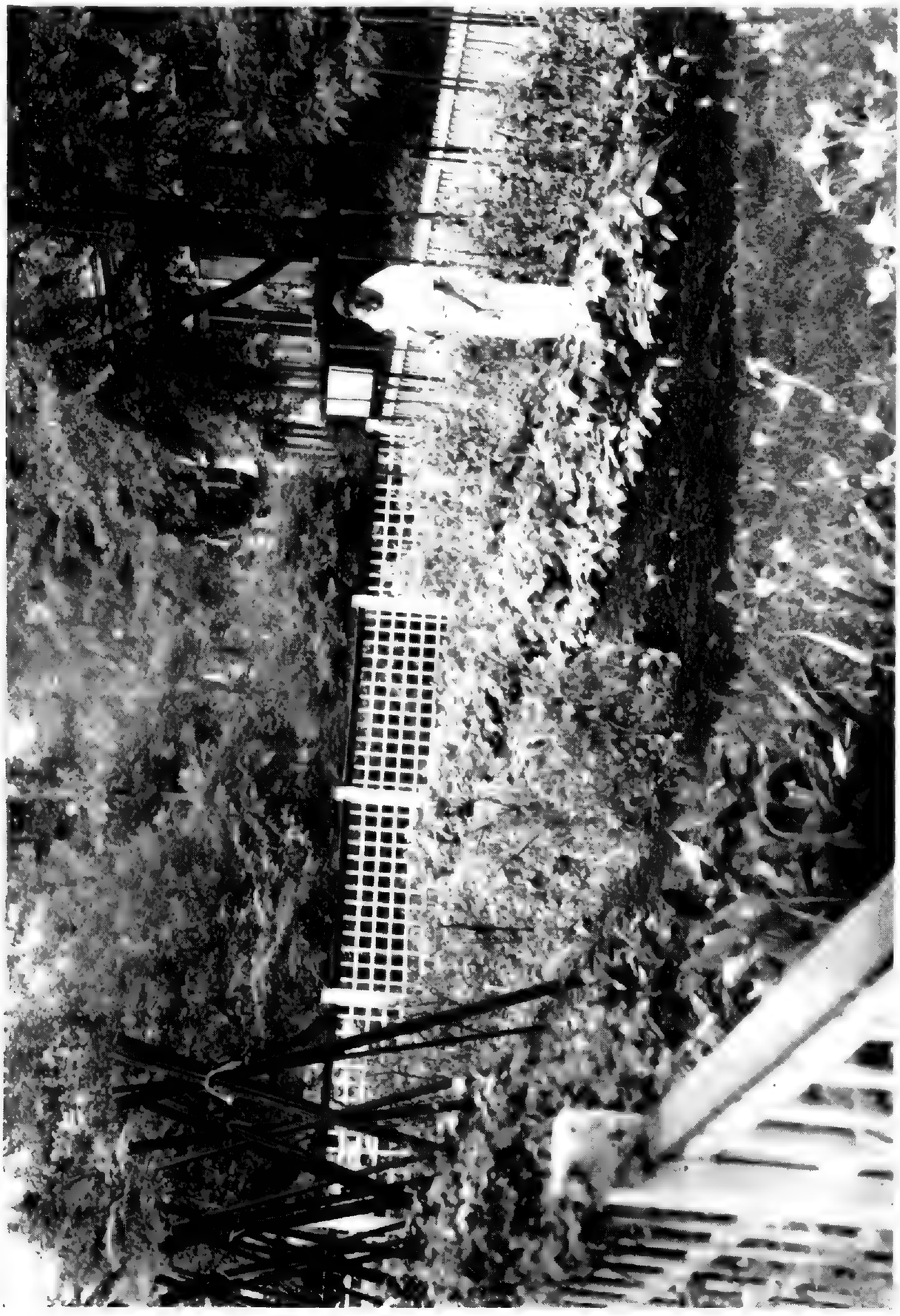
SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until sunset; Sundays, 10:00 a. m. until sunset. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah car line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.



MISSOURI BOTANICAL GARDEN VICTORY GARDEN, 1942

Missouri Botanical Garden Bulletin

Vol. XXXI FEBRUARY, 1943 No. 2

VEGETABLE GARDENING IN ST. LOUIS

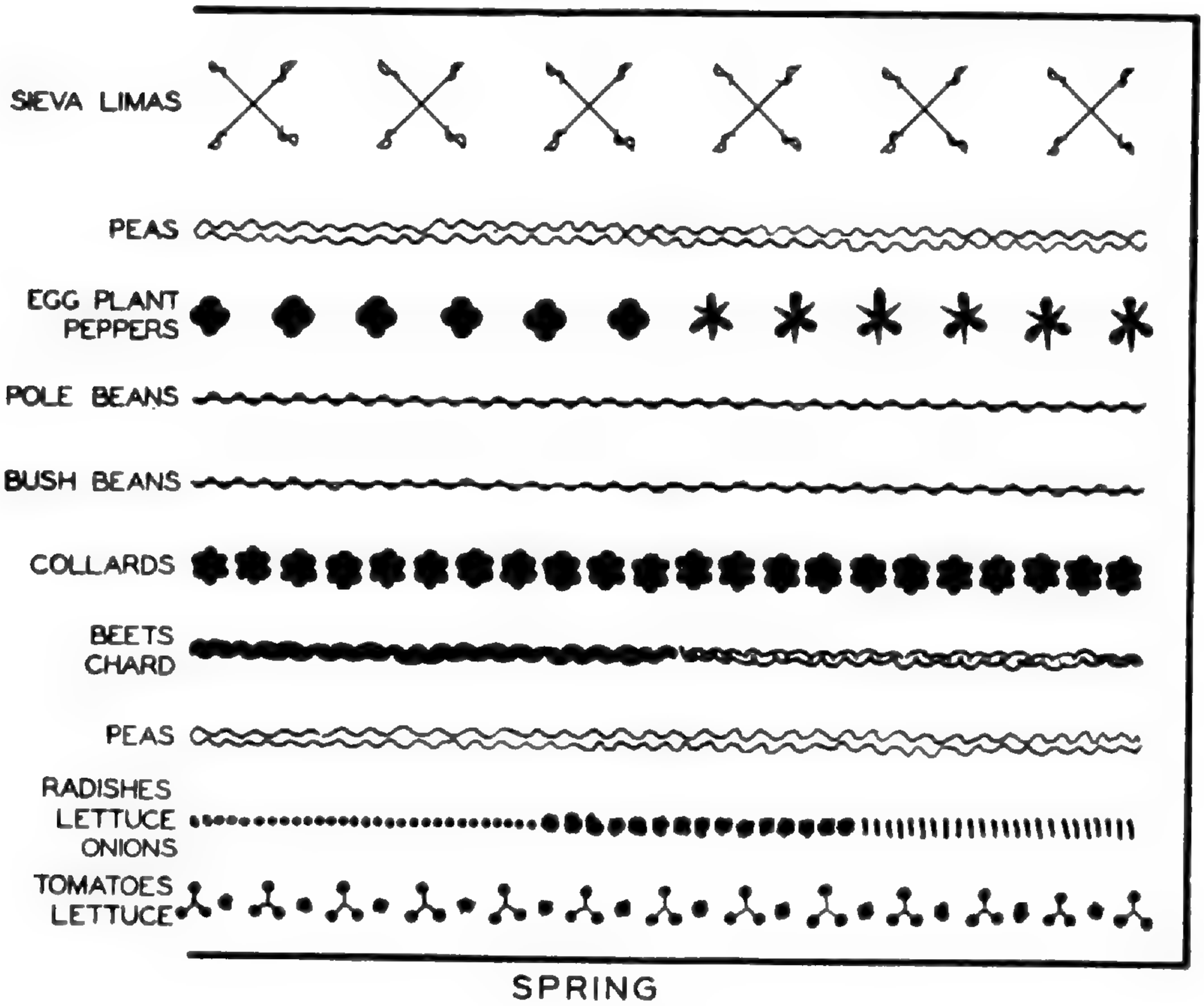
For detailed information as to planting dates, varieties to plant, number of plants needed, etc., the publications of the Agricultural Extension Service of the University of Missouri are excellent. It is assumed that any St. Louis amateur who is planting a garden will first of all avail himself of this literature. However, these bulletins are written for the whole state, and particularly for people on farms and in small towns. Gardening in a big city has its own problems and it might be well to amplify these general directions with special *advice for the amateur city gardener.*

Getting the most out of a small plot.—Most city gardeners have very limited space. If the garden is not too shady, however, there is always room upwards, and plants should be encouraged to grow *up* rather than *out.* Tomatoes should be grown fairly close together and carefully staked and tied, pinching back many of the long suckers which sprout out at the lower joints. Although it is a little difficult to find brush for climbing peas to grow on, it can usually be obtained with a little persistence and the crop carried up into the sunlight. The Sieva limas which we recommend are very active climbers. In the Victory Garden they were grown in hills of about five plants, one 10-foot pole to a hill and every four poles tied together into a square tent-like figure. The beans not only climbed to the top of these high poles but they ran along on strings which were stretched from the top of each "tent" to the next. No bush lima could ever have yielded so heavily on the same amount of soil. Another possibility for the city gardener is the use of odds and ends of space. Parsley, for instance, will ordinarily do better in the edge of a flower bed than it will in a vegetable garden. Okra can be planted among the flowers or shrubbery, and if the aphids are kept off it will be most attractive. Both sweet and hot peppers make good growth in a perennial border and look very well, leaving room in the vegetable garden for something else. Dill and sweet basil are better off in the

flower border than among the vegetables, and if the spot is to their liking they may self-sow from year to year.

Most important is planting a succession of crops, as shown on the accompanying diagrams. Early crops can be planted close together, and those which mature first will be out of the way before the late-maturing ones need the extra room. Lettuce and endive can be started in flats in early to mid-August and transplanted into the garden in early September after earlier crops have matured.

Cultivation.—In a city garden, cultivation is particularly important.

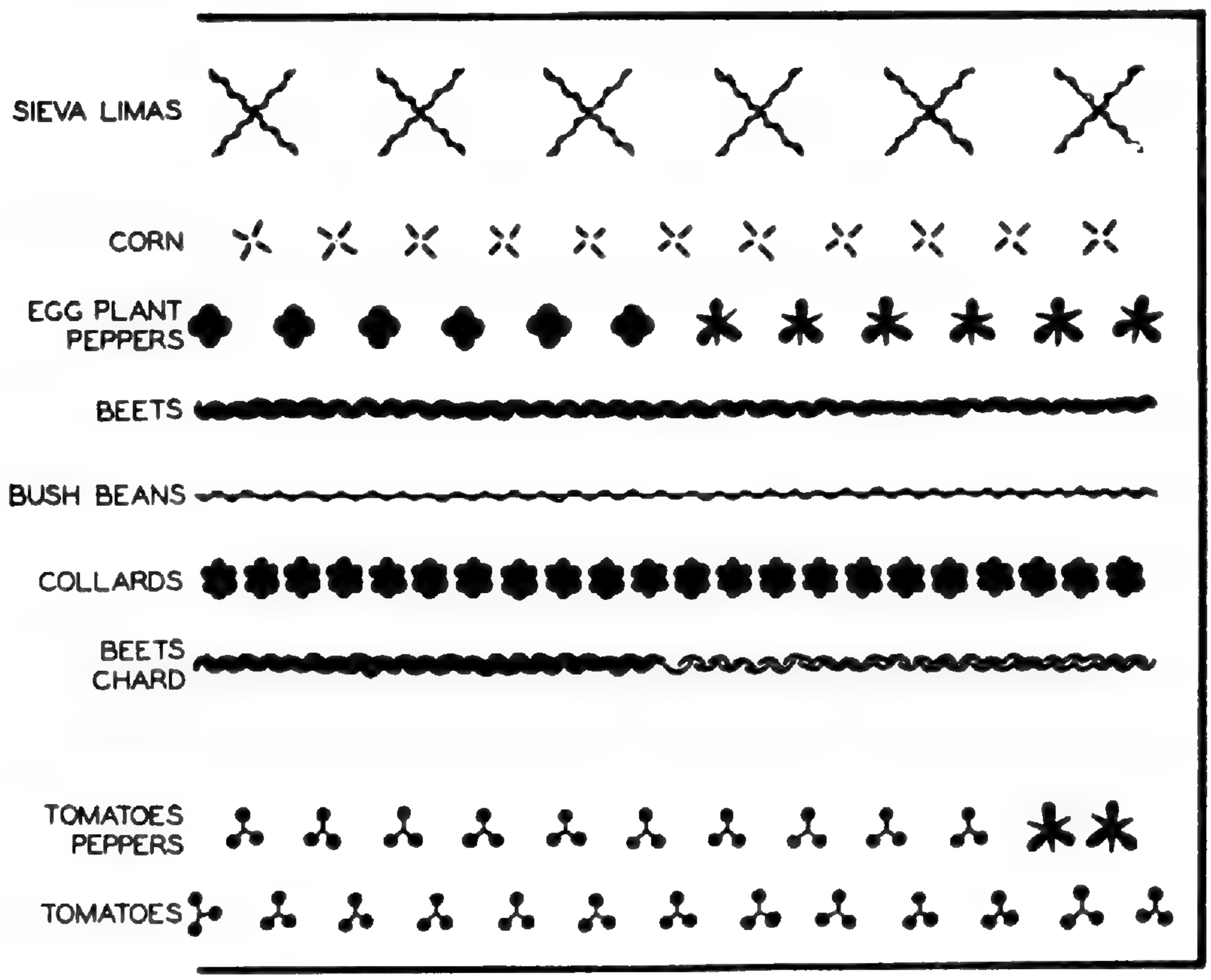


SPRING

Scale: 1 inch equals 10 feet.

City soils are apt to be dense and more or less puddled. The ground should be spaded up in making the garden and then when it is not too wet to cake, thoroughly hoed until all the lumps have been removed, not only from the surface but to the depth of a foot or more. Hoeing not only keeps down weeds but it seems to be positively beneficial in a city garden; it may be that it discourages ants and other small pests; at any rate a well-hoed garden yields much better per square foot than a poorly hoed one. In the city, where every plant must count, it is particularly important to keep down weeds. This is easy if one keeps ahead of them. With a small wheel hoe and a hand hoe it will only take a few minutes a day to keep out the weeds,

if it is done every day the garden can be worked (that is, when the soil is not too wet). For the year as a whole it will take less work to keep the garden practically weed-free, if this is done from the beginning, than it will to work only when the weeds get conspicuously bad. By keeping down every possible weed, the vegetables get a head start, they grow faster and are more tender, and when they get sizeable in early summer their roots use most of the available soil and weeds have a hard time making a headway. A little extra hard work in April and May will not only produce more and better vegetables, it will save a good deal of time in July and August. There



SUMMER

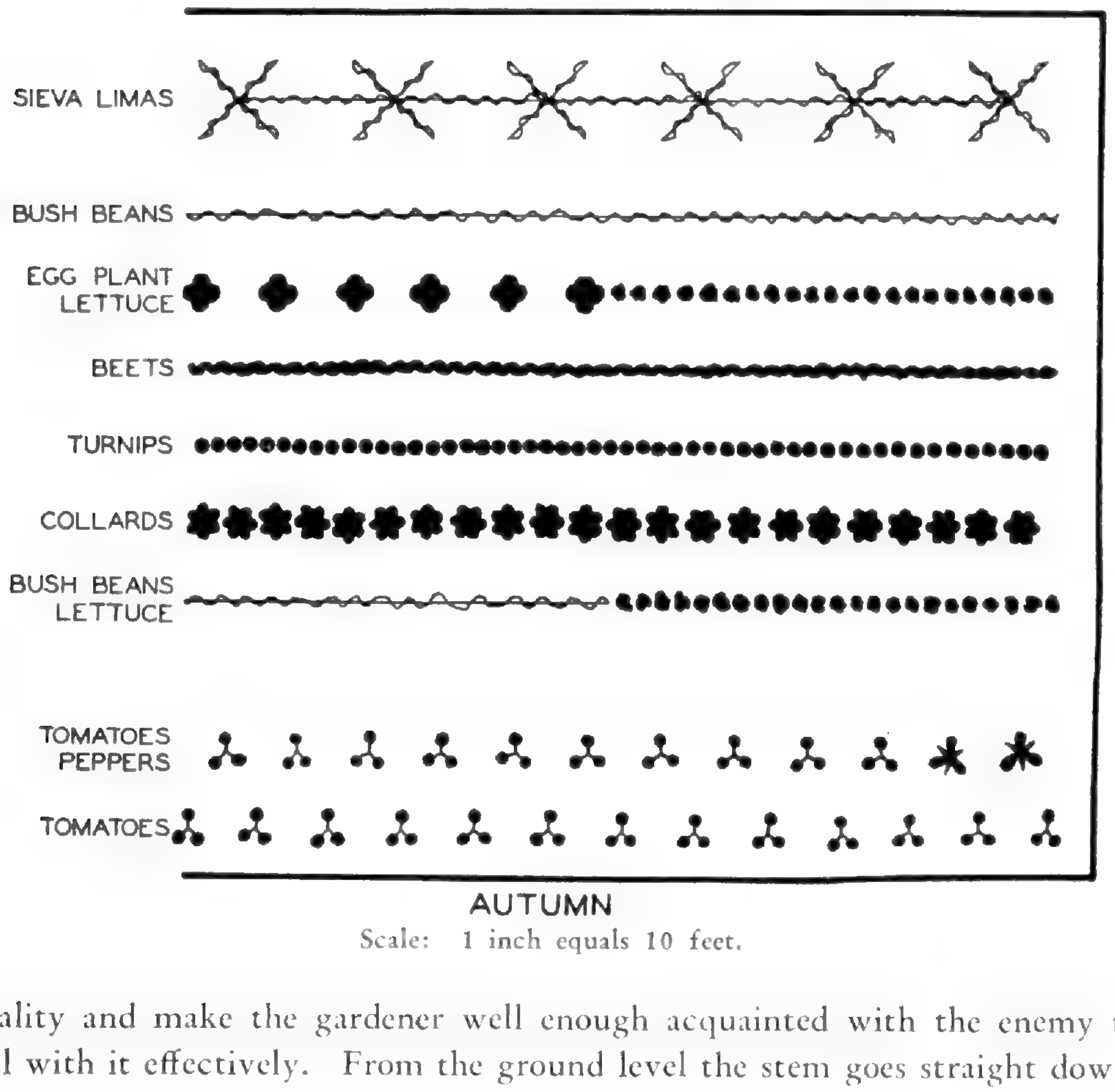
Scale: 1 inch equals 10 feet.

are only two cautions: do not work near the beans when their leaves are wet; to do so may spread disease. Do not work in the garden when the soil is so damp that hoeing it will make it dry into hard, flinty lumps.

Bindweed.—There is in St. Louis only one weed so pernicious that it deserves special mention, the common bindweed. Beginners will need to be warned against it, and those who have had only a little experience with it will need to be assured that a good garden can be grown in spite of a bad infestation. It is even a weed which can be completely eliminated but to do so takes industry and persistence. To see the bindweed at its best one should take a trip through the St. Louis railroad yards or along the express high-

way in June and July. It grows in these places among cinders and rocks in blazing sun, making sprawling gray-green mats of foliage which in the morning are starred with pure white flowers about the size of a five-cent piece. In the garden it climbs up anything and everything, its tiny stems growing with great rapidity and winding close to whatever plant they meet. If they are hoed off they come back in another ten days, apparently stronger for their rest under ground. If the garden is plowed, the one plant of the previous season appears all over the garden, as if by magic.

A little investigation with the spade will reveal the secret of this amazing



Scale: 1 inch equals 10 feet.

vitality and make the gardener well enough acquainted with the enemy to deal with it effectively. From the ground level the stem goes straight down, sometimes for two or three inches, sometimes for two or three feet. It gets a little larger rather than a little smaller and is often about the size of a knitting needle. It has few or no rootlets and is of a pale pinky gray color. It eventually terminates, not in a root, but in a nearly horizontal underground stem of about the same diameter. This underground stem may reach for a foot or for twenty feet, and it is the main reason why the delicate trailing vine has such amazing powers of recovery.

Whenever the garden is spaded one should keep a sharp eye out for these underground parts and remove as many of them as possible. Many will be left and each piece, no matter how small, seems to be capable of starting a new plant. To win the battle all that one needs to do is just to keep these little green vines from getting a head start. If they are in a place where one can get at them, the best thing to do is dig them out. This is not so hard a job as it seems since many of the diggings will lead to a main root and one can eliminate a number of apparently separate plants in a single operation. If there is no time to do this or if the bindweed is coming up right in the row then all one has to do is hoe it out before it has been above ground more than two or three days. If this is done faithfully the root will eventually be killed off. The first few times it will come back apparently stronger than ever. As the year wears on it will take longer and longer to recuperate. In the Victory Garden there was a good deal of bindweed to begin with but very little was seen coming up in September and none at all in October. It is too soon to be sure that we have completely eliminated it in a single year; at least we have reduced it to a fraction of what it used to be. Another good reason for spading the garden in the fall is that bindweed and other pests are exposed to the winter frosts and will at least be weakened if not killed outright by this treatment. One of the main arguments for keeping the small garden as weed-free as possible is that the bindweed will then be conspicuous when it comes up and will not be able to climb in among the other weeds and send supplies down to its underground hideaway.

REPORT ON THE 1942 VICTORY GARDEN

The 1942 Victory Garden at the Missouri Botanical Garden was managed as nearly as possible like an average city garden in St. Louis, even though it was located in the middle of a big botanical garden. All the work was done by one of the "white-collar" workers from the office, in such hours as could be spared from his regular job. Even during his vacation the plot was turned over to another office worker rather than a regular gardener. Perhaps this should have been made clear by a special sign, for during the rush of spring planting, when the work was being done in the morning before breakfast and late in the evening and on Sunday mornings, more than one visitor was heard to make the remark, "Well, it's a nice clean-looking garden but then it ought to be; look at all the help *they* have."

The Victory Garden was planned for a family of three, and a special effort was made to avoid growing more than was needed of any one crop. The plot chosen was 30 by 34 feet, the size and shape of many back-yard gardens in St. Louis. Since it was laid out on the site of the old "Before and

After" gardens, the soil and plants already there were similar to those of a below-average back-yard. Planting was started on March 20th and the first radishes and onions were harvested on April 27th. While there was occasionally too much of one crop or too little of another, on the whole the garden just nicely filled the needs of the family for which it had been planned. It lacked only two days of being in full production for six months when a heavy frost killed the tomatoes and other tender plants to the ground on October 25. Even after that date, however, it continued to supply lettuce, collards, turnips, beets, and parsley.

From the very start the Victory Garden was thought of not only as a demonstration during the 1942 season but as an experiment from which the average St. Louisan might get valuable information in 1943 or 1944. It certainly demonstrated that, in spite of special difficulties, vegetable gardening can be carried on successfully in the city of St. Louis. The yields are given below, under each crop. The vegetables obtained not only paid for the seed (the *tomatoes* harvested in one week in October more than paid the expenses of the entire garden) but they even gave a fair return in dollars and cents for the time spent in working in the plot.

The following report tells how many running feet were allocated to each crop, what varieties were planted, and when and what they produced. The vegetables are listed in the order in which they came into bearing.

RADISHES: *10 feet (also a few planted with the beets); Early Scarlet Globe; April 27–May 11; 7 bunches.*—

The radishes were excellent in quality, and it is remarkable how uniform many of the modern varieties are. Nearly every one was worth serving, though it should be emphasized that they had been thinned three times after they were planted. Many home gardeners plant two or three times too many radishes and then fail to take care of them. The idea of planting just enough, and giving them excellent care, worked all right except that they matured too much at one time, giving wonderful radishes for two weeks and then none at all. A better plan would be to plant about 12 feet in all but only to plant 4 feet at a time, with intervals of about a week between plantings.

ONION SETS: *10 feet; Southport Globe; April 27–June 8; 3 bunches green onions, 3 bunches small onions for cooking.*—

A few were used for eating fresh in the early spring. The remainder were allowed to get a size or two larger and were used for cooking. These were so delicious that about twice as many should be grown, providing onions through all of June and perhaps part of July.

LETTUCE: *10 feet (also planted between the young tomato plants); Oakleaf and Black-seeded Simpson; May 5–June 10, 18 big bunches; Oct. 24–Nov. 18, 12 bunches.*—

Oakleaf lettuce is an excellent variety for the St. Louis home garden. Its leaves are curiously slashed, whence the name, but this feature is really attractive in a salad. It is so tender that it is often injured in picking, so that it would not make a good variety for the market. It headed up well in May in spite of the hot weather and the heads did not run up quickly or get bitter. Its flavor is mild, perhaps not pronounced enough for some palates, and it has the general texture of a butter lettuce. All plants were thinned three or four times. Plants were also started indoors and were interplanted with the tomatoes when setting out the latter. There is no crop which responds better to thinning than does lettuce, yet, strangely enough, very few home gardeners ever bother to do so. By planting less and taking better care of it one can have better results with no more work. The same person who says "Oh, well, I might as well put in a whole row" will nearly always say when the lettuce comes up, "Oh, I've got plenty of lettuce, I don't need to thin it." Then a month later when you serve him some of your lettuce with big juicy leaves he will remark, "Well, I wish I could afford to fertilize my garden like you do yours. My soil just isn't good enough to raise lettuce of that quality."

PEAS: *60 feet of double row; Early Alaska; May 22–June 5; 25 quarts.*

When the Victory Garden was started a number of professional gardeners said, "You'll never get any green peas from those vines. The hot weather will come, the red spider will move in, and it will be 'Good-bye peas'." This is admittedly a common experience in St. Louis, but a good crop of peas can usually be secured here if one takes a few precautions. First of all, they should be planted as early as possible. Ours went in on the 20th and 27th of March. The first lot would have been put in by the fifteenth if the ground had been ready. In the second place, none of the high-quality varieties were used since these extra-fine peas are not able to stand the hot weather which nearly always arrives by the time the peas are maturing. Instead, the old hardy variety EARLY ALASKA was planted. It is so low in sugar content that its seeds are not at all wrinkled, but if picked before it gets hard and mature it has an excellent flavor. Both plantings of peas were put in as double rows not quite a foot apart and as soon as the plants were out of the ground, brush was provided for them to climb on. Here again, other gardeners remarked that they never bother to provide brush for peas or they plant the dwarf varieties which do not require any support.

Later in the season when the garden was supplying an abundance of green peas these same gardeners changed their tune and said, "There's too much luck about raising green peas in St. Louis."

Two double rows of peas take up undue space in a small garden but this difficulty can be removed by using a succession of crops, since peas mature very early. In one double row, sweet corn was planted in hills down the center, and then when the peas were given brush to climb on they were trained away from the developing corn plants. The vines were pulled up on the day of the last picking, thus getting them out of the way before they had competed with the corn. The other double row was planted next to the tomatoes, but by the time the tomatoes needed the extra room the pea-vines had been pulled up. Getting a little brush for the peas to climb on is not as difficult in the city as one might think. There are nearly always shrubs in the neighborhood, if not in one's own garden, which require pruning, and enough branches can usually be obtained for the asking.

If peas are grown in this way (that is, planting early, using brush, planting only EARLY ALASKA) the chances of a good crop, even in the city in St. Louis, are at least four out of five. Green peas are something which are always expensive and really fresh ones are difficult to find in a metropolitan area.

SWISS CHARD: *15 feet; Large White Rib; May 30–Aug. 14.*—

Swiss chard may be used in two different ways, either as greens or as a substitute for asparagus. In the latter case, it is the white leaf stalk rather than the leaf blade which is eaten, and it can be served in any of the ways one serves asparagus. The variety used is one which has been especially selected for this purpose and can be recommended to those who like chard. The flavor is delicate, the stalks are tender and many will think them delicious. Others (a great minority) find them rather tasteless. The plants bore well until mid-August when they died one at a time, apparently attacked by some kind of a virus disease.

BEETS: *early planting of 15 feet, late planting of 30 feet; Detroit Dark Red; June 8–June 22, 3 large bunches; Aug. 18–Nov. 15, 8 large bunches.*—

The beets were planted on April 3, and a month later, when they were thinned, were large enough to use as greens. It is unfortunate that more city gardeners, whose space is limited, do not realize that the tops, stems and roots of young beets make a delicious potherb, much better than spinach. When the KENTUCKY WONDER beans had to be taken out (see below) a second crop of beets was planted in their place on June 22nd and in spite

of the summer heat they gave a fair crop and were harvested at intervals from August to November.

BEANS *(Bush)*: *spring and fall planting 30 feet each; Stringless Green Pod; June 15-30, 13 quarts; October 12-25, 4 quarts.*—

All the beans suffered from the very wet spring and production was below what one might have expected. Considering the weather and the location (there were large clumps of shrubbery near the garden which cut off the air and encouraged the growth of fungi), this variety was quite satisfactory.

BEANS *(Pole)*: *30 feet; Kentucky Wonder.*

The pole beans were a total loss, which was a great disappointment since this variety is usually very productive in St. Louis. The late spring was exceedingly wet and the beans came down with anthracnose almost as soon as they were out of the ground. Though they partially recovered and a trellis was built for them, another spell of very wet weather came along and they had to be pulled up. A second planting of beets was immediately substituted, so far as we know the only beets which have ever been given a trellis to grow on.

LIMA BEANS *(Sieva)*: *grown in hills in 2 adjacent rows of 30 feet; Florida Butter; Aug. 1–Nov. 1; 28 qts. fresh baby limas, 6 lbs. shelled dried limas.*

There are two quite different kinds of lima beans. Make this remark to the average gardener and he will immediately reply, "Oh, yes, I know, the pole limas and the bush limas." He will be so impressed by the idea that he *does* know about two kinds of lima beans that it will be difficult to make him understand about Sieva limas. There are two *fundamentally different* limas, really different species, and there are bush types and pole types for each. In the North the common thick-podded lima beans are grown almost universally, but St. Louis is just far enough south so that they do not bear well in hot dry weather. It is much better here to choose one of the Sieva limas, commonly grown around the Mediterranean as their name indicates. The variety FLORIDA BUTTER has proved to be very productive in this area, and it will continue to yield well during dry spells. When dried it is a small "baby lima," white, with black (really very dark purple) spots. When it is picked for green limas these spots are usually just beginning to show, but there is enough pigment to discolor the beans as they cook so that when they come to the table, instead of being a pale clear green, they are a dull

brownish green. Their flavor, however, is excellent; most people find it much more delicate than that of the regular limas, and they seem to be more dependably productive than the unspotted varieties. They bear so heavily that a few poles will supply one family with green beans during the whole summer and a stock of dried beans for winter use. When dried they do not have the coarse flavor of ordinary limas and are excellent to use in making Boston baked beans.

SPINACH: *at intervals in flower beds; New Zealand spinach; June 24–Oct. 25.*—

New Zealand spinach is really not a true spinach but it makes a pretty good substitute during the hot weather, particularly if one collects only the little tender tips of the branches. It produced well when grown in the edge of the flower bed but it was rather unattractive most of the summer, and if it is grown at all another year it will be as a regular part of the vegetable garden.

PEPPERS: *15 feet and at intervals in the flower beds; Hungarian Sweet; June 22–Oct. 25.*—

HUNGARIAN SWEET is a long yellow pepper which bears better during hot dry weather than the big peppers more commonly grown in St. Louis. They bore well in the early summer, but all those in the row caught a virus disease in midsummer which practically stopped production. However, the isolated plants put here and there in the flower border did not catch the disease and they bore abundantly, providing all the sweet peppers one family could use. They looked very attractive in the flower bed and not at all out of place. One of the plants proved to be a hot pepper with round red fruits, and during the early fall it was both ornamental and useful.

TOMATOES: *60 feet (also along fence); Marglobe, Rutgers, Pritchard; Yellow Plum, Red Pear (along picket fence); July 7–Oct. 25; 225 lbs.*—

Since it was a small garden and tomatoes can use a good deal of room, all those planted in the rows were carefully tied to strong individual stakes. All the branches or "suckers" from the lower part of the plant were pinched out as soon as they appeared, thus encouraging bigger tomatoes on the upper part of the plant. Along the picket fence at the back of the garden we set out two varieties of little pickling tomatoes, the RED PEAR and the YELLOW PLUM. They are both rampant growers and little effort was made to pinch them back, merely an attempt to keep the vines up on the fence in so far as possible. The RED PEAR tomatoes were pretty to look at but small in

size and not very productive. The YELLOW PLUM, on the other hand, bore abundantly. Though the fruits were small they were large enough to use in salads and produced several quarts a week, even during dry periods when the big tomatoes were not bearing well.

CORN: *10 hills; Ioana; July 14–16.*—

Although corn is pretty big for a small city garden we planted a few hills of it between the early peas, and since we used a hybrid variety which is well suited to this region (it is one of the GOLDEN BANTAM types) it bore very well. Unfortunately for us, the rats found it almost as soon as we did and we got only the first picking. Had the garden actually been a home garden we might have been able to catch the rats or at least to protect the corn more effectively.

SUMMER SQUASH: *a few plants along the fence; Early White Bush; July 24–Aug. 17; 5 squashes.*—

We did not originally intend to plant summer squash and were late getting the seed in the ground. As a result it was a month late in coming into bearing, by which time such pests as pickle worms and squash bugs made it difficult to mature any squashes for the table.

EGGPLANT: *15 feet (also a few plants in the flower border); Black Beauty; Aug. 4–Oct. 25; 38 "eggs."*—

When the eggplants first came into bearing in midsummer the fruits were very large, so large that a single one was enough for a good-sized family. As the season went on the fruits became smaller and smaller so that by October a single one was scarcely large enough for an individual serving. However, as they became smaller they also became richer in flavor. The plants in the flower border yielded well but by the end of the season they were too large and sprawled about in an unsightly fashion.

OKRA: *5 plants in the flower border; White Velvet; Aug. 10–Oct. 10.*—

Okra does not grow well until the weather begins to get really hot, so these few plants were used to follow after spring bulbs in one corner of the flower border. They were very attractive there and did not seem at all out of place, the only difficulty being that they were prone to aphid attack and had to be dusted frequently. However, in a home garden a syringing off with the garden hose would probably have been sufficient. When they came into bloom their large flowers (like golden hollyhocks) seemed quite in keeping in the flower border, and the five plants yielded enough pods to meet the needs of a small family. They were used in soups and stews and

were combined (in small amounts) with other vegetables such as corn, tomatoes, and string-beans. The second planting of string beans was hit by the hot weather and did not yield very big pickings. By cooking the beans with a few tomatoes and one or two pods of okra there was enough to serve a family of four, and the mixture was relished by people who claimed not to care for okra.

COLLARDS: *15 feet; June 20–Nov. 25.*—

St. Louis is just far enough south so that collards can be grown profitably but it is just far enough north so that most gardeners have never heard of them. As the collards in the Victory Garden got bigger and bigger they were the subject of much amused and puzzled comment, "Why look at those cabbages; they're as big as all get-out but it seems they aren't ever going to head-up." Collards belong to the cabbage group of vegetables (cabbage, Brussel sprouts, kale, cauliflower, etc.) but they have the least specialized growth habit of any of them. They do not head up in any way but just keep on growing. During the summer they do not mind the hot weather but become rather coarse-flavored. However, they can be used at that time if only the *smallest* upper leaves are picked. They are eaten raw or cooked, much like cabbage. After the cool weather comes, collards almost make a head; the leaves cup together at the top and are slow to develop any green color. At this time many people consider them (the upper leaves) one of the most delicious vegetables in this whole group. Their flavor is more like that of Brussels sprouts than that of cabbage and they have a very delicate, buttery texture when cooked. In our opinion, however, collard plants are just a little too big for a garden of this size. It would be more efficient to plant early cabbage followed by endive.

PARSLEY *(Italian Flat-leaved) and* DILL:

Parsley and dill were planted in the flower border. They looked most attractive there and produced all that one family could use. Flat-leaved parsley is less affected by the heat than the moss-curled varieties. Both parsley and dill were large enough to be used by the middle of June and the parsley remained in good condition until Christmas time. The dill died back in midsummer, but some of it had been allowed to go to seed and self sow and the second crops of plants were in use by October. In many gardens if a semi-sunny spot is selected in the edge of the flower border dill will grow very well and can be trusted to come up from seed of its own sowing.

E. A.

VEGETABLES AND THEIR VARIETIES

The amateur gardener growing vegetables for the first time may find it difficult to select the kinds best suited to his particular needs. First of all, seedsmen offer about 45 different vegetables and innumerable varieties. The type of soil, the location and the size of the plot must also be considered.

When the soil in the average city back-yard is first spaded it is surprising to find what a large amount of building material is buried just beneath the surface. Stones, large and small, broken bricks, slate and roofing tile are just a few of the materials to be found. How vexing it is when with each thrust of the spade some hard object is encountered and only after careful maneuvering is it possible to pry it loose and bring it to the surface! A spading fork is a better tool for this work than a spade. Root crops, such as carrots and beets, would not be the vegetables to grow in such soil unless the stones were carefully removed. Large vegetables, or those which require the entire season to mature, have no place in the small garden.

Last year the Garden established a test plot to obtain first-hand information on the performance of many of the varieties of vegetables commonly grown in home gardens and to determine which ones are best adapted to this vicinity. This plot, located in the southern half of the Economic Garden, contained 36 kinds of vegetables represented by 142 varieties.

Four important points to consider in the selection and planting of any vegetable are: the variety, the quantity of seed required, the proper planting time, and the spacing in the garden. This information is given in the following list, and while it necessitates a certain amount of repetition it will be found useful. The list contains standard and new varieties, most of which were grown in the test plot last season, but it does not include perennials, such as asparagus and rhubarb, or vegetables which are difficult to grow in this climate or those which require much room.

BUSH BEANS

Varieties: (Green-pod) BOUNTIFUL STRINGLESS, STREAMLINER, STRINGLESS GREEN-POD, TENDERGREEN.

Varieties: (Wax-pod) BURPEE'S KIDNEY WAX, GOLDEN BOUNTIFUL WAX, PENCIL POD BLACK WAX, ROUND POD KIDNEY WAX, RUSTPROOF GOLDEN WAX.

Seed: 1 pkt. to 25 ft.; 1 lb. to 100-150 ft.

Plant: May 1. For succession every 2 to 3 weeks up to Aug. 15. Germination time: 4 days in summer; 8 days in spring.

Spacing: 1-2 in. deep; 2-3 in. apart; thin to 4 in.; 18-24 in. between rows.

BUSH LIMA BEANS

Varieties: BABY POTATO, BURPEE'S BUSH, FORDHOOK BUSH, HENDERSON'S BUSH.
Seed: 1 pkt. to 20 ft.; 1 lb. to 100-150 ft.
Plant: May 15. Germination: 4-8 days.
Spacing: 2 in. deep; 5 in. apart in row; thin to 12 in. for small-seeded varieties (BABY POTATO and HENDERSON) and 12-15 in. for large-seeded varieties; 2½-3 ft. between rows.
Note: It is usually recommended that lima bean seeds be planted with the eye down. Last year alternate rows of five varieties were carefully planted in this manner but we could detect no difference between the rows when the seedlings appeared above ground.

POLE BEANS

Varieties: KENTUCKY WONDER, KENTUCKY WONDER WAX.
Seed: 1 pkt. to 15 hills; 1 lb. to 100 hills.
Plant: May 1-15. Germination: 4-8 days.
Spacing: 2 in. deep; place 7- to 9-foot poles 3-4 ft. apart each way; sow 6 to 8 beans around each pole and thin to 4 plants.

POLE LIMA BEANS

Varieties: CAROLINA or SIEVA, FLORIDA BUTTER, KING OF THE GARDEN.
Culture: Same as for pole beans.

SOY BEANS

Varieties: BANSEI, FUNK DELICIOUS, HOKKAIDO, JOGUN.
Seed: 1 pkt. to 25 ft.; 1 lb. to 150 ft.
Plant: April 15-May 1. Germination: 8 days.
Spacing: 1 in. deep; 2 in. apart in the row and thin to 6 in.; 24 in. between rows.
Note: In the last few years edible soybeans have become available for general use. Fresh and dry soybeans are used but the extraction of the green beans from the tough pods is difficult. The Illinois Agricultural Experiment Station describes the use of the soybean as a food in Bulletin No. 443, 1938. The following information is taken from Bulletin 255 of the Alabama Agricultural Experiment Station, published in April, 1942:

"In shelling green soybeans, it is highly important that they be subjected to a preliminary heat treatment, for the seed pods are very tough, and in the raw condition are difficult to open. To facilitate shelling, the green pods should be plunged into boiling water for about two minutes after which the beans can be squeezed from the pods with no difficulty.

"The shelled green beans should be boiled until done (usually thirty minutes to an hour). They can then be seasoned and served like green lima beans, English peas or cowpeas."

BEETS

Varieties: CROSBY'S EGYPTIAN, DETROIT DARK RED, EARLY WONDER, WINTER KEEPER.
Seed: 1 pkt. to 25 ft.; 1 oz. to 100 ft.
Plant: April 1 and every 3 to 4 weeks up to Aug. 15. Germination: 7-10 days.
Spacing: ½ in. deep; 2 in. apart in the row; thin to 3-4 in.; 12-18 in. between rows.

Note: The first three are good early varieties. WINTER KEEPER grows slowly and produces much foliage.

BROCCOLI

Varieties: CALABRESE, PROPAGENO, ST. VALENTINE.
Seed: 1 pkt. produces about 250 plants.
Plant: Start seed in greenhouse or hotbed in February; plant out March 15 to April 1. Sow in coldframe May 15 to June 1 and plant in garden June 15 to July 15 for fall crop. Germination: 4 days.
Spacing: Transplant to 18 in. apart in the row; rows 2-3 ft. apart.
Note: Broccoli, like cabbage, only grows best in cool weather. CALABRESE is the best variety. Try it if time and space permit.

CABBAGE

Varieties: COPENHAGEN MARKET, DANISH BALL HEAD, EARLY JERSEY WAKEFIELD, GLOBE, GOLDEN ACRE, MARION MARKET, PREMIUM LATE FLAT DUTCH, RESISTANT DETROIT.
MAMMOTH ROCK RED and RED YELLOWS RESISTANT.
Seed: 1 pkt. produces about 250 plants.
Plant: Sow seeds in greenhouse or hotbed in late January, or purchase plants and set in the garden March 15 to April 1. For a fall crop sow seed in a frame or prepared bed between May 15 and June 15. Thin seedlings to 2 in. apart and transplant to garden June 15 to July 1. Germination: 4 days.
Spacing: GOLDEN ACRE 18 in. apart each way; larger varieties 24 in. apart each way.
Note: Good varieties in 1942 were COPENHAGEN MARKET, GOLDEN ACRE, GLOBE, MARION MARKET, RED YELLOWS RESISTANT, PREMIUM LATE FLAT DUTCH, and RESISTANT DETROIT.

CHINESE OR CELERY CABBAGE

Varieties: CHIHLI, PETSAI, WONG BOK.
Seed: 1 pkt. to 25 ft.; 1 oz. to 200 ft.
Plant: Sow seed in garden July 1, 15, or Aug. 1, whichever is the coolest period. Germination: 4 days.
Spacing: ½ in. deep; thin to stand 18 in. apart in the row and rows 24 in. apart.
Note: CHIHLI is the narrow variety most often seen on the market and the best one to grow in the garden.

CARROTS

Varieties: DANVERS HALF LONG, IMPERATOR, MORSE'S BUNCHING, NANTES IMPROVED CORELESS, RED CORED CHANTENAY, SUPREME HALF LONG, TENDERSWEET, VAUGHAN'S SELECT DANVERS, TOUCHON.
Seed: 1 pkt. to 30 ft.; 1 oz. to 200 ft.
Plant: April 1 and 2–3-week intervals up to Aug. 15. Germination: 5-10 days.
Spacing: ¼ to ½ in. deep; thin to 3-4 in. in the row; rows 12-18 in. apart.
Note: Good varieties are DANVERS HALF LONG, IMPERATOR, RED CORED CHANTENAY, TENDERSWEET, VAUGHAN'S SELECT DANVERS.

