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Cover: Wind sculpture at the Arboretum. Photograph by William E. Condray.

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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 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. 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 bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

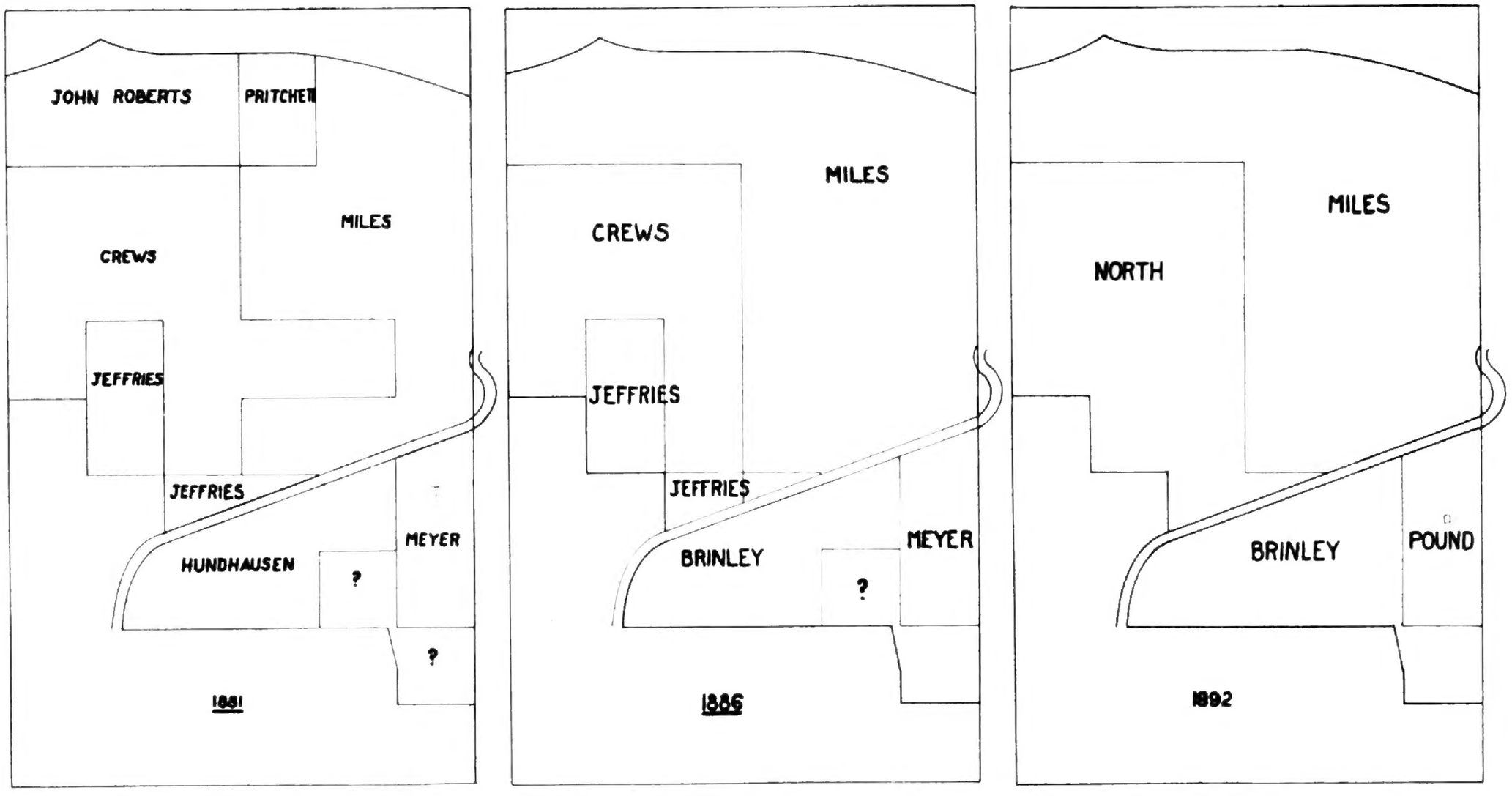


Fig. 1. Charts showing ownership of Arboretum land through the years.