CAULIFLOWER

Variety: SNOWBALL.
Seed: 1 pkt. produces about 150 plants.
Plant: Start seed in February; plant out in late March. Sow June 1-15 and plant out in garden July 1-15 for fall crop. Germination: 4 days.
Spacing: 2 ft. apart each way.
Note: Cauliflower cannot be grown in this climate unless cool weather prevails. Broccoli will do better in most seasons.

CELERY

Varieties: GIANT PASCAL, GOLDEN SELF BLANCHING, WHITE PLUME.
Seed: 1 pkt. produces about 400 plants.
Plant: Start seed in late March and set out plants June 1-15. Germination: 12-15 days.
Spacing: 8-12 in. apart in the row; 18-24 in. between rows.
Note: While celery can be grown in this region, it does much better in a cool climate.

COLLARDS

Variety: GEORGIA.
Seed: 1 pkt. produces about 150 plants.
Plant: In garden April 1 to 15 and June 1-15. Germination: 4-6 days.
Spacing: ½ in. deep; thin to 18 in. to 2 ft.; rows 3 ft. apart.
Note: A large plant the foliage of which is used as a substitute for cabbage in hot weather.

CORN

Varieties: GOLDEN CROSS BANTAM, IOANA, MARCROSS, SPANCROSS, COUNTRY GENTLEMAN, GOLDEN BANTAM, STOWELL'S EVERGREEN.
Seed: 1 pkt. to 40 hills; ¼ lb. for 100 hills.
Plant: April 15 and every 2 to 3 weeks until July 1. Germination: 4-6 days.
Spacing: ½ in. deep; 3-4 in. in the row and thin to 12 in.; 2-3 ft. between rows; hills 3-4 ft. apart each way and 2-4 plants to the hill.

EGGPLANT

Varieties: BLACK BEAUTY, NEW HAMPSHIRE, IMPROVED NEW YORK.
Seed: 1 pkt. will produce about 100 plants.
Plant: Sow seeds indoors about March 15 and set plants in garden about May 15, if the soil is warm. Germination: 10 days.
Spacing: 2 ft. apart in the row; rows 2-3 feet apart.
Note: BLACK BEAUTY is a good variety and last summer yielded more fruits than Improved New York.

ENDIVE

Varieties: BATAVIAN BROAD-LEAVED, COS TYPE BATAVIAN, FLORIDA DEEP HEART, GREEN CURLED.
Seed: 1 pkt. to 20 ft.; 1 oz. to 100 ft.
Plant: Sow seed between July 15 and August 15. Germination: 8 days.
Spacing: ½ in. deep; thin to 12 in. apart in the row; 12-15 in. between rows.
Note: Endive does well in the fall. The plants are not affected by light frosts and if protected with straw or if the plants are lifted and replanted in

a frame it is possible to have endive until the end of December. The curled varieties are more easily tied up for blanching than the broad-leaved BATAVIAN. However, there is a new COS TYPE BATAVIAN which would probably be better and should be tried. Plants should be tied for blanching, a few at a time, at least three weeks before they are to be used.

KALE

Varieties: DWARF GREEN CURLED, TALL GREEN CURLED SCOTCH.
Seed: 1 pkt. to 30 ft.; 1 oz. to 200 ft.
Plant: Sow May 15 to June 1 in seed-bed and transplant to garden in July. Germination: 4-6 days.
Spacing: ½ in. deep; thin to 6 inches in the row; 15-18 in. between rows.

KOHL-RABI

Variety: EARLY WHITE VIENNA.
Seed: 1 pkt. to 30 ft.; 1 oz. to about 200 ft.
Plant: March 15-April 1 and again about Aug. 15. Germination: 4-8 days.
Spacing: ½ in. deep; thin to 6 inches in the row; 15-18 in. between rows.

LEEK

Variety: BROAD AMERICAN FLAG.
Seed: 1 pkt. to 25 ft.; 1 oz. to 200 ft.
Plant: Start in greenhouse or frame in early March or sow in the garden about April 1. Germination: 6 days.
Spacing: Sow in furrow 4-5 in. deep, or plant seedlings in furrow and gradually fill trench with soil and hill plants as they grow. In garden sow seed ½ in. deep and thin to 4 in.; rows 18 in. apart.

LETTUCE

	LOOSE-LEAF	BUTTERHEAD, COS AND ICEBERG TYPES
Varieties:	BLACK-SEEDED SIMPSON	BIG BOSTON
	EARLY CURLED SIMPSON	COSBERG
	GRAND RAPIDS	IMPERIAL 44
	OAKLEAF	IMPERIAL 847
	PRIZEHEAD	MIGNONETTE

Seed: 1 pkt. to 30 ft.; 1 oz. to 250 ft.
Plant: Sow every 2 weeks from March 15 to May 1 and again during August and early September. Germination: 4-8 days.
Spacing: ¼-½ in. deep; thin loose-leaf to 4-6 in. and heading varieties to 1 ft.; rows 1-1½ ft. apart.
Note: IMPERIAL 44 was an exceptionally good head lettuce in 1942. Any loose-leaf variety is satisfactory.

MUSTARD

Varieties: FORDHOOK FANCY, GIANT SOUTHERN CURLED, IMPROVED OSTRICH PLUME, TENDERGREEN.
Seed: 1 pkt. to 50 ft.; 1 oz. to 200 ft.
Plant: Sow April 1 and 15 and again during August. Germination: 4-8 days.
Spacing: ½ in. deep; thin to 5-6 inches in the row; 12-18 in. between rows.

Note: Mustard is grown for the green leaves which are used in salad or as a substitute for spinach. TENDERGREEN is the largest of the four varieties.

ONIONS

Varieties: FANCY YELLOW GLOBE DANVERS, PRIZETAKER, RIVERSIDE SWEET SPANISH, SOUTHPORT YELLOW GLOBE, VALENCIA SWEET SPANISH, and onion sets, usually the variety EBENEZER.
Seed: 1 pkt. to 25 ft.; 1 oz. to 150 ft.; 1 lb. sets to 50 ft.
Plant: Onion sets in late March and early April. Seed April 1. Seed may also be sown indoors March 1 and transplanted to garden about April 15. Germination: 6 days.
Spacing: Sets 2-3 in. deep, 3 in. apart in the row; 12-15 in. between rows. Seed ½ in. deep; when 3-4 inches tall thin to 3 in.; rows 12-15 in.
Note: RIVERSIDE and VALENCIA SWEET SPANISH produced the largest onions. SOUTHPORT YELLOW GLOBE and YELLOW GLOBE DANVERS are good varieties for storing.

PARSLEY

Varieties: DOUBLE CURLED, EVERGREEN, CHAMPION MOSS CURLED, HAMBURG ROOTED, PARAMOUNT.
Seed: 1 pkt. to 30 ft.; 1 oz. to 200 ft.
Plant: April 15. Germination: 18 days.
Spacing: ½ in. deep; thin to 6-8 in.; rows 12-18 in. apart.
Note: All varieties of parsley grew well in 1942. The only difference is in the doubling of the leaves and possibly the flavor.

PARSNIPS

Varieties: GUERNSEY, HOLLOW CROWN.
Seed: 1 pkt. to 20 ft.; 1 oz. to 200 ft.
Plant: April 15. Germination: 21 days.
Spacing: ½ in. deep; thin to 4-6 in.; rows 2-3 ft. apart.

PEAS

Varieties: ALASKA, LAXTON'S PROGRESS, LITTLE MARVEL, IMPROVED GRADUS.
Seed: 1 pkt. to 20 ft.; 1 lb. to 100 ft.
Plant: Between March 15 and April 1. Peas sown after April 10 will only yield a good crop if weather remains cool. Germination: 5-10 days.
Spacing: Sow in single furrow, 4-5 in. deep and cover seed with 1 inch of soil. There is a better way of growing peas if brush is used to support the vines. Make a flat-bottomed furrow 5 to 6 inches wide and 4 to 5 inches deep and in this furrow sow two rows of peas, 5 inches apart. Cover the seed with 1 inch of soil and as the plants grow, gradually fill in the trench. When the peas are about four inches high place the brush between the rows, thus making it possible to grow two rows of peas on a single row of brush.

ALASKA and GRADUS are tall varieties; LAXTON'S PROGRESS and LITTLE MARVEL are dwarf varieties.

PEPPERS

Varieties: CALIFORNIA WONDER, PIMENTO, SUNNYBROOK, RUBY KING, WINDSOR A, WORLD BEATER. Hot peppers: LONG RED CAYENNE, HUNGARIAN WAX.
Seed: 1 pkt. produces 100 plants; 1 oz. produces about 1500 plants.
Plant: Sow seeds in greenhouse or frame in early March. Plant out about May 15. Germination: 6 days.
Spacing: Peppers produce large plants and should be spaced 18-24 inches in the row and rows 2-3 ft. apart.

RADISHES

Varieties: CINCINNATI MARKET, CRIMSON GIANT, EARLY LONG SCARLET SHORT TOP, EARLY SCARLET GLOBE, ICICLE, SCARLET TURNIP WHITE TIP, SPARKLER, WHITE STRASSBURG, LONG BLACK SPANISH, CHINESE ROSE, WHITE CHINESE.
Seed: 1 pkt. to 20 ft.; 1 oz. to 100 ft.
Plant: Spring radishes every week from March 15 to May 1 and again after Aug. 15. Summer radishes April 1. Winter radishes Aug. 1. Germination: 3-6 days.
Spacing: ½ in. deep; thin small varieties 2 in. apart, larger ones 3-4 in.; rows 6-15 in. apart.
Note: Radishes may be sown in the rows of carrots, parsley, and parsnips, and harvested before those plants grow too large.

SALSIFY OR OYSTER PLANT

Variety: MAMMOTH SANDWICH ISLAND.
Seed: 1 pkt. to 20 ft.; 1 oz. to 100 ft.
Plant: April 15. Germination: 10 days.
Spacing: 1 in. deep; thin to 4-5 in.; rows 18 in. apart.

SPINACH

Varieties: BLOOMSDALE LONG STANDING, NOBEL GIANT.
Seed: 1 pkt. to 25 ft.; 1 oz. to 75 ft.
Plant: March 15 and every 10 days up to May 1. For fall crop, between Aug. 15 and Sept. 1. Germination: 5-8 days.
Spacing: ½ in. deep; thin to 5-6 in.; rows 12-15 in. apart.
Note: Spinach is a cool-weather crop and should be sown early.

NEW ZEALAND SPINACH

Seed: 1 pkt. to 30 ft.; 1 oz. to 75 ft.
Plant: Between May 1 and 15 when soil is warm. Germination: 10 days.
Spacing: 1 in. deep; thin to 2 ft.; rows 2-3 ft. apart.
Note: This plant is not a spinach but a good substitute for it; furnishes greens during the hot weather.

SQUASH

Varieties: BUTTERNUT, COCOZELLE BUSH, EARLY WHITE BUSH, GIANT SUMMER STRAIGHTNECK, MAMMOTH WHITE BUSH, SUCCHINI, TABLE QUEEN, YELLOW SUMMER CROOKNECK, HUBBARD.

Seed: 1 pkt. to 10 hills; 1 oz. to 50 hills.
Plant: May 1-15 when weather is warm. Germination: 6 days.
Spacing: 1 in. deep; bush varieties 3-4 feet apart each way; vine type 8-10 ft. apart each way. Sow 6-8 seeds to the hill and thin to 3 or 4.
Note: In 1942 the weather was extremely cool after May 15 and the squashes failed to make a good start, some of them having to be re-sown. However, the variety COCOZELLE, the Italian vegetable marrow, was not affected by the cool weather. Summer squashes should be started as early as the season will permit in order to harvest a crop before the pickle worms and squash bugs injure the plants and fruits. The small BUTTERNUT squash, a comparatively new variety, was the most productive.

SWISS CHARD

Varieties: Light green: CUT AND COME AGAIN, LUCULLUS.
Dark green: DARK GREEN CURLED, FORDHOOK GIANT.
Red: RHUBARB CHARD.
Seed: 1 pkt. to 25 ft.; 1 oz. to 100 ft.
Plant: April 1-15 and July 15. Germination: 6-8 days.
Spacing: 1 in. deep; 1-2 in. apart in the row; thin to 10-12 in.; rows 18-24 in. apart.
Note: Swiss chard is an excellent vegetable for the home garden because of its heavy yield of greens from June until frost. The outer leaves should be gathered when they are about a foot in length, cooked and served with a cream dressing. The mid-ribs may be cooked with the leaves or they may be prepared separately and served like asparagus. Very large leaves should not be used as they are tough, but neither should the center leaves be used if the plants are to continue producing a crop. To insure a continuous supply until late in October it is advisable to make another sowing about July 15. FORDHOOK GIANT is an excellent dark, green-leaved variety.

TOMATOES

Varieties: BELMONT, BREAK O'DAY, EARLIANA, EARLY BALTIMORE, MARGLOBE, MARVELOUS, OXHEART, PONDEROSA, PRITCHARD, RUTGERS, VICTOR, RED and YELLOW PEAR, RED and YELLOW PLUM, RED CHERRY.
Seed: 1 pkt. will produce about 200 plants.
Plant: Start plants in greenhouse or hotbed between March 15 and April 1. Plant out May 1-15. Germination: 6 days.
Spacing: 3-4 ft. apart in the row; rows 4 ft. apart.
Note: The tomato test plantings were the most interesting of all the vegetable trials. Plants were set out May 11, which is about the right time for planting tomatoes in St. Louis. Wet and cool weather during the following four weeks was responsible for a considerable amount of leaf curl on all the varieties, BELMONT and OXHEART being most seriously affected and BREAK O'DAY the least. This condition interfered very little with production and tomatoes were picked from July 10 until frost, the maximum yield occurring in mid-August. BELMONT produced the smallest tomatoes and OXHEART the largest, some of the latter fruits

weighing as much as two pounds apiece. BREAK O'DAY was by far the best variety in the group from the standpoint of uniform fruits and the average number of pounds of tomatoes per plant. Tomatoes were picked at two- to four-day intervals between July 14 and Sept. 4 and carefully weighed with the following results:

	Ave. number lbs. per plant		Ave. number lbs. per plant
BREAK O'DAY	12.5	PRITCHARD	6.2
OXHEART	9.9	VICTOR	5.4
EARLY BALTIMORE	7.4	MARGLOBE	5.2
PONDEROSA	6.8	RUTGERS	4.9
EARLIANA	6.6	MARVELOUS	4.2
BELMONT	6.4		

TURNIPS

Varieties: GOLDEN BALL, LONG WHITE COW HORN, PURPLE TOP WHITE GLOBE, SEVEN-TOP (foliage turnip).
Seed: 1 pkt. to 50 ft.; 1 oz. to 250 ft.
Plant: April 1 and Aug. 1-15. Germination: 4-8 days.
Spacing: ½ in. deep; thin to 3-5 in.; rows 12-15 in. apart.

SOWING VEGETABLE SEEDS

Most of the soil in this vicinity is a heavy clay, which needs humus in the form of manure, leaf mold or peat moss. Sand and lime, hydrated or pulverized limestone, will also greatly improve clay soil. It will take several years to correct extremely heavy clay which is gummy when wet and hard when dry. Good vegetables cannot be grown in such soil and the only alternative, if the area is not too large, is to replace the clay with good top soil.

The seed-bed must be thoroughly prepared and all lumps removed before any seed is sown. Almost all vegetable seeds are placed in shallow furrows and covered with only a little soil. Seeds are sown slightly deeper in light soil and during midsummer. In spring the soil is moist and showers usually maintain that condition, but in summer the surface is hot and dry and, unless seed is sown deeper, germination will be uneven. For best results vegetable seeds should be sown in the following manner:

1—Measure a distance from the adjoining row or edge of the garden, the distance depending upon the kind of vegetable to be grown.

2—Stretch a stout line.

3—Draw the corner of a hoe along the line and regulate the depth of the furrow for small or large seeds.

4—Remove the line and sow the seed.

5—Cover the seed by drawing the soil into the furrow with the hoe or the back of a straight-top rake. If seeds are sown in a deeper furrow in midsummer cover them with one-half to one inch of soil and as the plants grow gradually fill in the furrow.

6—Firm the soil over the seed by tapping with a hoe or rake or with the feet. It is not advisable, however, to walk in the row if the soil is heavy or wet.

The two terms, "drills" or "hills" might be confusing. If seeds are sown in drills they are sown in rows, the term being taken from the mechanical seeder which drills the seed into the soil. The expression "hill" is also somewhat misleading. At one time it was the custom to grow plants in raised beds and in hills for better drainage. This method, however, is not necessary in this region where dry weather may be expected at some time each year. When the statement is made, for example, that seeds of corn and squash are sown in hills, three or four feet apart, it means that several seeds are sown in groups, three or four feet apart, instead of in a continuous row.

A CONDENSED VEGETABLE PLANTING CALENDAR FOR ST. LOUIS GARDENS

	In greenhouse or hotbed	
Jan. 15-31	Cabbage	
Feb. 15-28	Broccoli Cauliflower	
March 1	Leek Onions Peppers	
March 15	Celery Eggplant Lettuce (head) Tomatoes	
	In garden sow seeds of:	*In garden set plants of:*
	Kohl-rabi Lettuce (loose-leaf) Peas Radishes Spinach	Broccoli Cabbage Cauliflower Onion sets

April 1	Beets Carrots Collards Kohl-rabi Leek Lettuce (loose-leaf) Mustard Onions Parsley Parsnips Peas Radishes (spring & summer) Spinach Swiss chard Turnips	Broccoli Cabbage Cauliflower Onion sets or plants
April 15	Carrots Collards Corn Lettuce (loose-leaf) Mustard Radishes Salsify Soybeans Spinach Swiss chard	Lettuce (head)
May 1	Beans (bush) Beans (pole & pole lima) Beets Carrots Corn Lettuce (loose-leaf) Radishes New Zealand spinach Soybeans Squash	Tomatoes
May 15	Beans (bush lima) Beans (pole & pole lima) Corn New Zealand spinach Squash	Eggplant Peppers Tomatoes
	In special bed sow: Broccoli Cabbage	

VEGETABLES GROWN IN GARDEN OF CHATEAU DE VILLANDRY

June 1	Broccoli Cabbage Collards Kale	Celery
	In garden sow seeds of:	
	Beans (bush) Beets Carrots	
June 15	Beans (bush) Corn	Broccoli Cabbage Celery
July 15	Carrots Chinese cabbage Endive Swiss chard	Broccoli Cabbage Collards Kale
Aug. 1	Beans (bush) Chinese cabbage Radishes (winter) Turnips	
Aug. 15	Beans (bush) Beets Carrots Endive Kohl-rabi Lettuce (head) Mustard Radishes (spring) Spinach Turnips	
Sept. 1	Lettuce (loose-leaf) Radishes (spring) Spinach	

P. A. K.

VEGETABLES REPLACE FLOWERS IN ORNAMENTAL PLANTING

When a nation goes to war there follows a train of changes in daily life too numerous to mention. The gravest of these is the scarcity of food because of labor shortages, transportation difficulties and the tremendous demands of the army, the navy and, in this war, the lend-lease agency. Fresh vegetables are among the first of the food items to reflect the rapid changes. The Victory Garden movement throughout the country in 1942 made every one conscious of the importance of fresh vegetables, but when

cabbages vied for attention with the tropical water-lilies in the main plaza of the Missouri Botanical Garden, as they did last summer, that *was* news.

In times of peace we have cultivated flowering plants at the Garden because of their beauty, and we have paid little attention to the combined ornamental and utilitarian value of vegetables. Never before have vegetables been grown in the beds intended for foliage or flowering plants, but last year this was done with excellent ornamental effect.

The use of vegetables in the garden landscape during war and post-war periods is not a new idea. One proof of that assertion may be obtained by examining the picture of the formal garden at Villandry, France, photo-

RED CABBAGE, TOMATOES, PEPPERS, AND RHUBARB CHARD PLANTED IN MAIN PLAZA AT GARDEN IN 1942

graphed in the summer of 1919, less than a year after the close of hostilities of the first world war (pl. 6). The illustration shows a large formal garden with many box-edged beds some of which were planted with vegetables instead of flowers. Dwarf fruit trees and standard roses were used as accents in the beds, and fruit trees and climbing roses were trained against the latticed fences and shelters. The effect is more than pleasing.

In selecting ornamental vegetables those having a long growing season should be chosen. Short-season plants such as lettuce or radishes, which would be affected by the heat or which would set seed, are unsuitable for this kind of gardening. Last summer RED CHERRY tomatoes, trained to

stakes, were used for the tallest plants. Next in height was RHUBARB CHARD, a very ornamental red-leaved chard, alternated with RUBY KING pepper plants. The entire bed was bordered with red cabbage, the yellows-resistant strain. These plants remained in good condition until the first killing frosts. The chard and pepper plants required very little care, but the tomatoes had to be disbranched and trained to the stakes each week. The red cabbage plants needed constant attention in order to control the cabbage worms which seemed unusually numerous last year. In the circular beds we again used RED CHERRY tomatoes for the center plants, surrounding them with a row of Chinese ornamental kale and a border of globe artichoke. The ornamental kale was extremely interesting because of its rosette of ruffled foliage which assumed beautiful colors from green through white to pink in the autumn. It likewise was subject to cabbage worms and needed constant attention. The globe artichoke produced large plants with silvery-gray, thistle-like foliage, individual plants measuring 24-36 inches across.

In addition to the plants just described there are other vegetables that may be used in ornamental plantings. For tall plants okra and the PLUM, PEAR and RED CURRANT tomatoes are suggested. Collards and broccoli are also tall green-leaved decorative vegetables. Corn could be used but it would not be a full-season crop. Cabbage, chard, eggplant and peppers grow about two feet high. Suitable border plants would be beets, carrots, parsley, and possibly New Zealand spinach. Sweet-potato vines furnish a good green ground cover. To supplement the vegetables, equally ornamental and useful are cotton, tobacco and castor-beans.

The large plants should be started in frames from four to six weeks before being planted in the garden. By using pot plants it is possible to select and space the plants properly. The only vegetables that should be sown in the beds and later thinned are beets, carrots, parsley and New Zealand spinach. These four vegetables should be sown between April 15 and May 15. The pot plants may be planted about May 15, but it should be remembered that eggplants, peppers and tomatoes will not grow if the soil is wet and cold.

P. A. K.

NOTES

Dr. Edgar Anderson, Geneticist to the Garden, spoke before the Garden Club of St. Louis, January 19, on "Vegetable Gardening in St. Louis."

Dr. Robert W. Schery, Research Assistant to the Garden, has accepted a position with the Rubber Reserve Company to explore the natural resources of rubber in Brazil.

Dr. Edgar Anderson, Geneticist to the Garden, and Mr. Frederick D. Blanchard, formerly of the St. Louis Country Day School, have published a paper in the December number of the *American Journal of Botany* (**29**: 832-834) entitled "Prehistoric Maize from Cañon del Muerto."

The December number of the *Journal of the Cactus & Succulent Society of America* (**14**: 163-164) contains an illustrated article by Mr. Ladislaus Cutak, in charge of Succulents at the Garden, on "*Coryphantha ramillosa*, a New Species from the Big Bend Region of Texas."

Recent visitors to the Garden include Corp Gerald B. Ownbey, of the U. S. Infantry, Camp Blanding, Fla.; Dr. William J. Bonisteel and Mr. Charles Gilly, director and taxonomist, respectively, of an expedition to Mexico sponsored by the Board of Economic Warfare to investigate drug plants.

Dr. Edgar Anderson has been granted a leave of absence for an indefinite period to undertake a project sponsored by the Rockefeller Foundation. In collaboration with Dr. Carl O. Sauer, professor of geography at the University of California, Berkeley, he will outline a program for inter-American cooperation in the study of native American food resources.

STATISTICAL INFORMATION FOR JANUARY, 1943

GARDEN ATTENDANCE:

Total number of visitors	7,118

LIBRARY ACCESSIONS:

Total number of books bought	13
Total number of books and pamphlets donated	110

HERBARIUM ACCESSIONS:

By Purchase—

Langlois Herbarium—Plants of arctic North America collected by Artheme Dutilly	52
Rogers, Mrs. H. T.—Plants of western Montana	268
Wiggins, Ira L., and Rollins, Reed C.—Plants of Sonora, Mexico	418

By Gift—

Allen, Paul—Plants of Panama	22
Anderson, E.—Seeds of *Prunus maritima* Marsh. and photographs of seeds of *Tradescantia*	5
Atkins Institute of the Arnold Arboretum, Cuba— *Furcraea tuberosa* Ait. from Cuba	1

Degener, Otto—Plants of Hawaii and western United States	8
Ek, Charles M.—Plants of Indiana	600±
Florida Agricultural Experiment Station—Plants of Florida	2
Krueger, Henry, and Gillespie, Paul—Plants of Oaxaca, Mexico	50
Rancho Santa Ana Botanic Garden, by Carl B. Wolf—*Quercus* sp. from California	1
University of California, by T. H. Goodspeed—Plants of South America	9
By Exchange—	
Beetle, Alan A.—Plants of California	55
U. S. National Museum—Plants of Haiti	4
U. S. National Museum—Lichens of the U. S. Antarctic Expedition 1940-41	359
University of Illinois—Plants of Illinois, collected by V. H. Chase and by G. N. Jones	678
	2,540

ANNOUNCEMENT

A. D. E. Elmer's "Leaflets of Philippine Botany"

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until sunset; Sundays, 10:00 a. m. until sunset. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah car line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

THE CHINELA

Phragmopedilum caudatum var. *Warscewiczii*

Missouri Botanical Garden Bulletin

Vol. XXXI MARCH, 1943 No. 3

HYBRID FORMS OF PHRAGMOPEDILUM GRANDE

Phragmopedilum grande, the robust hybrid between the terrestrial *Phragmopedilum longifolium* and the epiphytic *P. caudatum*, has long been regarded as a persistent "good grower", unlike the staminate parent, *P. caudatum*. Three interesting forms of this hybrid have been in the Garden collection since 1918, when they were received from the late D. S. Brown. All three bear distinct traces of both parents in color and size of flower but the growth is twice the size of either parent. While the pistillate parent *(P. longifolium)* does form large clumps on rocks in its native habitat, the staminate parent *(P. caudatum)* never becomes very large and is not easily found (see Mo. Bot. Gard. Bull. May, 1927, April, 1932, and March, 1939).

Since there has recently been a revival of interest in these "long-tailed lady-slippers," a description of the two parents, with the resulting hybrid forms, is given.

Phragmopedilum caudatum var. *Warscewiczii* (Panama).—Leaves strap-shaped, more or less equitant, stiff and upright, keeled, about 1 foot or more long, 1–1½ inches wide. Flower stalk 1–1½ feet high, producing 2–4 flowers in cultivation (in Panama upwards of 8 have been observed by the writer—see pl. 7); dorsal sepal 4–6 inches long, 1 inch wide, lanceolate, pale greenish-yellow, lighter toward the apex, veined greenish; lower sepal similar in color; petals attenuated, 18–30 inches long, yellowish-green striped with brown which darkens toward the ends, margins lined with minute reddish-brown hairs; pouch or labellum yellowish-green, margin reddish-brown, revolute, introrse, fringed with minute hairs; bilobed staminode and where it joins the column spotted with bright reddish-brown.

As soon as the flowers open the attenuated petals elongate rapidly, growing 4 inches in 24 hours. In the Chiriquí region of Panama the dominant color of the slippers is reddish-brown, but under greenhouse cultivation at the Garden yellowish-green is dominant (see April 1932 Bulletin).

Phragmopedilum longifolium (Panama).—Leaves tufted, 8–12 inches long, narrowly strap-shaped, tapering to a point, strongly keeled. Flower stalk 2 feet high, purplish, sparsely pubescent. Flowers 6–7 inches wide; dorsal sepal ovate-lanceolate, pale yellowish-green faintly streaked with purple; lower sepal ovate, shorter than the lip; petals 3 ½ inches long, spreading, narrowly lanceolate, twisted, pale yellow with dark rose-colored margins edged with a white line; labellum 2 inches long, green shaded with deep

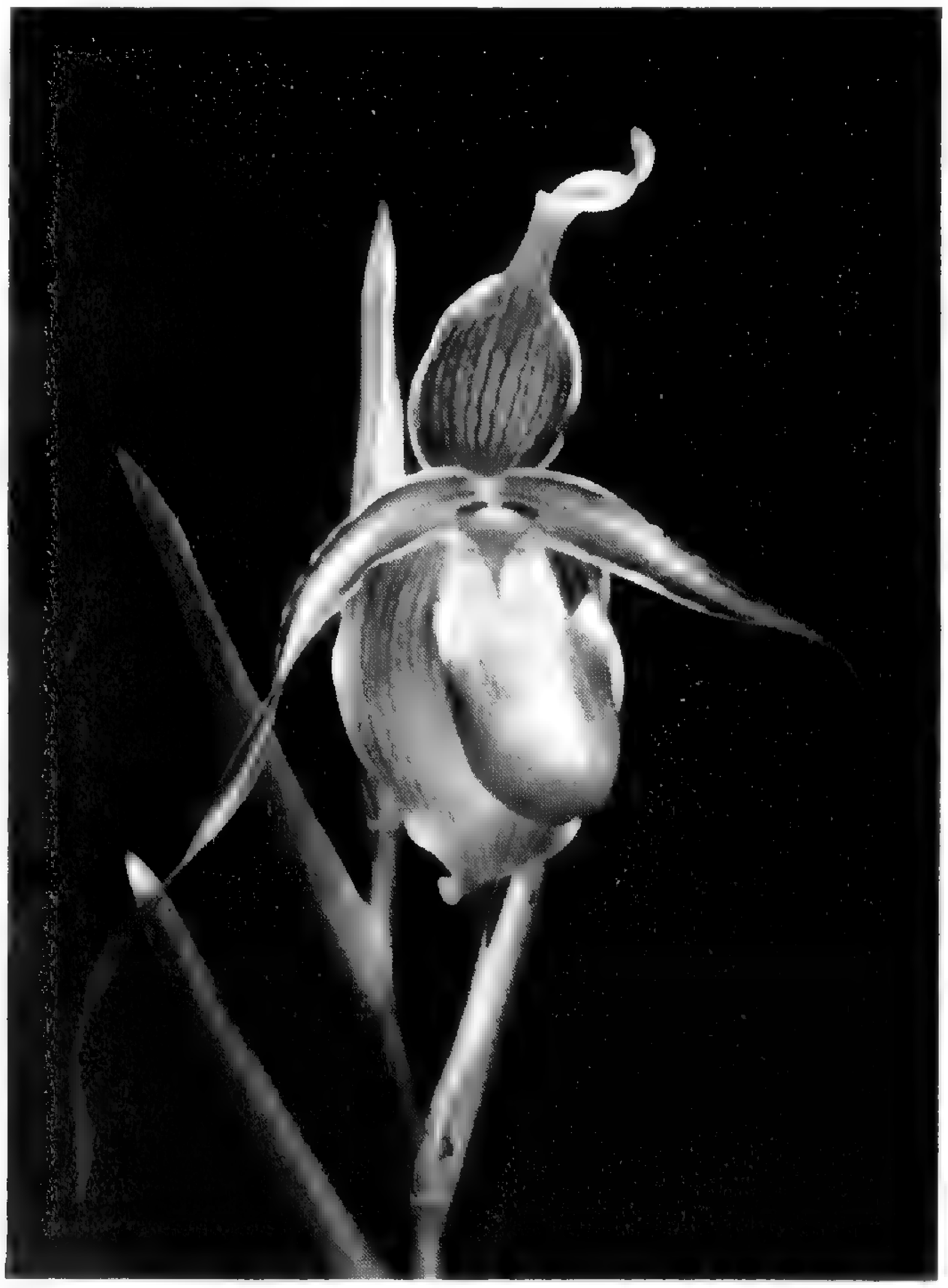

Fig. 1

Phragmopedilum longifolium

purple, or brown in front; lateral lobes yellow spotted with pale purple.

Phragmopedilum grande (P. caudatum X *P. longifolium).*—This represents the medium-colored form of the three hybrids, intermediate between the two parents. Flower stalk 18 inches long; pedicels about 3–3 ½ inches long, dark green with a blackish cast; dorsal sepal 4 inches long, ¾ inches wide near the base, very faintly chocolate-colored with greenish-brown

stripes, darker on the back; lower sepal about 3 inches long, 1 ½ inches wide near the base, lighter in color than the dorsal, with pronounced purplish striations; petals 8 ¼ inches long, linear, pendant, undulate and twisted, yellow-green at the base with deeper-colored stripes merging into red-purplish to the tip, margin white bordered by a purplish strip, margin and

Fig. 2

Phragmopedilum grande

lower half of the basal portion fringed with short purplish hairs; labellum pouch-like, greenish with a tinge of purple, deeper purple on the sides; incurved sides light green marked by light and dark purplish blotches throughout and by 6 large green spots near the converging margins; staminode brownish-green, fringed with dark purple hairs.

Phragmopedilum grande atratum (P. caudatum X *P. longifolium Hartwegii).*—This represents the darkest form, resembling *P. caudatum* in color. Flower stalk approximately 18 inches long, dark green; pedicels blackish-purple; dorsal sepal 4 inches long, greenish with darker striations, basal portion dark greenish, upper portion (above the middle) with a brownish cast, back

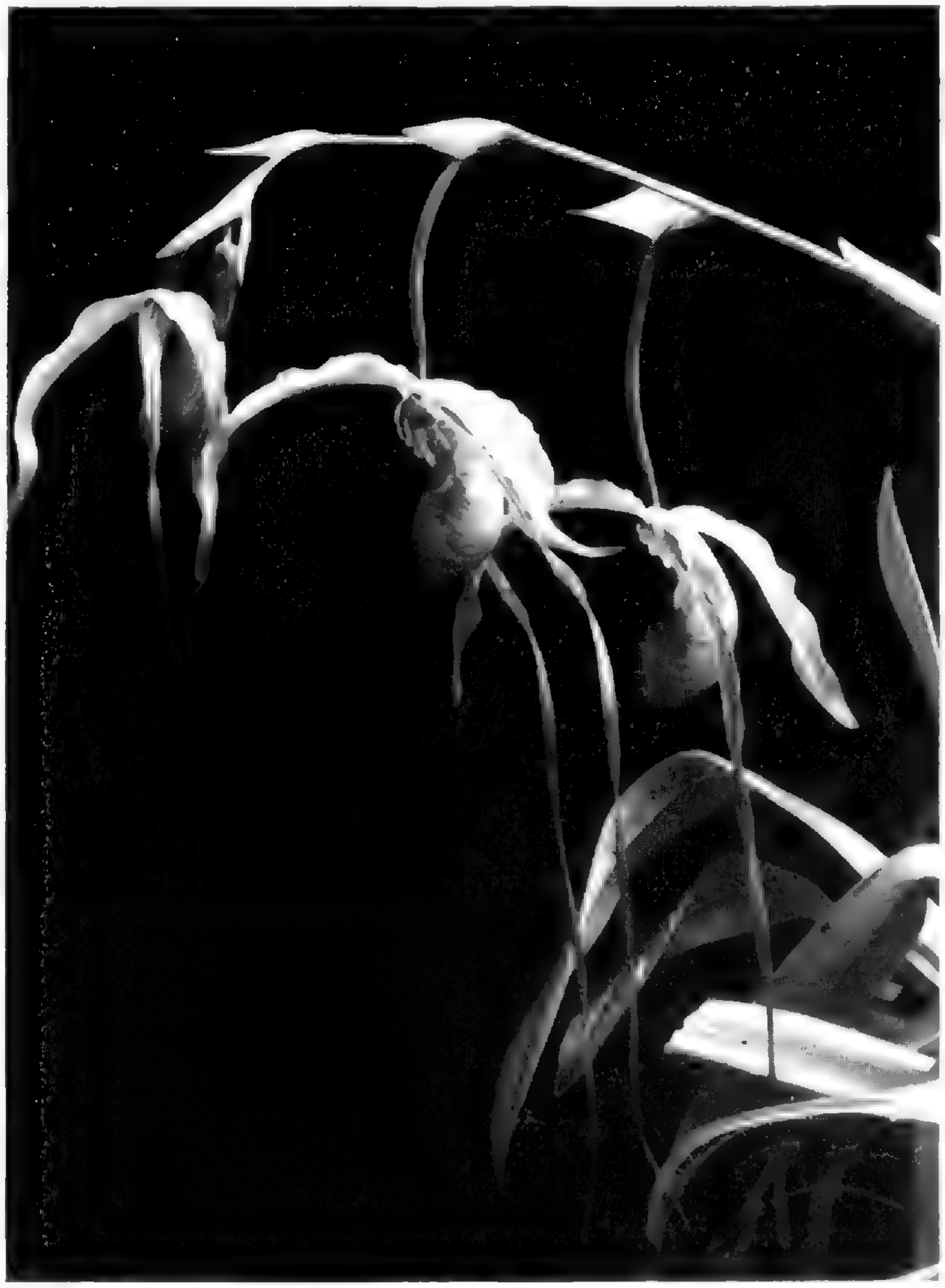

Fig. 3

Phragmopedilum grande atratum

of sepal a shining brown; lower sepal smaller but broader, 3 inches long, 2 inches wide at the broadened base, of about the same color as the dorsal but with a slightly lighter face; petals linear, 4 inches long, pendant, undulate, vivid green near the base gradually merging into dark purplish to the tip, border purplish-red with a waxy pink or light purple stripe on the edge,

purplish hairs on the margins of the basal portion and likewise scattered over the face of the petals; labellum pouch-like, 2½ inches long, chocolate-green to purplish-green, much lighter below, the sides with large purplish spots and about 6 greenish spots near the converging margins; pouch pale yellow, with prominent purplish dots; staminode purplish-green fringed with dark purple hairs.

Fig. 4

Phragmopedilum grande macrochilum

Phragmopedilum grande macrochilum (P. caudatum Lindenii X *P. longifolium).*—This is the lightest-colored hybrid. Flower stalk 16 inches long; pedicels 4 inches long, dark green; dorsal sepal white, about 11 inches long, with numerous green stripes, wavy, lanceolate; lower sepal 4 inches long, 2 inches wide at the expanded base; petals 13 inches long, linear, wavy and

twisting, the basal portion striped with green, margin wavy, whitish, bordered by a red stripe; petals becoming darker red below the middle to the tip, with purplish hairs on the basal margins and scattered on the face; labellum pouch-like, 3 inches long, cream-colored with greenish-brown striations, incurved sides tinged with purple and covered with small brownish spots, large greenish spots near the converging margins, inside of the pouch covered with light purplish dots.

G. H. P.

HOUSE PLANTS EVALUATED BY AMATEUR GARDENERS

The ever-expanding field of house plants today covers such a wide assortment of shapes, sizes, color, texture, etc. that it is practically impossible for any two indoor gardeners to agree on the best half-dozen. Substantial evidence to this effect was obtained recently at the Garden when fifty enthusiastic amateurs critically examined and carefully scored a special exhibit of 100 different kinds of house plants. The exhibit was divided into four groups: (1) flowering plants, (2) foliage plants, (3) trailing plants, (4) cacti and succulents. All the plants were cleaned, "deloused," and accurately labelled to present the best possible appearance. Each person then selected the specimens with the most "house plant appeal." A summary of the results follows.

Common Name	*Botanical Name*	*No. of Votes Rec'd*
African Violet	*Saintpaulia ionantha*	26
Cyclamen	*Cyclamen persicum*	26
Azalea	*Azalea indicum*	25
Spring Bulbs—		
Daffodil	*Narcissus pseudo-narcissus*	25
Tulip	*Tulipa* (hybrids)	25
Hyacinth	*Hyacinthus orientalis*	25
Gardenia	*Gardenia Veitchi*	24
Primrose	*Primula obconica*	24
Fairy Primrose	*Primula malacoides*	24
Ivy (Dagger Point)	*Hedera Helix* var. "Dagger Point"	24
Ghost Plant	*Byrnesia Weinbergi*	23
Norfolk Island Pine	*Araucaria excelsa*	22
Chinese Jade Plant	*Crassula argentea*	21
Apple Geranium	*Pelargonium fragrans*	21
Coleus	*Coleus Blumei*	20
Stonecrop	*Sedum Adolphi*	20
Stonecrop	*Sedum guatemalense*	20
Peppermint Geranium	*Pelargonium tomentosum*	20
Asparagus Fern	*Asparagus Sprengeri*	19

Common Name	*Botanical Name*	*No. of Votes Rec'd*
Amaryllis	*Hippeastrum* (hybrids)	19
Lemon Geranium	*Pelargonium crispum*	18
Pepper Elder	*Peperomia obtusifolia*	18
Ice Plant	*Aptenia cordifolia*	18
Everblooming Begonia	*Begonia semperflorens*	18
Common Geranium	*Pelargonium hortorum*	17
Christmas Cactus	*Zygocactus truncatus*	17
Kalanchoë	*Kalanchoe Blossfeldiana*	17
Ivy (Richmond Gem)	*Hedera Helix* var. "Richmond Gem"	17
Chinese Evergreen	*Aglaonema simplex*	16
Begonia	*Begonia Lucerna*	16
Rosette Bowstring Hemp	*Sansevieria Hahni*	15
Ivy (Hahn's Self-Branching)	*Hedera Helix* var. "Hahn's Self-branching"	15
Princess Pine	*Crassula lycopodioides*	15
Asparagus Fern	*Asparagus plumosus*	15
Rose Geranium	*Pelargonium Radula*	15
Artillery Plant	*Pilea microphylla*	14
Wax Plant	*Hoya carnosa*	14
Boston Fern	*Nephrolepis exaltata* var. *bostoniensis*	14
Woolly Kalanchoë	*Kalanchoe tomentosa*	14
Rex Begonia	*Begonia Rex-cultorum*	14
Variegated Lemon Geranium	*Pelargonium crispum* var. "Prince of Orange"	14
Variegated Rose Geranium	*Pelargonium Radula* var. "Lady Plymouth"	14
Desert Geranium	*Pelargonium echinatum*	14
Silk Oak	*Grevillea robusta*	13
Kleinia	*Kleinia ficoides*	13
Wandering Jew	*Tradescantia fluminensis*	13
Philodendron	*Philodendron cordatum*	13
Screw Pine	*Pandanus Veitchi*	13
Rubber Plant	*Ficus elastica*	12
Ficus	*Ficus utilis*	12
Pandanus (yellow stripes)	*Pandanus Sanderi*	12
Tiger's Jaw	*Faucaria tigrina*	11
Strawberry Geranium	*Saxifraga sarmentosa*	11
Pandanus (spineless form)	*Pandanus Baptisti*	11
Umbrella Plant	*Cyperus alternifolius*	11
Leather Fern	*Davallia decurrens*	11
Holly Fern	*Cyrtomium falcatum*	11
Dracaena	*Dracaena Sanderiana*	10
Fiddle-leaf Rubber Plant	*Ficus lyrata*	10
Spider Plant	*Chlorophytum elatum*	10
Peanut Cactus	*Chamaecereus Silvestri*	10
Variegated Aloe	*Aloe variegata*	10
Variegated Bowstring Hemp	*Sansevieria trifasciata* var. *Laurenti*	10
Baby-in-the-Cradle	*Rhoeo discolor*	10
Dwarf Bowstring Hemp	*Sansevieria parva*	9
Oscularia	*Oscularia deltoides*	9
Philodendron	*Philodendron dubium*	9
Corn Plant	*Dracaena fragrans* var. *Massangeana*	9
Dumb Cane	*Dieffenbachia picta*	9
Fig Marigold	*Lampranthus falciforme*	8
Grape Ivy	*Cissus rhombifolia*	8

Common Name	*Botanical Name*	*No. of Votes Rec'd*
Air Plant	*Bryophyllum pinnatum*	8
Bowstring Hemp	*Sansevieria trifasciata*	7
Hart's Tongue	*Gasteria nigricans*	7
Bunny Ears	*Opuntia microdasys*	7
Kangaroo Vine	*Cissus antarctica*	7
Carrion Flower	*Stapelia variegata*	7
Oleander	*Nerium Oleander*	7
Philodendron	*Philodendron erubescens*	7
Ceriman	*Monstera deliciosa*	7
Croton	*Codiaeum variegatum* var. *pictum*	7
Crown of Thorns	*Euphorbia splendens*	7
Date Palm	*Phoenix dactylifera*	6
Philodendron	*Philodendron hastatum*	6
Neoregelia	*Neoregelia marmorata*	6
Thatch Palm	*Howea Belmoreana*	6
Nephthytis	*Nephthytis Afzeli*	5
Rose Fig Marigold	*Lampranthus roseus*	5
Philodendron	*Philodendron Meliononi*	5
Amomum	*Amomum cordifolium*	4
Cast Iron Plant	*Aspidistra elatior* var. *variegata*	4
Nidularium	*Nidularium Innocenti* var. *striatum*	4
Dwarf Lily-Turf	*Ophiopogon japonicus*	4
Aechmaea	*Aechmaea Weilbachi*	3
Giant Carrion Flower	*Stapelia gigantea*	3
Purple Wandering Jew	*Zebrina pendula*	3
Banyan Tree	*Ficus benghalensis*	3
Variegated Rubber Plant	*Ficus elastica* var. *variegata*	3
Dwarf Grape Ivy	*Cissus striata*	3
St. Augustine Grass	*Stenotaphrum secundatum* var. *variegatum*	3
Basket Grass	*Oplismenus compositus* var. *vittatus*	2
Mistletoe Cactus	*Rhipsalis cassutha*	2
Dracaena	*Dracaena deremensis*	1

From this summary we venture to draw a few conclusions, subject to change without notice.