Missouri Botanical Garden Bulletin

Vol. XXXVI JANUARY, 1948 No. 1

FIFTY-NINTH 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, 1947.

One consideration that led to the location of the Arboretum on the 1600-acre tract just beyond Gray Summit was the junction at the main entrance of two major highways (66 and 50). It is interesting to note that this same tract must have been of importance from earliest time because of its accessibility. An area that could be readily reached was just as valuable to the Mound Builders, the Indians, and the settlers who followed them, as it is to us to-day.

Rivers have always been highways. There are many reasons why men followed the streams, besides the fact that the river followed the easiest gradient across the country. To the woodsman, fresh water, plant food and game were to be found in greatest abundance in the vicinity of waterways. To him it was the equivalent of the modern super-highway.

The Arboretum, lying on the northern fringe of the Ozark Uplift at a point where less than seven miles separate the Meramec and the Missouri Rivers, in all probability saw a great deal of this early traffic. If we examine the topography of the area, we shall see that the game trails and the trader's paths must have followed the high ground between the Missouri and the Meramec Rivers. The high ground was probably open prairie, or at least park-like, and so the westward trails must have passed very close to the Arboretum, following an easy grade lined out by the buffalo.

Visitors going through the Arboretum to-day always express surprise when told that the area was farm land when purchased by the Garden. Most of the fences have been taken down and so many other changes have occurred that it is difficult for them to believe the plow was ever used on this soil. As a matter of fact, the area had been farmed for more than one hundred years before the Garden acquired title. Ownership to the eighty

acres in which the Box Garden is now located, was perfected by John Reed, Jr., on May 2, 1828. This is the oldest piece of land from the standpoint of clear title. This doesn't mean that the area was unoccupied at an earlier date. The Spaniards, a hundred years before, had moved cautiously in this region and the French who followed them settled here.

Even though land titles were not patented until a little over one hundred years ago, we may be sure some homesteading occurred much earlier, since Point Labadie was begun in 1802. The need to prove ownership and acquire title became necessary only as more and more settlers arrived. By 1832, title to most of the land in the area had been transferred from the United States to some individual. There were a few exceptions, however; all of Section 16 was reserved for school purposes, and most of this was not transferred to individuals until nearly 1850. This is the eastern portion of the Arboretum, the title to which was transferred from the United States to the State of Missouri, February 2, 1825, and thence to individuals in later years. Minor changes in ownership were continuous, with John Roberts appearing as a large landowner about 1850. Extensive land exchanges occurred only sporadically, but by 1881 the ownership had changed very greatly (fig. 1). By 1886 some of the holdings had been consolidated and the entire property was in the hands of five owners. The succeeding six years saw another change in ownership so that in 1892 there were just four owners of the 1600 acres.

ARBORETUM ACTIVITIES

One of the hardest jobs at the Arboretum during the year was the salvaging of the tornado-downed timber in Hidden Valley, the tract of land donated to the Garden by Mrs. Oscar Johnson and Mr. Fairfax Funsten in 1942. The logging operation began on January 6 and continued every day until May 12, except for bad weather and press of other work. The size of the logs and the effort required of each individual and the machinery to move them were all on a Bunyanesque scale. This was a most spectacular logging operation, the logs being taken out on a cable-way which stretched 3,000 feet through the hills. The special equipment was designed, rebuilt, and freed of "bugs" by our own men. Twenty-five loads of logs were hauled to our mill; when sawed these yielded 25,803 board feet of lumber.