1. A house plant has to be brimful of merit to please even 50 per cent of the gardening public. The most popular plants in the entire exhibit only received 52 per cent approval.
2. The condition or appearance of the plants largely determined their ratings. Specimens which were not up to par were given minor recognition.
3. Plants with attractive flowers were the most popular. Some of the flowering plants shown happened to be out of bloom at the time, consequently their ratings were not as high as one might expect when examining the list.
4. The size, shape, texture and general vigor of the plants were decisive factors.

5. Plants with fragrant leaves (Scented Geraniums) and colorful leaves (Coleus) were quite popular.
6. The ability of plants to withstand unfavorable growing conditions existing in most homes seemed to be completely ignored. Rugged specimens such as the Rubber Plant, Cast Iron Plant, Palms, Dumb Cane and Mistletoe Cactus received very few votes.
7. Rare or unusual plants were given no higher ratings than many of the more common ones. Of course new introductions are at a disadvantage since their merits as window-garden subjects are unknown.
8. Apparently an attractive or "catchy" common name influenced the ratings of some plants.

D. C. F.

TWO EXCELLENT ECHEVERIAS FOR THE HOME

Roughly speaking, there are more than 150 species of American "hen-and-chicken" plants, belonging to the closely related genera *Echeveria* and *Dudleya*. I say "American" to distinguish them from the Old World counterparts, *Sempervivum*, *Aeonium*, *Aichryson* and *Greenovia*, which also are sometimes popularly known as "hen-and-chicken" plants. The popular name is well-earned because of the fact that innumerable plantlets are produced at the bases of the mother plants in most of the species, just like a brood of vegetable chicks under a sitting hen.

The genera *Dudleya* and *Echeveria* are very striking succulents indeed, notable for their attractive clusters of leaf rosettes in distinctive shades and tints ranging from powder-white to blue-green and from bright green to metallic hues. In size, the rosettes vary from about the size of a half-dollar to as big as a dinner plate; some are low-growing stemless forms, while others are short and bush-like.

There are a number of features by which the two genera are differentiated, but for the amateur the easiest and surest way is to observe the mode of attachment of the leaves. In *Dudleya* the leaf bases clasp the stem for their full width and are very persistent, remaining firmly attached to the stem, even when dead; in *Echeveria* the area of attachment is confined to a small "eye" and the leaves usually fall away upon withering, or in some species become easily detached upon the slightest disturbance. In *Dudleya* it is not possible to cut clean the leaf from the caudex, but in *Echeveria* this is usually easily accomplished. As far as I know, the leaves of *Dudleya* do not produce new plants but in *Echeveria* offsets are usually possible. In fact this is the most popular method by which these plants are propagated.

Dudleya extends from Oregon down to Baja California and eastward to Nevada, Arizona and Sonora, but most of its species are Californian. The majority of the species of *Echeveria* are native to the country below the Rio Grande, with one species inhabiting the Big Bend country in Texas and several others scattered throughout Central America and southward into Peru.

Of all the Mexican "hen-and-chickens," the most desirable for the home seem to be *Echeveria carnicolor* and *E. pulvinata*. It is true that others are equally as attractive, but these two require very little care and therefore are more commonly cultivated and more easily procured. They thrive in any good soil provided it is well drained. The addition of lime in small quantities

Echeveria carnicolor

Echeveria pulvinata

is recommended (this is true of most of the *Echeveria* species) because these plants are found in limestone regions. It may be worth while to mention that *Echeveria carnicolor* is an excellent plant for a desertarium. Both species will do well if kept slightly on the dry side; excessive moisture tends to rot the stems.

We have found that nematodes and mealy bugs are the most troublesome pests that attack Echeverias, but if the home gardener keeps a sharp lookout for them there is no cause for alarm. A weekly examination and prompt eradication will keep the plants in tip-top shape. Nematodes are microscopic thread-like worms that infest the roots, causing uneven swellings in these organs. When any suspicious root-swellings are noticeable, do not hesitate

to cut off the roots and reroot the plant. Of course, discard the roots and soil, not in the refuse pile but promptly in the fire. Mealy bugs are much more easily detected, since they appear as soft cottony masses, usually along the stems where the leaves are attached. Allowed to live undisturbed, these insects soon cause the leaves to fall and eventually even the stalks to dry up. Oil sprays often are injurious to tender succulents and therefore should be avoided. A syringing will frequently do the trick, but extreme care must be taken that it be gentle, especially with *E. carnicolor*, as the leaves are apt to be knocked off by too strong a jet. Nip the bugs immediately on the first appearance and there will be no serious trouble later. This all sounds as if the "hen-and-chicken" plants would be hard to manage, but really this is not the case. These conditions are merely mentioned to help in their successful management.

Echeveria carnicolor is an excellent pot plant, first brought into cultivation about the year 1870. Its origin was not established until many years later when C. A. Purpus rediscovered the plant growing on steep rocks in its native habitat at Barranca de Tenampa, Vera Cruz, Mexico. It is a stemless plant with a flattened rosette of 20 or more leaves. The leaves are usually highly colored, with a metallic lustre caused by the conspicuous papilla-like plates which cover the surfaces. Several stems arise laterally from the plant, densely covered with small leaves and bearing at the top a raceme of 6 to 12, bright orange-red flowers.

Echeveria pulvinata is the other admirable pot plant. It is characterized by neat rosettes of velvety texture crowning the dark brown stems. The leaves are covered with silken hairs, their tips a rich dark red. The reddish-orange flowers appear on short, stiff flowering stalks. It is a free bloomer, the bell-shaped blossoms making their appearance in January and continuing for several weeks.

L. C.

TWO FRAGRANT HERBS

Unfortunately, there is something about the idea of a garden of fragrant plants which appeals to the imagination. One thinks of a sunny little plot, drenched in sweet odors and murmurous with the hum of bees. I say "unfortunately" because, though such a garden is really an excellent idea, it requires a born gardener, a good deal of experience, and considerable artistic talent to make it come true. A garden of fragrant herbs is a garden with no strong accents, no brilliant colors, no striking shapes. For the most part, it is an attempt to make a garden picture out of a whole lot of leafy little

plants. In such a garden the health of the plants, or the lack of it, is very conspicuous, and if leaf miners get in the mint the whole garden is an eyesore.

But all this is no reason for not growing fragrant herbs. If you must eventually have an herb garden, or garden of scented plants (and there is nothing lovelier when it is done exactly right), begin with a few in the perennial border or the vegetable garden and get to know them, their special likes and dislikes, when to use them, and when not to use them. A good pair to begin with are Dill and Sweet Basil. If you ever do graduate to a separate herb garden you will want both of these and if you don't you will find them worth keeping in any kind of garden.

SWEET BASIL.—Basil is a good herb to begin with because it is easy to grow, it looks well in either a flower border or a vegetable garden, and it has a variety of uses. It has a gentle odor and flavor, something like anise but with a more home-spun quality. It can be used with salads or with meats but it has a special affinity for tomatoes. Pick a few of the largest leaves and lay them on the plate under the sliced tomatoes as a garnish and a flavor, or marinate canned tomatoes in basil vinegar to give them a fresh taste.

Anywhere out of the sub-tropics sweet basil is an annual. It may be started in the house or cold-frame along with the tomatoes, or planted out-doors as soon as the ground is permanently warmed up. Once it has germinated it grows like mad and makes a bushy plant looking something like a smoother-leaved red sage. If it gets at all leggy it responds well to being pinched back, and the pieces nipped off can be rooted easily and will make new plants. While it doesn't mind some shade, it really prefers sun and can use a great deal of water. It flowers rather attractively in loose spikes, but it must not be allowed to go to seed. Once a plant has seeded thoroughly it dies in whole or in part, though if it is persistently pinched back it will keep in excellent condition until frost. There are varieties with red leaves (purple basil) and a dwarf, branching type, but beware of growing these near each other if you want to save seed for next year. They mix very easily, so easily that when one buys seeds of these special varieties he usually gets some ordinary plants out of the same package.

DILL.—Dill too is an annual which makes a rapid growth as soon as the weather gets warm. It can be grown in the vegetable garden but it belongs in a sunny corner by itself, in the perennial border, or in front of some shrubs; a spot about two feet by three will be somewhere near the right size to supply an average family. Sow the seeds broadcast, weed the plot until the seedlings get strong enough to choke out further competition, and thin out the plants as they develop (the thinnings can be saved for the salad bowl, even the tiny ones). If a few of the plants are allowed to go to seed

early in the season they will self sow for a second crop, and careful pinching back of the others will help to hold the first lot until the second are ready to take their place.

Dill has beautiful feathery foliage which is strongly scented with the same odor as the seeds, though it is usually the seeds which are harvested. If the seeds are being used in pickling, remember that they develop the strongest flavor just before they ripen, after they have developed, but before they have turned brown and dried up. If one has dill in the garden, he will find the chopped fresh leaves an excellent flavor for salads and soups and meats (if they are not sprinkled on with too heavy a hand), and the feathery leaves make an attractive and unusual garnish. E. A.

CHENILLE PLANT OR RED-HOT CAT-TAIL

(ACALYPHA HISPIDA)

A plant which always attracts the attention of a visitor to the Aroid House is the Chenille Plant, or Red-Hot Cat-tail as children prefer to call it. The botanical name is *Acalypha hispida* but in the trade it is sometimes

Acalypha hispida showing flower catkins 18 inches long

referred to as *A. Sanderi.* The plant is of particular interest just now because it was found growing wild in eastern New Guinea, by Micholitz, the famous collector of orchids for Sander & Co., of New Albans, England. Strangely enough, although the plant had long been cultivated in India and the Malay islands it was not until after Micholitz' discovery in 1896 that it was introduced into Europe. According to this authority, it is a sun-loving shrub of strong growth, very floriferous, the drooping flower spikes lasting in perfection for a long time. At the Garden it is grown as a pot plant for summer use and in permanent beds in the greenhouse for a continuous display. As a pot plant it demands frequent transplanting to keep it in perfect condition, but if set in the ground and not disturbed it soon produces a flowering shrub as beautiful as Micholitz saw in its natural habitat.

The specimens of *Acalypha hispida* in the Aroid House are now four years old, vigorous bushy shrubs bearing brilliant red flower spikes throughout the year. The staminate flowers are borne in the axils of minute bracts; the pistillate flowers, in similar though more conspicuous bracts, provide the showy part of the catkin or aggregation of flowers and bracts. Neither type of flower has petals. *A. hispida* is not well adapted for outside planting, as is the copper-leaved Acalypha used for the color of its foliage in formal bedding.

G. H. P.

NOTES

Dr. George T. Moore, Director of the Garden, gave a lecture on "Victory Gardens, Pro and Con," before the Clotho Club, March 5.

Dr. William M. Bailey, Professor of Botany, Southern Illinois State Normal College, Carbondale, and Dr. Walter B. Welch, Assistant Professor of Botany, brought their classes to visit the Experimental Greenhouses at the Garden, February 13, to see how orchids are raised from seed.

Mr. George H. Pring, Superintendent of the Garden, spoke before the Pi Beta Phi Mothers' Club of Washington University, February 8, on "The Romance of the Orchid"; and at a meeting of the Maplewood Rotary Club, March 2, on "Victory Gardens."

Recent visitors to the Garden include Dr. Boris A. Krukoff, Honorary Curator of Economic Botany, New York Botanical Garden; Dr. John T. Buchholz, Professor of Botany, University of Illinois, Urbana; Dr. Marion L. Dawson, Professor of Botany, Lindenwood College, St. Charles, Mo.; Capt. and Mrs. Richard Walker, former graduate students in botany, University of California, Berkeley.

Mr. Ladislaus Cutak, in charge of Succulents at the Garden, has given the following illustrated lectures recently: February 7, "The Art of Grafting Cacti," before the Henry Shaw Cactus Society; February 16, "Cactus Hunt in Old Mexico," before the Poplar Bluff Garden Club, Poplar Bluff, Mo.; February 25, "Adventures in Cactus-land," before the Spectrum Camera Club.

Dr. Carroll W. Dodge, Mycologist to the Garden, has given the following talks recently: "Understanding Central American Problems," before the Monday Club of Webster Groves, February 1; "Central American Gardens," before the meeting of the St. Louis Horticultural Society, February 5; "Interesting Skin Diseases in Guatemala," before the Tau Pi Epsilon Pi Fraternity of Washington University, February 25.

Mr. Paul A. Kohl, Floriculturist to the Garden, showed the colored motion-pictures, "Four Seasons in the Missouri Botanical Garden," before the Garden Appreciation Club of University City, February 4. On February 22 he spoke before the Little Gardens Club of University City on "The Victory Garden," and on March 5, on "Victory Gardens and Their Planning" before the March meeting of the St. Louis Horticultural Society.

Observations made from the third-floor windows of the Administration Building of the Garden show that since the enforcement of the smoke ordinance there has not been a single time when smoke prevented one from seeing to Grand Avenue (one mile distant); whereas before the elimination of smoke this was often impossible during winter months. If the records of the Weather Bureau had been kept in this part of the city instead of in the downtown area, which is affected by smoke from East St. Louis, they would have been much more impressive.

The February number of the ANNALS OF THE MISSOURI BOTANICAL GARDEN (Vol. 30, No. 1) was issued during the month, with contents as follows: "Taxonomy of *Clematis* section Viorna" and "Population Size and Geographical Distribution of *Clematis Fremontii* var. *Riehlii*," by Ralph O. Erickson; "The Seeds of *Tradescantia micrantha*," by Edgar Anderson; "Environmental and Genetical Variations in Yield and Colony Size of Commercial Yeasts," by Carl C. and Gertrude Lindegren; "Contributions toward a Flora of Panama, VII," by Robert E. Woodson Jr. and Robert W. Schery.

STATISTICAL INFORMATION FOR FEBRUARY, 1943

GARDEN ATTENDANCE:

Total number of visitors	13,425

PLANT ACCESSIONS:

Total number of plants and seed packets received as gifts	133

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	14
Total number of books and pamphlets donated	57

HERBARIUM ACCESSIONS:

By Purchase—

Darker, G. D.—Thelephoraceae of Ontario, Massachusetts, Missouri, etc.	47

By Gift—

Atkins Institution, Cienfuegos, Cuba—*Agave Brittoniana* Trel. of Horticulture	1
Bennett, F. L.—*Cratoneuron filicinum* (Hedw.) Roth from South Dakota	1
Clemens, Mrs. Mary Strong—Lichens of New Guinea	12
Cutler, Hugh C.—Photographs of *Sicana odorifera* Naud. from Brazil	2
Degener, Otto—Plants of Hawaii, chiefly	258
De Vilbiss, A. D.—*Lonicera Standishii* Hook. from Horticulture	1
Moldenke, H. N.—Lichens and Fungi of Ohio	8
Moldenke, H. N.—Compositae of western United States	67
Moore, G. T.—*Lycogala flavofuscum* Rost.	1
Nearing, G. G.—Lichens of New York	4
Rae, Paul Marshall—*Lepiota Glatfelteri* Pk.	1
Schwab, Mrs.—*Polyporus giganteus* Fr. from Missouri	1
Thomson, John W.—Lichens and Fungi of Missouri and Panama	6
Whetzel, H. H.—*Lambertella*	4

By Exchange—

Arnold Arboretum, Harvard University—Plants of the Fiji Islands	690
McVaugh, Rogers—Plants of Delaware and of Horticulture	33
Texas Agricultural College, by H. P. Parks—Plants of Texas	500±
University of Michigan, by C. L. Lundell—Plants of Texas	63
Total	1,700

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MISSOURI BOTANICAL GARDEN BULLETIN

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Missouri Botanical Garden Bulletin

Vol. XXXI APRIL, 1943 No. 4

GARDEN SOILS AND FERTILIZERS

No one can produce a flower or vegetable garden of any consequence on poor soil. To grow well and *sligbtly* resemble those nice photographs in the seed catalogues, plants must have certain food elements at their disposal. A lean diet can only result in stunted straggly specimens that are of scant value even on the compost pile.

Amateur gardeners realize the necessity of having fertile soil all right, but relatively few of them ever adopt the proper measures of obtaining it. This situation may be due to lack of adequate information on the subject or it may be the result of too much "armchair" gardening. In the latter case we can only say there is nothing like good honest labor if there is no way to get out of it. And where the maintenance of soil fertility is concerned, there is no way to get out of it. Genuine gardening means lots of work as well as play, and those who are not prepared to get calluses on their hands, knees, etc., should find some milder form of recreation. Putting your hands deep into fertile soil is, however, one of nature's best remedies for everything except sunstroke, "Charley horse," and "blind staggers," so the ends justify the means.

Nearly any kind of soil can be built up to a state of fertility if the right materials and methods are used. The job may take several years but final results in plant growth can always be expected to compensate for the time and effort required. Actually, it is our responsibility to improve and preserve the soil. The federal government has emphasized this fact by developing extensive programs to control soil erosion all over the country.

After soil becomes productive, it must receive *periodic attention* to remain fertile. We must put back what is taken out in order to maintain the proper soil balance for plant growth. Too many gardeners seem to think one application of farm manure should solve the problem for a lifetime. In reality, it may last only a year or two at the most.

Since plants are so closely associated with the soil, it is essential that we know what should be done to *maintain* or *improve fertility*. Briefly summarized the important controlling factors are:

1. Organic matter (humus)
2. Mineral elements
3. Microörganisms
4. Moisture and drainage
5. Temperature
6. Soil reaction (pH)
7. Soil structure or physical condition

In many cases it is no simple problem to obtain a satisfactory balance of these factors in the soil. Information on this subject will appear later. For the present, keep the following suggestion well in mind: *know your soil conditions and then if possible choose plants which are naturally adapted to those conditions.* Too often, gardeners try to radically change soils to meet the cultural demands of imported plants not suited to existing soil conditions or even to the prevailing climate. This practice generally leads to failure. It is both practical and desirable to use as much native plant material as possible in your garden.

The relation of soil to plant growth has been a matter of speculation for centuries. Many of our early ancestors believed roots ate the soil particles like grandpa eats spaghetti. Different theories exist to-day, but still we are not over-burdened with understanding. Without any apparent effort plants are able to accomplish remarkable chemical transformations that baffle eminent scientists fortified with all kinds of impressive laboratory equipment. However, a certain amount of fairly reliable information has accumulated down through the years, so it is known in a general sort of way what goes on in and around the plant. Briefly, the story is as follows:

The roots absorb essential *mineral compounds* and *water* from the soil. These raw food elements are transported up the stem to the leaves. Air passes into the leaves through tiny "breathing pores," furnishing small amounts of *carbon dioxide*. In the presence of *sunlight*, *chlorophyll* (green pigment) and *enzymes* of various kinds, the water, carbon dioxide and mineral compounds are combined in the cells of the leaves to form *carbohydrates*, *proteins*, *etc.* As soon as these plant foods are manufactured, they are transported to all parts of the plant to supply energy for growth and to be stored away for future use.

This process may be simple to outline, but actually many extremely complicated chemical and physical reactions are involved, about which we know very little. Adding it all up, however, we do arrive at one inevitable conclusion—*fertile soil is the indispensable foundation of all successful gardening.*

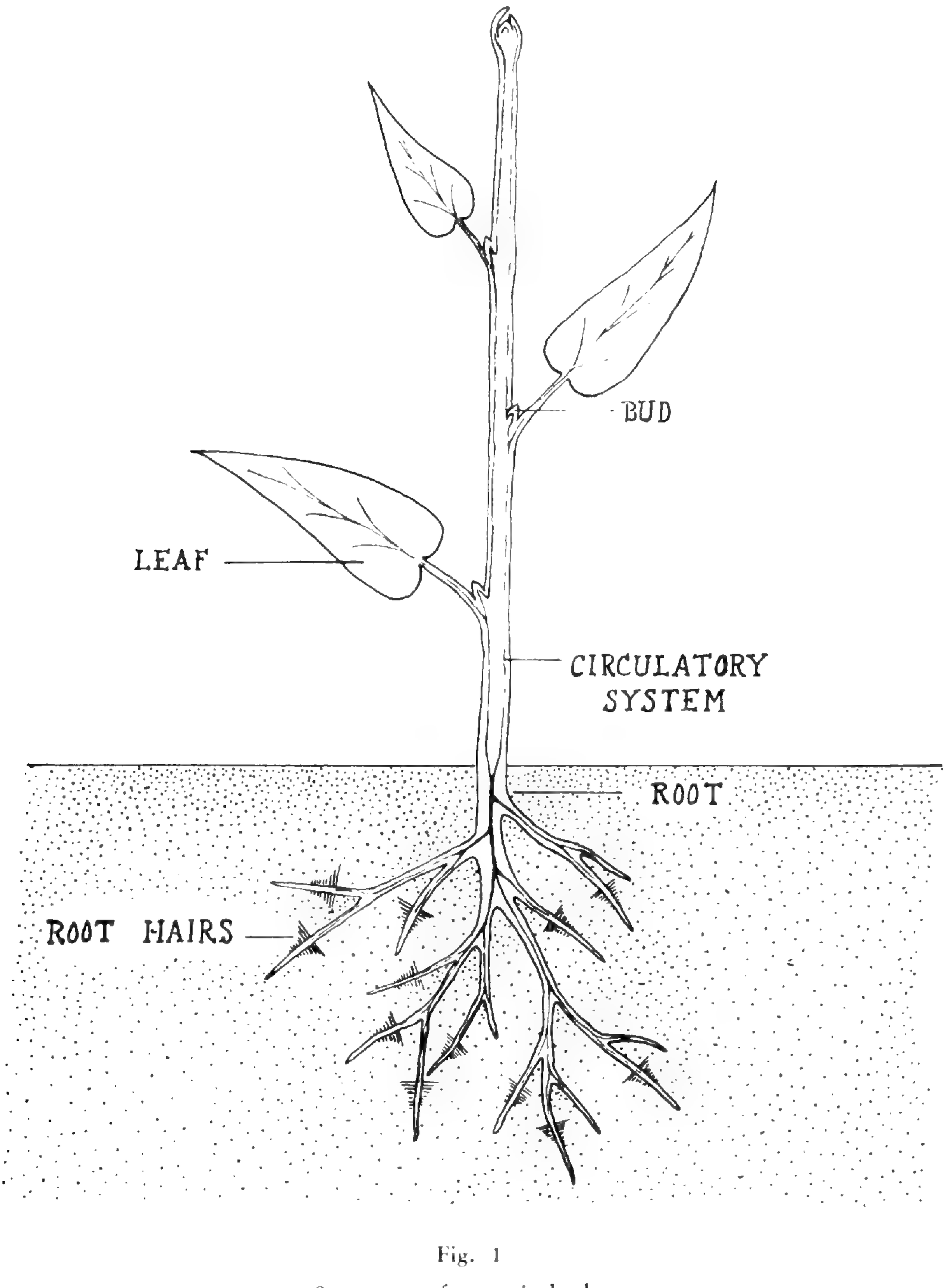


Fig. 1
Structure of a typical plant

COMPOSITION OF SOIL

Since our present soils have been formed by various natural agencies acting over vast periods of time, we would expect them to differ considerably in both physical and chemical composition. Gardeners who work with soils soon come to realize very few are alike.

The *color* of soil varies markedly in certain sections of the country. In Iowa it is black, in Georgia red, and in Missouri yellow, brown, black and gray. Color is not always an accurate indication of fertility, but in general the darker-colored soils contain the most organic material (remains of animal and plant life), and consequently they are more productive.

Although most garden soils are a heterogeneous mass of different-sized rock fragments, one or two sizes usually predominate. Thus we have sandy, sandy loam, loam, silt, and clay soils. *Texture* of soils can be roughly determined by feeling them and by general appearance.

1. *Sandy soil* contains large amounts of sand that is readily detected by touch. It is loose soil that falls apart easily, dries out quickly, warms up early in the spring and requires considerable amounts of organic and inorganic fertilizer.
2. *Sandy loam* contains enough sand to be detected by handling. It has more organic material and finer soil particles than No. 1, consequently it does not dry out as fast and naturally is more fertile. With a southern exposure it is a good soil for early spring flowers and vegetables.
3. *Loam* is made up of clay, silt, sand and organic material. It is loose, friable, potentially fertile, holds necessary moisture, permits adequate drainage, and responds well to cultivation. For nearly all forms of gardening it is the ideal soil.
4. *Silt* is made up of particles smaller than very fine sand. It forms a considerable part of sandy loam, loam and clay soils. Silts can be made fertile by adding generous amounts of organic material.
5. *Clay* is composed of extremely fine particles and feels smooth when handled. Clay soil does not permit good drainage, is sticky when wet, packs hard and, when dry, large cracks appear which encourage the serious effects of drought. A handful of moist heavy clay, pressed tightly together, forms a solid ball that can be thrown surreptitiously and effectively at the neighbor's cat whenever the occasion demands.

In addition to rock fragments and organic materials, garden soil contains countless numbers of *microscopic plants* and *animals* known as bacteria, algae, amoebae, protozoa, etc. The importance of these tiny organisms to the growth of plants in the garden cannot be over-emphasized. Biological activities which occur in the soil supply a major portion of the soluble food elements required by plants for normal growth. In turn, the microörganisms depend on plants for their supply of carbon which is returned to the soil in the form of *organic materials* (leaves, rotted wood, roots, manure, peat). As long as these microörganisms have plenty of organic material to use as food, they remain active and the soil is fertile. When the organic material becomes scarce or absent, biological activity fades out of the picture and fertility no longer exists.

Most of the organic materials accumulate on or near the surface of the ground, forming what is known as *"top soil"* which may vary in depth somewhat as follows:

Less than 6 inches	very shallow
Up to 1 foot	shallow
One to 2 feet	medium
Two to 3 feet	deep
Over 3 feet	very deep

Beneath the fertile layer of top soil lies the *sub-soil* which contains little or no organic material and therefore lacks active fertility. In many cases, clay subsoil is blue or gray in color, indicating extremely poor drainage. Yellow clay is far more desirable.

When building a new home it is a good idea to stand guard when it comes time for grading. Contractors usually worry very little about your lawn and garden problems. They scoop the heavy clay sub-soil out of the basement and spread it neatly over the surrounding area often completely blotting out any fertile top soil that may have been present. This heavy clay should be used to level areas remote from the building, or discarded entirely. Use good top soil for grading. It will be more expensive at the beginning, but in the long run, results obtained will far outweigh the extra cost.

The *chemical composition* (plant food content) of soils varies greatly in different sections of the country. Even in the same soil changes occur from day to day, depending on temperature, rainfall, biological action, cultivation and acidity. Radical variations occur in soils originating from different kinds of rock formations. For example, sandy soil arises from hard rocks rich in quartz, whereas clay comes from soft rock, such as limestone.

Since the plant requires certain mineral elements from the soil in rather definite quantities, a deficiency in one or more of these elements results in unbalanced nutrition that slows up growth, causes deformities, yellowing of the leaves or complete collapse of the plant. When soil is known to be deficient in plant food elements the gardener should make haste to apply proper fertilizers to obtain a favorable mineral balance. The results of intelligent applications of fertilizer never fail to fire the imagination of anyone who likes to watch plants grow.

Strangely enough, soil may contain a great abundance of all the essential mineral elements and yet plants can starve to death trying to grow in it. The food elements must be in soluble form (dissolved in the soil solution) before roots can absorb them. If, for some reason, they remain insoluble or "locked up" in resistant chemical combinations, the plant is totally unable to make use of them.

SOIL FERTILITY

Plant growth is governed by certain chemical elements, the most important being:

Carbon	Phosphorus	Magnesium
Hydrogen	Potassium	Calcium
Oxygen	Sulphur	Iron
Nitrogen		

In addition to these *essential elements*, minute quantities of manganese, copper, boron and zinc sometimes play an important role, but in most soils there is usually an abundance of such *minor elements*. If one or more of the essential food elements are lacking in the soil, plant growth is retarded or entirely stopped.

Since soluble plant food materials never occur in the soil in large amounts, they must be constantly replenished if growth is to continue uninterrupted. Extensive cropping and erosion make it necessary to apply fertilizers regularly. An impoverished soil condition at the roots naturally influences the general appearance of the plant. Some of these deficiency symptoms are worth noting.

Calcium or lime is closely associated with root growth and cell structure. Soils that are strongly acid in reaction (pH 5.5 or less) generally lack sufficient calcium for most plants to develop normal roots and function properly. Lack of this element also retards the assimilation of nitrogen, phosphorus and potassium. Therefore, a plant that is stunted, both roots and tops, may be suffering from calcium deficiency.

Nitrogen is very important because it enters into many of the vital compounds in the plant. It stimulates leaf and stem development. A deficiency of this element causes stunted growth and yellow leaves which do not drop off easily.

Phosphorus gives the plant energy, aids in the formation of roots, strengthens the stems, helps storage of reserve food, and activates flower, fruit and seed production. Lack of phosphorus causes general loss of vigor, delayed growth and leaf drop.

Potassium influences root action, coloration of flowers, food supply and disease resistance. Potassium deficiency results in stunted growth, burning at edges of leaves and loss of green color.

Iron is associated with the formation of chlorophyll (the vital green coloring matter). Iron deficiency causes green leaves to turn yellow, but the large veins remain green.

Magnesium is important in seed-production, cell division and formation of chlorophyll. Yellowing of the leaves, with veins remaining green, and distorted leaf margins are indications of insufficient magnesium.

In regard to these deficiency symptoms, it is well to realize that the functions of all plant food elements are so interlocking that the absence of any one may affect plant growth in several ways, making an accurate diag-

Coleus plants growing in full nutrient solution, showing effects: (left) with nitrogen omitted; (center) with phosphorus omitted; and (right) with potassium omitted.

Coleus plants growing in full nutrient solution (left), and in nutrient solution with calcium or lime omitted (right).

nosis difficult, if not impossible. Consequently, it is often necessary to rely on trial and error methods to remedy mineral deficiencies of the soil.

Some of the plant food elements are very soluble and leach out of the soil rapidly during periods of heavy rainfall. Others such as certain forms of phosphorus are relatively insoluble and remain in the soil so tenaciously that even roots have difficulty obtaining the small amounts they need. Good examples of the soluble group are: nitrogen in the form of nitrates, and calcium in the form of carbonates or lime. Since nitrogen escapes so easily, most commercial fertilizers contain a relatively high percentage of this element in readily available form. Soils become acid in reaction when calcium is not present in sufficient quantity. To offset this deficiency ground or crushed limestone is added. The amounts of limestone and fertilizer to use on a given area will be considered later.

ORGANIC MATTER

A good garden soil is porous, crumbles easily when moderately dry, and responds well to cultivation. A heavy clay may contain an abundant supply of mineral elements, but it bakes as hard as cement when dry. It is thus apparent that fertility must depend largely on some other factor. The answer of course is *organic matter which is the key that unlocks the door to genuine soil fertility and better gardening.* It directly controls aeration, water-holding capacity, temperature relations, drainage and available plant nutrients, and it sustains the countless microscopic organisms in the soil which give rise to chemical reactions essential for normal plant growth. Inorganic commercial fertilizers and vitamin B_1 cannot provide the same beneficial effects that are obtained from farm manures, leafmold, compost and cover crops. Amateur gardeners who fail to realize this all important fact will never obtain results that even approach their mildest expectations.

In warm, humid climates organic matter is rapidly decomposed by microörganisms in the soil and should be replenished annually or at least once every two years. To be effective, it should be added in fairly large quantities. A 2-inch layer mixed thoroughly with 6 inches of top soil gives about a 1 to 3 ratio that is quite satisfactory for most flower and vegetable gardens. Experiments at the Missouri Agricultural Experiment Station have shown that on large areas 3 tons of farm manure per acre is an effective rate of application. For small flower and vegetable gardens this amount could be increased up to 1 bushel per 25 sq. ft., or about 20 tons per acre. It should be turned under as soon as possible to avoid loss of nitrogen. Sources of organic materials and the approximate amount of available fertilizer elements they contain are given in the following table:

Material	% Nitrogen (N)	% Phosphorus (P_2O_5)	% Potassium (K_2O)
PLANT ORIGIN			
Cottonseed Meal	4.5–9.0	2 –3	1.5–2.0
Tobacco Stems	2.0–2.5	0.7	4.0–6.8
Wood Ashes	None	2 –3	5.5–8.0
Garbage Tankage	1.5–2.5	1 –3	0.5–1.5
Castor Pomace	4.5–6.0	2	1
Spent Hops	0.8	0.3	0.05
Leafmold	0.5–2.0	0.5–1.0	0.5–2.0
Peat	0.5	Trace	Trace
Humus	1.5	0.1	0.1
ANIMAL ORIGIN			
Farm Manures	0.5– 6.0	0.5– 3.0	0.5–2.0
Bone Meal (steamed)	1 – 2	22 –32	None
Fish Meal	7 –10	4 – 8	None
Blood Meal	6 –14	0.3– 1.5	Trace
Horn and Hoof Meal	10 –15	2	None
Tankage	3 –10	6 –20	None
Milorganite	6	2	None
Guano (Peruvian)	11 –16	8 –12	2 –3

From the percentages given in the table it is evident that plant residues contain very little nitrogen, phosphorus and potassium. Animal residues have more nutritional value, but not enough to be considered strong. One ton of mixed stable manure contains only about 10 lbs. N, 5 lbs. P_2O_5 and 10 lbs. K_2O. Obviously, then, organic matter is important mainly as a soil conditioner and activator, not as a carrier of plant food elements. However, it does supply certain beneficial organic acids and vitamines not contained in inorganic commercial fertilizers. Just in passing, let it be thoroughly understood that vitamin B_1 is no substitute for farm manure, leafmold, peat or compost. If there is a fair amount of organic matter in the soil, the addition of B_1 is both a waste of time and money. Actually, this highly advertised vitamin does not stimulate the growth of most plants, but from time to time many backyard gardeners seem to require a psychological pill, and for this purpose B_1 has no equal.

Organic matter is also available in the form of *green cover crops* such as Soy-beans, Cow-peas, Red Clover, Buckwheat, Vetch, Alfalfa, Rye, and Sweet Clover. These cover crops or green manures, which should be plowed or spaded under before they entirely mature, are excellent soil conditioners. Of course, in small gardens they may be rather difficult to fit into the picture, but on large areas they are extremely useful. Seeded in fall, the crop can be turned under in spring or summer; if seeded in summer it may be turned under in late fall. In order for green manures to produce the maximum amount of organic matter and return a fair percentage of nitrogen

to the soil, they should be allowed to approach maturity before being used. This procedure results in a high yield of fiber and roots which loosen up the soil far more effectively over longer periods of time than would be possible if the crop was turned under while young and succulent. Inoculation of legume crops (Beans, Peas, Clovers, Alfalfa) with nodule-forming bacteria will help insure satisfactory growth. The bacteria culture is obtainable at seed stores in powder form and is simply dusted on the seeds before planting. Liming the soil may be necessary too as legumes do not thrive on land which tends to be acid. Soy-beans, Cow-peas and Crimson Clover are reliable cover crops in Missouri.

For small backyard gardens the *compost pile* is perhaps the best inexpensive source of organic matter. Compost is made up of such materials as leaves, grass clippings, scraps from the vegetable and flower gardens, weeds which have not gone to seed, manures, and sod with enough soil attached to act as a binder. Most of us like the odor of burning leaves, but from a practical gardening standpoint it is to be regretted that such excellent organic matter goes up in smoke. Leaves added to the compost pile, used as a winter mulch around evergreens, shrubbery and perennials, or spaded into the soil, go a long way towards maintaining fertility. Conservation is just as important on a city lot as on a farm, so save the leaves! A compost pile is made somewhat as follows:

1. Choose a shady, well-drained, level spot in an inconspicuous corner of the garden. An area 5 ft. x 10 ft. is a convenient size. It can be made as a pit in the ground if desired. Actually it is a good idea to have two piles or pits along side of each other with space between for a wheelbarrow. Then you can fill up one as the other is used.
2. Pile up leaves, manure, peat and garden left-overs in layers about 6 inches thick, adding 4 to 6 inches of soil or sod (if you can get it) to cover each layer until the pile reaches a convenient height, say 4 to 5 feet.
3. To hasten decomposition and improve the nutritional value of the compost, add 5 to 10 lbs. of a high-grade complete fertilizer and an equal amount of ground limestone to each layer. Also add a generous sprinkling of charcoal to keep down odors and prevent the escape of valuable ammonia gas.
4. Each layer should be well moistened with the garden hose and the top of the pile should be slightly depressed in the center so rain can soak in. Moisture is absolutely necessary for decomposition to take place. Soil can be banked around the sides to prevent excess leaching.
5. Turn the pile over with a spade at 3-month intervals to mix the materials thoroughly. Within one year the compost should be ready to use in the garden as a top dressing or spaded into the soil.

The small amount of labor involved in making a compost pile will be generously repaid in better growth and quality of garden products. A leafmold pile is made in similar fashion except the alternate layers of soil are only about one inch thick. Keep the pile moist at all times because *dry leaves do not decompose for years.* Leafmold is a good substitute for stable

manure which is not plentiful like it was before Henry Ford put the "plugs" under a hood. In these days any serious-minded gardener would be overjoyed to receive a load of manure as a Christmas present. Oak leaves do not disintegrate as rapidly as other kinds, but they do eventually make good leaf-mold that can be used any place in the garden. Being acid in reaction, they are excellent for mulching around Rhododendrons, Azaleas, Mountain Laurel, Blueberries and other plants that require an acid soil.

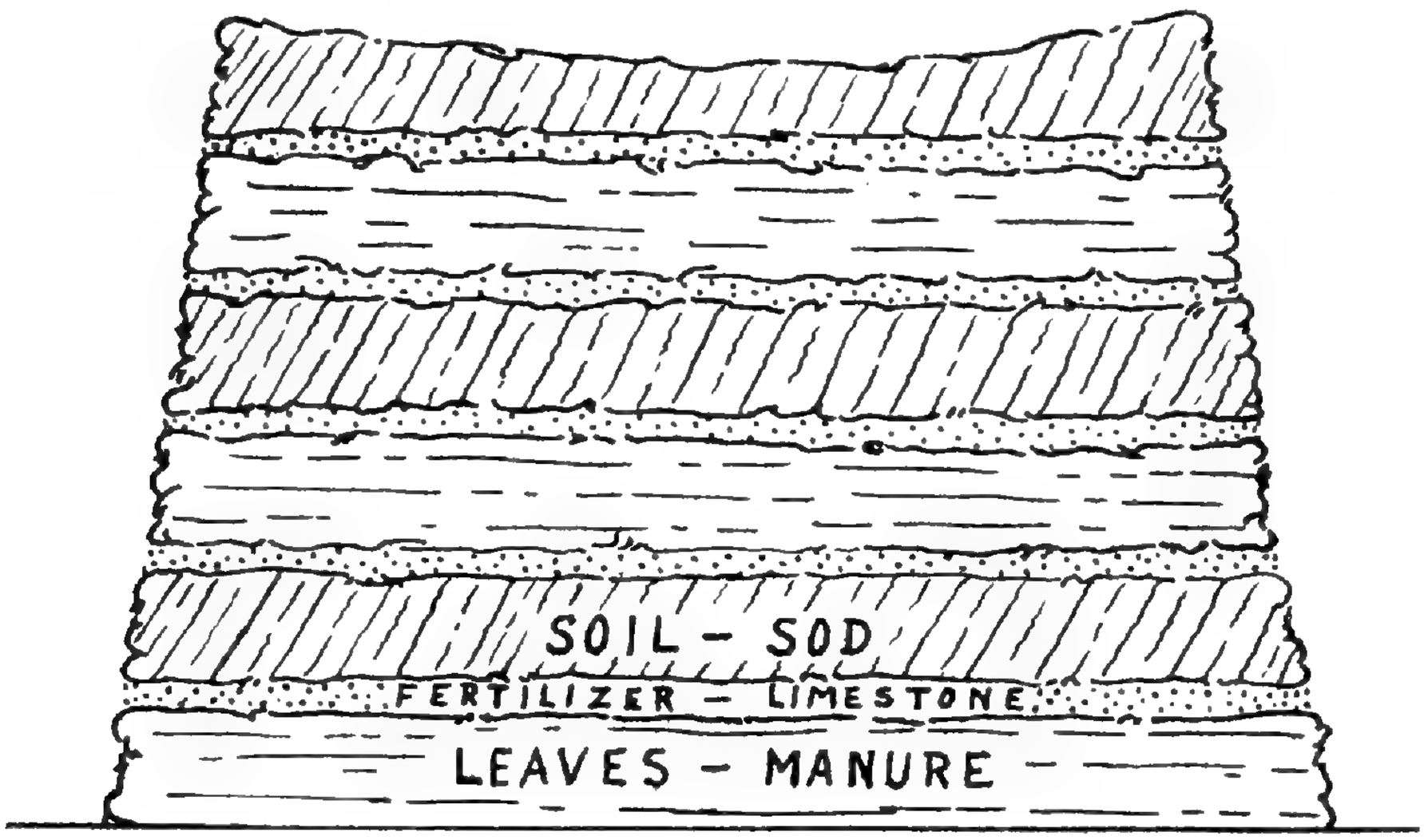


Fig. 2
How to make a compost pile

Artificial manure can be made from leaves, straw, hay, and shredded cornstalks by adding certain fertilizers and keeping the material moist for a few months. The finished product resembles farm manure in appearance, and is equally beneficial to the soil. One ton of dry straw will produce about three tons of moist manure. The fertilizer added to hasten decomposition consists of: 45 lbs. Ammomium Sulphate, 15 lbs. Superphosphate, 40 lbs. ground Limestone. Use 150 lbs of this mixture for each ton of straw, etc. Adco, a special mixture for decomposing organic materials, is available on the market and can be used in place of the home-mixed fertilizer.

INORGANIC FERTILIZERS

After the physical condition of the soil has been properly adjusted by the addition of organic matter (and ground limestone if the soil is strongly acid) attention can be focused on the problem of eliminating any prevailing mineral deficiency. This leads us into the broad and rather confusing field of commercial fertilizers. When handling these materials, gardeners must

know what they are doing to avoid disappointments and possible failures. Of course, the present war restrictions make the problem very simple as only one kind (3-8-7) of chemical fertilizer is available for general use, but it seems best to consider this subject as it will undoubtedly exist after *Homo sapiens* succeeds in blowing most of his brains out on the battlefield.

Inorganic fertilizers are sold by the bag or box in pulverized form, as tablets, and in cartridges that can be attached to the garden hose when watering. There are many different brands, trade names and formulas on the market, making it rather difficult for beginners to select the ones best suited to their needs. Before buying much fertilizer, they should consult local gardeners, farmers, the county agent, the state agricultural college or some other recognized authority on the subject. In spite of alluring pictures that often appear in advertisements, these chemical compounds have their limitations. No amount of fertilizer will make prize winners out of straggly plants trying to grow in sub-soil excavated from a basement, or in dense shade and poorly drained areas. The effect of chemical fertilizers depends on a number of factors.

1. *Soil texture.*—Soils that are extremely light (sandy), heavy (clay), shallow or badly eroded do not benefit much from inorganic fertilizers.
2. *Organic matter.*—Soils low in organic matter and in poor physical condition cannot use these fertilizers to best advantage.
3. *Proper drainage.*—Wet, soggy soils lack oxygen, which is essential for root growth and biological activities.
4. *Moisture supply.*—Do not apply fertilizer to soils that are excessively dry. Wait until it rains, or irrigate.
5. *Soil reaction (pH).*—Many plants refuse to grow in soil that is strongly acid, making the addition of fertilizer (unless it is alkaline in reaction) useless or even harmful until lime has been added.
6. *Mineral deficiencies.*—Soils which lack certain nutrient elements such as calcium, iron and magnesium do not respond favorably to fertilization. The absence of one element influences the effects of others, so deficiencies must be determined and corrected.
7. *Kind and amount of fertilizer used.*—The chemical composition and availability of fertilizers vary considerably. Applying the wrong kind or the wrong amount can do more harm than good.
8. *Method of application.*—The effectiveness of any fertilizer depends on the way it is applied to the soil and also on the time of year.

Reference to these factors will be made on the following pages.

SOIL TESTING

Rapid soil tests to determine the approximate fertility of garden soils have become quite popular in recent years. These tests are easy to make, but often difficult to interpret. When making them gardeners should keep the following things in mind.

1. The *chemical composition* of soil varies from season to season, and even from day to day under certain conditions. Changes in temperature, moisture and cultural practices have a marked influence on the amount of soluble plant

nutrients in the soil. Nitrogen is the most variable element because of its high solubility.

2. *Soil reaction* (acidity-alkalinity) changes during the year and may radically effect the availability of certain plant food elements.
3. The *physical condition* and *type of soil* may make it necessary to raise or lower the requirements indicated by the tests. Previous manuring and fertilizer treatments should be known if possible.
4. *Kinds of plants* to be raised on the soil. Some need acid soil and require an abundant supply of food; others need an alkaline soil and very little food.
5. *Method of taking the soil sample for the test.* This is very important. On small areas take a slice of soil 6 to 7 inches deep from several spots, mix them well, dry a handful of the composite sample in a clean dish at room temperature and then test it according to directions which accompany the testing kit. On large farm areas separate samples taken from a number of different sectors should be tested individually, not mixed.

Since these soil tests involve the use of color, anyone who is color-blind would be unable to make them. Gardeners who do possess all the necessary physical and mental faculties should use with reservation the information obtained. *Results in a test tube are far from comparable to the solvent, biochemical reactions of the soil and plants in the garden.*

Here is a simple *mechanical* test that anyone can make, and it requires no special equipment. Fill a glass vial, test-tube, cylinder or slender bottle half full of garden soil. Add plain water to the brim and shake vigorously until all the soil is in suspension. Then let the muddy mixture settle out. The heavy particles of gravel and sand sink to the bottom first, followed by increasingly smaller fragments of soil, the fine particles of clay settling last. Any fibrous organic matter, such as bits of leaves, twigs and straw, that may be present, will float on the surface of the water. Thus you can obtain a fairly accurate picture of the soil structure. A good garden soil should contain about 1 part sand-gravel or cinders, 3 to 4 parts clay-loam, and 1 part fibrous organic matter.

Of course in the last analysis the best test of any soil is—*how well do plants grow in it.* If the plants are healthy and vigorous, there is nothing to worry about, but weak, distorted specimens that lack deep green color are good indications of soil troubles.

THE THREE MAIN FERTILIZER ELEMENTS

In some cases calcium, iron, magnesium and boron may be lacking in garden soils, but the elements most likely to be deficient are *nitrogen (N)*, *phosphorus (P)* and *potassium (K)*. Consequently, the fertilizer industry centers on these three plant foods which appear on the market in various proportions and under different trade names. Fortunately, there is a law which requires all manufacturers to state on the bag or container what percentages of available N, P, and K the material contains, so the buyer has a definite idea what he is getting. For example the figures 4-12-4 on a

100-pound bag of fertilizer indicate: 4% or 4 lbs of available nitrogen (N), 12% or 12 lbs. of available phosphorus (P) or (P_2O_5), and 4% or 4 lbs. of available potassium (K) or (K_2O). These figures add up to 20 pounds of actual plant food or only 1/5 of the 100-pound bag. The other 80 pounds represent the chemical compounds which are combined with the N, P, K, and a certain amount of "filler." All fertilizers do not carry the same percentages of nutrients. Some combinations other than 4-12-4 are:

(N)		(P)		(K)	
5	—	10	—	4	
2	—	12	—	6	
3	—	8	—	7	← (standard Victory fertilizer)
4	—	10	—	6	
10	—	6	—	4	
15	—	30	—	15	

Obviously 100 pounds of 15-30-15 contains as much plant food as 300 pounds of 5-10-5, so the higher-priced fertilizers are often the most economical.

A *complete* fertilizer is one that contains available nitrogen, phosphorus and potassium in various proportions such as those just mentioned. Recently, some manufacturers have made it a point to include calcium, magnesium, manganese, and boron in "super" complete fertilizers. In certain types of soil these additional elements may be necessary, but, except for calcium, the soils of Missouri are amply supplied with them. An *incomplete* fertilizer is one that contains only one or two of the big three elements. Thus we might find formulas reading 0-16-0, 6-2-0, 14-0-0, 0-0-50. Such fertilizers are used to correct deficiencies in one or two elements only. A *balanced* fertilizer is one that supplies N, P, K in proportions needed to supply the nutritional requirements of plants growing in soil of known fertility.

Fertilizers may be graded low, medium, high and concentrated, depending on the amounts of available nutrients they contain. One with percentages of N, P, K, totaling up to less than 14, would be considered low grade; from 14 to 24 medium; 24 to 36 high; over 36 concentrated. The following table gives most of the common inorganic or chemical fertilizers and shows the approximate percentages of plant food they carry.

1. *Incomplete Fertilizers.*—

A. *Nitrogen-carriers*	*% N*	*Soil Reaction*
Ammonium Nitrate	35	Neutral to acid
Ammo-phos	10–16	Neutral to acid
Ammonium Sulphate	20	Acid
*Calcium Cyanamide	21–22	Alkaline
Calcium Nitrate	15	Alkaline
Cal-nitro	20	Neutral to alkaline
Potassium Nitrate	13	Neutral
Sodium Nitrate	15–16	Alkaline
†Urea	46	Neutral to acid

B. *Phosphorus-carriers*	*% P (P_2O_5)*	*Soil Reaction*
Ammo-phos	20–46	Neutral to acid
Basic slag	8–15	Alkaline
Superphosphate	16–20–46	Neutral
Rock Phosphate	30–40	Alkaline

C. *Potassium-carriers*	*% K (K_2O)*	*Soil Reaction*
Kainite	12–20	Neutral to alkaline
Potassium Chloride	48–50	Neutral
Potassium Nitrate	46	Neutral
Potassium Sulphate	48	Neutral

2. *Complete Fertilizers.*—	*% N*	*% P (P_2O_5)*	*% K (K_2O)*
Bloom Aid	5	10	3
Bonro	12	6	4
Loma	5	10	4
Nitrophoska	15	30	15
Red Steer	4	16	4
Sacco	4	12	4
Vigoro	4	12	4

*Chemically, these are organic compounds, but since they are synthetic, non-proteid materials we included them in this list.

Many other common commercial grades have no special trade name, but are known by the percentages of N, P, K they carry. These complete fertilizers have little or no effect on soil acidity or alkalinity. Recently, however, limestone has been added to certain brands to correct the residual effects of acid-forming fertilizers.

Comparing the strength of these materials with that of farm manures and other organic fertilizers, it is readily apparent that 100 pounds of some of them would about equal a whole ton of manure. In other words they are powerful and have to be used carefully according to directions on the bag or box. Slight overdoses may seriously burn or kill the plants. It is better to apply them sparingly and at frequent intervals throughout the growing season, than to rely on one heavy application.

To get the most benefit out of fertilizers of any kind, they should be *thoroughly mixed with the soil*. This is best done in early spring when the garden is being prepared for planting. After the plots have been spaded or plowed, broadcast about 5 pounds of medium-grade, complete fertilizer for every 100 sq. ft. of area and rake it in deeply.

In the established *perennial border*, spread a thin layer between the plants and hoe it into the soil. Repeat this treatment about once each month.

Lawns should be fertilized in early spring and fall, broadcasting 4 to 5 pounds of complete fertilizer for every 100 sq. ft. of area.

Shrubs need more nourishment than lawns. Use about 1 to 2 lbs. of fertilizer per plant spaded into the soil under the branches in early spring.

Trees require considerable fertilization to keep them thriving. Young

Fig. 3
Coleus plants showing the effects of too much fertilizer (left), no fertilizer (center), and just enough fertilizer (right).

trees can use 2 lbs. of complete fertilizer for each inch of trunk diameter. Double this amount for old trees. Scatter the fertilizer on top of the soil from trunk to outer tips of branches and spade it under. On lawns dig small holes, 2 feet apart and 18 inches deep, from trunk to tips of branches, put in a few handfulls of fertilizer and fill the rest of hole with soil. Trees should be fed in late fall or early spring.

Incomplete fertilizers are useful when it is definitely known that only one or two plant food elements are lacking in the soil. For instance, to apply a complete fertilizer to soil which already has a high nitrogen content would be a waste of money and would result in excess top growth of the plants. So in this case we would omit nitrogen by using Superphosphate with Potassium Chloride to correct the P and K deficiencies. The amount of incomplete fertilizer to use depends on the percentage of available N, P, K it contains. The following table gives a fair idea of how much fertilizer to use on a given area.

Total % N-P-K	Lbs. per 100 sq. ft.
10 or less	10
10–20	5
20–30	3
30–40	2
40–60	1

It is clear then that the stronger a fertilizer is the less we have to use. To avoid burning established plants in the garden, powerful nutrients like Nitrophoska (15-30-15) are often applied in liquid form, using about one teaspoon of the fertilizer in a quart of water. Vigoro and similar materials can be safely applied in powder form, merely stirring one or two teaspoonfuls into the soil near the plant. Avoid getting fertilizer on the leaves as it may burn them.

Fertilizers must be *stored properly* to prevent them from getting hard and possibly losing their nutritional value. 1. Keep bags in a dry place, not on the ground or on damp concrete. 2. Stack the bags on end; do not lay them down nor put them in high piles as the ones on the bottom will harden from pressure. 3. Do not store fertilizer for several years as the bags may rot. 4. Unless fertilizer gets wet, it retains its original strength, even though hard and lumpy. It can be pulverized by spreading on a concrete floor and beating with a tamper or spade.

The kind of fertilizer to use will depend on the type of plant to be raised and the existing soil reaction. Acid fertilizers (Cottonseed Meal, Ammomium Sulphate, Tankage) are used to advantage on Azaleas, Rhododendrons, Gardenias, Holly, Potatoes, Bent Grass and evergreens. Fertilizers with an alkaline reaction (Cyanamide, Bone Meal, Hardwood Ashes) would be used with Clover, Alfalfa, Beans, Peas and other legumes. Fertilizers with a neutral reaction may be used on any soil that already has a satisfactory pH value.

SOIL REACTION AND LIME

One of the controlling factors in plant growth is soil reaction, that is, soils are acid, neutral or alkaline. They become *acid* when lime and other basic compounds are removed by drainage water and chemical activity, leaving an excess of acid-forming elements which do not dissolve so readily. Lime deficiency occurs mostly in the top soil and gradually spreads downward. An *alkaline* condition arises when there is an excess of basic materials in the soil. When acid and alkaline materials are present in chemically equivalent amounts, the soil reaction is *neutral*.

The degree of acidity and alkalinity is expressed in terms of pH values as follows:

pH SCALE

Acid range	4	very strong
	4.5	strong
	5	medium
	5.5	moderate
	6	slight
	6.5	very slight

	7	NEUTRAL (pH of pure water)
Alkaline range	7.5	slight
	8	moderate
	8.5	strong
	9	very strong

Most plants seem to prefer a slightly acid soil with pH range of 6.0 to 7.0. However, if there is plenty of organic matter in the soil to act as a buffer, the range of tolerance may extend from about pH 5.0 to 8.5. Some plants do have very definite pH limits that must be observed in order to obtain satisfactory growth. For instance, a handful of lime worked into the soil around the roots of an Azalea would be an insult to the plant and might easily kill it, whereas Peas, Beans and Clover would relish such treatment.

The following lists give some idea of the approximate pH ranges for different plants.

Strongly acid (pH 4.0–5.0).—

Andromeda
Azalea
Blueberry
Bunchberry
Camelia
Cranberry
Daphne
Ferns
Galax
Heather
Holly
Hydrangea (blue flowers)
Mountain Ash
Mountain Laurel
Orchid
Pitcher Plant
Rhododendron
Sweet Bay
Trailing Arbutus

Moderately acid (pH 5.0–6.0).—

Bent Grass
Birds-foot Violet
Bluebell
Boxwood
Dewberry
Dogwood
Euonymus
Gardenia
Ground Pine
Hemlock
Magnolia
Mahonia
Orange
Pachysandra
Potato
Raspberry
Scotch Broom
Smilax
Spruce
Strawberry
Watermelon
Wild flowers (most of them)
Wild Blackberry

Slightly acid (pH 6.0–7.0) to slightly alkaline (pH 7.0–8.0).—

The vast majority of garden flowers, vegetables, vines, shrubs and trees fall in this group.

Abelia
African Violet
Ageratum
Alder
Alyssum
Amaranth
Ash
Asparagus
Aster
Barberry
Bean
Beech
Beet
Begonia
Bittersweet
Blue Grass
Broccoli
Cabbage
Calceolaria
Calendula
Campanula
Canna
Carnation
Carrot
Catalpa
Cauliflower
Celery
China Aster
Chives
Chrysanthemum
Clematis
Columbine
Cornflower
Cosmos
Costmary
Crocus
Cyclamen
Dahlia
Delphinium
Deutzia
Dianthus
Dill
Douglas Fir
Forsythia
Foxglove
Fruit Trees
Gaillardia
Gentian
Geranium
Gladiolus
Globe Flower

Hawthorne
Hibiscus
Hollyhock
Hyacinth
Hydrangea (pink flowers)
Impatiens
Iris
Ivy
Juniper
Kale
Larkspur
Lavender
Leek
Lettuce
Lilac
Lily
Linden
Lupine
Maple
Marigold
Mint
Morning Glory
Narcissus
Nasturtium
Oak
Onion
Pansy
Parsley
Parsnip
Peas
Peony
Pepper
Petunia
Phlox
Pine
Poinsettia
Poppy
Primrose
Privet
Radish
Redbud
Rose
Rosemary
Sage
Snapdragon
Spinach
Spiraea
Spruce
Squash
Sumac
Sweet Basil
Sweet Marjoram
Sweet-potato
Tamarix
Tarragon
Thyme
Tomato
Tulip
Verbena
Vinca
Violet
Vitex
Wax-plant
Wisteria
Yew
Yucca
Zinnia

Strongly alkaline (pH 8.0–9.0).—

Alfalfa
Alpine Aster
Androsace
Clover
Cow-peas
Edelweiss
Lespedeza
Rock Rose
Saxifrage (certain kinds)
Soy-beans
Sweet Clover

The limits of plant growth are from around pH 4.0 to 9.0. Very few plants survive a pH above 8.5 or lower than 4.5. There are at least four probable reasons why soil reaction is important.

1. The availability of certain plant food elements varies with the existing acidity or alkalinity. For example, in soils low in organic matter iron is available only when the pH is about 6.5 or lower. In very acid soils calcium and magnesium become unavailable. Lack of these elements stops plant growth. It is also possible that acid-loving plants will not thrive in alkaline soils due to a deficiency of some minor element so far undetermined.
2. Soils that are strongly acid or alkaline may contain certain chemical elements in amounts sufficient to become toxic to plant growth. It is claimed that aluminum becomes toxic to the roots of some plants in acid soil, thus reducing the absorption of necessary food materials.
3. Soil reaction is related to disease resistance. Potatoes require an acid soil (pH 5.5 or lower) to prevent injury from a disease called "scab."
4. Important biochemical changes which occur in soil are strongly influenced by the existing pH. Certain beneficial bacteria thrive only in neutral or slightly alkaline soil, whereas others require an acid soil.

When plants fail to grow well, backyard gardeners generally assume that the soil is "sour" and needs a stout dose of lime and Bone Meal. Unfortunately, these materials are not cure-alls for infertile soil; in fact, since both of them are alkaline, they may be considered rank poisons for acid-loving plants. *Never add lime unless you are absolutely sure it is needed.* The presence of moss is no definite indication of acidity, but it can mean low fertility, poor drainage, too much shade, heavy soil and possibly lack of

potassium. Some of the symptoms of unsatisfactory pH are: poor top growth, pale green leaves with dark veins and very little root development.

The best way to find out whether or not lime is needed is to have the soil tested at the State Agricultural College or get one of those inexpensive testing kits at the seed stores and make your own determinations. The sample to be tested should be taken from the top 6 to 8 inches of soil. As radical differences may occur in limited areas, it may be advisable to take samples from several parts of the garden. After making the test, the next thing to consider is the pH preferences of the plants that are to be grown. Maybe you will find them mentioned in the lists of pH ranges for different plants (pages 96–97).

If the soil is too acid, ground limestone or agricultural lime used at the rate of 10 lbs. per 100 sq. ft. (2 tons per acre) will raise the pH one point, say from pH 5.0 to 6.0. For hydrated lime use 25 per cent less as it is more active.

To lower the pH one point add 1 to 3 lbs. of powdered sulphur per 100 sq. ft. If necessary, use stronger doses or repeat the treatment several times until tests show the soil has reached the desired pH value. Iron Sulphate, 2 lbs. per 100 sq. ft., can be added to the sulphur if quicker results are needed. Aluminum Sulphate may be used in place of the sulphur, but in large quantities it tends to become toxic. The addition of acid peats and acid fertilizers (Ammonium Sulphate, Cottonseed Meal, Spent Hops, Tankage) also lowers the pH very effectively. Bone Meal, Sodium Nitrate, Hardwood Ashes, and Cyanamide are basic in reaction, so they can be used to raise the pH or make the soil alkaline. All these materials must be thoroughly mixed with the soil to obtain the desired results. Merely scattering them on the surface greatly reduces their effectiveness.

Determine the amount of material necessary to change the pH of a small soil sample first, then calculate what is needed for larger areas. When soil is *excessively* acid or alkaline, the best thing to do is choose plants that will tolerate the existing condition rather than trying to radically change the pH.

Sandy soils usually require less lime than tests might indicate, clay soils more. The best time to apply limestone is after the soil has been plowed or spaded and partially worked. This can be done to good advantage in the fall. One application of ground limestone may be enough to last several years. Hydrated lime has to be applied more often. Neutral and alkaline soils are to be expected in arid or semi-arid regions where heavy rains do not wash away the basic elements. Acid soils occur mostly in regions of heavy rainfall and in cities where sulphur from smoke is constantly being added to the soil.

SOIL MANAGEMENT

So far we have been dealing mostly with the fundamental principles of soil fertility; now let us proceed to put some of this information to practical use in the garden.

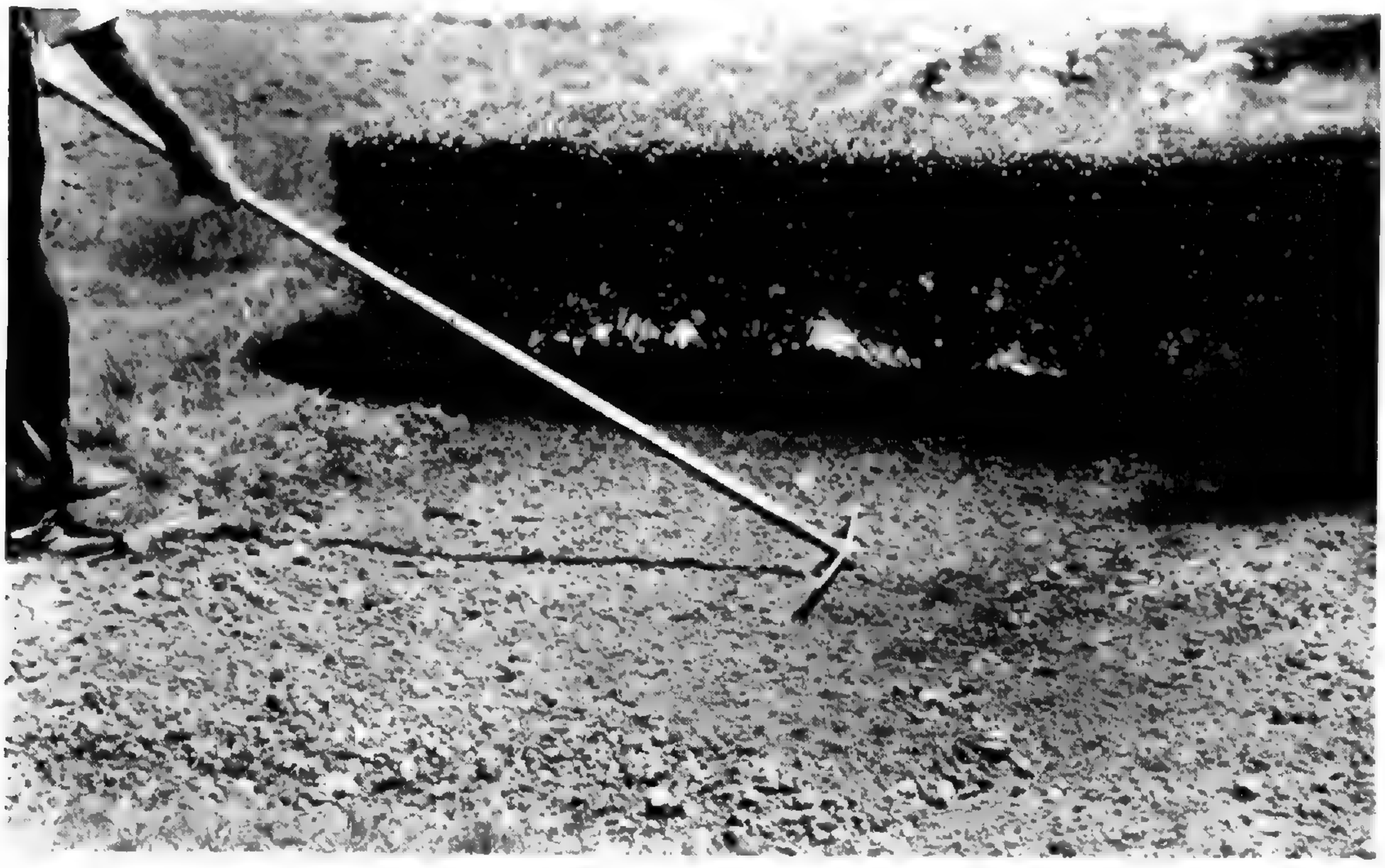
First, of course, there is the *preparation of the soil.* Most amateurs have little or no choice when it comes to selecting a favorable garden site; they have to use just whatever land is available. Frequently the soil is in very poor physical condition, low in plant food materials, and decidedly unsatisfactory for any kind of gardening. In Missouri this generally means a *heavy compact clay.* Such a soil needs:

1. *Organic Matter.*—
   A 3- to 4-inch layer of old farm manure, leafmold, artificial manure, peat or fibrous compost spaded in thoroughly.
2. *Coarse sand, fine gravel or cinders.*—
   A generous amount of these materials should be mixed in with the organic matter to improve drainage and air circulation. Coal ashes, well-washed and sifted to remove large clinkers, are excellent for lightening heavy soil.
3. *Ground limestone.*—
   Most garden soils in Missouri need a bit of lime. After spading under the leafmold, sand, gravel and cinders, broadcast 5 to 10 lbs. of limestone per 100 sq. ft. and rake it well into the soil. Increase the amount if tests show the soil is strongly acid. One treatment with limestone may be enough for several years as it reacts rather slowly. Never add lime where plants requiring an acid soil (page 96) are to be grown.
4. *Chemical fertilizer.*—
   Broadcast 5 lbs. of complete, medium-grade fertilizer per 100 sq. ft. and rake it into the soil along with the limestone. Use an incomplete fertilizer if tests show nitrogen, phosphorus or potassium to be present in sufficient quantities.
5. *Cultivation.*—
   Spade or plow the soil deeply, break up the lumps by raking, and after the plants are set out keep the soil well stirred up with a hoe. Do not allow a hard crust to form on the surface. Cultivate before it rains and a day or two later, after the soil has had a chance to dry out a bit. Never cultivate soil when it is wet and soggy as this causes "puddling," an unfavorable structural condition which is not easy to rectify. Cultivation stimulates the essential chemical and bacterial action in the soil and makes it possible for rain to soak into the ground instead of running off as surface drainage.

If this program is followed for several years, the soil will eventually be in excellent condition for any kind of gardening. Instead of building up a poor soil, impatient gardeners who want results in a hurry may prefer to dig out the clay completely and replace it with fertile loam hauled in from a nursery or the country. This system works all right, but it is expensive in most cases. Rather than replace all the clay soil at one time, it may be advisable to get a load or two of fertile loam every year and mix it with the garden soil on hand, thus gradually increasing fertility.

To improve *sandy soil*, add large amounts of organic matter and some clay loam to act as a binder. The proportions of course vary with the degree of sandiness, but as a general guide we suggest: 4 parts sandy soil, 2 parts clay loam, and 2 parts organic matter. The addition of limestone may not

Spade up garden soil in the spring and fall, turning under a mulch of leaves or fibrous manure if possible.



After spading in the spring, rake the soil to break up lumps and remove stones before planting.

be necessary as sandy soils are not as acid as most clay soils. Complete fertilizer should be added at the rate of 5 lbs. per 100 sq. ft. Cultivation, although not so essential as with clay soils, should not be neglected. During dry weather a dust mulch maintained on the surface of the soil by regular hoeing will conserve some of the valuable moisture. A summer mulch of straw, peat, or grass clippings will accomplish the same thing and reduce the amount of hoeing necessary to discourage the growth of weeds. A surface mulch also keeps the soil cooler in hot weather.

Garden soil that is *too shallow* (1 foot or less) can be made deeper by *trenching* or double digging. Remove the top soil and spade about 6 inches of manure, leafmold, or compost into the subsoil to a depth of 1 to 2 ft. Then replace the top soil. It is slow, hard work, but good results are almost certain to follow.

Wet, swampy soil of course must be drained before it can be used for flower and vegetable gardens. Tile drains installed a foot or more below the surface of the soil will do the trick, but usually it is an expensive proposition. Irrigation ditches leading to a low spot or catch basin can often be used to advantage. Improving the structure of clay soil by the addition of organic matter, gravel and cinders gradually eliminates common drainage troubles.

For many amateur gardeners *soil moisture* is one of the major hurdles on the road to success. When, how and how much to water? These are questions that have a very familiar ring. Since soils vary so much in physical texture, we can only make general recommendations.

The amount of moisture in the soil is really one of the most important factors controlling the growth of plants. When there is too little, plants wilt and die of thirst; when there is too much the roots rot off from lack of oxygen and the beneficial microörganisms in the soil cease to function. Fortunately, most plants tolerate fairly wide fluctuations, so with reasonable weather and a length of garden hose equipped with an efficient sprinkler, the moisture problem should not be too difficult. However, watering with the hose seldom gives results comparable to a good soaking rain. This may be due to loss of water by surface evaporation in hot weather, and also to the method of watering. It takes about 2½ hours watering in one spot with the average sprinkler to equal 1 inch of rain. After sprinkling, test the depth of penetration with a spade. The moisture should go down 6 to 8 inches or more where the roots are able to make the best use of it. Merely wetting the surface of the soil tends to encourage shallow root development and poor drought resistance. *Gardens and lawns should be watered less frequently but more thoroughly.*

The best time of day to water is early morning before the sun gets too

hot. This way, a minimum amount of moisture is lost by direct evaporation and the plants have a chance to dry out before evening. Leaving the plants wet all night promotes the development of fungus diseases such as black spot on Roses and mildew on Zinnias. When the soil feels very dry to the touch or when the plants show signs of wilting, do not waste any time getting out the sprinkler, even if it is high noon. As long as the spray continues to fall on the plants there is absolutely no chance of the sun burning the leaves by concentration of the rays passing through drops of water.

Now that you know *everything* about soils and fertilizers, perhaps you can tell me why so many of my Snapdragon plants "passed out" last summer; why the Radishes all went to tops; the Carrot roots looked like octopuses instead of incendiary bombs; and the garden Peas failed to attract even a decent crop of aphids. Well anyway, happy landing with that Victory Garden!

D. C. F.

NOTES

Dr. David C. Fairburn, Horticulturist to the Garden, and Mr. P. A. Kohl, Floriculturist to the Garden, are conducting a five-weeks basic course on Victory Gardens for the Senior Girl Scouts.

Mr. Leslie Hubricht, formerly assistant to Dr. Edgar Anderson, Geneticist to the Garden, has recently accepted a position with Remington-Rand, of Ilion, New York.

Mr. Ladislaus Cutak, in charge of Succulents at the Garden, gave a talk before the Nazareth Brotherhood of the Nazareth Evangelical Church, March 9, on "Cactus Hunt in Old Mexico."

Dr. Carl C. Lindegren, Research Associate, Henry Shaw School of Botany, spoke at the meeting of the Academy of Science of St. Louis, April 8, on "The Improvement of Industrial Yeasts by Breeding."

Dr. Edward C. Berry, former graduate student at the Garden and recently assistant in the Garden Herbarium, has accepted a position at Jefferson College, Air Corps Division, St. Louis, as professor of physics.

Dr. Henry N. Andrews, Paleobotanist to the Garden, and Mr. L. Wayne Lenz, formerly graduate student at the Garden, are the authors of a paper in the March issue of the *Bulletin of the Torrey Botanical Club* (**70**:120-125) entitled "A Mycorrhizome from the Carboniferous of Illinois."

Mr. George H. Pring, Superintendent of the Garden, has given talks on "Victory Gardens" before the following groups recently: March 22, before

the Air Raid Wardens of Zone 2; March 29, O. C. D. Block Workers at Southwest High School; March 31, O. C. D. Block Workers at St. Roch's Church.

Dr. Edgar Anderson, Geneticist to the Garden, now on leave of absence, has been awarded a fellowship by the John Simon Guggenheim Memorial Foundation in New York. As his project, he will study the races of Indian corn, with special reference to Mexico and the Southwest.

The display of narcissi at the Garden Arboretum, Gray Summit, is said to be more gorgeous this year than ever before. On account of the delayed spring the varieties normally flowering in March did not flower until April, with the result that early and late varieties are blooming at the same time, forming a brilliant carpet of yellow.

Mr. Paul A. Kohl, Floriculturist to the Garden, has addressed the following groups on "Victory Gardens" recently: March 27 and April 3, Senior Girl Scouts; March 28, over Station KWK, with the "Inquiring Girl Reporter"; March 31, O. C. D. Block Workers at Beaumont High School; April 1, O. C. D. Block Workers at Carr Square Auditorium.

Dr. Edgar Anderson, Geneticist to the Garden, spoke before the genetics staff seminar of the University of California, Berkeley, March 2, on "Problems in the Genetic Differentiation of Maize." On March 6 he spoke at the Biosystematists' lunch meeting at the University of California Faculty Club on "Genetic Patterns of Speciation."

Dr. George T. Moore, Director of the Garden, discussed "Science in the Garden," and Mr. Paul A. Kohl, Floriculturist to the Garden, showed movies in color of various subjects in the Missouri Botanical Garden at a meeting of the St. Louis Garden Club, March 16. Dr. Moore spoke before the Marguerite Krueger Conservation Club, March 25, on "Henry Shaw and His Garden."

Recent visitors at the Garden include: Dr. Mary Maxine Larisey, Assistant Professor of Biology, Judson College, Marion, Ala.; Dr. George B. Happ, Assistant Professor of Biology, Principia College, Elsah, Ill.; Miss Antoinette Miele, Assistant in Botany, Cornell University, Ithaca, N. Y.; Mr. Nathan Stahler, Junior Entomologist, Bureau of Entomology, U. S. Dept. Agr., St. Louis, and Mr. Richard Froeschner, Assistant Entomologist, Missouri State Dept. Agr., St. Louis; Dr. M. G. Yatsevitch, Director of Research, Ordnance Department, U. S. Army.

STATISTICAL INFORMATION FOR MARCH, 1943

GARDEN ATTENDANCE:	
Total number of visitors	10,445
PLANT ACCESSIONS:	
Total number of plants and seed packets received as gifts	57
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	23
Total number of books and pamphlets donated	102
HERBARIUM ACCESSIONS:	
By Purchase—	
Darker, G. D.—Fungi and lichens of Missouri	7
Krukoff, B. A.—Plants of Brazil, collected by A. Ducke	400
Lundell, C. L.—Plants of British Honduras, collected by Percy H. Gentle	126
By Gift—	
Degener, Otto—Plants of Hawaii	129
Hoopes, Thomas J.—Photograph of a Chinese Iron Sculpture representing an orchid flower	1
Horr, W. H.—Plants of Kansas	3
Hubricht, Leslie—Plants of Arkansas	12
O'Byrne, Harold—Photograph of George W. Letterman	1
Pring, George H.—*Oncidium Powellii* Schlechter and *Melinis minutiflora* Beauv. from Horticulture	4
By Exchange—	
Breitung, August J.—Plants of Saskatchewan	59
Field Museum of Natural History—Plants of Guatemala	137
New York State Museum, Albany—Plants of New York	300
Total	1,179

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until sunset; Sundays, 10:00 a. m. until sunset. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah car line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

THE GARDEN, 2315 TOWER GROVE AVENUE, ST. LOUIS, MISSOURI

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Director

HERMANN VON SCHRENK,
Pathologist

JESSE M. GREENMAN,
Curator of Herbarium

CARROLL W. DODGE,
Mycologist

EDGAR ANDERSON,
Geneticist

ROBERT E. WOODSON, JR.
Assistant Curator of Herbarium

HENRY N. ANDREWS,
Paleobotanist

ROBERT W. SCHERY,
Research Assistant

NELL C. HORNER,
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Floriculturist

DAVID C. FAIRBURN,
Horticulturist

JOSEPH CUTAK,
In charge of Exotics

LADISLAUS CUTAK,
In charge of Succulents

THE ARBORETUM, GRAY SUMMIT, MISSOURI

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ROY E. KISSICK,
Engineer

FRED WEGLOENER,
Orchid Grower

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PAUL H. ALLEN,
Balboa, Canal Zone

REPRESENTATIVE IN EUROPE

GURNEY WILSON, F. L. S.,
Hove, Sussex, England

MISSOURI BOTANICAL GARDEN BULLETIN

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CONTENTS

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LARGEST GINKGO TREE IN THE GARDEN

Missouri Botanical Garden Bulletin

Vol. XXXI MAY, 1943 No. 5

WHERE IS THE LARGEST GINKGO TREE IN THE UNITED STATES?

In the *Florists Exchange* for January 30, 1943, is an illustration of a ginkgo tree growing at Narberth, Pa. According to the accompanying description it measures 40 inches in diameter at the base, is about 40 feet high, and has a spread of 40 feet. In the April 24 number of the same magazine, Mr. Robert Pyle reports a ginkgo from West Grove, Pa., that is 42 inches in diameter with a 90-foot spread of branches. It is presumed that a near-by stone bearing the date 1796 records the date of the planting of the tree.

There are a number of ginkgo trees in the Garden, most of the older ones having been planted at the time Mr. Shaw was laying out his original garden, some eighty years ago. One of the most interesting is to be found west of the Mausoleum, near the eastern entrance to the Economic Garden. This tree, like the two referred to above, has devoted its efforts to developing a group of massive branches growing almost horizontally, particularly attractive to children who climb. While having neither the diameter nor the spread of the West Grove tree, it certainly exceeds the Narberth specimen in spread and height if not in girth. Considering it is only about half as old as the West Grove tree, it has done pretty well to attain a spread of 65 feet, a height of 45 feet, and a diameter of 3 feet. Perhaps by the time our tree is 150 years old it may be a candidate for the honor of being the largest ginkgo in this country. Even then it will have to grow some to compete with ginkgos in China, the tree's native home. Wilson, in his "A Naturalist in Western China," figures a ginkgo of unknown age which is 90 feet tall and has a girth of 24 feet.

Just how old a ginkgo tree may live to be, no one knows. While a relic of a very ancient flora, it has never been found in the wild, all the existing trees having been propagated from trees cultivated by Chinese priests. But

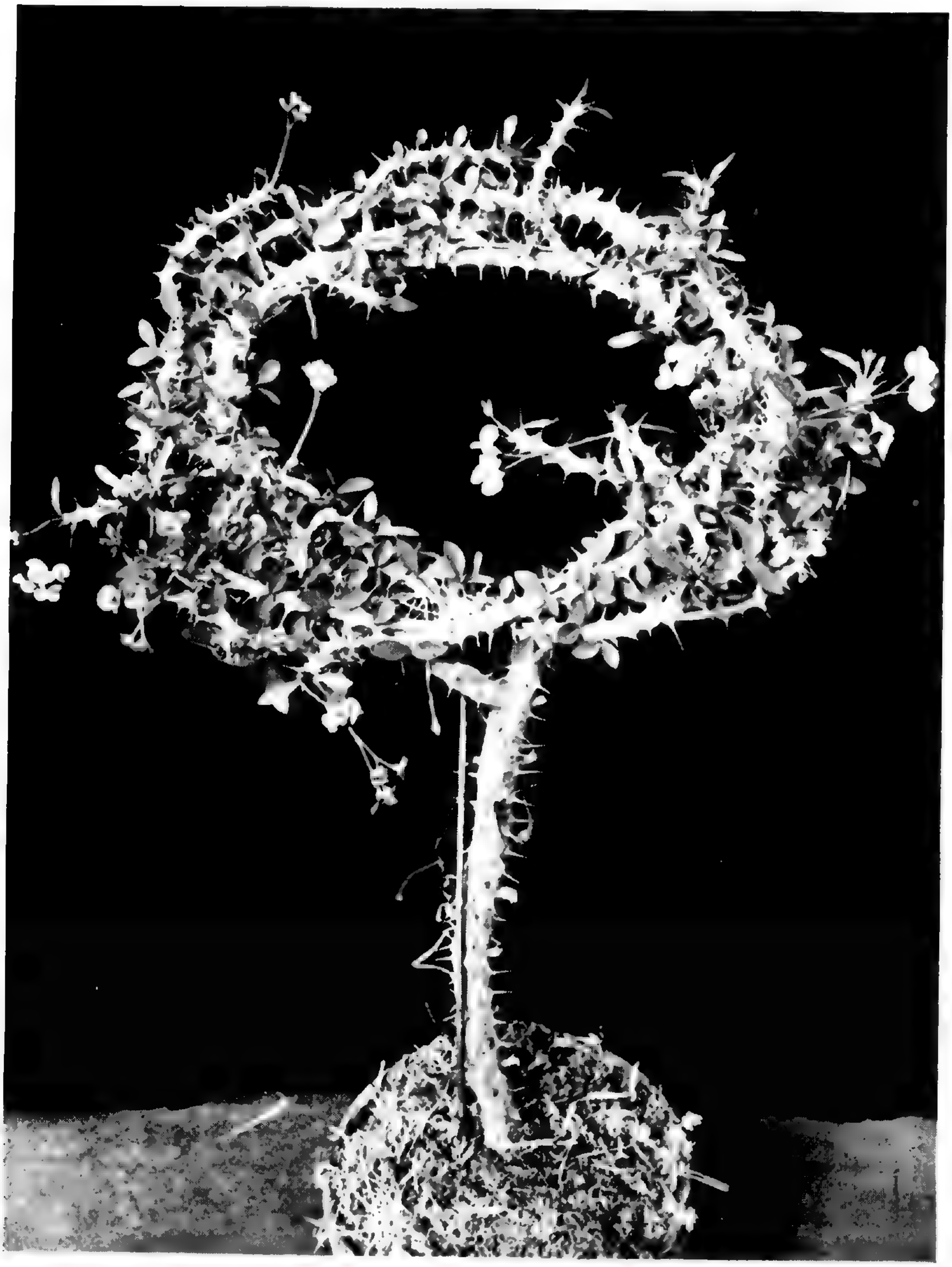
it would be hard to find a tree so well adapted to survive indefinitely. It is free from any serious insect or fungus disease, withstands perfectly the fluctuating climate of the temperate zone, and seems to be immune to the effect of the unfavorable environment of soil and air found in most modern cities. We have yet to learn of any one who has seen a ginkgo tree that appeared to have died a "natural" death. In fact, of the many hundreds of trees growing in St. Louis and elsewhere the only dead one we have ever seen was one in the Garden struck by lightning in July 1939. This was allowed to stand for two years, but finally had to be cut down as it was rapidly decaying. Incidentally, this is believed to be the only known case of a ginkgo tree having been struck by lightning.

G. T. M.

TWO PLANTS ASSOCIATED WITH HOLY WEEK

With the passing of Holy Week it seems fitting to bring to attention two of the plants which have been so intimately associated with the occasion, even though the stories be of legendary origin. Our narrative concerns the "Crown-of-thorns" and the "Passion-flower." Botanically the plants are quite unrelated and geographically separated by several thousand miles. Though Palestine is far distant from the native home of both of them,

Passion-flower *(Passiflora incarnata)*



The crown-of-thorns *(Euphorbia splendens)*

legend and superstition associating them with the death of Christ have tenaciously clung to them from the very beginning.

If you have ever examined the odd blossoms of the passion-flower you could appreciate why the early Spaniards gave the plant this highly descriptive name. The adventurous conquistadors were very often zealously

religious, associating everything possible with their faith, and when they beheld the delicate Passiflora flowers they had no difficulty in visualizing in them the emblems of the crucifixion. The three stigma lobes were the nails; the five stamens represented the five wounds, or, as some thought, the hammers used to drive the nails; the colored filamentous corona suggested the crown of thorns; and the five sepals and five petals stood for ten of the twelve apostles, Peter and Judas being absent at the crucifixion.

Passiflora caerulea is probably the most common passion-flower cultivated in American greenhouses, and *P. incarnata* the commonest out of doors. There are about 300 species of the genus found growing wild, for the most part in tropical America. At least a dozen species are native to the United States, of which the maypop *(P. incarnata)*, with its large purple and white flowers, is probably the best known.