During the first half of the year work at the Arboretum was often interrupted by rain and soft ground. The last rain of the season (2.2 inches) fell on July 1, after which hot and dry weather prevailed until September 11, when a good shower fell. During the dry period 111,700 gallons of water were hauled by tank truck for irrigation purposes, which far exceeds any previous use at the Arboretum. This summer broke several records for

sustained hot weather, and virtually every plant showed some sign of distress. A few plants were lost in the Pinetum, but irrigation and mulching kept the rest alive and no species are missing as a result of the dry summer. The nurseries which were laboriously whipped into shape during the wet and difficult spring remained clean and weed-free until August 18. By this time a weed cover would have been most welcome; either weeds or mulches can reduce soil temperatures very appreciably. Little damage occurred in the nurseries devoted to woody plants, although temperatures were high enough to reduce yields of corn and soybeans in nearby fields. The nurseries now contain 17,153 plants; 4,082 propagations, mostly from selected specimens on the grounds, were made during the year. The major new plantings include that at the Main Gate, an elaborate one in the Rhododendron Valley, the area about the Box Garden entrance, enlargement of the azalea beds, the establishment of a Bee Garden, and a beginning toward the development of a Woodland Garden. Altogether, 633 plants of all sizes and species were moved to permanent locations.

The dragline was first sent to the river bar on July 16, to load gravel. Enough gravel was hauled (over 6,000 cubic yards) to resurface Cliff Ridge Trail, North Trail, much of the new East Road, Rhododendron Trail, Woodland Trail (new), and portions of the Main Roads. Later in summer the dragline was moved to Wood-duck Lake, where 4,000 cubic yards of soil were removed and hauled to ditches and low spots in the nursery. As a result, this little lake near the East Bridge has a capacity of about 1,090,000 gallons of water when full; it will serve as a source of irrigation water for both the nurseries and the Boxwood Garden. Work on the north road edge and fence line facing the Old Pacific Road was begun in the spring, and after an interruption was resumed in the fall. Since the grade of the county road bore little relation to the adjoining fields the sharp banks were cut down and some of the low spots filled so that a shelter-belt might be planted and a permanent fence erected. This operation, which requires the dragline and two trucks, is often interrupted by rain and press of other work, but so far 1,159 loads of soil have been carried by truck to near-by ditches.

Farming south of the Meramec River went ahead as usual. The yield of wheat, rye, corn, and soybeans was lower than in previous seasons due to the dry hot summer. Soybeans are still in the field, but all other crops have been harvested on time. One hundred tons of corn were cut for silage to feed the beef cattle during the winter. The combine was used to harvest 1,200 pounds of red clover seed to be sown along with the small grains. The Aberdeen-Angus herd now numbers 52 head, of which 14 are being used on the Arboretum pastures to supplement mowing.

Tractor mowing required 603½ hours—an appreciable reduction due to cattle grazing on the fields and the fact that the tractor was used for filling ditches. Cutting brush, which seemingly will always be a problem, used 1,340 man hours. The reservoir was emptied and cleaned for the first time since it was filled in November, 1939, more than a little trouble being experienced in refilling it. The shallow well near the River proved able to supply only half of the usual 7,500 gallons per hour. It failed altogether when the reservoir was nearly full, due partly to the intermittent pumping, and apparently another well must be drilled next summer. The reservoir was filled when completed November 28, 1939, additional water being pumped in February and June of 1940; it was refilled in August, 1943, but not again until November of this year. In spite of the tremendous amounts of water which are annually drawn off, we have found that the rainfall and the condensation were sufficient to add five or more feet of water each year and thereby keep the reservoir full.

The crabapples and the narcissus, although giving a somewhat belated display, were so attractive that 636 cars of visitors came to view them during April and May. This is the greatest number of visitors we have ever had in spring. About 5,000 people visited the Arboretum during the year, including members of many garden clubs and other organizations meeting here in the summer.

The stone and brick laboratory designed for research in horticulture, particularly in connection with breeding hybrid orchids, was completed during the year. The equipment is still to be installed. Considerable progress was made in the construction of a suitable main entrance at the Arboretum. The stone work and iron gates were finished, but the placing of the urns, the completion of a hard road, and most of the planting remain to be done. Both of the above projects were made possible through contributions made to "The Friends of the Garden" fund.

The management of the Arboretum is under the direction of Mr. A. P. Beilmann.

ORCHID DEPARTMENT

Orchids were displayed in the alcoves of the Aroid House at the City garden throughout the entire year, the plants being brought in from Gray Summit every week. Included in these displays were representatives of the seventy-five showy genera which are grown in the greenhouses at the Arboretum. The annual orchid show, in February, filled the four alcoves of the Aroid House and two additional stages at the west end of the House. The English Lady-slippers that had recently reached maturity were staged in one alcove and formed a feature of this show.

For experiments in gravel culture at the Arboretum, another bench, 100 x 5 feet, has been planted in the newly constructed house between the Dendrobium House and *Cattleya gigas* House. Two 50-foot benches were built and planted in the house paralleling the boiler house. One of the 50-foot benches in the Dendrobium House was used for hydroponic culture, being planted with 450 old plants badly in need of transplanting. The plants responded well and were in production during Christmas.

One problem during the war was the inability to obtain peat for use in transplanting flowering plants, the normal requirement being 100 bales annually. Recent decreased flower production definitely showed the need for repotting orchids every second year. Since an adequate supply of peat has again become available 19,469 flowering plants have been transplanted. The entire collection of Cymbidiums was divided for the first time in four years, resulting in 1,471 specimen plants of which 1,270 back bulbs were planted in the hydroponic bench for propagation. Nearly 3,200 hybrid Cattleya seedlings were planted in two side benches, 5,000 seedlings in benches of the new greenhouse, and 2,575 in pots, using Meramec gravel and peat. About 275 community pans were filled with seedlings transplanted from flasks; and 500 seedlings of *Dendrobium nobile* hybrids, which were in two-inch pots in peat, were placed in the gravel bench to stimulate growth. Since these are used in the annual orchid show it is necessary for the flowering plants to be in individual pots. The Dendrobiums of the deciduous type make excellent growth in the open bench, but flower development cannot be controlled by decreasing temperature and moisture.

Mr. G. R. Lowry is the present orchid grower.

REPAIRS AND MAINTENANCE

As the result of the damage from a small "tornado" in September, 1946, much extra outside work has been necessary during the past year. While the walks were cleared of fallen trees and dangerous branches almost immediately, most of the cleaning-up work took place in 1947. During the winter and spring 76 large trees, including their stumps, were removed from the main garden. Broken or split branches on the larger trees required heavy pruning, particularly the upper branches. In all, 150 trees were treated, including elm, cottonwood, willow, box-elder, sweet gum, ash, locust, mulberry, ailanthus, soft maple, osage orange, oak, catalpa, magnolia, and birch. In the spring the larger trunks and branches were cut up for cord wood, and over 500 truck-loads of brush were stacked and burned. The area west of the Economic Garden, which was badly damaged by the storm, has been cleared of surplus trees, opening up an area to the west from the north to the south entrances of this garden. This area has been plowed, harrowed, graded, and planted to blue grass.

Reglazing.—The gable ends of the Palm House, Cycad House, Economic House, and Floral Display House, which had been damaged by the storm, have been entirely reglazed. Double-strength ground glass, 24 x 24 inches, was used, being lapped ½ inch and supported by clips. To prevent periodical slipping of the glass, H-shaped strips, either of lead or zinc, were used. The two sizes of heavy glass on the north and south gable ends of the Palm House were already on hand, having been bought and held in reserve since the 1928 storm. All Linnean House vents which were replaced in October, 1946, came in for a second damage on January 30, when one-fourth of those on the west end were blown off. Reglazing not being possible on account of the weather, the open area was boarded over temporarily. During the winter the 150 feet of broken vents were rebuilt and in August were replaced on the roof.