While the blossoms are the chief attraction of the passion-flower this is not true of the spurges, to which the popular crown-of-thorns belongs. In most cases the flowers of the crown-of-thorns are quite inconspicuous, and the average person would regard them as consisting of only stamens and pistils. However, on closer examination it will be seen that each stamen or pistil has its pedicel or stalk, making it a true flower in the botanical sense even though it does not possess the typical number of floral parts. The highly colored "petals" which often surround the "flower-cups" are only the bracts, the name given to the leaf-like organs which subtend a flower, or, as in the case of most Euphorbias, an aggregation of flowers.

Euphorbia splendens, the legendary crown-of-thorns, usually bears a copious supply of inflorescences the whole year around. Unlike the Poinsettia, its "flower-cups" are subtended by only two small petal-like bracts, but because of their great abundance the plant always presents a colorful appearance. Far from there being any evidence that this plant was the true crown-of-thorns, the fact is that it was not even known in the Holy Land during the time of Christ. The popular name was evidently tacked on because its slender branches are thickly studded with wicked-looking spikes and the stems can easily be trained into a crown of thorns (see p. 107).

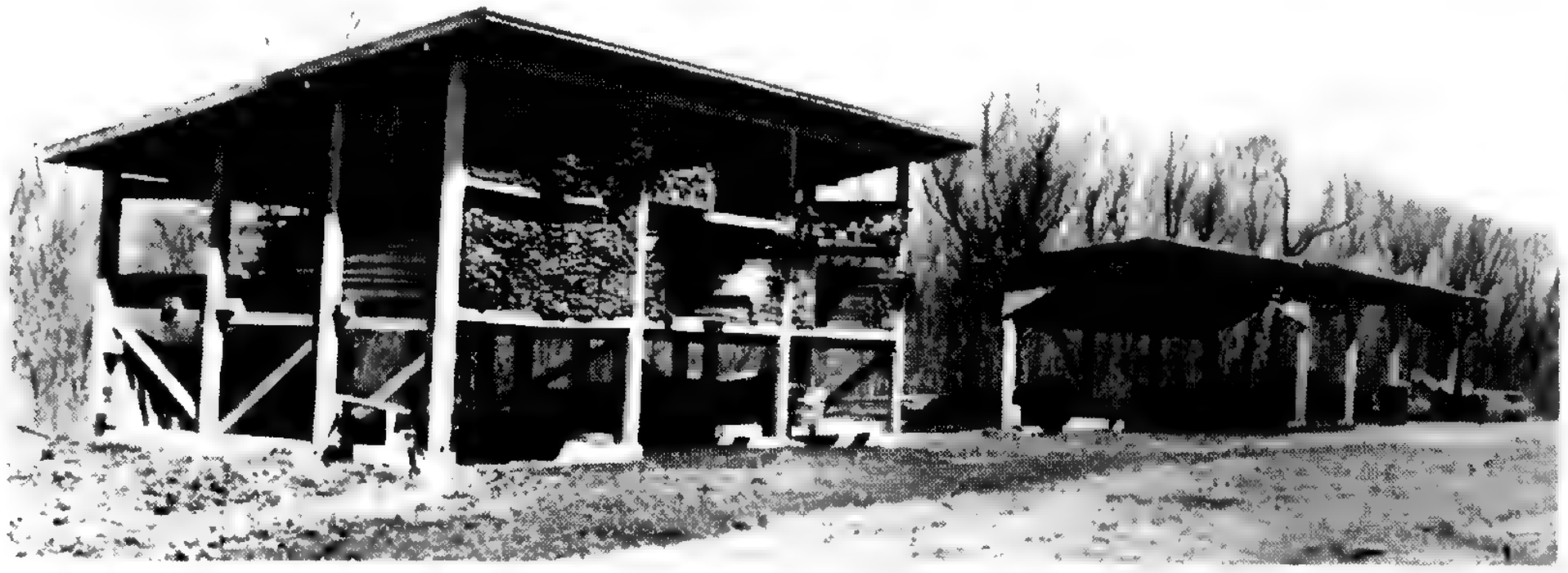
L. C.

THE ARBORETUM AND THE SAWMILL

A picture of the Arboretum sawmill published in an earlier number of the BULLETIN has brought forth questions as to the purpose of a sawmill in a botanical garden. Since an Arboretum is devoted to the growing of trees why should time and effort be spent to harvest them? One answer is that

this is one step toward making the Arboretum self-sustaining in that it will produce some lumber from the trees which from time to time must be cut. And since an arboretum is concerned with the growing of trees it seems logical that it should be interested in what might be done with them after they have attained full growth. Also, there are certain investigational and experimental problems dealing with wood-lots in which a sawmill has a direct bearing.

If we trace the history of a farm wood-lot from the time that the first settlers cleared fields for farming until the present day, we find that throughout all those years only the best trees were cut, no matter what their final use might be. Over a period of time the character of the wood-lot changed. And where the first settler had the choice of oaks and hickories and used them with little restraint, the time has come when the third or fourth generation drawing on that same wood-lot for a few fence-posts and an occasional saw-log finds it increasingly difficult to locate a suitable tree. Very few



Sawmill and lumber-shed at the Arboretum

farm wood-lots have been handled in such a way that they will produce logs fit for sawing into lumber or even for making fence-posts. As better trees were removed the less desirable types entered. The average farm wood-lot to-day consists of a stand of mixed timber of uneven age, with the desirable red and white oaks far less numerous than the inferior ash, elm, locust, and hackberry. From this stage on, unless an improvement program is started which will favor the growing of oaks and harvesting the less desirable species, a time will come when the wood-lot will not contain the winter's fuel supply. The owner will then be compelled to purchase fuel and all lumber needed for even the roughest use. This situation will inevitably follow if the best and straightest oaks are cut for fuel while the inferior kinds and

the crooked hard-to-split trees are left to grow and reseed the area. Perhaps the best example in this neighborhood of what an intelligent program can do for a typical wood-lot occurs on the farm of Mr. John Howe, a mile or so north of Pacific, Mo. This property has been owned by Mr. Howe and his father for the past 55 years. During that time it has been the practice to cut the poorest trees for fuel, and to-day the clean straight trunks of white and red oaks offer a striking contrast to the usual run-down woods filled with trees not fit even for firewood.

The abused timber-land is common throughout most of Missouri. We have the "weed" trees. We have the elm, the locust, the hackberry, the box-elder—some of considerable size—and the problem is to find a method of using them and a place in which they may be used. This then is part of the experimental work connected with an arboretum sawmill. The utilization of natural resources is a national problem at this time, and any large tree, regardless of species, should have a place in this program. Since the sawmill was set up at the Arboretum in the winter of 1941 about 33,000

Showing flood damage along Meramec River (22-inch bur oak in river in foreground).

Showing the notch and the use of the cross-cut saw

Driving wedges to force the tree to fall in the correct direction and to keep the cut open

Bur oak crashing to the ground

"Backing up" a tree into 16-foot logs

board feet of all kinds of lumber have been cut. This has been used in various ways. A part has gone into the construction of stagings for the orchid houses, the lumber being cut into 1 x 4 and 2 x 4 and used without seasoning. The following kinds of trees have been tried for this purpose:

Slippery Elm *(Ulmus fulva)*
American Elm *(Ulmus americana)*
Cottonwood *(Populus balsamifera)*
Soft Maple *(Acer saccharinum)*
Locust *(Gleditsia triacanthos)*
White Oak *(Quercus alba)*
Red Oak *(Quercus borealis)*
Sycamore *(Platanus occidentalis)*

After two years of service in the greenhouses it appears that any and all of these are superior to pine or fir. If such little-used lumber stands up well under this usage it seems reasonable that there may be many other places where it may be employed to advantage.

General view of loading "yard"

After the high water of January had washed up a considerable number of trees on the south bank of the Arboretum grounds it was decided to log the remaining trees before another flood completed the destruction. It is estimated that 25,000 board feet were lost during this high water and that another 75,000 board feet would be in danger in the event of a later flood. Logging began late in January and developed into a rather large operation for this vicinity. The trees were "felled" with a cross-cut saw, an axe notched the trunk in the direction it was to fall, and wedges and sledges were used where necessary. This is the usual method and well-known to any woodsman, but the accompanying pictures will be of interest to those not familiar with such work. After a tree has fallen it is trimmed of

branches and cut into proper lengths, usually 16 feet. The individual logs scattered about through the woods were skidded to a loading "yard" with a crawler tractor. When enough of them were assembled the job of transporting them to the mill began. The longer logs were hauled by a tractor-trailer truck; the shorter ones were loaded on a flat bed truck. Since many of the logs weighed over three tons they could not be loaded by hand but were pulled up a skid by a cable run through a block high up in a big tree. The crawler tractor furnished the power by pulling the free end of the cable and kept constantly shuttling back and forth between loading and "yarding." If the logs were much alike and about 20 to 24 inches in diameter as many as six could be hauled at one time on the trailer truck. Some of the logs occupied so much space that only two could be taken in one load,

Forty-two-inch sycamore

as, for instance, a sycamore 42 inches in diameter, 16 feet long, weighing about 7,800 pounds, and an elm of about the same size. When the proper number of logs had been placed on the truck they were chained to the bolsters and the chains pulled taut with load binders. Although the sawmill is less than two miles in a direct line from the logging site the trucks travelled 12½ miles to cross the Meramec River and reach the Arboretum by road. At the mill the large logs were piled near the skidways and sawing began after all hauling was completed. The following kinds of trees were cut:

Bur Oak *(Quercus macrocarpa)*
Red Oak *(Quercus borealis)*
Pin Oak *(Quercus palustris)*
Black Walnut *(Juglans nigra)*
American Elm *(Ulmus americana)*
Slippery Elm *(Ulmus fulva)*
Hickory *(Carya ovata)*
Hackberry *(Celtis* sp.*)*
Sycamore *(Platanus occidentalis)*

Largest sycamore arriving at sawmill

Many of these trees were 90 feet in height and between 110 and 130 years old. Most of them were growing vigorously except the red oaks which were dying at the top.

The sawmill itself is the small "portable" type having a 56-inch saw driven by a 41-HP gasoline engine. Being set up on concrete foundations and with a permanent roof some of the difficulties common to small mills are avoided. Since the 56-inch sawmill will handle a log only up to 33 inches in diameter the largest logs presented something of a problem. In some cases it was necessary to use wedges and axes to remove the first slab when "sawing around the log." It might be argued that this is not an effi-

cient method, that it would be better to ship these big logs to a larger mill. However, large trees are quite uncommon and when they are found in a wood-lot they are definitely "wolf" trees. Usually, they have been avoided in earlier cuttings; they are often inferior in quality, frequently a worthless species except during a national emergency and generally can't even be reduced to firewood. They take up an area ample for three younger trees and increase so little in diameter each year that their existence cannot be justified except for sentimental or aesthetic reasons. Although the large sycamore yielded 660 board feet of 1 x 12-inch boards, it took twice as long to saw the big log as for an equal volume of smaller ones. At the same time, such trees must be removed if a small wood-lot is to continue to produce, especially if the tree represents a species not in current demand in the lumber trade.

The size of the saw alone does not determine the maximum log size which can be cut. Of much more importance is the power plant. Most small mills are operated by gasoline or Diesel engines, and in our experience 41 HP is adequate for a 33-inch sycamore but wholly inadequate for a 22-inch bur oak. As the diameter of the log increases more and more teeth are brought into the cut and the power requirments steadily increase. A dense timber such as white oak will require over twice as much engine power as elm or soft maple. There are many other problems to be encountered in operating a sawmill. Generally they must be solved by experience since there is but a limited amount of published information available. It seems that in two years of operation we have exhausted the list of troubles which can be corrected by adjusting the mill itself. The inadequacy of the power plant cannot be compensated for, and we might add that this is a very common condition in small mills. However, such mills can produce a high-quality lumber of consistent and uniform dimensions if properly set up and cared for.

During normal times the owner of a small tract of timber has virtually no way of using it except to cut it for firewood unless he is able to induce a small mill operator to set up in the neighborhood. Often all the wood-lots within an entire township are in such poor condition that no mill operator can be interested in the timber. At the same time, if the farm wood-lot is to be considered a natural resource and a national asset, it must produce wood for fuel and some lumber. Perhaps the lumber should be used locally. The owner could often use it in his own buildings if his wood-lot contained many "weed" and "wolf" trees for which there was no demand, or if a very long haul was required to get such logs to the consumer.

The Arboretum sawmill was set up with the thought that our experience in logging, sawing, and seasoning lumber might be of some value in the solution of these problems, at least locally. However, regardless of what information we may be able to gather, it seems now that a sawmill is a natural part of the development of an arboretum and may even prove sound from an economic standpoint.

A. P. B.

NOTES

Mr. Paul A. Kohl, Floriculturist to the Garden, spoke on "Victory Gardens" before the Neighborhood Gardens, April 7.

The annual flower sermon, provided for in the will of Henry Shaw, was preached at Christ Church Cathedral, May 16, by Dr. Walter H. Judd, Congressman from Minnesota.

About twenty students from the St. Louis School of Occupational Therapy have been making use of the Garden library recently in an extensive study of the uses of various plants in medicine.

The May number of *Home Garden* (**1**:31-33) contains an article by Helen Van Pelt Wilson and George H. Pring, entitled "Day- and Night-Blooming Waterlilies are the Most Satisfactory and Attractive Plants for Garden Pools."

Mr. George H. Pring, Superintendent of the Garden, gave the lecture "Four Seasons of the Year at the Missouri Botanical Garden," illustrated with colored slides, before the Springfield Nature League, Springfield, Ill., April 30.

The Edgar Anderson Chapter of the Junior Academy of Science of Southwest High School, under the guidance of Mr. C. H. Sackett, Superintendent, and Miss Lilian Nagel, teacher of biology, visited the Garden library, April 29.

The April number of the *Monsanto Magazine*, the journal of the Monsanto Chemical Company, contains an article "Hothouse Royalty," which features and illustrates the Garden orchids and describes the part chemistry plays in their propagation.

Dr. C. W. Dodge, Mycologist to the Garden, lectured before the Academy of Science of St. Louis, geology section, April 2, on "The Geology of

Guatemala in Relation to Current Problems"; and before the Practical Arts Club of College Women, April 19, on "Obstacles to the Realization of Our Good Neighbor Policy in Central America."

Mr. Ladislaus Cutak, in charge of Succulents at the Garden, gave an illustrated talk, "A Cactus Hunt in Old Mexico," before the Mother of Perpetual Help Auxiliary of St. John Nepomuk Church, on May 5; on May 9 he spoke before the Henry Shaw Cactus Society on "Growing Succulents from Seeds," giving actual demonstrations of the operations.

Recent visitors to the Garden library include: Pvt. Neil MacGregor, of Scott Field, formerly a botany major at the University of California, Berkeley; Miss Eugenia White, plant collector of Panamá, Panama, now majoring in botany at Pomona College, Claremont, Calif.; Pvt. Alexander F. Bucholtz, of the Medical Corps at Jefferson Barracks; Mrs. Chatfield, of the Garden Club of Plymouth, Ohio; Dr. Frederick L. Wellman, Senior Agriculturist and Assistant Director, Cooperative Agricultural Experimental Station, San Salvador, El Salvador; Corp. Louis G. Brenner, of the Topographical Engineer's Battalion, Portland, Oregon.

STATISTICAL INFORMATION FOR APRIL, 1943

GARDEN ATTENDANCE:	
Total number of visitors	18,663
PLANT ACCESSIONS:	
Total number of plants and seed packets received as gifts	1,440
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	30
Total number of books and pamphlets donated	313
HERBARIUM ACCESSIONS:	
By Gift—	
Bauer, Mrs. Nettie—*Cheiranthus* sp. from Horticulture	1
Degener, Otto—Plants of Hawaii	168
Featherly, H. I.—*Carex oxylepis* Torr. & Hook. from Oklahoma	1
Hubricht, Leslie—Lichens of Herkimer County, New York	24
James, Leslie—Plants of Alabama	12
Terry, Robert J.—Acorn with two mature germinating seeds	1
By Exchange—	
United States National Museum—Lichens, mostly from Virginia	181
University of Tennessee, by A. J. Sharp—Plants of Tennessee and Wyoming	400
Total	788

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MISSOURI BOTANICAL GARDEN BULLETIN

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until sunset; Sundays, 10:00 a. m. until sunset. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah car line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

AGARITA *(Berberis trifoliolata)*

Missouri Botanical Garden Bulletin

Vol. XXXI JUNE, 1943 No. 6

TWO NEW DESERT SHRUBS FOR MIDWEST GARDENS

Since 1935, when the writer made his first visit into desert regions primarily to get acquainted with cacti in the field, the urge to learn more about xerophytic plants slowly began to assert itself. On each subsequent trip more attention was paid to dry-climate shrubs and trees, and whenever possible, seeds of interesting xerophytes were collected or small plants dug up and carried home for trial. At first these were placed in the Cactus House, there to impart that certain touch characteristic of the Southwest's waste places. After all, don't xerophytic shrubs play such an important role in the development of cacti? Then why deny them space in the American desert house? In Nature, cactus seedlings seem to establish themselves best under more or less protection during the first few years of their existence. It is really exceptional for an individual to reach maturity without having had some sort of shelter during the first years of growth. This shelter may have been a rock or some kind of vegetation in the form of huisache, retama, mesquite, creosote-bush, palo verde, ironwood, hackberry, allthorn, ocotillo, saltbush, or some other lacy-leaved shrub or half-shrub. Further, in our travels through Mexico, Arizona, Texas, New Mexico and other states we have seen even massive specimens, such as the pillar cacti (Cephalocereus, Lemaireocereus, etc.), rear their formidable arms above the dense verdure of hillsides and plains. It is a fallacy to think that all cacti prefer to grow right out in the full burning sun; the few that do will be found to possess a very spiny armament which acts like a lath-house.

For the past few years several xerophytic shrubs have been growing lustily in the Cactus House, and some have even condescended to bloom. Our interest in these plants did not wane but rather increased considerably when we realized that they could be grown with ease in the conservatory. We knew that several of the desert shrubs grew at altitudes where winters sometimes became quite severe and snow and sleet covered them. Why then couldn't these plants grow in our Midwest gardens where the climatic

conditions somewhat approached those of their natural home? Weren't we constantly looking for and seeking new plants that might add to the attractiveness of our gardens?

Thus in the spring of 1940 a small experimental garden was established for the express purpose of testing cacti, succulents and other desert shrubs as to their hardiness in our climate. Three winters have already elapsed and we feel that it is now safe to introduce two new desert shrubs to the Midwest gardeners. These innovations are *Chilopsis linearis*, or desert willow, and *Berberis trifoliolata*, or agarita, sometimes known as chaparral berry. The former is a small tree or shrub with willow-like leaves and delicate lavender, bignoniaceous blossoms, while the latter is an evergreen bush with stiff, 3-foliolate, holly-like leaves and clusters of small yellow flowers.

Agarita and desert willow should prove popular in our gardens in foundation plantings, in open mass displays or as hedge-rows. Coming from desert regions they will not require moisture as do some of our more common shrubs and bushes and therefore will be better suited to the dry summers so prevalent in the Midwest regions. Of course, to deprive these plants of all water is a great mistake, for even desert plants will respond to care, but they will withstand some drought. It may be of interest to record that our plants in the experimental garden have never been watered artificially since their introduction three years ago but depended entirely on the rainfall for moisture. This was done on purpose to test the adaptability of the plants. The soil in the experimental plot is rather porous, containing a great amount of sand, to which a little leaf-mold has been added and some lime. The garden is located in a rather open spot, subjected to all the elements that visit the Midwest regions, but it is protected somewhat lightly on the west side by a lath-house.

Our plants were raised from seed, and as year-old seedlings they were set outdoors early in spring when danger of frosts was past. The writer believes that xerophytes, including succulents, have a better chance of withstanding the first winter when allowed to establish themselves as early in the spring as possible. On several occasions we have collected desert-grown bushes and attempted to grow them here, but so far have failed. Most desert shrubs, although they stand considerable stress, such as drought, wind, and cold, do not have the ability to withstand transplanting, especially if they are dug from the dry desert. Nursery-grown desert plants are the only answer, although one can grow his plants just as easily from seed. The Spring Canyon Nursery, Box 402, Handley, Texas, is the only commercial establishment known to handle the seeds and plants of both these plants.

Desert willow *(Chilopsis linearis)*

Chilopsis linearis is a fairly rapid grower, attaining a man's height in two or three years. The willow-like plant grows as a shrub 6–8 feet high in its native home but as a cultivated specimen in eastern Texas it is said to assume the dimensions of a forest tree 30 feet high. The writer doubts whether the Chilopsis would attain these proportions in the Midwest, for it is believed that a very severe winter would retard its growth considerably. As proof of this the writer offers the experience of Mrs. James N. Andrews of the Dolly Madison Garden Club, who has tried this shrub in her garden at Somerset, Virginia. It was ten years ago that this gardener planted several unusual things from a southern nursery, among them, *Chilopsis linearis*. She had not

heard of this plant before, but she was eager to try growing it once. Mrs. Andrews planted her little desert willow in the lowest and wettest part of a garden containing shrubs and small trees. It came along nicely until winter set in, when the temperature dropped down to 19 degrees below zero and killed the top growth. The dead wood was pruned and the following summer several new shoots shot up from the root, grew in vigor, and in 1940 reached a height of 12 feet. The average winters of that part of Virginia seldom drop to less than 16 degrees above zero. Our winters are a trifle

Flower of desert willow

more severe, dropping down to 5 above or sometimes lower, but so far only the very tips of the branches have become nipped, necessitating pruning.

Berberis trifoliolata does not grow as rapidly as *Chilopsis linearis*, but it is a very ornamental bush attaining a height of about 7 or 8 feet. It grows in dry soil and on stony hillsides in the Big Bend region of Texas and also in Nuevo Leon and Coahuila in Mexico. The dark green, holly-like leaflets are thickly studded over the branchlets and are rather prickly. The clusters of small yellow flowers later mature into showy red berries which can be made into a jelly of excellent quality. Agarita makes an excellent hedge and

often is used for this purpose in Texas, in parks and along roadsides.

Both the agarita and the desert willow have bloomed here outdoors in the third year. The flowers of the desert willow are far more showy, being larger and more delicate in color. Individual blossoms measure 1½ inches in length and have the funnelform-campanulate shape of those of the Bignoniaceae family, in no way resembling the true willows, as the popular name would have you believe. The flower tube is deep pink above, lighter below, with a flaring 5-lobed limb, the lower three lobes deep rose-purple and the white throat crimson- and yellow-striped. The branchlets are slender and wand-like with alternate, simple, linear-lanceolate leaves.

L. C.

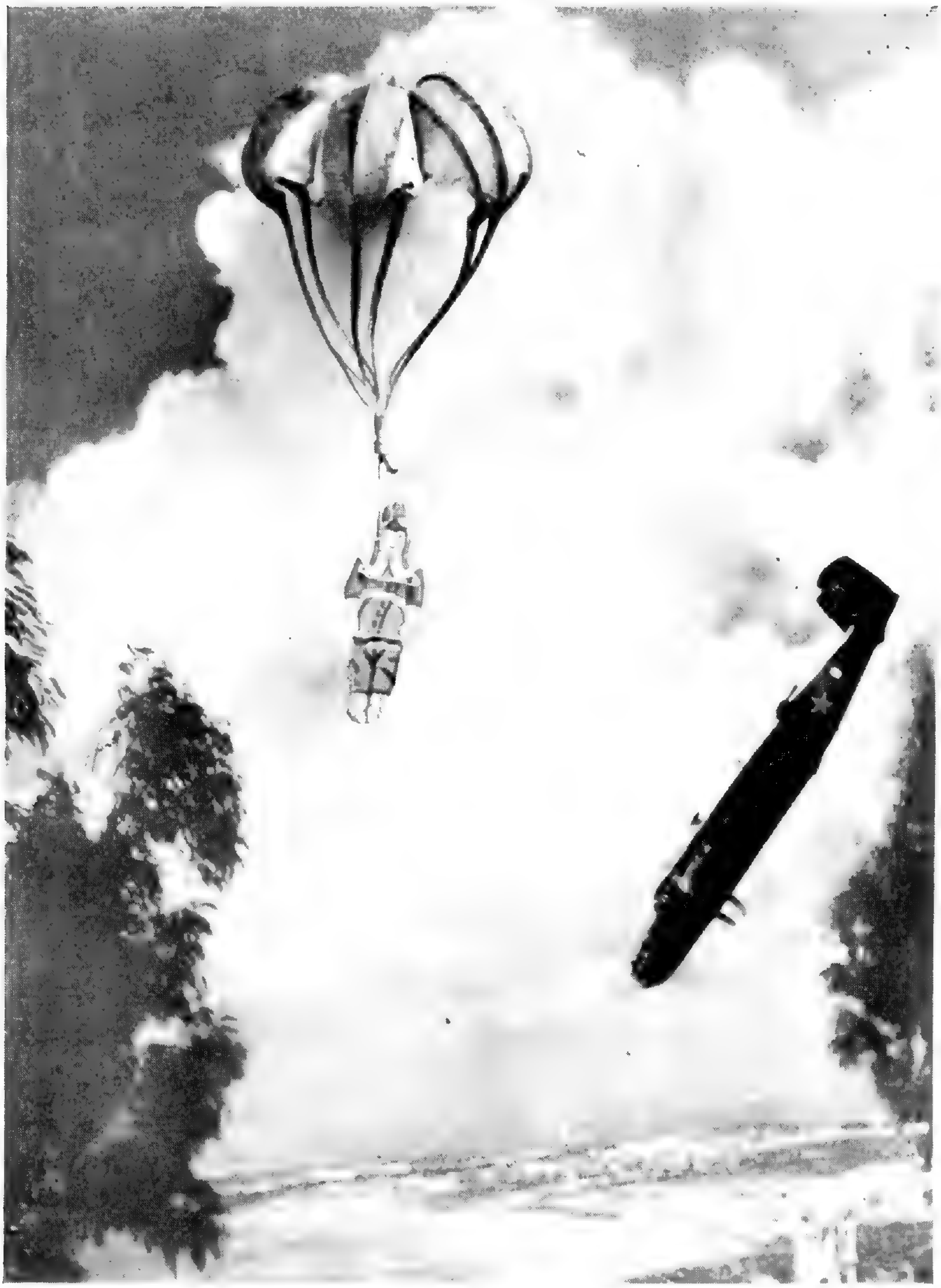
THE PARACHUTE SEED-POD OF ARISTOLOCHIA

At no time in the history of the world has the parachute been used to such an extent as in the present global war. The papers are full of stories telling how men and women, soldiers and civilians, have been dropped from airplanes by this means into enemy territory. To the plant world, however, the use of the parachute is just an old story.

The genus Aristolochia contains about 180 species indigenous to tropical and temperate regions, all of which have the parachute type of seed-pod. On the vine the pods are developed in the axils of the leaves, occasionally in pairs but usually singly. It is not until the seeds are ripe that the pods split open, forming a parachute of six divisions suspended by thread-like ropes fastened to the stem of the vine. However, the parachute does not float in the air to drop its seed. It persists on the vine, upside down, and the seeds are shaken out by the action of the wind.

The species illustrated is *Aristolochia tagala* Cham., a native of the Philippines. The pods were collected by Mrs. George H. Pring in Florida from plants growing in Coconut Grove and in Davenport. Because the flowers of the various species bear a resemblance to the goose, the pelican, the Dutchman's pipe, etc., the plants are popularly called by such names.

Nature provides various ways for scattering seeds so that they may grow removed from parental environment. In aquatic plants, such as water-lilies, the seeds are furnished with a buoyant jelly-like covering which, when the seed-pods are ripe, bring the seeds to the surface of the water. By wind or tide they are then floated away. After two or three days the gelatinous covering will disintegrate, permitting the fertile seeds to sink to the bottom



Seed-pod of *Aristolochia tagala* used as a parachute by a wooden soldier

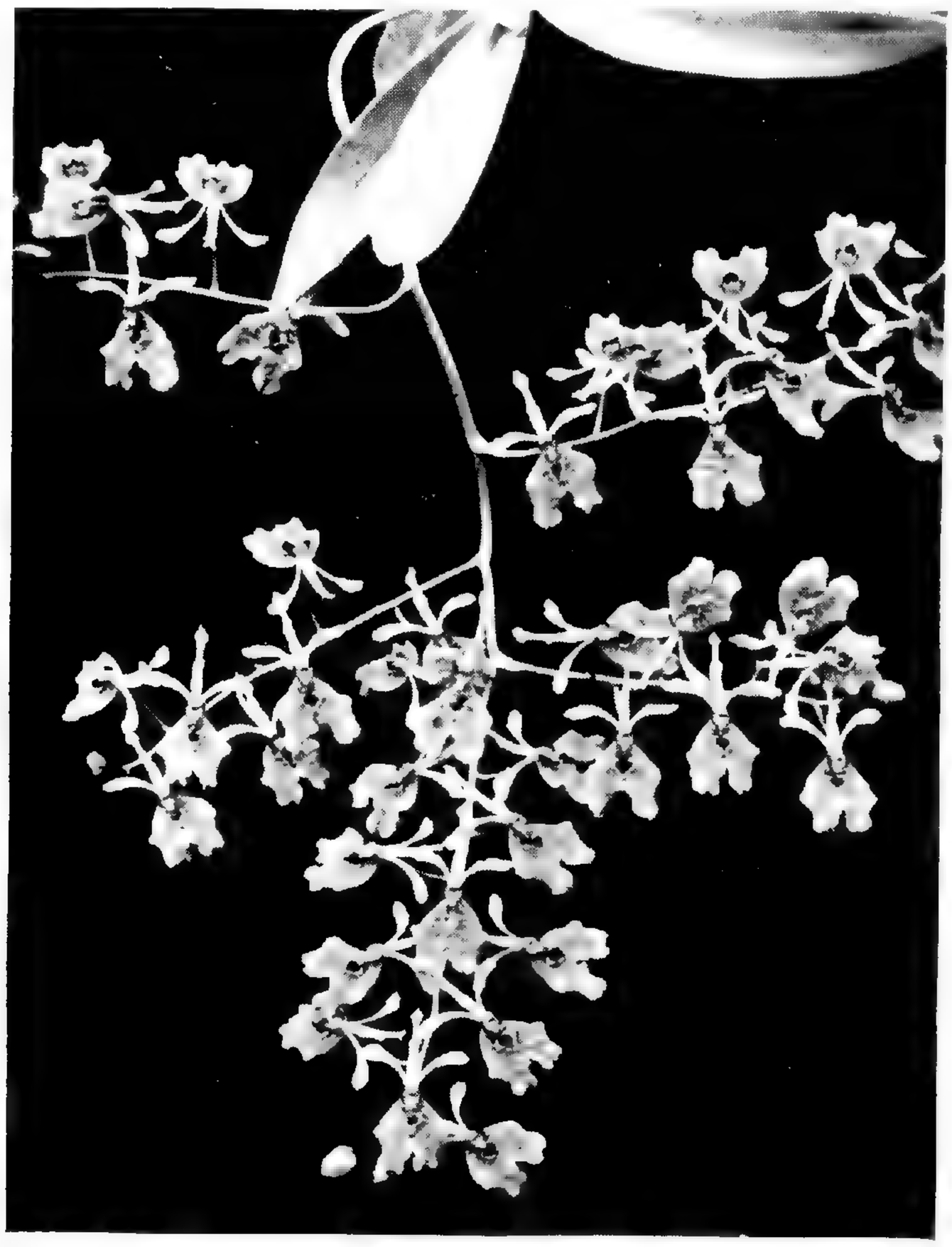
for germination. In the autumn a trip through the fields or woods will end in the task of removing the beggar-ticks, or seeds of coreopsis, which have adhered to one's clothes by miniature barbs or spines. The seeds of the common dandelion are attached to a plume-like parachute which blows them

over onto the neighbor's lawns. When ripe, the pods of oxalis and geranium open as if released by a spring and throw the seeds many feet away from the mother plant. The tropical artillery plant, Dorstenia, which may be seen in the Aroid House, possesses a natural catapult which expels the seeds from its fig-shaped pod in much the same fashion that orange seeds are shot from between the thumb and index finger of a mischievous boy. In fact, the contrivances which Nature has developed for the distribution of seeds are too numerous to catalogue.

G. H. P.

RENANTHERA STORIEI

Renanthera Storiei, a native of the Philippines, was first described by Reichenbach in 1880. Botanically it resembles *Renanthera coccinea*, but it is a much more showy species with larger and vividly colored flowers. The three specimens which were included in the collection of Philippine



RENANTHERA STORIEI

orchids sent to the Garden in 1931 by Governor-General Dwight F. Davis have grown remarkably under cultivation and are now 8 feet high. Three years ago, after the plants had been moved from the center of the Vanda House to the south gable of the Orchid Range, flowering spikes appeared, obviously the result of a decided increase in light which permitted the extended growth to climb along the roof glass under the ventilators. The plants begin to bloom in July, the flowers remaining from 6 to 8 weeks.

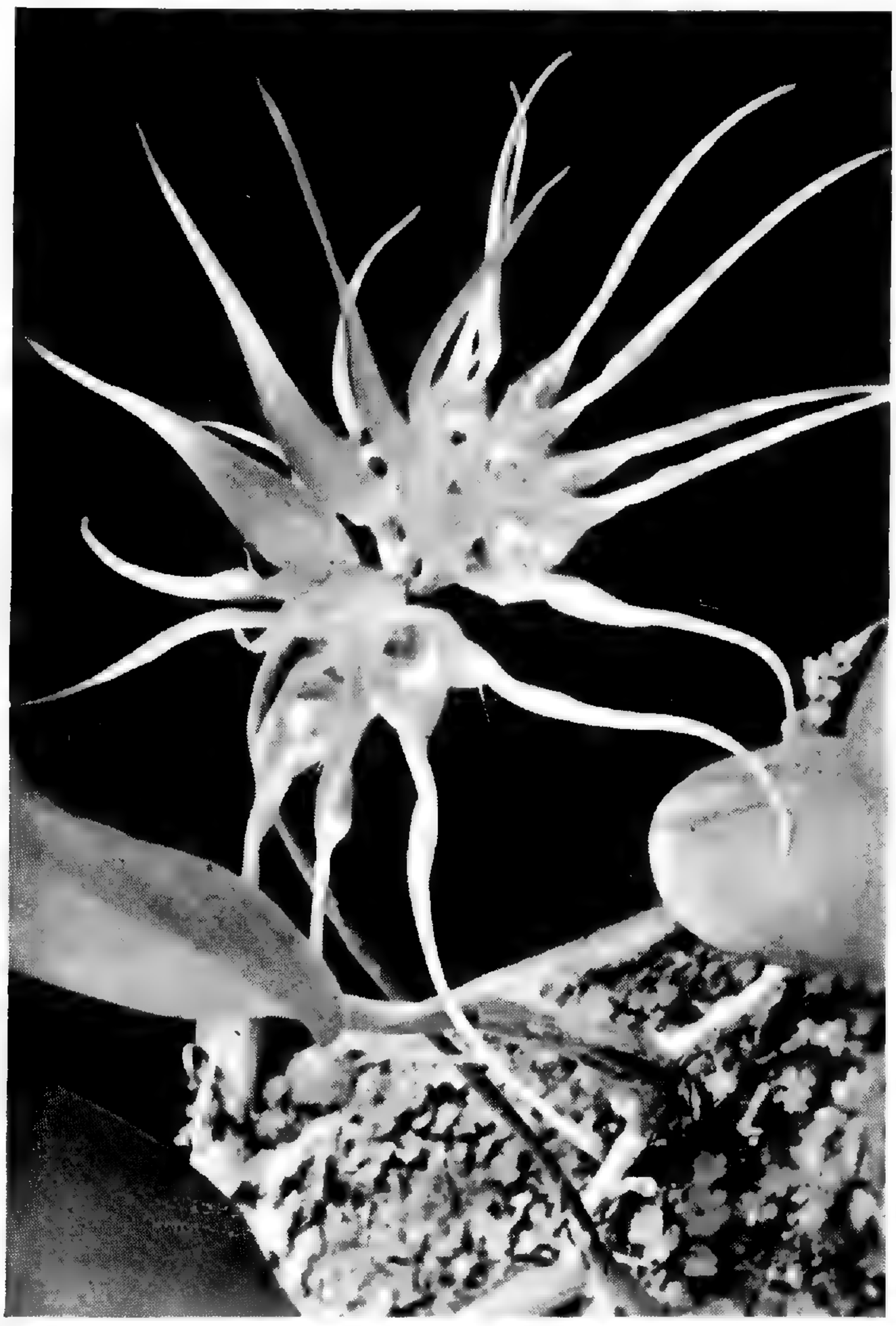
Description.—Stem 6–12 feet high, about 1 inch thick at the base, woody and devoid of leaves at the base, leafy and more or less succulent towards the apex. Leaves alternate, fleshy, strap-shaped, keeled, 8–12 inches long, 1 foot wide, bright green, 2-lobed; peduncle 1 foot long, pale reddish-brown. Inflorescence a pendulous panicle 1–2 feet long, bearing 45–50 flowers blooming in July and August; flowers 2½–3 inches long from the tips of the dorsal to the tips of the lateral sepals; dorsal sepal erect, linear, widening toward the obtuse tip, orange-red mottled with crimson; lateral sepals pendulous, obovate, undulate-margined, crimson with large blood-red blotches; petals erect, linear, widened toward the apex, colored like the dorsal sepal; lip very small, side lobes erect, blood-red, bases externally golden-yellow, internally red streaked with yellow. G. H. P.

THE OCTOPUS FLOWER FROM NEW GUINEA

(BULBOPHYLLUM VIRESCENS)

The octopus flower *(Bulbophyllum virescens)* belongs to an unusual and distinct group of Malayan orchids. The species was first described in 1900 from plants collected on Mount Tuna, in Amboina, one of the Molucca Islands, at an elevation of 2500 feet. A specimen from "an island off the coast of New Guinea," purchased by the Royal Botanic Gardens, Kew, from Stuart Low & Co., flowered in 1909. The first Garden plant was obtained by the writer in 1925, also from Stuart Low & Co. Through vegetative propagation we now have two plants which have flowered during May for the past three years, the accompanying illustration showing the one with the largest flowering spikes. The umbels measure 11 inches across and consist of well-developed flowers supported on 8-inch stems so curved that the flowers look like an octopus or outstretched hand.

Description.—Plants epiphytic upon trees, climbing by means of creeping rhizomes which are clothed with imbricating sheaths. Pseudobulbs widely separated, linear-oblong, 4 inches long, supporting a solitary ovate-



Octopus Flower *(Bulbophyllum virescens)*

oblong leaf 12 inches long and 5 inches wide; scapes produced from the old pseudobulbs, suberect, 8 inches long, clothed with spathaceous sheaths. Inflorescence consisting of a large and showy 4- to 7-flowered umbel, the flowers arranged like the tentacles of an octopus; sepals prominent, spreading, ovate-lanceolate, attenuated, the dorsal sepal 4 inches long, ½ inch wide at the base, lateral ones 5 inches long, ¾ inch wide at the curved base, pale greenish-yellow with green venation; petals obscure, somewhat hidden by the sepals, ovate-lanceolate, terminating in thread-like tips, 1½ inches long, greenish-yellow with green striations; lip recurved, cordate-ovate, greenish-yellow flushed with rose at the tip, somewhat fleshy, possessing the rocking or oscillating movement so characteristic of the plants of this group; column very short, rose-colored at the base. G. H. P.

SHOWY PURPLE-STRIPED DENDROBE

(Dendrobium Sanderae)

A rare epiphytic orchid flowering for the first time at the Garden during March, 1943, was *Dendrobium Sanderae*. It is by far the showiest of the evergreen dendrobes from the Philippine Islands and closely resembles an earlier introduced species, *D. Dearii*. Both species were among the collection of forty-six species of orchids presented to the Garden in June, 1931, by Dwight F. Davis, then Governor-General of the Philippines. *Dendrobium Sanderae* was first introduced into cultivation by Sander & Sons of England

DENDROBIUM SANDERAE

in 1909. In the same year it flowered at the Royal Botanic Gardens, Kew, England, and the next year it was described and illustrated in the *Botanical Magazine*.

The flowers of *D. Sanderae*, like those of *D. Dearii* (which have flowered annually since 1931), are produced laterally, five blooms being borne on the

upper portion of the stem-like pseudobulbs. The purple striations within the funnel of the lip contrast with the snow-white floral envelope.

Description.—Pseudobulbs 1 foot 4 inches long, ½ inch in diameter, stem-like, bearing 12 alternate leaves 3 inches long and ¾ inch wide. Flowers 1–6, upon short peduncles; petals snow-white, spathulate, 2 inches long, 1½ inches wide; sepals snow-white, adnate to the prominent spur, 3 inches long including the spur, 1 inch wide, spathulate-acuminate; lip snow-white striped with purple within, 3-lobed, front lobe heart-shaped, 2¾ inches wide, ¾ inch long; lateral lobes curved, flanking but not covering the column, the interior prominently striped with purple; column adnate to the sepals and petals, very slender, curved up so that the wings form a split tube.

G. H. P.

COLUMNEA GLORIOSA

Columnea gloriosa is a native of Costa Rica, but the Garden plants came to us by way of England, having been purchased in 1938. They are epiphytic in habit and grow on moss and decayed leaves, upon trunks and lower crotches of trees, in dense shade. The scarlet vase-shaped flowers are produced singly from the axils of opposite leaves, the ones at the base of the pendent branches opening first. They are supported upon a trumpet-shaped calyx which divides at the top into five leaf-like sepals. The four adnate stamens and extended stigma are shielded by the upper three-lobed petal. The variety *purpurea* differs only in having wine-colored foliage.

The genus Columnea is named in honor of Columna, or Colonna, a botanical writer of the sixteenth century. Plants of this genus were observed in Central and South America by the writer during his orchid explorations but they are rarely seen in temperate regions except in botanical gardens. Its nearest relative, Gloxinia, is more common, its blue, red or white, bell-shaped flowers being conspicuous in florists' windows during certain seasons. Several species of Columnea are grown at the Arboretum in the Nepenthes House where they are suspended from the roof-glass and bloom during April and May. The cultivation requirements are high temperature, 70 per cent humidity, and a location away from strong sunlight. A good growing medium is three parts chopped orchid peat and one part chopped sphagnum moss mixed with sand. Like the African violet *(Saintpaulia ionantha)* it

COLUMNEA GLORIOSA

objects to being given water below the temperature of the house. Too cold water or too much sunlight will cause yellowing of the hairy leaves.

G. H. P.

NOTES

Dr. Mary Maxine Larisey, Assistant Professor of Biology, Judson College, Marion, Ala., will assist in the Garden Herbarium during the summer months.

Mr. George H. Pring, Superintendent of the Garden, gave a talk, illustrated with lantern slides, on "Tapping the Para Tree," before the MacArthur High Twelve Club (Masonic Luncheon Club), May 25.

Mr. Paul A. Kohl, Floriculturist to the Garden, showed the colored

motion pictures, "Four Seasons at the Missouri Botanical Garden," before the Bel-Nor-Bellerive Civilian Defense Organization, May 11.

The first installment of the *Flora of Panama* (Part II, Fascicle I—Cycadaceae–Gramineae), by Robert E. Woodson, Jr., Robert W. Schery, and collaborators, has been recently issued as the April number of the ANNALS OF THE MISSOURI BOTANICAL GARDEN.

The June number of *The Home Garden* (1^6:4) contains an article by George H. Pring, Superintendent of the Garden, and Helen Van Pelt Wilson, on "Summer Care of the Garden Pool." Mr. Pring's article in the November 1942 Garden BULLETIN on "The Five-fingered Swan-neck Orchid *(Cycnoches pentadactylon)* has been reprinted in the *American Orchid Society Bulletin* for May (11^2:411-412).

Recent visitors to the Garden library and herbarium include: Sgt. (Dr.) H. Emery Moore, of the Medical Service, U. S. Army, formerly Assistant at the Gray Herbarium of Harvard University, Cambridge, Mass.; Ensign L. Wayne Lenz, of the U. S. Navy, formerly graduate student at the Garden; Lt. Robert B. Clark, of the U. S. Air Forces, at Scott Field, Ill., formerly Research Assistant at the Garden; Dr. D. T. Mallery, Senior Agronomist, Soils and Agricultural Engineering, Bureau of Plant Industry, U. S. Dept. Agr., now engaged in rubber work in Mexico; Dr. Delzie Demaree, Chairman Natural Science and Mathematics, Arkansas Agricultural and Mechanical College, Monticello; Dr. Laurenz Green, Professor of Horticulture, Purdue University, Lafayette, Ind.; Mr. Maunsell Van Rensselaer, Director Santa Barbara Botanic Garden, Santa Barbara, Calif.

Wisteria or *Wistaria*.—The spring has brought an unusual number of inquiries as to the correct spelling and pronunciation of this vine recently in bloom. That the plant was named in honor of Caspar Wistar, professor of anatomy at the University of Pennsylvania during the early part of the nineteenth century, there can be no doubt. However, Nuttall, the author of the genus, spelled it Wisteria. Wistaria was apparently adopted later. Professor Liberty Hyde Bailey, in his "Manual of Cultivated Plants," says, "Wisteria is written as originally spelled even though it is made in compliment to Caspar Wistar (a family name sometimes spelled Wister); names of plants are not primarily commemorative; Nuttall had a right to spell his genus as he chose, and he may have considered Wisteria more comfortable and euphonous Latin;—at all events he appears to have so spelled the name deliberately."

The Missouri Botanical Garden and Washington University are represented by nine graduates of the Henry Shaw School of Botany who are engaged in special investigation and administrative work for the Government in developing new sources of rubber and quinine to take the place of those lost in the Orient. The nine are distributed amongst three government agencies, the Bureau of Plant Industry, the Rubber Development Corporation, and the American Quinine Company, the last having charge of the quinine interests of the Board of Economic Warfare. It is interesting to note that all, save two, were trained particularly in the taxonomy and classification of tropical flowering plants, a fact which serves to emphasize the value of this type of experience in times of economic emergency.

T. Dwight Mallery (M.S., '27) and Russell J. Seibert (A.B., '37; M.S., '38) are participating in the long-term rubber project of the U. S. Bureau of Plant Industry for the development of permanent plantations, particularly of Guayule (Parthenium) and Para (Hevea) rubber.

The Rubber Development Corporation is an agency of the United States Government interested in the immediate exploitation of native sources of rubber in the American tropics. An account of these activities appeared recently in the news-magazine *Life* for May 24. Five men from the Garden are employed in this project, scattered throughout the length of South America. Each has a large district assigned to him in which he is combination administrator, production manager, and publicity agent for the exploitation of a particular rubber plant. Paul H. Allen, Tropical Representative of the Missouri Botanical Garden (Special Student, '32-34), is in Colombia in the interests of Sapium rubber in the broad llanos of the Intendencia of Meta. Hugh C. Cutler (Ph.D., '41) is in charge of Hevea production in the vast Brazilian state of Matto Grosso. Harry J. Fuller (A.B., '29; M.S., '30; Ph.D., '32) is the representative of the R.D.C. in Venezuela. Robert W. Schery (A.B., '38; M.S., '40; Ph.D., '42) is on leave of absence from his teaching and research duties at the Garden and the University, and is in charge of the exploitation of Manicoba rubber (Manihot) in the state of Ceara, Brazil. Louis O. Williams (Ph.D., '33) is in the Brazilian state of Minaes Geraes searching for new sources of Mangabeira rubber (Hancornia).

Julian A. Steyermark (A.B., '29; M.S., '30; Ph.D., '33) is in Ecuador for the American Quinine Company, and Charles B. Heiser, Jr. (A.B., '43) is awaiting an assignment in the same project.

Mr. Paul H. Allen, Representative in the Tropics, of the Missouri Botanical Garden, when last heard from was in Bogota, Colombia, where he was

investigating the possibilities of a natural rubber supply from that region for the Rubber Development Corporation. He still continues to send herbarium specimens to the Garden and his comments on local floras are always of interest, as evidenced by the following quotation from a recent letter:

"Colombia is beautiful, and is certainly botanically interesting. One short collecting trip was made when we first arrived onto the high range backing the city, to a small patch of paramo, where we saw for the first time the famous "Frailejones" *(Espeletia* sp.) interspersed with low Ericaceous shrubs, queer Passifloras, Bomareas, etc., with occasional Masdevallias and Odontoglossums. Parks in the city offer a fascinating series, some old friends from the United States, and others which I had only read about. Here I am seeing for about the third time that curious southern European fan palm, *Chamaerops humilis*, and have viewed with interest the change from the Royal palm to the towering, white-trunked Andean *Ceroxylon andicolum*. Banks of Pittosporum and Genista, with accompanying Clivias, give me a homesick feeling for the old Linnean House at the Garden. *Solanum Wendlandii*, an old friend from Costa Rica, is much grown, as is *Solanum jasminoides* which I had previously known only from literature. Eucalyptus, Melia, Acacia, and other California and Australian trees are about the only things grown, and those almost entirely confined to the parks. The European Plane Tree grows here, but slowly, while the common Grevillea, seen everywhere else, seems to be entirely absent.

"My first junket was to one of the tributaries of the upper Orinoco, in the Intendencia de Meta, near the town of Villavicencio. This region in Colombia is regarded as *ultima thule*, and rightly so, since it is vast and transportation virtually nil. Our river, if you can find it on the map, was the Guayuriba, an affluent of the Rio Meta. Our object was the computation of the density of stands of rubber, here *Sapium tolimense*. While rubber was the primary reason for my being there, it didn't prevent my at least LOOKING at other plants, and some of them certainly are worth the trouble. These are the famous trans-Andean llanos, huge plains as flat as the Texas Panhandle, with an almost park-like aspect, level grassland alternating with islands of timber, and long tongues of forest following the stream courses. Groves of Mauretia palms stand out, very reminiscent of the Sabals in our own South. A remarkable percentage of plants are the same species that we have in Panama, and hundreds of others, while distinct species, are in the same genera. While certain specialized groups such as Orchids, Heliconias and Palms display an entirely changed series of species, nevertheless my impression is that Panama's floral affinities are most decidedly South American. Of the dozen or more species of Heliconia seen, not a single one was identical with any species in Panama, although several were rather close. I know you don't agree with me, but my observation of Heliconia has been that the species are very hard and fixed, with absolutely no indication of hybrids or intermediate forms.

"Orchids were rather scarce, but I did see many plants in fine flower of *Cattleya superba*, which I had only known from illustrations. It is a magnificent thing and should be more generally cultivated. Palms abound and may be said to constitute the most conspicuous single feature of the landscape. Here I saw for the first time specimens of *Guilielma utilis* that seemed to be actually indigenous, in spite of much learned literature to the effect that it is native to Central America. Fine species of Arecastrum, in gorgeous orange fruit, Iriartea, Jessenia, Oenocarpus, Mauretia, Euterpe, Geonoma, Acrocomia, Astrocaryum, and Aiphanes abound, and would well grace any Botanic Garden grounds. Bactris, so common with us, is represented by a single species, unknown to me. Thousands of a low, acaulescent genus were seen,

superficially like a smaller Phytelephas, but with entirely different flowers and fruits, although having a similar dioecious habit. I have somewhere seen the genus illustrated, probably in Bailey's excellent palm papers, which I had to leave behind.

"My stamping ground will probably be in the Putumayo and Caceta watersheds, although it will depend somewhat on when the Medicos say I can get out. I can't attempt general collections, but am going to try to do something on the Palms, and perhaps Orchids, since those are the groups I feel I know best. I am almost sure the big Astrocaryum seen on the last trip is undescribed."

STATISTICAL INFORMATION FOR MAY, 1943

GARDEN ATTENDANCE:	
Total number of visitors	26,368
PLANT ACCESSIONS:	
Total number of plants and seed packets received as gifts	87
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	47
Total number of books and pamphlets donated	159
HERBARIUM ACCESSIONS:	
By Gift—	
Beilmann, A. P.—*Clematis Pitcheri* T. & G., from Missouri	6
Florida Agricultural Experiment Station, by Erdman West—	
Plants of Horticulture	4
James, Leslie—Plants of Alabama	5
Pedrotti, Mrs. Lester—*Clematis Pitcheri* T. & G. from Franklin County, Missouri	1
Pring, George H.—Plants of Horticulture	2
By Exchange:	
Field Museum of Natural History—Fungi, Algae, Lichens and Mosses, from various localities	146
Gray Herbarium, Harvard University—Plants of North America, Mexico, and South America	632
Mouzon-Heber by Bernardo Rosengurtt—Plants of Uruguay	60
New York Botanical Garden—Plants of Florida, Washington, Arkansas, Hawaii and China	1,312
University of Minnesota—Plants of Minnesota	172
By Field Work—	
von Wedel, H.—Plants of Panama	356
By Transfer—	
Moore, George T.—Plants of Horticulture	6
Pring, George H.—*Dendrobium hymenanthum* Reichb. f.	1
Total	2,703

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OF THE MISSOURI BOTANICAL GARDEN

THE GARDEN, 2315 TOWER GROVE AVENUE, ST. LOUIS, MISSOURI

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MISSOURI BOTANICAL GARDEN BULLETIN

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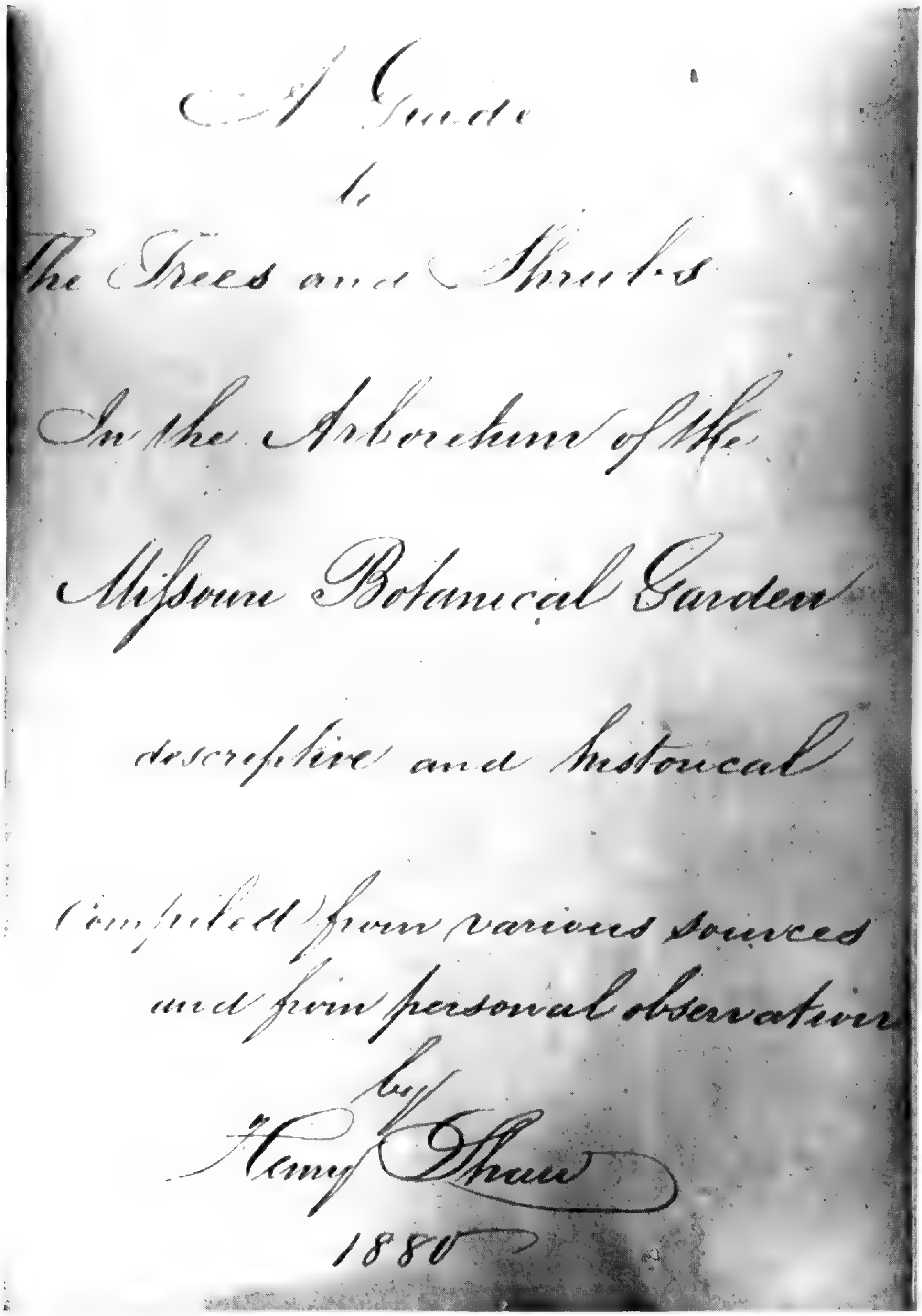
SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until sunset; Sundays, 10:00 a. m. until sunset. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah car line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.



COVER OF HENRY SHAW'S MANUSCRIPT, IN HIS OWN HANDWRITING.

(Note difference in wording from title on page 136.)

Missouri Botanical Garden Bulletin

Vol. XXXI SEPTEMBER, 1943 No. 7

HENRY SHAW'S IDEA OF A BOTANICAL GARDEN

Among the various papers found in the effects left by Mr. Shaw were a number of lists of plants and trees, together with references to the building of the Missouri Botanical Garden, that not only are valuable as records but in some instances of great historical interest. One of the most worth-while is the "Guide to The Missouri Botanical Garden," which consists of some 500 fools-cap pages in Mr. Shaw's handwriting. This apparently was begun about 1880 and extended over a period of several years, probably completed when Mr. Shaw was 85 years old—four years before his death.

Over 500 plants and trees are discussed including their descriptions, habitats, economic uses, etc., and if published at that time would have been a valuable contribution to the subject. Now, a lot of this material is completely out of date, and there would be no point in printing it. On the other hand, the ideas of the founder of the Garden concerning the functions of a botanical garden are still well worth reading; in fact, they constitute the best general discussion of the subject that has probably ever been brought together by one who had such an intimate connection with the conception and execution of a great botanical institution. The following pages are reproduced exactly as Mr. Shaw wrote them, even as to the spelling and punctuation.

"These pages are a compilation of extracts from various sources, which although of little merit in the selections, have for several years given me an immensity of labour, *wearing out my eyes and cudgeling my brains* over books and periodicals in search of information for my own satisfaction & as I humbly hope for the benefit of those who may visit these Gardens.

"The enumeration of the various species of trees, growing in the Arboretum will be accompanied by such observations, as to their suitableness to the soil and climate of St. Louis, for use, ornament, and shade, as the writer

has gathered in an experience of thirty years past, in planting and improving the Missouri Botanical Garden and Tower Grove Park. When the writer first visited these grounds in 1820 they were called "La Prairie de la Barriere a Denoyer," from Louis Denoyer, who formerly lived at, and kept the gate of the fence (barriere) by which the commons of the old village of St. Louis were surrounded. For a distance of nearly two miles from where Tower Grove Park is now laid out to Taylorwick station, or rather the pond still existing there [1875], no trees were growing, except two or three venerable Cottonwoods *(Populus Canadensis)* in the low ground, on the water course running to Rock Spring, and thence to Chouteaus Millpond; on this water course were a few plants of the (*Nymphea ordorata* Ait.) sweet-scented Water Lily, and a clump of Hazel Bushes on the rising ground, where the grove at the garden now exists. The prairie was grown over with a tall natural grass Andropogon, prairie grass, with an occasional patch of the wild Strawberry *(Fragaria Virginiana)* of which neither a tuft of the grass or a plant of the strawberry can now be found. There were no residences in sight nor any to be seen on the narrow road passing Rock Spring to St. Louis, till coming to the stone dwelling of Mr. John B. C. Lucas, on the street now called 7th Street, and the house and garden of Mr. Joseph Charless Sen., now 5th and Market Streets; where he was the first to cultivate the grape vine (Isabella) at St. Louis, and a zealous planter and protector of shade trees."

A GUIDE
to the
MISSOURI BOTANICAL GARDENS
ST. LOUIS

by Henry Shaw

with brief descriptions of plants, compiled from various sources

"At length the finished Garden to the view,
Its vistas opens, and its alleys green,

"Of all public resorts a scientific garden when properly kept, will be found to be, not only one of the most delightful mediums for intellectual gratification and amusement, but, also one of the greatest of temporal blessings that can be enjoyed by a people.

"To all classes of society, the old and the young, the infirm invalid, or the robust and the vigorous, the rich and the poor, a garden may be considered, almost alike an object of interest, of instruction, and amusement. It is a field which abounds with objects, that generally make lasting impressions on the mind; and happily there are but few, who, however un-

acquainted with the principles of botanical science, are not more or less filled with admiration at the endless variety of form, presented by any considerable assemblage of the vegetable kingdom; their grotesque trunks, and tapering stems; their leaves so varied in shape, and so beautiful in structure; their flowers, so curious in their parts, so diversified in colour, and often so exquisitely fragrant; but above all, how admirably adapted is each, in one way or another, for the use and gratification of man.

"A Guide that should indicate to strangers the more remarkable features of the Missouri Botanical Gardens of St. Louis, and point out the many interesting plants cultivated there, has long been a desideratum. The very fact of the continual additions to the plants, and their rapid growth, renders it difficult to give a perfect Guide or Handbook, for only reference to the more remarkable objects can be desired; the constantly increasing bulk of the plants, and fresh arrivals of novelties, causes such a guide to become in a measure imperfect soon after its publication. In summer from May to September, most of the plants are placed in the open air; thus individuals that are recorded as occupying any particular plant house, may require shifting the very next day. It must also be obvious to every intelligent observer, that in a comparative limited collection, requiring artificial protection, not botanical arrangement, or class divisions can be expected; in cultivation, the required temperature has to be attended to, any neglect of which would be speedy destruction to tropical plants.

"This Guide is historical and descriptive, rather than botanical, a science to which the writer has but small pretensions, and tho' little qualified, knew no other person competent and willing to undertake the task; so it is nothing more in fact, than a compilation of information gathered from various sources. The beauty of these grounds, and the plants they contain, combined with the free admission of the public, attracts, as may be supposed, at certain seasons, a great crowd of visitors, and a few needful regulations here given, are mainly taken from the Guides of the Kew Gardens.

"1st Smoking, or eating & drinking or the carrying of provisions of any kind into the Gardens, are strictly forbidden, No dogs can be admitted.

"2nd No packages or parcels, bags or baskets are allowed to be carried into the grounds. All such must be deposited at the Gate of Entrance, while the owners make the tour of the Gardens.

"3rd No person attired otherwise than respectably can enter, nor children too young to take care of themselves, unless a parent or suitable person be with them—the police (when there) have orders to remove such, or also persons guilty of any kind of impropriety, and when large schools are admitted they to be accompanied by a requisite number of tutors & in accordance with the rules of the Garden.

"4th It is by no means forbidden to walk upon the grass walks; still it is requested that preference be given to the gravel-paths & especially that the lawn edges paralel to the walks, be not made a foot way, as nothing renders them more unsightly. It is scarcely needfull to say that all play, leaping over beds, running on the grass &

slopes are prohibited. The Gardens are intended for agreeable recreation and instruction, not for idle sports.

"5th It is requested that visitors will refrain from touching the plants, and flowers; a contrary practice can only lead to suspicion, perhaps unfounded, that their object is to abstract a plant or flower, which when detected must be followed by expulsion.

"6th In entering the plant houses it is particularly requested that visitors will keep to the right, if they do otherwise they will pass each other which the narrowness of the walks renders difficult, and this must occasion inconvenience to all parties, and often injury to the plants.

"The accompanying plan of the grounds will, it is expected, prove useful to the visitor. More might be said on these heads, but while bearing testimony to the excellent conduct of the many thousands who frequent the gardens, I prefer to rely on the good sense and honorable feeling of visitors, and the value they must attach to the priviledge here afforded, rather than multiply restrictions that may not be absolutely required.

"It will be observed the Garden is in three grand divisions.

"1st The Garden proper, containing the plant-houses for tropical and other plants requiring protection, but which in summer are put out of doors, except the ferns and large palms; the Herbaceous ground with plants scientifically arranged and named, is in the centre around the pavillion, and the Cacti in the north end of the Garden next the wall.

"2nd The Fruticetum, for shrubbery, and experimental fruit garden.

"3rd The Arboretum, containing a collection of Trees comprising all that will grow in the open air in this climate and locality; a Pinetum for the pine family, a Quercetum for oaks, and Salicetum for willows.

"To strangers desirous of presenting museum objects or plants to the Garden from abroad, I here take leave to mention that in despatching packages or parcels, the quickest mode of transit is always the best. The address should be

To Henry Shaw
Missouri Botanical Garden

BRIEF HISTORIC NOTICE

"The public being freely admitted to the Gardens, under a few needful regulations, must naturally want to know something, about improvements, and the intentions of the projector in making these collections of plants & plantations, of trees & shrubs. It is with a view to satisfy such laudable curiosity, and to increase the interest with which the Gardens are visited that this Guide is now compiled.

"About the middle of the last century the spot that now forms the Botanical Garden at Tower Grove, was a fertile rolling prairie, & from its productiveness was early selected for cultivation by the inhabitants of the village of St. Louis—it was separated from the Commons by a fence running along what is now call'd Grand Avenue—and concessions or donations of land made by the Spanish Military Commanders to such heads of families as required them, of one or more arpents in width by forty deep running west—& so cultivated in Maize & Wheat, but more frequently left in Natural Grass, to cut for hay—the fence was kept up against animals feeding on Commons, until about 1780. A Gate was kept, near where the East Gate of Tower Grove Park now stands, on Grand Ave., by a concessioner,

call'd Louis Denoyer who lived there until the year of the attack by Indians 1780, the place being call'd Barrière à Denoyer, the concessions of land being so designated, as recorded in the old Livre terrien or Land Book.

"About the year 1830 Thos Jefferson Payne, becoming the owner of some of the 40 arpen'lots, enclosed a portion of the west end & erected a small house in 1840 which Henry Shaw came into possession by purchase & by perfecting the title to the acquisitions of Payne & further purchases from the old French claimants—Payne had built stables for the keeping of blooded horses, and laid off a race tract, the centre of which was the grove, near which in 1849 Shaw (the writer) erected his house, with a tower & called it Tower Grove and from that date to the present time, he has been assiduously occupied in laying off avenues & planting trees. During his travel in Europe from 1840-1850, observing the great attention paid to public Parks & Gardens in England, France & Germany & the high esteem in which these institutions are held by the people of those countries, he conceived the idea of founding a Missouri Botanical Garden—for which, the grounds, ample in extent, & in close vicinity to the future great city of the west were so appropriate, & the quality of the soil being all that could be desired. The plan of the Garden was determined on, drains constructed, & the walls surrounding the same commenced in 1855—a number of Bohemian cultivators were engaged & the soil of the Garden & Fruticetum (16 acres) trenched or turned over two feet deep—the substantial enclosures & entrances being finished, the Museum and Library was built in 1860, the books and herbarium for which were selected by our learned citizen Doct. Geo. Engelmann during his visit to Europe about that time. In 1870 the plants requiring more room than the original houses afforded, the Palm house was erected in a more central part of the Garden, which with the additional wings for mist stove & temperate houses affords accomodation to the accumulative treasures of the vegetable kingdom, for which still further space being required a larger house with double walls & glass was constructed in 1882 and dedicated to Linnaeus by placing his bust on the entrance. That interesting division the Arboretum, was commenced in 1860 & planted from that time to the present—it contains a collection of all such trees as will grow in the open air in the climate of St. Louis—persevering attention has been paid to the pinetum where will be found growing specimens of the Coniferae. The Quercetum includes such Oaks as have been found hardy—when the importance of timber trees is considered and the length of time required for the full growth of the most usefull & desirable kinds these specimens will be most interesting to future planters of timber trees. Medi-

cine, commerce, agriculture, horticulture, & many valuable branches of manufacture, will derive much benefit from the establishment & maintenance of a Botanical Garden at St. Louis—the climate being intermediate more species of plants can be cultivated than either north or south of this latitude —The Garden in its three divisions (comprising from 50 to 60 acres) from the first has been open to the public for daily admittance not only the grounds, but the plant houses, & museum are open to visitors, the number of whom during the past twenty years had been near a million.

GARDENS & BOTANIC GARDENS

"Gardening at the present day is divided into many branches. We have landscape gardening, teaching us how to lay out our grounds to the best advantage, how to plant our woods and dispose of water, how to build our houses, and make our roads, walks, and fences, so that we may gain the world's approval. We have vegetable gardening and market gardening, teaching us how an abundant supply of vegetables may be obtained at all seasons of the year. We have flower gardening in many a style and character—Florists Gardens, for sale of flowers, Nursery Gardens for sale of Plants and trees, and Botanic gardening.

"'It is recorded of the first created of our race, that, to fully enjoy the blessings of life, he was to dress and keep a garden; and his first pursuit was horticulture. The good gardener of those days was not only the first of men, but the most honored of mortals; and while he faithfully followed that ancient occupation, manifested the highest state of civilisation the world has ever seen. He conducted the first operations of that model of a goodly Garden, but when he ceased from his labours therein, happily bequeathed to prosperity, an enduring, and appreciative taste for the gentle art he loved so well. The legacy he left us has found claimants in all civilised communities and countries from that remote age until now.'

"Gardening as an Art. To adopt the words of Christowell, There is nothing in the world half so beautiful as the gardeners work. What are jewellers, or watchmakers or ivory carvers, or even painters, to compare with a genuine Gardener? The things that they handle are dead and artificial, and cannot know the treatment they receive. But our work is living and natural, and knows us, and adapts itself to follow our desires and pleasures. It has its own tempers, and moods of feeling, the same that we have; for every plant that lives is sensitive.

"Botany is that branch of Natural History which relates to the vegetable kingdom, not only the naming and classification of plants, but embracing all the phenomena of vegetable life in their widest extent; of the external

forms of plants, and of their anatomical structure however minute; of the functions they perform, of their distribution over the globe at the present, and at former epochs, and of the uses to which they are subservient. It examines the plant at its earliest state of development, when it appears as a simple cell, and follows it thro' all its stages of progress until it attains maturity. It takes a comprehensive view of all the plants which cover the earth, from the minutest lichen or moss, only visible by the aid of the microscope, to the most gigantic production of the tropics. It marks the relations which subsist between all members of the vegetable kingdom, and traces the mode in which the most despised weeds contribute to the growth of the mightiest denizens of the forests. It is a science then, which demands careful and minute investigations, requires great powers of observation and research, and is well fitted to train the mental powers to vigorous and prompt action as in the case of the great Linnaeus; is the Key to the Natural Sciences. The term Botany is derived from the Greek, Botanikos, meaning an herb or plant.

"A Botanic Garden is defined as a garden devoted to the culture of a collection of plants with reference to the science of Botany. The legitimate objects of such gardens is to collect and cultivate all the species and varieties of plants that can be cultivated in the given climate, with or without, the aid of glass, and then to distribute these to private individuals, throughout the district by which the Botanic Garden is supported. The most complete system of this kind ever established appears to have been that of France. All the botanical articles that could be procured from other countries, were sent to the Jardins des Plantes at Paris, and after they had borne seeds, or been propagated there, the progeny was distributed among the provincial botanic gardens, of which there was one or more in every department of France; and after being propagated in these provincial botanic gardens, the seeds or products were distributed to the public. Something of the same kind takes place in Great Britain and other countries. Botanic gardens, in their dedication to scientific purposes, and in the economical uses to which they are destined to be applied, may be regarded as the most important institutions of a civilised country. They are intended to contain general collections of plants, both native, and exotic, both hardy, and requiring protection, and particularly those species which, from their rarity, and possessing ornamental qualities, are not likely to be found in common gardens.

"But apart from a Botanical Garden being a scene of beauty and attraction in itself, it should stimulate all amateurs in the city and State to plant ornamental trees and shrubs not generally found in their immediate vicinities; so that all our gardens and pleasure grounds, might take their tone from

this central emporium, and induce the planting of those magnificent and enduring ornaments of nature. A botanical collection open to the public, acts as a stimulus to ornate and beautify our country; for to see fine plants and trees is far more persuasive and satisfactory, than a picture or description of them however elaborate.

"In the vicinity of medical schools, they are of great utility as possessing systematic arrangements, in a living state, of the plants employed in "materia medica". They are also likely to become highly beneficial, by forming collections of vegetable productions adapted as food, and used in the arts, and manufactures; on these grounds Botanic Gardens can meet the demands of the most rigid utilitarium. To persons of a scientific turn of mind, and cultivated understanding, they possess very high interest. They have done much to feed with oil the lamp of the science of the vegetable kingdom, which during the last century has burned so brightly, and has shed so brilliant a light on the methodical study, as applicable to the nature of sciences in general. They have stimulated the search for plants abroad, and then diffusion in countries, where they previously did not exist; they facilitated in a greater or less degree, investigation, and so have extended the knowledge of the vegetable system of our globe; the knowledge members of which, the wise and beneficent Creator, has endowed with constitutional peculiarities, suited to every habitable region of our earth, and has fitted, either directly or indirectly, to house, clothe, and feed the infinite variety of animal life to be found on its surface. Doubtless Botanic Gardens have considerable difficulties to contend with; a city or country may not have sufficiently advanced in science and population to require such an institution, as was probably the case with St. Louis thirty or forty years ago; for they acquire abundant liberality on the part of their patrons, wisdom and science on that of the directors, and great diligence, some versatility, and activity of mind and entire consecration of time and attention in the Curator.

SPECIAL PURPOSES OF BOTANIC GARDENS

"1st A systematic arrangement of herbaceous plants, classed as far as possible, according to some one of the natural systems, including an arrangement of medical plants.

"2nd A general arboretum, in which all ligneous or wooded trees may be in scientific combinations, as far as the nature of their growth will allow. As the climate of these western states will not admit of the outdoor cultivation, of the recently introduced trees, and plants, so numerous, and valuable, of Australia, New Zealand, the Himaylayas, and the Cape, or even of Oregon

and California, we must limit our care of them, to a few species that can be grown under glass.

"3rd The American garden, so called by the horticulturist of Europe, is a collection of flowering shrubs natives of this continent to which may be added many fine lately introduced shrubs from Japan—certainly the unbotanical public would find more attraction and instruction in these, than in strictly scientific arrangements.

"4th A Fruticetum for the growth of all kinds of shrubbery and experimental garden for fruit trees, the cultivation of which is of such vast importance to the productive wealth of the country—to teach the art of grafting, budding, layering, and everything pertaining to the growth, and management of vines, and fruit trees, belongs to this department.

"5th Plant houses properly glazed, and supplied with heating apparatus. The more there are of these structures the better, but their number and extent, will depend on the amount of funds placed at the disposal of the institution. A Botanic Garden can scarcely be complete without a palm house, with stoves, fernery, green houses, and propagation pits. It must always be remembered, that the deepest interest, awakened by this department of gardening, connects itself with the preservation and growth of those curious, and often beautiful exotics, which are the natives of tropical and other warm countries.

"6th The Botanical Museum is a most interesting and necessary appendage to the botanic garden; it is intended for the preservation of specimens of fruits, and seeds, samples of woods, and in short, for every form of vegetable production, that can be rendered permanent, and kept in bulk.

"7th Library consisting of books on botany, and natural history, the works of the great masters in natural science, Linnaeus, Jussieu, DeCandolle, Humboldt, Hooker, Lindley, Endlicher, Diels, Brown, Balfour, Gray, Loudon, and others necessary to the student and man of science; The Herbarium, every botanist is aware how important is the hortus siccus (collection of dried plants named and classified) to authenticate species, and generally to the history of botanical science. It may be said that a collection of the vegetable products from various countries, reared by agriculture, and employed in domestic economy, and the arts, is an exhibition highly interesting, and instructive. Great Britain and its colonies yield a most useful exhibition of this kind. The Museum in the Royal Botanical Gardens at Kew, is the object of national patronage, and is rapidly increasing in magnificence, and importance, and the admiration of every American traveler visiting London.

SCIENCE OF BOTANY

"The first dawn of the science of botany broke out of the deep investigations, of the nature of matter, and mind, by the philosophers of Greece. Theophrastus, who lived 350 years before Christ, was the first to apply particular terms, to modifications of plant structure. The Arabs, when at the height of power and civilization, paid some attention to the art of gardening, and carried with them their tastes into Spain. This is shown by the fact that the Caliph Abd-ur-Rahman I, himself laid out a botanical garden at Cordova, and caused rare seeds to be collected by his own travelers in Syria and other countries of Asia. Prescott, in his "Conquest of Mexico", says, 'There is no doubt from the concordant testimonies of Hernan Cortes, in his reports to the Emperor Charles V, of Bernardo Diaz, Oviedo (Hernandez), that at the time of the conquest of Montezuma's Empire there were no menageries and botanic gardens in any part of Europe, which could be compared with those of Huazpaltepec, Chapultepec, Iztapalacan, and Tetzcuco.' With whom the curious arts of grafting, budding, and striking plants by layers, by cuttings or division, originated, is now unknown, but there is reason to believe, that the greater part of those processes was in the classical ages, as well understood as now, as is obvious from the verses of a well known Latin poet of the Augustan age. A cessation of all philosophical enquiry into the nature of vegetation, endured about 1700 years; during the whole of which time scarcely a single addition was made, to the stock of knowledge left behind him by Theophrastus; toward the end of the 17th century, John Ray, and Joseph Pitton de Tournefort flourished, and upon whose systems, the modern arrangement, according to natural orders, is founded.

"The Gardens have been visited by eminent men of Science, among whom the late Prof. Agassiz, Sir Joseph Hooker, Director of Kew Garden, Prof. Asa Gray and the celebrated plant collector Roesl, now in S. America, and others, who have warmly encouraged the proprietor in his exertions, in collecting, and bringing forward the plants, shrubs, and trees to their present state of growth. He has had much aid by the contributions and councils of Dr. Geo. Engelmann, and the approbation of the citizens of St. Louis, and the public in general, who visit the gardens in increasing numbers.

"In conclusion a Botanical Garden has since the revival of Natural History been looked upon as essential to educational institutions, where the natural history of plants should form a part of the curriculum of study. Originally the principal object was to supply the means whereby students could identify and study the character of medicinal plants. Daily experience

shows, in the opinion of some learned men, that sufficient use is not now made of such gardens for that purpose, and that a general knowledge of the principal natural orders, and the skill of identifying common poisonous, and medicinal plants are essential to a properly devised scheme of medical education. Besides strictly educational and scientific purposes, and apart from direct instruction a Botanic Garden may contribute very materially to the development of a taste for botanical pursuits, and the diffusion of a correct knowledge of plants and plant life. From this point of view, for the general public has now-a-days to be considered, recreation and the indulgence of a taste for the beautiful in nature or aesthetics in art; a botanical garden has important functions to fulfill. In all cases then by courtesy or by right, the general public should have access at stated times to these gardens and their interests considered, as well as that of the botanical student. Horticulture and botanical science will thus contribute to the promotion of pure taste, and pleasant recreation.

"A Botanical garden is also experimental in the way of introducing new or otherwise desirable plants, to the notice, not only of the botanists, but also of the agriculturist, the gardener, and the amateur. When means suffice decorative gardening should be carried out more extensively, especially from an experimental point of view. Our Botanic Garden will then be at once a museum, an exhibition, and an experimental ground, where all classes interested in botany and horticulture, will be sure of finding material for investigation and study.

GOLDEN LEAVED TAPIOCA

(MANIHOT UTILISSIMA VAR. VARIEGATA)

The Garden specimen of this strikingly ornamental cassava was purchased in 1938 from L. R. Russell Ltd., Surrey, England. Several plants have now been propagated and are on exhibition both in town and at the Arboretum at Gray Summit. Its origin does not seem to be definitely known, but it possibly is a bud mutant. It is cultivated as an ornamental shrub in the western part of Java where it presumably originated in a native garden. An award of merit was given by the Royal Horticultural Society in 1928 to a specimen exhibited by the Royal Botanic Gardens, Kew.

In habit the golden-leaved tapioca is similar to the unvariegated form and if grown in a temperature of 70° response will be rapid. This ornamental is very noteworthy on account of its showy foliage. The leaf segments are irregularly golden yellow flanking the mid-rib, light pea-green

GOLDEN-LEAVED TAPIOCA
(*Manihot utilissima* var. *variegata*)

FLOWERS OF TAPIOCA
(*Manihot utilissima*)

along the edges. The petioles are bright red when young, fading with age. The terminal growth possesses the brightest coloration, the stem being golden yellow, turning to a light gray-brown when older.

The plants are easily propagated from cuttings. By removing the terminal growth laterals will soon appear from the leaf scars which may be rooted when sufficiently large. Surplus stems may be layered in moss for propagation as with dracaenas. A rich soil is essential to obtain good coloration. Red spider will soon defoliate the plants unless controlled by forcible spraying. Shrubs grown in the city garden are among the first to show the effect of sulphur in the atmosphere and defoliate much sooner than the green-leaved type. G. H. P.

A WHITE OAK OVER 300 YEARS OLD

In February the largest and in all probability the very oldest White Oak *(Quercus alba)* in the Arboretum was cut down. Only a few small branches

OLD WHITE OAK AT ARBORETUM, SHOWING HOLLOWED TRUNK

near the lower part of the crown were alive, and it was decided to utilize what logs could be taken from it before the entire tree was destroyed by rot. Upon cutting, it was found that the entire trunk was hollowed for a

distance of 18 feet, only a 10-inch shell remaining in good shape. An examination of the growth rings indicated that the tree was far older than we had expected. It required 109 years to grow the last 8 inches in diameter, and except for the last 11 years, in which the tree increased but 10 mm., the growth rate had been remarkably uniform. In the preceding 50 years it had grown 90 mm.; in the 27 years before that it grew 40 mm.; and the earliest rings which could be counted numbered 16, totaling a 20 mm. increase in diameter. From this incomplete study the total age of the tree has been calculated as 327 years; in other words, it began to grow in 1615, before the Pilgrims landed.

OLD WHITE OAK SURROUNDED BY A STAND OF OAKS AND JUNIPERS

Unfortunately, no logs of any value could be cut, because several species of wood-rotting fungi had invaded the upper part of the tree and rendered it worthless. This tree forked about 18 feet from the ground, giving rise to two leaders, each 3 feet in diameter. The side branches were very heavy and persisted to within 25 feet of the ground. The extreme age of this tree and its general growth habit lead one to believe that it had grown as an isolated specimen for several centuries and that only in recent times, perhaps in the last 50 years, has it had any neighbors. It will be seen in the illustration that a group of common Junipers were growing all about the trunk

and a mixed stand of White and Black Oak furnished additional competition.

The age and habit of this tree lend some support to the theory that some portions of the Ozark hills are now much more heavily timbered than they were a century ago. A few similar specimens can be found in this region. The growth habit—a wide crown with very low branches—seems to indicate that these veterans had very few neighbors when they were in their prime.

It might be argued that the tree was avoided by lumbermen and thus reached a tremendous size and age. In fact this may be true. It was a "wolf" tree—the massive crown and the relatively short saw log would not appeal to any lumberman. But the low very heavy branches could not have been developed if this tree had grown in competition with many neighbors. The struggle for light would have forced the growth into a taller and narrower crown, and this type of tree regardless of size would have appealed to the logger.

Because of the slow growth rate the tree was practically as large a century ago as it was on the day of its death. It is quite likely that in 1843 the area under the branches was free of competing seedlings. It is interesting to speculate on what modifications of the environment may have occurred in the last century. Would an increased rainfall favor the seedlings, at the expense of an old veteran? The growth-ring pattern gave no clue or hint of any marked change in the environment. The tree grew slowly—it always had—but now there are fully a hundred seedlings striving to take its place, while 100 years ago there probably were not that many seedlings per acre.

A. P. B.

NOTES

As has been the custom for many years, a wreath of orchids was placed on the tomb of Henry Shaw, on August 25, in commemoration of his death.

Dr. Henry N. Andrews, Paleobotanist to the Garden, has published a paper "Notes on the Genus Tempskya", in the *American Midland Naturalist* (**29**:133-136).

The American Rose Annual for 1943 (pp. 12-14) contains a paper by Dr. Edgar Anderson, Geneticist to the Garden (on leave), on "Two Varieties of *Rosa alba*."

Dr. Edgar Anderson spoke before the biology seminar of the California Institute of Technology, Pasadena, August 24, on "The Races of *Zea Mays*."

Dr. Robert E. Woodson, Jr., Assistant Curator of the Herbarium, has published a paper in the August number of *Rhodora* (**45**:328-329) entitled "A New Amsonia from the Ozarks of Missouri."

Miss Madelaine Chalette, of the Merchandise Research Department, Interstate Department Store, New York, spent several weeks at the Garden during the summer in a study of little-known properties of plants.

Mr. George H. Pring, Superintendent of the Garden, showed moving-pictures illustrating "Tapping of Para Rubber" before the Kiwanis Club of Alton, Ill., August 3, and before the St. Louis Horticultural Society, September 3.

Dr. Edgar Anderson, Geneticist to the Garden (on leave), has been appointed to the Committee on Common Problems of Genetics and Palaeontology of the National Research Council and participated in its deliberations at Berkeley on June 14–16.

Mr. Halldor Jonsson, graduate of the School of Horticulture, Reykjum, Iceland, who has a twelve-months permit to study horticulture in the United States, is spending two months at the Garden (August 15–October 15), working especially on vegetable and fruit production under glass.

Dr. Robert W. Schery, Research Assistant to the Garden (on leave), recently flew back to this country from Fortaleza, Brazil, where he is stationed as Associate Field Technician for the United States Rubber Development Corporation. On August 31 he showed colored pictures of that section of the rubber country to members of the Garden staff.

Mr. James A. Fitzpatrick, of Metro-Goldwyn-Mayer Studios, spent a part of the time while in St. Louis obtaining pictures in color of orchids and water-lilies at the Garden. The completed film is one designed to be sent all over the world, particularly to countries now occupied or to be occupied by American troops.

Two papers from the Garden BULLETIN have recently been reprinted in other magazines: "Two New Desert Shrubs for Midwest Gardens," by Ladislaus Cutak, in Charge of Succulents at the Garden, reprinted in the July 9 *Southern Florist* (**55**:3-4, 31); and "Tropical Water-lilies," by George H. Pring, Superintendent of the Garden, reprinted in the August 5 *American Eagle*.

Out-of-town visitors to the Garden during the summer months include: Rev. Robert R. Brinker, O.F.M., Instructor in Biology, Quincy

College, Quincy, Ill.; Dr. Henry Schmitz, Dean of the School of Forestry, University of Minnesota, St. Paul; Capt. William A. Evans, Station Hospital, Camp Crowder, Mo.; Mr. Norlan C. Henderson, Teacher of Biology, Enfield High School, Enfield, Ill.; Dr. A. F. Bucholtz, Bacteriologist, Pabst Brewing Co., Peoria, Ill.; Dr. T. H. Kearney, Principal Physiologist, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.; Miss Helen Schiefer, graduate student, Radcliffe College, Cambridge, Mass.; Sr. Jader T. Rezende, of the Divisão Fomento Vegetal, Ministerio da Agricultura, Rio de Janeiro, Brazil; and the following former graduate students or members of the staff, who are at present in the Armed Forces: Lieut. Ralph W. Emons, of the Station Hospital at Greenville, Texas; Lieut. Stanley Bettoney, of Fort Sill, Okla.; Lieut. Henry McQuade, of Lowrey Field, Denver, Colo.; Lieut. Bradford Pring, of Army Air Field, Roswell, N. Mex.; Ensign L. Wayne Lenz, now in the South Pacific.