Damaged Roof Areas.—The storm damage to the Main Gate buildings did not become evident until the melting snow and ice leaked through the roofs. This necessitated resurfacing parts of the roofs on the office and rest-rooms. The tar-paper roof on the old barn was so damaged that the entire area was recovered.

Walls and fences.—The break in the brick wall at the east end of the Linnean Garden was repaired, as were the large broken areas in the rock wall on Tower Grove Avenue, due to falling trees. Over 100 pickets in the iron fence on Magnolia Avenue which had been broken by the storm were welded back into place.

Sewers.—During the last four or five years periodical blow-outs occurred in the large Alfred Avenue sewer which extends from the North American Tract Lake to Shaw Avenue. The 20 inches of rain during August, 1946, definitely proved the sewer incapable of carrying the backwash of water from Tower Grove Park, Magnolia Avenue, and our own drainage system. The flood waters in the main garden, being unable to enter the sewer, backed up in the boiler house and the tunnel under the Palm House. During the September storm the plaza area opposite the Main Gate was flooded above the coping of the pools. The only way to obtain permanent relief from this condition is to divert the water from the Tower Grove Park water-lily pool area into the Tower Grove Avenue sewer. The repair of the Alfred Avenue sewer necessitated excavating over 500 feet of pipe.

When an excavation was made to learn the reason for continued floods in the basement of the Main Gate office, the footings of the building were found to be resting on an old brick cistern from Henry Shaw's time at the south side of the House. At the west side of the office below the founda-

tions an old rock sewer was uncovered. In order to remove the rock sewer (which evidently was causing the major trouble in the basement) the foundations of the office building were deepened and the footings continued below the cellar floor.

Walks.—Due to lack of materials none of the walks in the Main Garden were repaired during the war. The September storm left them in such poor condition that a major rebuilding was demanded. However, since the high bids received from the contractors would permit only a small area being done, it was decided to use Garden labor. The greater part of July and August was devoted to this work. Two applications—the first of cut-back asphalt on half-inch macadam, and the second, penetration asphalt with torpedo gravel covering—were given the walks in the Linnean and Italian Gardens. Those in the Economic Garden had to be entirely rebuilt since the original asphalt covering was on a cinder base, and six inches of cinders and old macadam had to be removed. All the main garden walks were covered with a single penetration treatment, and broken-down areas were treated with half-inch macadam and the double application. Since the old cinder road from Alfred Avenue to the Old Residence caused considerable trouble in the summer with dust blowing west to the Alfred Avenue residences, it was made an all-weather road.

The Garden walk area either rebuilt or resurfaced amounted to 15,263 square yards. Total material used: 247 tons of torpedo gravel; 343 tons of one-and-a-half-inch macadam; 77 tons of half-inch macadam; 2,050 gallons of cut-back asphalt, and 11,635 gallons of penetrating asphalt. Labor used: 2,244 man hours.

We would have been unable to accomplish this road building without the cooperation of Tower Grove Park and Washington University from whom we obtained necessary road equipment.

Steamlines.—The steam pipes in the greenhouses have been in operation between thirty and thirty-five years. A number of the coils required clamps over pin-hole leaks, and some had been disconnected entirely. This fall a start was made to replace all the steam lines from which trouble might be expected. Naturally, the work can best be accomplished during the summer months, but with building of roads, removing of trees, and general Garden maintenance it had to be postponed until the middle of September. At the present time all the steam lines in the Bromeliad House have been replaced, using 1,590 feet of new 1¼-inch pipe. The Citrus House used 2,510 feet of 1¼-inch pipe. One side of a private growing house has been repiped with 240 feet of 1¼-inch pipe and 180 feet of ¾-inch pipe for a new water line.

Painting.—All gable ends which were reglazed received two coats of aluminum paint. The entire basement of the Administration Building was sprayed with two coats of Bondex. A new graduate lecture room was built and installed with electric lights and tables in the south end of the basement. The interior and exterior of the Assistant Engineer's House were repainted.