STATISTICAL INFORMATION FOR JUNE–AUGUST, 1943

GARDEN ATTENDANCE:

Total number of visitors in June	14,696
Total number of visitors in July	17,190
Total number of visitors in August	19,121

PLANT ACCESSIONS:

Total number of plants donated in June	115
Total number of plants and packets of seeds donated in July	6
Total number of plants and packets of seeds donated in August	144

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought in June	18
Total number of books and pamphlets donated in June	331
Total number of pamphlets bought in July	16
Total number of books and pamphlets donated in July	109
Total number of books and pamphlets bought in August	20
Total number of books and pamphlets donated in August	63

JUNE

HERBARIUM ACCESSIONS:

By Gift—

Anderson, Edgar—*Tradescantia* and *Tripsacum*	2
Bauer, Mrs. Nettie May—*Cheiranthus Cheiri* L. from horticulture	1
Degener, Otto—Plants of western United States and Hawaii	261
Fairburn, D. C.—*Eruca sativa* Mill. from horticulture	2
Featherly, H. I.—*Carex cherokeensis* Schwein. from Oklahoma	1
James, Leslie—Plants of Alabama	6
Murrill, W. A.—*Viola* sp. from Florida	5
Whitehouse, Eula—Plants of Texas	29
Total	307

JULY

By Gift—	
Bauer, Mrs. Nettie May—*Dianthus Armeria* L. from horticulture	1
Cutler, Hugh—Grass from South America	1
Degener, Otto—Plants of western United States and Hawaii	215
Demaree, Delzie—Plants of Arkansas	19
Hopkins, L. S.—*Acer nigrum* Michx.	3
Hubricht, Leslie—Lichens from New York	21
James, Leslie—Plants of Alabama	3
Seibert, Russell J.—Plants of horticulture	2
By Exchange—	
Gray Herbarium, Harvard University—"Plantae Exsiccatae Grayanae," Cent. XIII	100
Gray Herbarium, Harvard University—Miscellaneous duplicates	86
Mouzón-Heber by Bernardo Rosengurtt—Plants of Uruguay	21
Philadelphia Academy of Natural Sciences—Plants of Pennsylvania, mostly	156
Total	628

AUGUST

By Purchase—	
Cooke, William Bridge—"Mycobiota of North America," Fasc. 5, Nos. 116-150, inclusive	35
Krukoff, B. A.—Plants of Brazil collected by Ducke	301
By Gift—	
Darker, G. D.—Fungi of eastern United States and Canada	39
Degener, Otto—Plants of eastern United States	61
Demaree, Delzie—Plants of Iowa and Arkansas	13
Greene, H. C.—*Phyllosticta Desmodii* Ell. & Ev.	1
James, Leslie—Plants of Alabama	3
Reeves, R. G.—*Tradescantia Wrightii* Rose & Bush from New Mexico	1
von Schrenk, Hermann—*Lespedeza formosa* Koehne from horticulture	1
By Exchange—	
de Pauw University by T. G. Yuncker—Plants of Indiana, etc.	190
Hermann, F. J.—Plants of Maryland	40
New York Botanical Garden—Plants of India	315
United States National Museum—Plants of Virginia	94
Total	1,094

STAFF
OF THE MISSOURI BOTANICAL GARDEN

THE GARDEN, 2315 TOWER GROVE AVENUE, ST. LOUIS, MISSOURI

GEORGE T. MOORE,
Director

HERMANN VON SCHRENK,
Pathologist

JESSE M. GREENMAN,
Curator of Herbarium

CARROLL W. DODGE,
Mycologist

EDGAR ANDERSON (on leave),
Geneticist

ROBERT E. WOODSON, JR.
Assistant Curator of Herbarium

HENRY N. ANDREWS,
Paleobotanist

ROBERT W. SCHERY (on leave),
Research Assistant

NELL C. HORNER,
Librarian and Editor of Publications

GEORGE H. PRING,
Superintendent

JOHN NOYES,
Consulting Landscape Architect

WILLIAM F. LANGAN,
Chief Engineer

JOSEPH LANGEN,
Assistant Engineer

ALBERT PEARSON,
Painter

PAUL A. KOHL,
Floriculturist

DAVID C. FAIRBURN,
Horticulturist

JOSEPH CUTAK,
In charge of Exotics

LADISLAUS CUTAK,
In charge of Succulents

THE ARBORETUM, GRAY SUMMIT, MISSOURI

AUGUST P. BEILMANN,
Manager

ROY E. KISSICK,
Engineer

FRED WEGLOENER,
Orchid Grower

REPRESENTATIVE IN THE TROPICS

PAUL H. ALLEN,
Balboa, Canal Zone

REPRESENTATIVE IN EUROPE

GURNEY WILSON, F. L. S.,
Hove, Sussex, England

MISSOURI BOTANICAL GARDEN BULLETIN

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Missouri Botanical Garden Bulletin

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THE LIFE-SAVING BARREL CACTUS—MYTH OR FACT?

Several months ago, three soldiers perished in the California desert. They were on maneuvers in the desolate, waterless region of the Chocolate Mountains. The Chocolates are a 60-mile span of brown hills that extend along the north side of the Salton basin from Glamis to Mecca. It is a wild, rugged country where hundreds of gold-seekers have picked and panned gold in days gone by. Somewhere south of the chocolate-tinted hills, in the rough and dreary desert of rocks and sparse vegetation, a platoon of trainees became isolated from the other units. Running out of water, their plight was aggravated by temperatures which soared to 130 degrees, the highest recorded for that region for several years. When a searching party located them, three of the thirty-nine soldiers had perished of thirst. Had they but known of the life-saving liquid stored within the thorny cylinders of the Barrel Cacti, small as they are in that region, they might perhaps have lived to record their adventure.

"Bisnaga" or "Barrel Cactus" is the common name usually applied to the large species of *Echinocactus* and *Ferocactus*, particularly the latter. This is in reference to the barrel-like shape of the plants, since the individual stems are large, thick, globose to cylindric. *Echinocactus ingens*, which the writer saw and photographed in the vicinity of Ixmiquilpan, Mexico, is one of the most picturesque in the group, often attaining a height of 5 feet or more, and a circumference nearly as great. *Echinocactus Grusonii* is another popular Mexican species, often found in collections, and more commonly known as the "Golden Barrel" on account of the almost transparent golden spines which cover the thick globular stem. In our own Southwest, the commonest Barrel Cactus is the *Ferocactus Wislizenii*, found in Texas, New Mexico, and Arizona, but it never assumes the immense girth of the largest Echinocacti. In California the common Barrel is *Ferocactus acanthodes*. Other Bisnagas grow in Lower California and certain parts of Mexico. The ruby-spined *Ferocactus Pringlei* is one of the most colorful, and specimens 5 to 7

feet tall can be located in northeastern Mexico in the vicinity of Saltillo. In all, there are about forty species of Echinocactus and Ferocactus but only about a third of them can be rightfully classed as Bisnagas or Barrel Cacti.

The "stored water" of the Bisnaga has been a subject of lively interest, some maintaining that it was all that was claimed for it, others that it was mostly fake. Many stories circulated about the life-saving qualities are probably exaggerated, but that there is some truth in them cannot be denied. This writer has always believed that *in time of stress* the water of the Bisnaga can be utilized for drinking. Herewith are presented some experiences of well-known people whose honesty in the matter cannot be doubted.

Fig. 1
Papago Indian drinking the juice of the Bisnaga

The great majority of those who have read or heard of the Bisnaga's potential thirst-allaying qualities are under the impression that all you need to do is to insert a faucet in the thorny cylinder and the water will flow out in copious quantity. This is not so. It should be remembered that the juice

of the Bisnaga is mucilaginous and therefore will not flow like ordinary water. It has to be squeezed out by hand.

About a year ago, my good friend, Mr. William Taylor Marshall of Los Angeles, wrote a short story about the Barrel Cacti in the *Amateur Bulletin of the Cactus and Succulent Society* (Nos. 7-8, 1942) debunking, as it were, the Ferocacti as regards their water value in an emergency. One of the illustrations accompanying the article was that of a Papago Indian drinking the juice of the Bisnaga (fig. 1), and Mr. Marshall dubbed it, "the most famous fake picture of the Barrel Cactus and its water supply." This same picture has been used in various publications whenever the Barrel Cactus is featured. The drinking scene was photographed by Dr. Daniel Trembly MacDougal, eminent desert botanist, in February of 1903, when he and the late Mr. Frederick V. Coville, botanist of the United States Department of Agriculture, were seeking a site for the future Desert Botanical Laboratory of the Carnegie Institution of Washington. The photo first appeared in the *Carnegie Institution Publication*, No. 6, November, 1903, containing the full report on the Desert Botanical Laboratory made by both these men. Coville also used it to illustrate his story, "Desert Plants as a Source of Drinking Water," in the *Smithsonian Institution Report* for 1903, while MacDougal again reproduced it five years later with an additional photograph in "Botanical Features of North American Deserts" (*Carnegie Institution Publication*, No. 99).

Dr. MacDougal informs me that upon sampling the liquid of the Bisnaga, forty years ago, he found it to be good in relieving the discomforts of parched membranes, and that on many occasions he has carefully demonstrated to members of field parties the manner in which this juice might be obtained in regions where lack of drinking water from dawn until sunset might be a serious matter. One such demonstration was given by Dr. MacDougal for the expedition party to the Pinacate Mountains in 1908, the account of which is vividly described by William T. Hornaday in his stirring book "Camp-fires on Desert and Lava." In Dr. Hornaday's own words, "The water was surprisingly cool, a trifle sweet, and in flavour like the finest kind of raw turnip."

Dr. MacDougal reports having decapitated many such plants in remote regions, although no very serious need was ever experienced, a fact partly due to good fortune and also to a practice of providing at least two gallons of water daily per man on all expeditions. Some years ago, Dr. MacDougal

Fig. 2

Echinocactus ingens growing in the vicinity of Ixmiquilpan

gave a lecture in St. Louis, and on the stage he demonstrated how a Bisnaga could be decapitated and the juice extracted.

The water of the Bisnaga is not the best in the world. It has a flattish, somewhat alkaline taste, but it is at least fluid, and infinitely superior to some of the brews of mud, dead mice and lizards which all too often have saved the lives of travelers perishing from thirst at almost dry waterholes. It is a plant juice and should be regarded as such. It should be drunk cautiously for what it is, an emergency life-saver. And in this, its rightful role, it has all the excellent qualities that have ever been ascribed to it. It may be true that a person in the last extremities of thirst would find it a tough job to break open a lusty Bisnaga, but it is not to be supposed that

anyone, knowing anything about the plant (and being short of water), would wait until getting so weak as to be unable to batter open the cactus. At least, it would be no harder for a weakened man to avail himself of the cactus juice than it would be for him to reach some of the hard-to-get-at desert waterholes, as for instance Tinajas Altas on the Devil's Highway—at which point several persons have perished owing to sheer inability to climb the slippery rocks to the upper pools.

The Indians often sought relief in the juices of plants when water failed. However, these tough old desert redskins were not particular about their water supply or whence it came as long as there was a little of it to sate their thirst. You may recall that an Apache would, if hard pressed by enemies, cut the long intestine from the first horse that died of exhaustion, empty the tube as well as he could, which means in a hurry and not too fussily, and fill it with any sort of water from the first waterhole. It was then tied at both ends to prevent water loss, looped about the belly of any handy remaining pack horse, and the flight continued. It is highly probable that the liquid refreshment which this improvised canteen afforded was not of the most enjoyable order, but it served to get the Indian across the desert alive. And that is exactly what the juice of the Bisnaga will do—and in a much more enjoyable and sanitary manner.

For some time I have been corresponding with Marshal South, a unique figure in present-day desert history. From him I have gathered much interesting material about the water-bearing and life-saving properties of the Bisnagas. Prior to his marriage, Marshal South was a wanderer in the West and has written a number of Western stories. His wife, Tanya, aspired to be a poetess. Back in the old depression days, when the market fell out of their particular writing field, the Souths went into the desert, discarded their modern clothes, and lived like the primitive Indians. They owned few possessions and little money, but the desert was hospitable. They built their home upon the summit of a mountain that rose 2500 feet above a canyon in a California desert. The task of building the house was beset with many difficulties, for all the material had to be packed upon their backs and carried up the boulder-strewn path to their home site. They named their home "Yaquitepec" and for ten years occupied it, in the meanwhile raising a family of two boys and one girl. The cramped quarters and lack of suitable permanent water supply has forced them to search for another home, but up to the present they have not as yet found it. Except for an occasional trip

to town, they follow closely the pattern of life of the primitive Indians and apparently are happy in their desert refuge. The Souths have experimented pretty thoroughly with the Bisnagas but now, having proved their worth, they leave them strictly alone, for they are opposed to wantonly destroying these slow-growing and picturesque plants.

According to Marshal South, the best way to break open a Bisnaga is with the aid of a small hatchet. With this instrument, the spines around the top of the cactus can be trimmed, the top cut off, and a hollow worked out by chopping into the pulpy flesh. Some writers recommend doing this by pounding with the hatchet handle, or with a stone or stout stick. The Souths, however, have found that the best way is to use the hatchet blade, holding it vertically and working it back and forth and around, as though boring a hole. As the hole gets bigger and the fleshy mass of water-bearing pulp becomes shredded, it is advisable to take up the pulp with the hand and squeeze it, allowing the juice to run back into the hollow and throwing away the pulp. Pretty soon a quantity of juice accumulates in the hollowed-out top. In order to get your mouth into the hollow the side spines should be trimmed off, but there's nothing wrong with using your hands to cup up the juice. As previously stated, Bisnaga water may not be the best liquid you've ever tasted, but if you are really hard-pushed for water it tastes pretty good. Possibly, it may make you feel a bit sickish and dizzy if indulged in too freely. It isn't ice water, or spring water, but it will carry you on. Myth or fact? Judge for yourself. The facts are before you.

L. C.

THE GIANT HERB

(GUNNERA INSIGNIS)

Summer visitors to the Missouri Botanical Garden have long been familiar with an attractive aquatic plant grown in the Italian Garden known as "Parrot's Feather (*Myriophyllum proserpinacoides* Gill.). Most of the members of the family Halorrhagaceae, to which these plants belong, are tropical, and many are of strikingly different aspect from the more familiar Myriophyllums. One in particular is the genus Gunnera, a race of titanic herbs having a most interesting distribution. Found in the mountains of Africa, Java, New Zealand, Tasmania, it crosses to the Americas, with many species

The giant herb (*Gunnera insignis* (Oerst.) DC.)

known from the Juan Fernandez Islands and in the Andean Chain of South America. A single species (*Gunnera petaloidea* Gaud.) is found in the high mountains of the Hawaiian Islands, one of the many proofs of the basic relationship which undoubtedly exists between the flora of those islands and that of Central America.

The species illustrated is *Gunnera insignis* (Oerst.) DC., which is rather generally distributed from Guatemala to Panama. By far the best-known locality is on the slopes of the Volcán Irazu in Costa Rica. Here the huge rhubarb-like leaves have been seen and described by nearly every botanically minded traveller fortunate enough to investigate the fascinating flora of that mountain.

The plant was first seen by the writer in Panama, on the steep slope of the headwaters of the Río Chiriquí Viejo, in Chiriquí Province, at elevations over 5000 feet, during the collecting season of 1939. More recently its range was considerably extended when plants were found in Coclé Province, in the mountains to the north of El Valle de Antón, at about 3000 feet elevation, a locality within seventy miles of Balboa.

The habitat of these plants, particularly in Coclé, is of more than ordinary interest, in that they are found exclusively on nearly sheer walls, where landslides have occurred forming colonies often of fifty or more individuals. It is difficult to conceive how the tiny seeds manage to establish themselves in such seemingly impossible situations, but it is often observed that an area where a small slide not more than three yards across has occurred will support a thriving miniature colony of three or four individuals. The fleshy rootstocks are about the diameter of a man's arm and grow tightly pressed against the wet soil wall, rooting freely as they grow. They usually bear three to five of the gigantic leaves. Once established, propagation seems to be entirely by vegetative means.

P. H. A.

NEW OR NOTEWORTHY PLANTS FOR ST. LOUIS. XV.

Prinsepia sinensis

For the past three years the first shrub to develop leaves and to flower at the Arboretum has been the Cherry Prinsepia (*Prinsepia sinensis* Oliver). This plant is a member of the Rose family, native to northwest China and the Himalayan region. Long before the Forsythias start to grow it produces some interesting yellow flowers and dense green foliage.

Two species of Prinsepia are to be found at the Arboretum, the Cherry Prinsepia *(P. sinensis)* and White Prinsepia *(P. uniflora)*. The largest plants are from seed imported in 1936 from Manchuria. So far we have not seen the flowers of the White nor the fruit of the Cherry Prinsepia. The flowers are reported as inconspicuous for both species, and neither one is supposed to produce edible fruit in cultivation. However, we cannot agree that the flowers of the Cherry Prinsepia are inconspicuous. While they do not rival the Forsythia for mass effect, the clear yellow flowers, peeking out from the dense foliage, are very attractive.

The Cherry Prinsepia may not be quite hardy in this region during the first year when grown from seed, but after that it seems perfectly at home. Both species are reported hardy in Boston. As a foliage plant the Prinsepias are entirely satisfactory. The leaves are narrow, about ½ inch wide and about four times as long, dark green above and light below. The branches are armed with spines, much like barberry, except that the spines are not so numerous. The maximum height may be 6 feet and the breadth is perhaps as great. It appears that either a partially shaded or a sunny location is satisfactory, and so far as we know these plants enjoy a good deep soil but are otherwise not very exacting in their requirements. They are primarily foliage plants and should be a welcome addition in any garden either planted in a group or as individual specimens.

A. P. B.

THE VELVET-LEAVED GLOXINIA

(SINNINGIA SPECIOSA)

It was probably from *Sinningia speciosa* that the florists' showy Gloxinia was developed. T. A. Sprague, in the English *Gardeners' Chronicle* for 1904 (p. 88) states: "The turning point in the history of the cultivated 'gloxinia' was in 1845, when an erect and regular-flowered plant was raised by Mr. John Fyfe, gardener at Rothesay, Bute (England); this had a white corolla with a violet center, and five perfect stamens, instead of four usual in Gesneriaceae. Unfortunately for the systematic botanist, no exact record of its parentage was made, though in *Flore des Serres*, t. 311, where it was figured three years later, *Sinningia speciosa* is stated to have been one of the parents."

As *Gloxinia speciosa* the plant was described and illustrated three times in 1817 (Loddiges' *Botanical Cabinet*, no. 28; *Botanical Magazine*, pl. 1937; *Botanical Register*, pl. 213). A pure white form was also figured in 1833 in the *Botanical Magazine* (pl. 3206). However, as it turned out, the plant did not belong in the genus Gloxinia but in Sinningia, a genus not described until 1825 and based on the Brazilian S. *Helleri*. The correct botanical name

The velvet-leaved Gloxinia *(Sinningia speciosa)*

should be *Sinningia speciosa*, and all the garden Gloxinias are therefore Sinningias. About twenty species have been described in the genus which was named in honor of William Sinning, gardener at the University of Bonn, Germany.

The plant growing at the Garden (see above) was sent us by Mr. Mulford Foster, of Orlando, Florida, who had propagated it from one collected in its native Brazil. It has flowered throughout August in the "pit" house in the private exotic range and, unlike the Gloxinia, it does not seem to object to high temperatures.

The flowers are campanulate, pendent, and of a brilliant violet color, supported by 2 to 6 erect stems above the rosette of leaves. The leaves are opposite, elliptic-oblong, obtuse-tipped, velvety and dark green above with prominent light green radiating veins, delicate orchid-mauve beneath. The stems rising from a tuberous rhizome are usually simple, but occasionally multiple growths are produced.

G. H. P.

WILD GINGER AS A GROUND COVER

Since the discussion of "Ground Covers for St. Louis Gardens" was published in the October, 1936 BULLETIN, the reaction of native ground-cover material to the hot dry months of Missouri summers has been observed at the Arboretum. The Wild Ginger *(Asarum canadense)*, which is fairly common in the woodland areas, was outstanding in its ability to hold its foliage in spite of drought and competition with trees. Plants that had been growing satisfactorily in the Medicinal Garden suggested that they "could take it" as a ground cover in the city, and in 1938 Dr. Edgar Anderson collected some rootstocks for testing in the Mausoleum enclosure. Now, after five years, the Mausoleum plot still produces an excellent cover despite the lack of special attention. A perfect growth of dark satiny foliage covers the entire area planted, one from which direct sunlight is practically excluded by the surrounding trees.

The dark green kidney-shaped leaves are from 4 to 6 inches broad. The leaf-stalks are produced in pairs from the perennial thick creeping rootstock,

Wild Ginger on east side of Mausoleum plot

supporting the foliage one foot above the ground. The bell-shaped flowers are brownish or madder-purple, surrounded by a 3-pointed calyx. This somewhat curious flower is usually concealed by its low position and the foliage above.

The accompanying illustration is from a photograph taken on September 1 to illustrate the condition of the cover following an extended dry period. Since Wild Ginger is easily grown from seeds, stock should be obtained by this means and the native wild plants left unmolested.

G. H. P.

THE EFFECTS OF EARLY AND LATE MOWING ON ANDROPOGON VIRGINICUS

Andropogon virginicus, commonly called Beard-grass, is widely distributed throughout the eastern, middle and southern United States. Henry Shaw records that when he first visited the grounds now occupied by the Garden and Tower Grove Park (1820), "the prairie was grown over with a tall natural grass, Andropogon." It is altogether too abundant in Missouri and will increase rapidly unless some effort is made to eradicate it. Moreover, because of its high oil content it is one of the most serious fire hazards to be found in the field. Once ignited it spreads with great speed, and the heat generated makes it impossible to fight the fire with any ordinary methods.

In order to study the effect of mowing as a means of eradicating Andropogon, and thereby encouraging the growth of more desirable meadow grasses, an experimental plot was staked out at the Arboretum on a relatively pure stand of the grass. The plot was divided into four sections: (1) arranged for early mowing, (2) late mowing, (3) both late and early mowings, and (4) a check section. In this report the term "early mowing" will signify that the plants were mowed before the seed culms had begun to elongate; "late mowing" was done after the grass had flowered and before the seeds had ripened. The mowing in both these cases was done by hand and the grass tops raked off.

Early mowing took place on July 7. The culms had not then developed and the basal leaves were green and procumbent. Late mowing was done on

September 29, at which time the plants were approximately 30 inches tall and were setting seeds, the basal leaves having dried up and fallen away.

When the effects of early and late mowing were compared some three weeks after the late mowing, the following observations were made.

The most marked effect was that the early-mowed plants averaged 3–5 inches lower than unmowed plants. There was also a considerable increase in field and pasture weeds such as Rumex, Lactuca, Campsis, and Rubus, but growth of Solidago was obviously retarded. Plants of Blue-grass were still bunchy and showed no noticeable change. Few seedlings were to be found, due perhaps to the exposure of the soil surface to the intense summer heat. Growth of the new fall shoots of Andropogon was not noticeably checked by the early mowing, appearing to be as luxuriant as in the unmowed check section.

Late mowing was apparently more destructive to the Andropogon plants, since at this time they are forming the new fall shoots which are weaker and fewer than on the unmowed plants. The section laid off for the late mowing already contained a large patch of Blue-grass. However, it was obvious that this late mowing had encouraged the growth of many seedlings which were few and scattered on the check area.

The effect of early-late mowing was more like that of late mowing than of the early. Fewer new fall shoots of Andropogon were seen, and fewer Blue-grass seedlings were to be found in this section than in the late-mowed section.

As a result of this preliminary experiment it may be concluded that early mowing alone has little effect on the Andropogon plant and also that it encourages summer field weeds. Late close mowing by machine, in late September or early October, injures the new fall shoots which protect the crown over winter. If persisted in, it should ultimately result in the elimination of a large proportion of the Andropogon. Late mowing also permits an abundance of light and air to seedling Blue-grass plants.

Louis Brenner.

NOTES

Miss Julia Guzman-Naranjo, of Bogota, Colombia, S. A., is registered as a graduate student in the Henry Shaw School of Botany.

Mr. Ladislaus Cutak, in charge of Exotics at the Garden, spoke before the Men's Club of the Shaw Ave. Methodist Church, October 12, on "Plant Hunting in Old Mexico."

The *Home Garden* for September (**2**[3]:20-21) contains a paper by Dr. David C. Fairburn, Horticulturist to the Garden, entitled "Outdoor Annuals for Indoor Bloom."

The science students of the Cote Brilliante School, under the guidance of their teacher, Mr. L. F. Pinkus, visited the Garden library and herbarium, October 1.

Dr. David C. Fairburn, Horticulturist to the Garden, gave two lectures to the Girl Scouts trying for the Merit Badge: September 15, on "Insects and Weeds," and September 22, on "Medicine Plants and Fall Flowers."

Mr. Mulford B. Foster, of Orlando, Florida, spent several days at the Garden recently studying the collections of Bromeliaceae, both greenhouse and herbarium specimens.

Dr. Edgar Anderson, Geneticist to the Garden (on leave), spoke at the meeting of the Anaximandrian Society of the California Institute of Technology, Pasadena, September 13, on "The History of *Robinia Pseudacacia*."

The Greater St. Louis Chapter of the Special Libraries Association were guests of the Garden library staff on October 16. After viewing the display of rare and old books arranged for their benefit in the folio room, they were shown through the library and Garden.

Mr. C. R. Runyon, Superintendent of Spring Grove Cemetery, Cincinnati, Ohio, spent September 13 and 14 at the Garden Arboretum. Mr. F. D. Clark, F.R.H.S., Supervisor of six Toronto (Canada) cemeteries, was an Arboretum visitor on September 5.

The second fascicle of Part II of Woodson and Schery's *Flora of Panama* was issued during September. This part includes the Cyperaceae to Cyclanthaceae, H. K. Svenson, of the Brooklyn Botanic Garden, collaborating on the Cyperaceae, and L. H. Bailey, of Cornell University, on the Palmaceae.

Mr. Paul A. Kohl, Floriculturist to the Garden, gave a talk to the Ladue War Garden School, September 27, on "Varieties of Vegetables Grown at the Missouri Botanical Garden." On October 5 he spoke before the St. Louis Hills Garden Club on "Dividends from the Vegetable Garden."

Dr. Marion Ownbey, Associate Professor of Botany and Curator of Herbarium, Washington State College, Pullman, formerly a graduate student in the Henry Shaw School of Botany, stopped off for a couple of days at the Garden recently on his way to South America. Dr. Ownbey will be

Botanist on an expedition sponsored by the American Quinine Co., in the interest of the government, to investigate the native sources of Cinchona in Ecuador.

Among those visiting the Garden recently were: Mrs. J. N. McClure, of Washington, Mo.; Prof. Winslow Porter, Librarian, Southern College of Pharmacy, Atlanta, Ga.; Mr. Ralph O. Erickson, Chemist, Western Cartridge Co., Alton, Ill.; Miss Peggy White, plant collector, Balboa, Panama, C. Z.; Lt. Hubert C. Keith, of Randolph Field, Tex., and Lt. Robert B. Clark, of Scott Field, Ill., both former students in the Henry Shaw School of Botany; Mr. Walter C. Scholl, orchid enthusiast, of Chicago, Ill.

STATISTICAL INFORMATION FOR SEPTEMBER, 1943

GARDEN ATTENDANCE:

Total number of visitors	15,880

PLANT ACCESSIONS:

Total number of plants received as gifts	5

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	9
Total number of books and pamphlets donated	373

HERBARIUM ACCESSIONS:

By Purchase—	
Murley, Margaret—Plants of Idaho	150
By Gift—	
Bailey, L. H.—Palms of Panama	13
Bettis, Mrs. J. M.—Plant of horticulture	1
Fairburn, D. C.—*Eryngium amethystinum* L. from horticulture	1
Greenman, J. M.—Plants of Jefferson County, Missouri	15
Rau, Mrs. D. W.—*Buchnera americana* L. from Missouri	1
University of Texas, by Fred Barkley—Plants of Texas	2
By Exchange—	
Schallert, Paul O.—Plants of Arizona	291
By Field Work—	
Woodson, R. E.—Plants of Panama	25
Woodson, R. E. and Schery, R. W.—Plants of Panama	99
Total	598

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until sunset; Sundays, 10:00 a. m. until sunset. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah car line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

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GERALD E. ULRICI

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until sunset; Sundays, 10:00 a. m. until sunset. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah car line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

GARDEN'S EXHIBIT OF NEPENTHES AT THE NATIONAL ORCHID SHOW, NEW YORK, 1929.

Missouri Botanical Garden Bulletin

Vol. XXXI NOVEMBER, 1943 No. 9

NEPENTHES (PITCHER-PLANTS)

Of the several groups of plants capable of excreting a digestive juice similar to animals, the Nepenthes, or Pitcher-plants are the rarest. Such carnivorous or insectivorous plants as the Venus Fly-trap (Dionaea), the Sundew (Drosera), and the Pitcher-plants of the South (Sarracenia) grow wild in the United States, but the Nepenthes are found only in tropical Asia and Australia, more particularly in the Malayan Archipelago. There are some 75 species of Nepenthes with numerous hybrids, and it is probable that the Missouri Botanical Garden possesses the most complete living collection of these plants in this country, at least so far as the rare hybrids are concerned. In the collection may be mentioned: *Nepenthes Balfouriana, N. Chelsonii, N. Chelsonii excellens, N. Chelsonii x Dominii, N. cylindrica, N. Dicksoniana, N. Dominii, N. Dyeriana, N. intermedia, N. Mastersiana, N. Mastersiana* var. *purpurea, N. maxima, N. mixta, N. Morganiana, N. paradisae, N. Williamsii.*

Linnaeus named the genus in allusion to the story in the Odyssey where Helen mixed the wine with the drug Nepenthe so that by drinking it men would be free from care and grief. He added: "If this is not Helen's Nepenthes, it certainly will be for all botanists. What botanist would not be filled with admiration, if after a long journey he should find the wonderful plant? Past ills would be forgotten when beholding this admirable work of the Creator."

Nepenthes are native to the humid jungle, where they root in decayed humus, and frequently climb on trees to a height of 60 feet. The basal stem varies from the thickness of a pencil to an inch in diameter. Some of the species such as *N. Veitchii* later become epiphytic, with the stem creeping horizontally or obliquely along tree branches. Most species, however, are rather straggling climbers and support themselves by the prolonged midrib of the leaf which acts as a tendril, the pitcher developing later at the extreme end. So tenaciously does this extended midrib cling that if it

twists around a wire support or near-by plant the stem and young pitcher must be broken in order to free it.

The flowers of the Pitcher-plant are dioecious (the female and male on separate plants), small, and of a greenish or chocolate color. However, it is the leaves that are responsible for the Nepenthes being included among the curiosities of the plant kingdom. The prolonged midrib is spirally twisted and expanded at the end into an appendage termed a pitcher. These pitchers vary in shape, sometimes decidedly on the same plant, and may be either green, yellow, or reddish-purple in color. The mouth of the pitcher is furnished with a thickened corrugated rim which not only strengthens

Fig. 1. Full-grown Pitcher-plant holds a pint of water.

Fig. 2. Mature plant of *Nepenthes Dyeriana (N. Rafflesiana* x *N. Veitchii).*

and keeps the mouth distended but also secretes nectar. It may even develop into a funnel-shaped tube which projects into the pitcher, preventing the escape of any insect which may have entered. On the outside of the pitcher, from the rim to the base, there usually extends a pathway bordered with long hairs or bristles. Before the pitcher is fully developed the lid to the mouth is closed, but later it is permanently open and serves to protect the interior from rain. It is not true, as is popularly supposed, that the lid closes when an insect enters the pitcher.

Nepenthes Dyeriana cut vertically to show interior of pitcher.

Mature plant of *Nepenthes Dominii* grown in a 6-inch clay pot.

The interior of the pitcher is covered with innumerable spherical glands which secrete, before the opening of the lid, a fluid comparable to the gastric juice of the stomach. The nectar on the under-side of the lid and on the corrugated rim entices the insects to enter the pitcher. There they are drowned in the liquid, which afterwards partially digests them, thus making these plants as truly carnivorous as many animals. At the Garden, in addition to flying insects found in the pitchers, it is a common sight to see ants travelling down the supporting wires to the leaves, continuing the journey by the pathway on the pitcher, then, after circling the corrugated rim, make the fatal jump into the bath below where they are ultimately consumed. The natives of Borneo are said to collect the digestive fluid from the fresh pitchers and use it as a remedy for indigestion.

Cultivation.—The ideal exhibition plant is a low, shrubby, leafy specimen carrying numerous well-developed pitchers. Pruning is necessary to produce such a plant. This is best accomplished in the spring, prior to repotting, by cutting the plant back to about one foot so as to force the lower laterals to break for future growth. If allowed to assume its normal climbing habit the upper and lower parts of the plant may develop entirely different shaped pitchers. For example, the lower pitchers of *N. Chelsonii* are more or less bowl or cup-shaped with reddish-brown spots, while the upper pitchers are cylindrical to narrowly vase-shaped, light green, and sparsely spotted.

Since Nepenthes grow naturally in the hot humid jungle, the greenhouse should be kept at a temperature of at least 70° F. and the plants protected from cold drafts; otherwise the young pitchers will not develop but will turn brown and hard. Plants may be grown either in pots or baskets suspended at least four feet below the roof glass, baskets being more convenient and generally used. If, before repotting, the roots are immersed in water to soak off the old potting medium one is less apt to break the small thread-like roots which are hard to distinguish from the peat. For the potting medium use three parts orchid peat to one part sphagnum moss. This should be wedged around the plant with a lateral pressure sufficient to hold it in place, but not to break the roots. Because of the difference in root structures Nepenthes should not be potted with the downward pressure used for soil plants. The plants should be kept well supplied with moisture, both at the roots and in the air. Syringing them several times a day is a good practice. When in active growth and well rooted they should be given liquid cow manure to stimulate pitcher formation. During summer months the plants should be well shaded. Visitors should be persuaded from

Pitchers vary in size and shape

Left: climbing pitcher and typical basal pitcher of *Nepenthes maxima*
Right: typical basal pitcher and climbing pitcher of *N. Chelsonii*

pouring the liquid out of the pitchers (a practice in which they seem to delight), since the plants are unable to replenish it rapidly, and drying up of the pitchers frequently results.

Propagation.—After three or four years plants will become woody and less apt to produce an abundance of pitchers. It is therefore advisable to have young stock on hand for cuttings. For this purpose the plants should be allowed to assume their normal climbing habit so that plenty of growth will be available. The best propagating material is obtained from the middle growth which is neither woody nor succulent. At least two or three leaves of the terminal growth should be removed to where the stem begins to harden. The length of the cutting depends on the variety, but the average length is between three and six inches or one possessing two or three leaves. Remove half of the leaf growth to reduce transpiration. Cuttings will readily root in a mixture of one-half peat and moss and one-half sand, provided with bottom heat and the necessary moisture. The propagating case should be filled with two or three inches of sphagnum moss and the cuttings planted in rows. However, individual pots are preferable, since in repotting the young brittle roots are not so easily broken. The large-pitcher species such as *N. Dicksoniana*, *N. Dyeriana*, and *N. mixta* do not root as easily as those with small-pitchers. Two or three months are necessary to complete the rooting but within three weeks the dormant eye above the leaf joint should start to expand, indicating that callusing and root development have begun. If the cuttings are taken from medium-hard wood, kept moist at all times by frequent syringing, provided with a bottom heat of 75° F. and properly shaded, there should be no difficulty in rooting Nepenthes. Cuttings may be taken at any time during the year that the proper growth is available.

G. H. P.

RAISING NEPENTHES FROM SEED

Although only a very few Nepenthes plants have been grown from seed in the United States, experience at the Garden has shown that this method of propagation is not especially difficult if the right procedure is followed. One of the big problems is to get the seed. Pitcher-plants hybridize readily enough if both male and female flowers are available at the same time. Quite often there will be plenty of plants on hand with male flowers that produce the pollen, but none with female flowers that bear the seed-pods following fertilization (pl. 19).

In this climate Pitcher-plants usually flower in August. When they are

Flowers of Nepenthes: top, male; bottom, female.

Young seed-pods starting to develop.

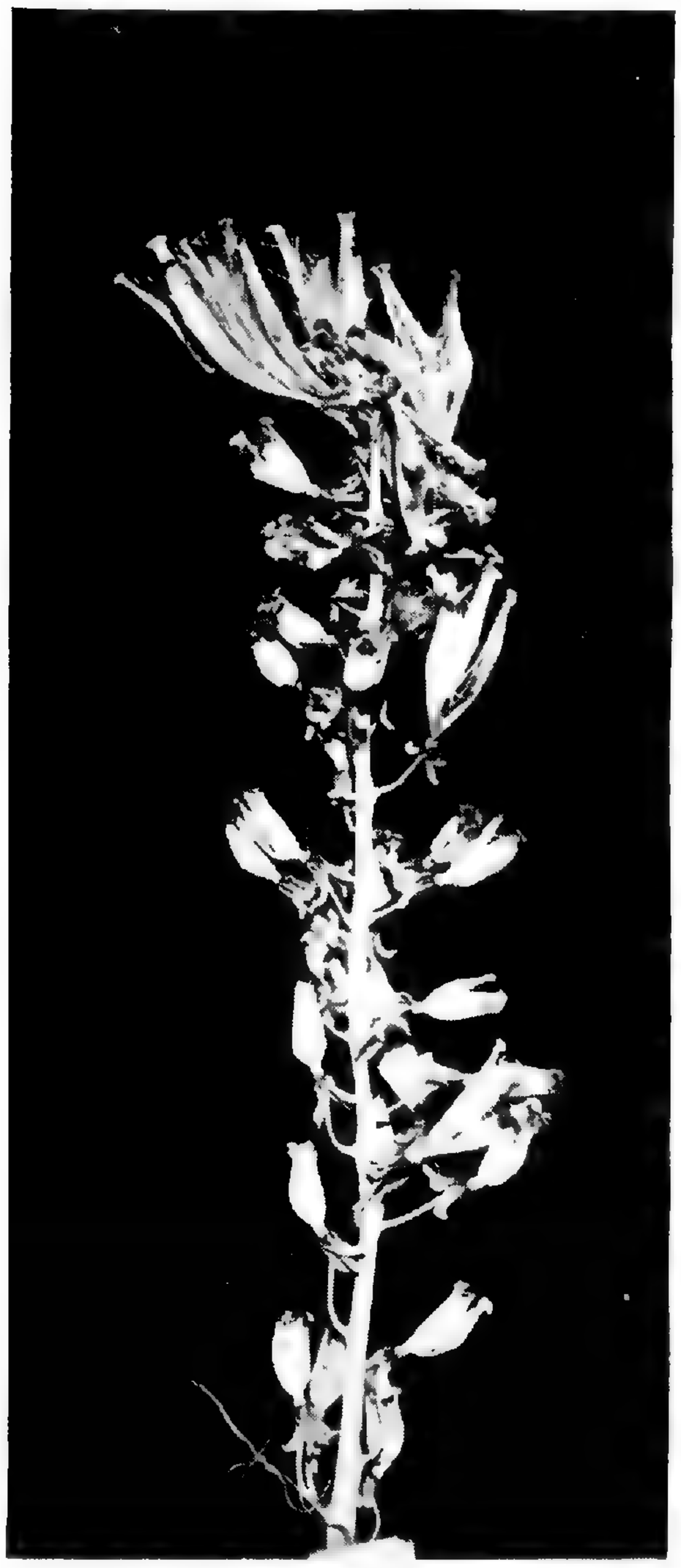
in full bloom, pollen from the male flowers is transferred to the stigmas of the female flowers. After pollination has been completed, the female flower spike is enclosed in a cellophane bag to keep out all insects which might introduce additional pollen of an undesirable type and thus upset the hybridization plan. If fertilization has occurred satisfactorily, the center portion of each female flower soon swells and elongates to form a seed-pod. In some cases fertilization may not proceed "according to plan," and the pods containing infertile seeds or chaff will remain about one-third the size of those bearing fertile seeds (pl. 20). Three months after pollination, when the pods turn yellow and split open, the seed is ripe. In each pod there are two to three dozen thread-like seeds about ½ inch long with a slightly thickened portion in the center that contains the embryo. Infertile seeds are much smaller and contain no embryo (pl. 20).

To get maximum germination the seeds should be sown as soon as they are ripe. The period of viability, of course, depends to some extent on storage conditions. In dry storage at 45° F. the seeds will retain their power of germination for several months.

Fig. 3. Culture flask with seedlings 8 months old.

Pitcher-plant seeds are sown in Erlenmyer flasks, using an agar base with nutrient salts added. In other words, they are treated about the same way as orchid seeds. The formula used for the nutrient solution is as follows:

Calcium nitrate	1.0	gram
Mono-basic potassium phosphate	0.25	gram
Magnesium sulphate	0.25	gram
Ammonium sulphate	0.50	gram
Ferric phosphate	0.05	gram
Cane sugar	20.0	grams
Hydrant water	1	liter



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2

3

1. Nepenthes pod with fertile and infertile seed on same spike.
2. Pod with infertile seed.
3. Pod with fertile seed.

To each clean flask add two grams of agar and 150 cc. of nutrient solution. Stopper the flasks with tightly rolled cotton plugs, and sterilize them in an autoclave for 15 minutes at 15 pounds pressure. Following sterilization, let the flasks cool in a horizontal position so that the media will have a maximum amount of surface area.

Before sowing the seeds they must be thoroughly sterilized in a solution of calcium hypochlorite (bleaching powder) made as follows: Add 5 grams of the powder to 70 cc. of water, shake vigorously for several minutes, then filter. To about 100 seeds in a small vial, add 5 cc. of the filtered solution, plug the vial with a cork or rubber stopper and shake well for several minutes. The seeds are now ready for sowing in the prepared culture flasks.

In order to avoid contamination of the cultures by molds, yeasts, and various bacteria, actual seeding operations are best done in a small room that

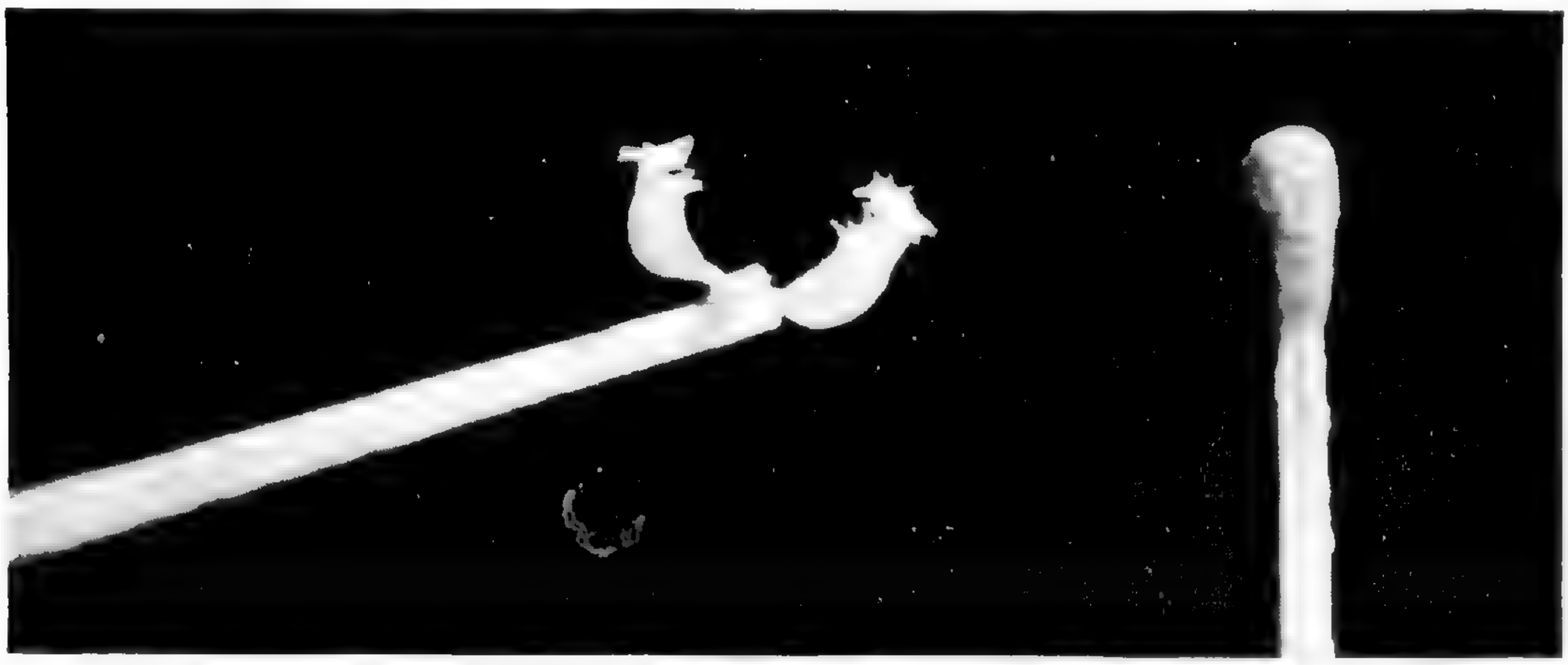

Fig. 4. First true leaves actually are miniature pitchers. Compare the baby plant with paper match at right, both magnified three times.

has been thoroughly cleaned and sterilized with steam or some strong disinfectant. All the equipment used in the room should be carefully sterilized too, as fungus spores are ever-present in the atmosphere, and contamination of the cultures is a forgone conclusion unless strict precautions are taken.

The seeds are transferred directly from the vial of hypochlorite solution to the culture flask, using a pair of long sterile forceps or a platinum wire loop on a glass rod. The flasks should be held by a ring-stand in a horizontal position when the cotton plug is removed to introduce the seed, otherwise contaminating spores may fall into the mouth of the flask. The seeds should be scattered as evenly as possible (but not too thickly) on the surface of the culture media, and the cotton plug replaced in the flask.

After the seeding operations have been completed, the flasks are placed in a shaded greenhouse where the light averages around 10 per cent of the outdoor readings. A temperature of 70-75° F. day and night is most favorable for germination which generally occurs within three weeks after sowing the seeds. When the embryonic portion of the seed starts to enlarge and gradually develops a green color, germination is definitely under way. In about six weeks the first tiny cotyledonary leaves emerge, and these are soon followed by successive pairs of true leaves. One of the most striking features of these small leaves is that they all bear miniature pitchers. Even the cotyledonary leaves have them. Quite a number of well-informed people who have seen this oddity couldn't believe their eyes until they returned later, entirely sober, for a second look.

Our investigations at the Garden have shown definitely that these seedling Pitcher-plants grow far more vigorously in symbiotic cultures

Fig. 5. Community pots in Wardian case. Seedlings one year old.

(using the regular Cattleya orchid fungus for inoculations) than they do in sterile non-symbiotic cultures. In fact the fungus often means the difference between success and failure when the seedlings happen to be weak growers.

The young seedlings develop rapidly and in from six to eight months (fig. 3) they are large enough to take out of the flasks and plant in community pots (3-inch size) containing Osmunda fiber or orchid peat. Each

Fig. 6. Seedlings 10 months old (right) to 18 months old (left).

pot will accommodate around two dozen seedlings. Since they grow quickly, it is well not to plant them too close. These community pots should be placed in some type of Wardian case where they will have constant atmospheric moisture. An aquarium fitted with a glass lid makes a very satisfactory Wardian case (fig. 5). If the plants are allowed to become dry, the pitchers will turn brown and die. Spraying the plants with fresh water at least once a day will keep the young pitchers firm and the plants healthy. An occasional application of weak liquid cow manure is also beneficial. Never expose Pitcher-plants to strong sunlight as this causes them to turn brown and may even kill them. About 20 per cent light is the maximum amount they can stand in summer, with around 30 per cent in winter.

The seedlings remain in the community pots two to four months depending on how fast they grow, then they are transplanted into single 1½- or 2-inch pots of orchid peat. At this stage they stretch out fast and soon require another shift to 4-inch pots. If plants are permitted to become "pot-bound," stunted specimens may result that seldom regain their lost ambitions. As the plants get older the pitchers increase in size. Of course, when working with new hybrid seedlings, interest never fails to run high as we wait impatiently to see if we have pleased or insulted Mother Nature by our ingenious handiwork.

D. C. F.

REMOVING SOME OF THE BUNK FROM SOIL ANALYSIS

The amateur gardener is accustomed to being browbeaten by the self-styled expert, being perpetually pushed about either verbally or in print. If he happens to be interested in a particular group of plants he shortly discovers that he can grow much better plants—according to the experts—if

he just modifies the pH point. Now generally the experts don't give him a recipe for this; they loftily tell him what to do and dare him to ask more silly questions. Perhaps he is interested in a group of plants which are very tolerant of the soil reaction and thus he never worries about the pH, but sooner or later he discovers that people who really know always analyze the soil in order to get the kind of flower pictured in the catalogue. Exactly how he should go about a soil analysis or what he should do about it, assuming that some expert would make it for him, is never made very clear.

Now the writer confesses to having answered many gardening questions by the time-and-tried procedure of asking another question. The implication here is that no knowing gardener would bring up a question which had been answered so many times before. All in all, there seems to be a conspiracy designed to keep the amateur in his place, and to protect the pedestal on which the expert stands.

Perhaps it might be well to examine some of these methods, discover what the expert knows, and possibly give some comfort to the amateur. There are a number of "running-board laboratories" on the market, and these are called "soil-testing kits." Editorially, the gardener is advised to purchase such an outfit, go into the backyard, stir a bit of soil into various tubes, add this and that, shake vigorously and arrive at the acre production of watermelons. It must be said that the makers of these tin-box laboratories never intended them except as a *guide* for soil reaction. When used with experience and discretion they will show the alkalinity or acidity of a soil and give some indication of fertilizer shortages.

As far as the writer is aware, the most elaborate use of soil analysis for commercial purposes has been made by the Hawaiian Sugar Planters' Association. Many other people have used soil analysis, and a great many have drawn conclusions for its occasional use, but its commercial application has probably reached greatest development in the sugar-cane fields of the Hawaiian Islands. There is a great deal of difference between a laboratory technique developed as a research project and the application of that technique to every-day gardening. There is also a great deal of difference between the technician working with his controls in the laboratory and the use of a modified procedure by the uninitiated in the field.

In Bulletin No. 50 of the Hawaiian Agricultural Experimental Station the evolution of soil analysis from the first testing kits to the present-day efficient methods is shown in considerable detail. The rapid examination of soil is not a new idea but was described in the 1906 edition of "Soils" by Hilgard. It appears that Professor F. H. Krauss, an associate of Professor Hilgard, began this work in Hawaii before 1931. Later investigators found

that some of the early kits had objectionable features. They found, just as every gardener will find, that much experience is needed in making soil analyses and that the procedure must be standardized for each soil type. In some cases the results were found to be "inaccurate, lacking a high degree of precision . . . . and were in many cases utterly unreliable." From this early work the present fertilization program has been developed, but in order to obtain comparable results technicians who were to do the actual sampling were expertly trained. They were given special schooling and special equipment; some developed just for this purpose. The chemical reagents were changed periodically and a system of checking the results was begun. In the commercial application of soil analyses the Hawaiian Sugar Planters have standardized every piece of apparatus and have taught the field men exactly how to shake a test-tube in order to get a reaction comparable to those obtained by other technicians.

Now, if we examine this empirical procedure in the light of its possible application to amateur gardening we immediately see that no two gardeners are going to get the same results. If they shake the test-tube differently, or examine the result under a different light, the same soil may prove very fertile in one case and greatly in need of fertilizer in another. The same difference occurs when dealing with the soil reaction, the "pH" of our gardening literature. We often read that the gardener needs only a piece of litmus paper to determine whether he should do something to increase or decrease the acidity. We may say bluntly that if the gardener relies on litmus paper as a soil test he should not convert his findings into a long session involving hard work. By careless sampling one can get almost any desired alkaline or acid reading. Should the gardener be unable to resist the urge to pry into the secrets of the soil he should at least obtain a more elaborate pH test kit. After purchasing this better kit he should study and standardize the procedure by making many tests before going to that part of the garden which he thinks needs "fixing." About six reagents are required to give a reading of from 3.2 on the acid side to 9.6 on the alkaline side. Now it is true that most soils are in the mid-range, say, from 5.4 to 8.4. Even this cannot be covered entirely by just one reagent.

Some years ago the writer became interested in a rapid method of determining soil moisture. While this has no bearing on either the test for soil fertility or the test for soil acidity, it will serve to show how difficult it is to get comparable results with any reagent used in an empirical procedure. This method of determining soil moisture was summed up by Dr. Emert who proposed that it be standardized for each soil type. In the course of some weeks the method was investigated and standardized for the soils in

the garden and it was found to be entirely satisfactory. The results closely approximated those obtained by oven-drying the soil. The great difficulty encountered in the standardization of this method will be given in detail later. The theory back of the method was that a temperature rise would follow the addition of sulphuric acid to soil and that the heat involved would show the amount of moisture in that soil. The procedure was as follows: two grams of soil were placed in a porcelain crucible and to this was added 4 cc. of concentrated sulphuric acid. This was then stirred with a thermometer and the maximum temperature recorded could be translated from a chart as the "per cent of moisture present." One difficulty was that the method must be standardized for each soil. Also, different technicians arrived at different results because they failed to distribute the solution in precisely the same way. It was found that the size of the crucible also affected the result; it could not vary more than 1 gram from the standard. If the specific gravity of the sulphuric acid varied slightly this was important. Even the precise way in which the acid was added to the soil, as well as the outdoor temperature, had a very marked effect on the reading obtained.

From the above then we see that soil tests, for whatever purpose, must be standardized for local soils; they must be carried on in precisely the same way each time; and these tests should always be made by the same person. Now if the amateur wishes to delve in the mysteries of the soil, whether it be to determine the pH point or the fertility, he should obtain the most elaborate and costly kit available. These kits are miniature laboratories, and if he is not frightened by the array of bottles, tubes, etc., he is ready to begin a study of soils. If he begins with a determination of the pH point and pilfers the baby's silver spoon for sampling the soil then he must continue to use this spoon in spite of any objection that might be raised. He must not wash off this spoon with city tap-water one week and then carefully rinse it in cistern water in some country friend's garden a week later. He will have discovered by now that certain flourishes must accompany and become a part of this procedure. Therefore, if he habitually uses a handkerchief or the seat of his pants for cleaning some of the equipment he must continue to use the same handkerchief or to wear the same pants. Perhaps the amateur has standardized, with the proper gesticulation, a method of determining soil acidity in his locality, and he graduates to the more elaborate tests of soil fertility. Here he can give unlimited rein to his histrionic ability. In fact, if he doesn't ladle out the various reagents with exactly the same flourish, or if he fails to shake the tube in exactly the same way for the same length of time, no two tests will be comparable. He must go through the routine in the fashion of an old-time bartender polishing glasses. He then

will be able to make a satisfactory test with a kit on the soils of his neighbor.

Seriously then, an analysis of the soil for both fertility and acidity can be made by the amateur. He must, however, develop a standardized routine; he must do the test over and over in each locality in which he gardens. The flourishes and the routine are absolutely necessary and this picture is not overdrawn. The control laboratory of the Hawaiian Sugar Planters periodically kept in touch with the field man by telephone during his tests. Each field man was checked up by a representative of the laboratory but in between times he patiently explained by telephone each detail, step by step, in his testing. If he gave too much flourish to shaking a tube or failed to stir long enough or rapidly enough, the control office immediately insisted on a change in technique. Only in this way could several men make comparable tests.

If the expert advised you to test your soils, or intimates that this is the thing any good gardener would do, then by all means take him up on it. Buy the very finest testing kit you can and devote a great lot of time to soil sampling. Much information can be gained from this procedure but it is a mistake to place any value on a very simple test taken by some one who has not worked in the locality before or by some one who doesn't standardize each movement and gesture. The soil testing kit can be of much value to the gardener but don't let the expert get by with the complacent statement, "you should have your soil tested." Remember that there are very few "experts" who are really expert in making a soil analysis, and any test less than the most complicated is not very dependable. But a person who becomes familiar with his equipment can glean some information from the soil, and if he makes many tests he will know more than the expert!

A. P. B.

NOTES

Mr. George H. Pring, Superintendent of the Garden, spoke before the Brentwood Garden Club, October 14, on "Landscaping the Small Lot."

Mr. August P. Beilmann, Manager of the Arboretum, gave a talk before the members of the Chevy Chase Garden Club, October 11, on "Trees."

Mr. George H. Pring, Superintendent of the Garden, acted as one of the judges at the schoolchildren's tree-growing contest, October 20, sponsored by Mr. John S. Swift, of St. Louis.

Recent visitors to the Garden include: Dr. H. W. Rickett, Bibliographer,

New York Botanical Garden, Bronx Park; Lieut. Ralph Emons of the Station Hospital, Greenville, Texas, and Lieut. Henry McQuade of the Army Air Forces, both formerly graduate students in the Henry Shaw School of Botany; Sgt. Willard L. Hagen of the Army Air Forces, Herrington, Kansas.

Mr. Ladislaus Cutak, in charge of Succulents at the Garden, has given the following illustrated talks recently: "Cacti and Succulents," before the Maplewood Garden Club, November 4; "A Plant Hunt in Old Mexico," before the Missouri chapter of the National Association of Secretaries, November 5; "Wonders of the Cactus World," before the St. Pius branch of the Holy Name Society, November 17.

"Notes from Kew" (from *The Gardeners' Chronicle,* England, August 28, 1943).—"During the holiday season the two most popular features with the majority of the many visitors to Kew have been the tropical Water Lilies and the Conservatory . . . . That so many should, with one accord, be determined to see the tropical Nymphaeas is rather astonishing. I write *determined* deliberately, because it must require strong determination to patiently wait one's turn, as so many did during the "peak hours," in a long queue on a hot day to enter a still hotter glasshouse. But they must have felt that it was well worth the effort when they saw the magnificent Water Lilies.

"For the most part these are the Missouri hybrids . . . . The most striking of them all is an immense rich, dark blue variety . . . . *Nymphaea gigantea* [an Australian species] produces another exceptionally large bloom, well matched by rich green leaves which measure over two feet across. N. Sunbeam is of lovely primrose colour. These are some of the day-flowering type; of the night-blooming sorts, which close up before noon, there are N. Missouri, a beautiful pure white flower fully a foot across, and the pale lemon-coloured N. St. Louis."

STATISTICAL INFORMATION FOR OCTOBER, 1943

GARDEN ATTENDANCE:	
Total number of visitors	20,823
PLANT ACCESSIONS:	
Total number of plants and seed packets received as gifts	342
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	5
Total number of books and pamphlets donated	311
HERBARIUM ACCESSIONS:	
By Purchase—	
Tharp, B. C.—Plants of Mexico collected by H. LeSueur	960
Waterfall, U. T.—Plants of western Texas	640
By Gift—	
Anderson, E.—Plants of California	18
Bettis, Mrs. J. R.—*Triosteum perfoliatum* L. from Missouri	1
Darrow, Robert—Lichens of Arizona	29
New York Botanical Garden—Lichens of northern India	70
Moran, E. C.—Lichens of Montana	16
Smith, Harrison W.—*Ravenala madagascariensis* J. F. Gmelin, "Traveler's Tree"	1
Waterfall, U. T.—Plants of western Texas	17
Whetzel, H. H.—*Sclerotinia caricis-ampullaceae* Nyberg, from Wyoming	1
By Exchange—	
Demaree, Delzie—Plants of Arkansas	1,000±
Rocky Mountain Herbarium—*Sphaeralcea procera* Porter, from New Mexico	1
State Teachers College, River Falls, Wisconsin, by Catharine Lieneman—Plants of Wisconsin	86
University of Texas, by B. C. Tharp—Plants of Texas	91
Total	2,931

STAFF
OF THE MISSOURI BOTANICAL GARDEN

THE GARDEN, 2315 TOWER GROVE AVENUE, ST. LOUIS, MISSOURI

GEORGE T. MOORE,
Director

HERMANN VON SCHRENK,
Pathologist

JESSE M. GREENMAN,
Curator of Herbarium

CARROLL W. DODGE,
Mycologist

EDGAR ANDERSON (on leave),
Geneticist

ROBERT E. WOODSON, JR.
Assistant Curator of Herbarium

HENRY N. ANDREWS,
Paleobotanist

ROBERT W. SCHERY (on leave),
Research Assistant

NELL C. HORNER,
Librarian and Editor of Publications

GEORGE H. PRING,
Superintendent

JOHN NOYES,
Consulting Landscape Architect

WILLIAM F. LANGAN,
Chief Engineer

JOSEPH LANGEN,
Assistant Engineer

ALBERT PEARSON,
Painter

PAUL A. KOHL,
Floriculturist

DAVID C. FAIRBURN,
Horticulturist

JOSEPH CUTAK,
In charge of Exotics

LADISLAUS CUTAK,
In charge of Succulents

THE ARBORETUM, GRAY SUMMIT, MISSOURI

AUGUST P. BEILMANN,
Manager

ROY E. KISSICK,
Engineer

FRED WEGLOENER,
Orchid Grower

REPRESENTATIVE IN THE TROPICS

PAUL H. ALLEN,
Balboa, Canal Zone

REPRESENTATIVE IN EUROPE

GURNEY WILSON, F. L. S.,
Hove, Sussex, England

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until sunset; Sundays, 10:00 a. m. until sunset. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah car line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

Maidenhair tree growing at the residence of Mr. John S. Clark, Bryn Mawr, Pennsylvania. (See Note on page 198.)

Missouri Botanical Garden Bulletin

Vol. XXXI DECEMBER, 1943 No. 10

THE CHRISTMAS CACTUS AND ITS CULTURE

Zygocactus truncatus sounds rather formidable, yet it is only the scientific name of an old-fashioned house plant familiar to most of us as the Christmas Cactus or Crab Cactus. Both common names seem appropriate, the former being the more popular because it suggests its flowering season, while the other refers to the peculiar shape of the short flattened joints. Many oldtimers still insist upon calling the plant *Epiphyllum truncatum*, and this name is often found in cactus catalogues. Adrian Haworth, a keen English student of succulent plants, gave the Christmas Cactus this erroneous scientific name in 1819, which has prevailed for more than a century. No doubt he was fooled by the flattened, leaf-like joints or stems which are so characteristic of the genus Epiphyllum which he himself authored in 1812. However, if one studies the flowers of the Christmas Cactus, it will be seen that they are unlike those of any of the true Epiphyllums and therefore cannot be included in that group. Dr. Schumann, the German cactologist of a half century ago, realized Haworth's error and corrected it by excluding this species from Epiphyllum and proposing it as a type of a new genus, Zygocactus, in 1890. From this short history of the plant, it is evident, if you want to be botanically correct, that you must call it *Zygocactus truncatus*.

About this time of the year we are beseeched with letters and telephone calls from people seeking information on how to flower the Christmas Cactus. It is hoped that the notes contained herein will guide the home gardener toward a better understanding of the needs of this holiday favorite. A properly grown plant is truly a beautiful sight.

The Christmas Cactus is native to the mountains in the State of Rio de Janeiro, Brazil. It shares its home with the ferns, orchids, and other tropical plants that inhabit the trunks and branches of trees in the forests. In the wild state the plant prefers to live an aerial life, high above the forest floor, where it receives subdued sunlight and derives most of its food from the air

and decayed humus that abounds in the crotches of branches and fissured bark of trees. When we attempt to grow this cactus in our homes we should strive to treat the plant as a jungle inhabitant rather than as a desert species.

Culture isn't at all difficult. Since the plants are epiphytic in their native home, some attention must be given to the kind of soil in which they will thrive best. Opinions on this matter will vary with the different growers, but we have found that an equal mixture of light loam, well-rotted leaf-mold and sand suits their needs admirably. If well-rotted cow manure can be obtained a little of it should be added, and by little we mean three to four good handfuls to about a half bushel of soil. The plants will require plenty of water, especially in the growing season. How often it must be given depends on the soil, temperature, and the time of the year. These needs will be discussed later.

Generally, Zygocactus starts blooming in November and finishes in March, although the heaviest flowers are usually produced in December or January. A rest period of 1–1½ months follows the blooming season. During this time the plant will have a tendency to become weak and drooping, some of the joints even dropping off, but this need not cause any alarm. The amount of water should be greatly reduced or only enough given to keep the soil from becoming very dry. Usually two or three waterings will suffice during this rest period. After dormancy the shrivelled joints take on a healthier appearance and new stems develop. When the warm months come the plants may be taken outdoors and placed in a well-lighted location, but not in direct sunlight or where they will be exposed to the sun all day long. Porches are ideal places. Plants that are left outdoors part of the year seem to grow sturdier and are given an opportunity to ripen their wood more thoroughly. An occasional application of liquid manure during the summer will do much good. Daily syringing is recommended and is as refreshing to the plant as a shower is to us. When liquid manure is not available, any complete plant food can be applied at three-week intervals.

During the fall another short rest period is advocated. It may be started about the middle of September and continued for a month or two. This means that sprinkling will have to be reduced again, only enough water being given to keep the ground from drying out. Any immature links or joints, easily recognized by their smallness and weakness, should now be pinched off. In the St. Louis area the Christmas Cactus should be brought indoors about the end of September, unless mild weather prevails a little longer. The rest period may be started outdoors or postponed until the plants are brought inside. Through the withholding of water, the growth

Zygocactus truncatus grafted on *Pereskia aculeata*

A massive Christmas cactus *(Zygocactus truncatus)* grown on its own root

Flowers of the Christmas cactus

is hindered and the plants are forced to a strong formation of buds. When the tiny buds begin to show, the amount of water may be increased. Usually watering every other day is sufficient to keep the soil moist but not soggy. While the buds are forming it is advisable not to sprinkle plants from overhead, not to move them about, and to avoid drafts. The lack of such precautions may cause the buds to blast and fall off without reaching maturity. A sudden change in temperature is also injurious. Only when the blossoms begin to unfold can the plants be moved about or sprinkled. The temperature need not be too high during the development or flowering stage, 60 to

70° F. being ideal. Of course, higher temperatures will force flowering sooner, but this is not recommended.

The Christmas Cactus need not be transplanted often. A plant can be kept in the same container for four to six years as long as the drainage is perfect, the soil light and porous, and plant food given in season. We have found that plants will flourish and flower even if grown on their own roots, but since the branches are rather weak the flowers have a tendency to hang below the container where they are not seen to advantage. For this reason grafted specimens are desirable, especially on tall stocks where they form umbrella-like heads. Zygocactus is easily grafted onto the slender stems of Pereskia, Opuntia, Hylocereus, and Selenicereus. In grafting, a small branch with three to five links is fastened onto the stock by either the side- or cleft-graft method. Directions for cleft grafting are very simple. With a sharp clean knife cut the stock to a desired height and make a slit at the top about an inch long. Then cut the stem of the scion on each side to form a wedge and insert this into the slit of the stock. One or two cactus thorns will keep the graft in place, but it is recommended to bind the union with raffia or twine to keep the cut surfaces from spreading open. The side graft is likewise easily accomplished. Shave off about an inch square of the epidermis on one side of the stock, do the same on the scion, then attach the cut surfaces with a spine and bind securely. A two- to three-jointed Zygocactus grafted on an Opuntia, Pereskia, or a night-blooming Cereus grows amazingly fast and in two or three years should produce a wonderful head.

There is only one species of the Christmas Cactus but there are many forms produced through hybridization, and the colors of the flowers run the gamut of brilliant shades from pink to purple, scarlet, orange and red.

L. C.

THE ARBORETUM WOLF PACK

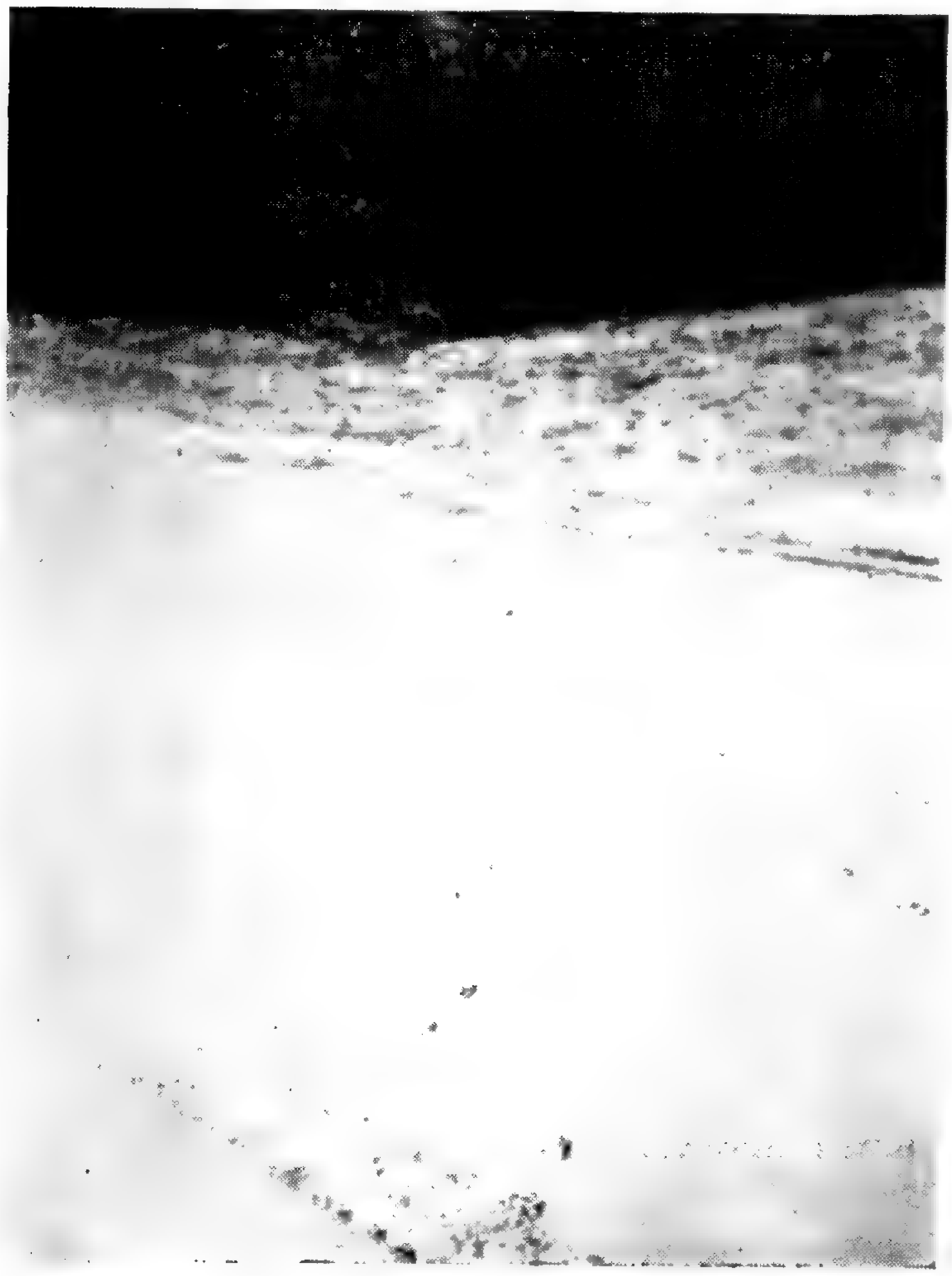
Wherever local sportsmen gather, the subject of wolves—especially Arboretum wolves—is sure to be thoroughly discussed. And all "sure" methods of hunting and killing them are reviewed in great detail. Every one has just the dog, the right gun, and the experience needed to do the job. Fortunately, the fact that the Arboretum is an inviolate game refuge and no hunting is permitted without the express permission of the Conservation Commission has prevented a wholesale testing of theories on this property.

The city dweller will probably doubt the existence of wolves, in this day and age, so close to St. Louis. However, a recent publication by the Wildlife Service of the United States Department of Interior states "that the beast has shown remarkable adaptability to the changes brought about by civilization . . . that within the last 12 years it appears to have become established in nearly all of the Eastern States."

In general, it may be said that the food habits of certain individual wolves make the animals of considerable economic importance to live-stock and poultry raisers. If a wolf begins raiding a chicken yard he is likely to continue until killed. Our own experience indicates that at least some complaints concerning the killing of live stock, more particularly poultry, are based on fact. We have seen feathers from many chicken dinners piled about the dens in early spring. However, the Wildlife Service concludes, after an examination of nearly 9,000 wolf stomachs, that 76 per cent of the animal's food is made up of rabbits, rodents, and carrion. To this extent, at least, their activities are not inimical to man.

To give the neighbors some relief, two "Wolf Drives" were organized, one on November 11, 1942, and another on January 21, 1943. Both were under the direction of Mr. L. N. Elson, the Wildlife Conservation Agent for Franklin and Gasconade counties. On both occasions many trained dogs and a number of competent hunters participated, and although wolves were seen both times none was killed. In most instances these animals stay far out of shotgun range and ordinarily are taken by shotgun only when trained dogs are used for trailing and driving them. Since the customary method of hunting—the wolf drive—had failed to produce results, it was decided to use a high-powered rifle and depend on skill and woodcraft to obtain some specimens.

It is necessary to know the life history and to study the habits and daily routine of the wolves before hunting can be attempted. It is obvious from what has been written that these animals are quite capable of existing and even increasing in the face of all opposition and in spite of modern agricultural practices. A few instances will serve to show the sagacity of these beasts. In February, after photographing some beaver work, the author discovered a single wet footprint on a log used as a stair tread. The condition of the track and the weather conditions of the day indicated that the animal had passed but a few minutes previously. Continuing a policy of studying their habits whenever possible, both day and night, these tracks were immediately followed as quietly and as quickly as possible. It might be observed here that wolves rarely step on any spot which will leave a clear track. For instance, they avoid snow, always walking on ice in preference



A wolf "crossing" showing characteristic tracks

to snow and following any depression holding water for the express purpose of leaving no clue. With this in mind the tracks were followed for a quarter of a mile until they reached a fire-trail covered with snow. It was by then apparent that two animals were traveling together since they left a very clear and easily followed trail through the unmelted snow. These tracks were so suspiciously clear that they purposely were ignored and the real trail was carefully searched for in exactly the opposite direction. About 30 yards farther south, the finding of an occasional track proved that the surmise was correct. These wolves had attempted to throw off pursuit by leaving a very clear track through the snow bank, and, circling about on frozen ground, struck off in the opposite direction. There seems to be little doubt but that this pair of animals sat down to watch the performance; to discover whether or not they had thrown off pursuit. About 25 yards farther on clear tracks were found showing that they had waited and finally jumped to land about 12 feet off the trail. From this point all tracking

became increasingly difficult. An occasional footprint could be found every 5 to 10 yards, but the trail was lost on the next ledge an eighth of a mile away. However, this performance was verified, insofar as such behavior is ever able to be proven, when the same pair of wolves passed a crew of men in a clearing a half a mile away, about an hour later.

Eventually one of this pair was killed, but for some weeks previous they followed the same routine, passing over this trail and crossing a clearing within an hour of the same time every day. To a large extent these animals are nocturnal. They are almost never seen in summer and only for a short time before the pups are born, in February or March, are the pairs found traveling together in daylight.

The only time they become careless about their tracks is in the vicinity of the dens. For a distance of 20 yards about the den one can find piles of feathers and fur and several well-beaten tracks leading to and from it. It is known that the litters contain at least 3 pups and perhaps many more. Whelping time may be as early as January. However, on these points, our experience is very limited. The den is often an enlarged ground-hog hole, and while sufficiently obvious when found, it is always in some obscure section difficult to locate. Usually some vantage point close to the den commands a good view of the surrounding country. Needless to say, such a vantage point also permits one of the adults to "test" the air. On several occasions these animals have shown that they can scent a man well over 500 yards.

We have no first-hand knowledge concerning their eyesight, but their utter disregard for a crew of workmen, as contrasted to their great caution when near an armed hunter, leads one to believe that there is no deficiency in any of the senses. In regard to the track itself it differs but slightly from that of a dog. It is longer, the middle toes being longer, and there is a strong tendency to place the back feet in the print of the fore feet when traveling at certain speeds. Perhaps the best distinguishing feature in the snow is the straight line from point to point. Sometimes a wolf will travel for one-fourth of a mile leaving a track so straight that it might have been laid out with a transit, while a dog always wanders about and never travels in a straight line. These two differences are perhaps the best distinguishing features of the track. The wolf normally has several gaits. It may travel in excess of 25 miles from sunset to sunrise. During the winter one particular set of tracks on light snow in open country showed a footprint every 7 feet. This obviously was a large animal traveling very rapidly at a characteristic lope. Here again the back feet were placed exactly in the marks of the fore feet.

As has been stated, the customary method of hunting has been a "Wolf Drive." In this case a number of trained dogs are released about sunrise after a number of men were posted at "crossings" in the woods or at the edge of the timber. If the dogs are successful in finding a cold trail or jumping a wolf that has bedded down, the animal is almost certain to pass the post of some hunter. This method has not been successful at the Arboretum. Perhaps there is a certain amount of dog mixed with these wolves; perhaps there are other factors involved. At any rate, the dogs which had successfully trailed in neighboring districts were unable to trail any of those at the Arboretum. In two instances, dogs were brought on a hot trail within a few minutes after the wolf had passed.

Hunting with a rifle has been more successful. In the 12-month period, from midsummer of 1942 to midsummer of 1943, eight animals have been killed. The first four showed no wolf blood in either markings or size, and were dismissed as wild or stray dogs, but on December 23 a genuine wolf was killed. This was the male of a pair which had been tracked many times previously. On this particular evening he lost some of his caution, although none of his speed, and passed within 100 yards of the writer who was posted in a group of pines. The animal was hit once with a .348 Winchester but continued to travel at considerable speed for another 20 minutes. He was lost at dark but found dead the following morning. His hide, which is now in the Arboretum office, has a good deal of white down the middle of the stomach and much red about the eyes and ears. This color and the quality of the fur led Mr. Paul Schwarz, the taxidermist who mounted the hide, to consider the animal as part dog. However, the denture was distinctly wolf-like. The lighter color proved to be not far from that of one of three half-grown wolves which with their parents were shot while rustling food late in the morning of April 21. All three had the same dentures; two showed no white marks, while the third was marked exactly like the adult previously described. From this it will be seen that some dog blood may be present in these beasts which in turn may account for the failure of the hounds to trail the quarry.

One pup was shipped to Dr. R. Bennitt at the Wildlife Laboratory in Columbia, Missouri. Mr. Frank Sampson, of the same office, identified the animal as the Timber Wolf *(Canis nubilus)* and stated that this species may reach 75 to 80 pounds in weight. The other two pups were sent to Dr. Robert J. Terry for a study of the denture, following his wish for specimens to compare with that of the dog.

It will be seen that the Timber Wolf is now a resident of the Arboretum. It is very unlikely that any visitor will ever see a specimen, and much less

likely that it will prove dangerous. However, unfortunately for our neighbors who are poultry raisers, it is also unlikely that these animals will be entirely eradicated.

Insofar as the Arboretum is concerned, we hope it will not be necessary to kill all of these animals. They have a place in the balance and interplay of natural forces which cannot be occupied by any other animal. In short, they control our rabbit population. Without the wolves it would be necessary from time to time to stage very determined rabbit drives. The wolf is a competent natural check to the rabbits, and we feel it will be easier to keep the wolves in check than it would be to protect the nurseries, seed-frames and many plant groups from depredation of rabbits.

Full-grown male wolf shot December 23, 1942

A. P. B.

WINTER COURSE IN GARDENING FOR AMATEURS

A course in flower and vegetable gardening for amateurs, calculated to give the students as much practical work as possible, will start in February, 1944. The classes will be held in the experimental greenhouses, Tuesdays, 10:00 to 12:00 a. m. The course will be in charge of Dr. Fairburn.

REGISTRATION: It is desirable that registration be made by letter, with check enclosed payable to the Missouri Botanical Garden, as soon after January 1

as possible. Tickets will be distributed at the experimental greenhouses on day of first lecture.

FEE: The registration fee is $15.00 per student, and tickets are not transferable.

OUTLINE OF GARDENING COURSE

February 1—
The selection and care of house plants. Methods of forcing bulbs into flower during winter.

February 8—
The relation of soil to plant growth. Preparation of fertile garden soil and methods of testing fertility.

February 15—
How to improve soils by the use of fertilizers.

February 22–29—
Vegetable gardening. The planning, planting and general care of the family vegetable garden. Varieties that grow well in this climate.

March 7 to March 28—
Plant propagation. Four class periods will be devoted to this important phase of gardening in order that the students may become familiar with a wide variety of plants and practice raising them from seeds and cuttings. Plants raised in class may be taken home by the students.

April 4—
Students will pot up plants raised from seed.

April 11—
Students will pot up plants raised from cuttings.

April 18—
Identification and control of common garden insects and diseases.

April 25—
Landscaping the home grounds. Preparation and care of lawns.

May 2—
Garden work demonstrated:
Pruning trees and shrubs.
Transplanting trees, shrubs, perennials.
Digging and preparing flower beds.
Application of lime and fertilizers.
Planting annuals and perennials.
Cultivating.
Spraying.

NOTES

Dr. George T. Moore, Director of the Garden, spoke before Town and Gown, November 19, on "Botany in the War."

Mr. Clint McDade, owner of Rivermont Orchids, Signal Mountain, Tennessee, and Trustee of American Orchid Society, visited the Garden recently.

Dr. Carroll W. Dodge, Mycologist to the Garden, addressed the Institute on Middle America, November 24, his subject being "The Contemporary Culture Pattern."

The October number of the *Bulletin of the Garden Club of America*

(No. 16, 8th ser., pp. 18-19) contains a paper by Dr. Edgar Anderson, Geneticist to the Garden (on leave), on "Some Indian Uses of Corn."

Dr. Edgar Anderson, Geneticist to the Garden (on leave), and Dr. R. H. Barlow have contributed a note in the November number of *Tlalocan* (**1**[2]:159-160) on "The Tlacopintli."

The Rover Club, a group of Washington University faculty wives interested in historic St. Louis, visited the Garden recently where they were conducted on a special tour of both of Henry Shaw's old residences.

Dr. Robert W. Schery, Research Assistant to the Garden (on leave), who has been working at the Garden for the last few months while recovering from illness, has returned to his position with the Rubber Development Corporation, at Fortaleza, Brazil.

The science students of Moberly Junior College, Moberly, Mo., conducted by Miss Esther Adams, instructor in biology, visited the Garden on November 30 and were shown through the herbarium, library, and greenhouses.

"Orchids at the Missouri Botanical Garden," a paper by Dr. George T. Moore, Director of the Garden, from the February 1942 Garden BULLETIN has been reprinted in the November number (**12**:191-197) of the *American Orchid Society Bulletin*.

The November number of *Home Garden* (**2**:[3]) contains two papers by members of the Garden staff: "Counter-attacks on Indoor Plant Pests" (pp. 68-70), by David C. Fairburn, Horticulturist to the Garden; and "How to Propagate Tropical Water-lilies" (pp. 71-73), by George H. Pring, Superintendent of the Garden, and Helen Van Pelt Wilson.

The fourth number of Volume 30 of ANNALS OF THE MISSOURI BOTANICAL GARDEN was issued in November, containing the following papers: "Sweet Corn in Jalisco," by Edgar Anderson and Isabel Kelly; "The Maize Tribute of Moctezuma's Empire," by Edgar Anderson and R. H. Barlow; "On the Vascular Anatomy of the Cycadeoid Cone Axis," and "Contributions to Our Knowledge of American Carboniferous Floras. VI. Certain Filicinean Fructifications," by Henry N. Andrews; "Some Hourly Observations of Tree Growth," by August P. Beilmann; "Segregation, Mutation, and Copulation in *Saccharomyces cerevisiae*," by Carl C. and Gertrude Lindegren; "A Variety of Maize from the Rio Loa," by Edgar Anderson.

In the May, 1943, number of the BULLETIN the question was raised as to the location of the largest Maidenhair Tree *(Ginkgo biloba)* in the United States. There seems to be no doubt but that the first plantings of this tree

were in Pennsylvania, possibly the oldest being the one started by William Hamilton in 1784 at "Woodlands," near Philadelphia. Now comes the information that another Pennsylvania tree is a close contender for the record. This tree is growing at the residence of Mr. John S. Clark, Bryn Mawr, Pennsylvania, and the measurements as vouched for by Mr. Clark are as follows:

Height—80 feet ("Six years ago lightning struck the top of the trunk breaking off 20 feet; otherwise I would claim 100 feet")
Spread—80 feet
Trunk, 2 feet from the ground— { diameter, 4 feet / girth, 12 feet
Trunk, 6 feet from the ground— { diameter, 3½ feet / girth, 11 feet

Of the historic Henry Clay Ginkgos at Lexington, Kentucky, only one is in the first rank as to height (75–85 feet), and none approaches the Pennsylvania trees in spread or girth.

STATISTICAL INFORMATION FOR NOVEMBER, 1943

GARDEN ATTENDANCE:

Total number of visitors	29,989

PLANT ACCESSIONS:

Total number of plants received as gifts	12

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	22
Total number of books and pamphlets donated	261

HERBARIUM ACCESSIONS:

By Purchase—	
Tolstead, W. L.—Plants of Texas	160
By Gift—	
Ball, Carleton R.—*Salix* from the Eastern and Central United States	13
Hester, J. Pinckney—Photographs of *Agave*	14
Hubricht, Leslie—Plants of Virginia	43
Schery, Robert W.—Plants of Brazil	66
Tolstead, W. L.—Plants of Texas	211
U. S. Department of Agriculture, Forest Service—Plants of Panama	22
By Exchange—	
State College of Washington, by William A. Weber—Plants of "Pacific Northwest"	500
University of Texas—Plants of Texas	2,914
University of Washington—Plants of California and Mexico	77
Total	4,020

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Figures in *italics* refer to page numbers of plates and cuts.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

THE GARDEN, 2315 TOWER GROVE AVENUE, ST. LOUIS, MISSOURI

GEORGE T. MOORE,
Director

HERMANN VON SCHRENK,
Pathologist

JESSE M. GREENMAN,
Curator of Herbarium

CARROLL W. DODGE,
Mycologist

EDGAR ANDERSON (on leave),
Geneticist

ROBERT E. WOODSON, JR.
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HENRY N. ANDREWS,
Paleobotanist

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Research Assistant

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In charge of Exotics

LADISLAUS CUTAK,
In charge of Succulents

THE ARBORETUM, GRAY SUMMIT, MISSOURI

AUGUST P. BEILMANN,
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Engineer

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Orchid Grower

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Balboa, Canal Zone

REPRESENTATIVE IN EUROPE

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Hove, Sussex, England