MAIN CONSERVATORIES AND EXOTIC RANGES

The regular routine work, such as watering, spraying, cultivating, pruning, planting and fertilizing, has been faithfully carried out as in past years; however, the latter two operations have increased to such an extent that it is nearly impossible to find a vacant spot for some of the new material. As a result, many duplicate plants have been removed and discarded.

It is felt that institutions such as ours should strive to bring forward new ornamental plants or resurrect others that have long since fallen into oblivion. Popularity in plants increases and wanes almost as much as do styles in women's clothes. For instance, the Sansevieria, commonly called "mother-in-law's tongue" is one of the easiest to grow, besides being very ornamental. There are over fifty good species in the genus, yet no one has really attempted to popularize the beauties contained in the group. Varieties of the very common *Sansevieria trifasciata* are now being offered on the market, but there are many more species which could be introduced into cultivation. In the South African house are to be found many Sansevierias of botanical and horticultural interest, and others will be placed on display when their identity is established. In addition to their handsome foliage many species have spikes of slender, white, lily-like flowers which open fully in late afternoon and remain open until morning and usually emit a pleasing fragrance. Clumps of S. *longiflora*, *trifasciata*, *trifasciata* var. *Laurentii*, *cylindrica* and *subspicata* furnished a gorgeous display during the early winter season. Of the several horticultural forms, Bantel's "Sensation" is one of the most outstanding with narrow, erect, stiff, silver-streaked leaves. This form, developed at the Sieloff nursery in St. Louis, was patented and offered for the first time to the trade during the latter part of 1947. It is safe to say that visitors to the Garden may view the largest and finest public display of Sansevierias in the country.

Bromeliads are also being given much attention, particularly the desert types. In continental Europe great interest was formerly shown in these western plants by patrons of horticulture who were the only ones who could afford them. Later some of the American gardens began to acquire specimens, but interest in them was more or less sporadic. It is only in the past

few years that a concerted effort has been made to establish them as favorites, a place they rightly deserve. The Garden, from the very beginning, assembled a good collection of epiphytic types, but in the last four years an attempt has been made to grow more of the desert kinds such as Dyckias, Hechtias, Puyas, and others. These xerophytes are being established permanently in beds in the Cactus House. During the year many species have been added, and the Missouri Botanical Garden possesses what is thought to be the largest xeric collection under glass in America.

Twenty years ago the Garden boasted a good collection of ferns, but many species were lost by the disastrous hailstorm of 1927. During the past year or two, when cultural operations such as spading and fertilizing have been on a much larger scale, a number of "lost" species suddenly made their appearance. Fern spores apparently can lie dormant for many years in the ground and come to life when favorable conditions arrive.

In the Palm House the Amazon Lilies have put on a better show during the winter months of 1947 than in preceding years. *Eucharis grandiflora* does exceedingly well, in fact much better, than when grown in pots on benches. The plants look like succulent counterparts of the common Aspidistra, but with conspicuous white daffodil-like blossoms on long stalks. Due to the hot, late summer a few of the greenhouse plants were burned severely. The large Birdnest, *Anthurium Hookeri*, although shielded from direct sun at all times, had all its leaves "toasted." In contrast, the specimen maintained in the Aroid House was not touched at all because it stands on a pedestal in a pool.

Heavy feeding of most of the beds in the main conservatories and exotic ranges has resulted in superb growth everywhere. Practically six or seven bunches of bananas could be seen throughout the year where formerly only one or two plants bore fruit at one time.

A concrete bench was erected in the back of the Cactus House where Mr. Cutak propagates new plants for display and research purposes. During the spring Mr. Cutak made a seven-weeks trip to little-known parts of Mexico, which included the states of Hidalgo, Queretaro, Guanajuato, Michoacan, Mexico, Oaxaca, and Chiapas. Over three hundred plants were collected, but due to the transportation delays (in some instances two and a half months elapsed from the time of packing at shipping point until the boxes reached the border) most of the tender kinds from the Isthmus of Tehuantepec, like pepper elders, bromels, and aroids, were dead upon arrival. However, nearly all of the cacti and succulents such as the Echeverias, Agaves, Nolinas, Pedilanthi, etc., arrived in excellent condition and are thriving, some of them even condescending to bloom. Not all of them have been identified as yet, and there are a few which appear to be new species.

One, *Peniocereus Macdougallii,* has already been published as new in the June *Journal Cactus Society of America.* Young offshoots are being taken off the type plant and propagated as fast as they appear, so that later the species will be introduced into general cultivation. A colorful Nyctocereus from the Tehuantepec area was collected, and indications point that this one is yet undescribed. It should make an excellent pot plant, for the slender fluted cylindric stems are armed with variegated brown to golden spines.

Mr. Ladislaus Cutak is in charge of the Main Conservatories, including Cacti and Succulents.

GARDENS

A report on the conditions in the gardens during the growing season can be written in a more hopeful mood at the end of the year than in mid-summer. After the fall rains come, as they did this year, and the soil is again moist, all plant life is refreshed and eagerly awaits the call of another spring.

Gardening is a pleasant occupation when temperature and moisture conditions are normal, but it seems that the climatic conditions we hope for each year seldom are realized. When the mid-west corn crop was being seared in August, the same weather conditions were affecting the ornamental plants here in the Garden. While artificial watering can never replace a good rain, the permanent sprinkler systems in the Main Garden, Rose Garden, Linnean Garden, and Italian Garden were very useful in maintaining these gardens, as was the Skinner system in the nursery. From June to October much time was consumed in operating portable pipe-line sprinklers to water groups of azaleas, hollies, shrubs, and ground-cover plantings.

The tulip display in the main plaza was the first large planting since the war years. Darwin tulips were also effectively grouped in the spring garden adjoining the Floral Display House. This garden was later planted with annuals and hardy chrysanthemums, the latter being very colorful in October.

The Rose Garden remained in good condition throughout the season. It had to be watered once, and sometimes twice, a week, and to control leaf diseases and insects the roses were sprayed or dusted eleven times.

The Linnean Garden was colorful with a succession of hyacinths, tulips, tree wisterias, pansies, iris, peonies, and many other perennials.

South of the Old Residence the Iris and Peony Garden is maintained for the pleasure of those who specialize in these two flowers. Since the garden was completely replanted in 1946, the number of flowering stalks was not as numerous as in former years. Additional varieties were added to the garden and seventeen new ones were purchased.

The bedding plants in the Italian and Main Gardens were colorful throughout the summer. The privet hedge in the Italian Garden, of which there is more than 3,000 feet, had to be clipped six times during the summer. For a number of years we have used an electric trimmer, but when this tool wore out this season and could not be replaced, we had to revert to the hand shears which take much more time.

Two-hundred additional hybrid tea and a few climbing roses were planted in the Rose Garden in March. Four hedge beds were replanted in the Hedge Garden, a total of forty-eight plants. Eight hardy hybrid azaleas and three varieties of *Ilex opaca* were acquired for comparison with existing varieties, and thirty-six "indica" azaleas were added to the floral display collection of azaleas.

NURSERY

In the last few years many cuttings of the needle and broad-leaved evergreens have been made during the winter months with the object of determining the best rooting medium and the difference in rooting-time with the various hormone powders. In the fall all of these plants were set in nursery beds. The nursery now contains 450 American hollies, most of which are selections from old trees growing in the Garden, but there are also named varieties and a few species such as *Ilex aquifolium, cornuta, crenata,* and *Pernyi.* Of the needle evergreens there are 750 plants representing a dozen species and varieties. Two beds of boxwood contain 1200 plants in three types, and the last bed was planted with 125 lilacs in twelve varieties.

FLORAL DISPLAYS

The schedule of flower shows was maintained in the same sequence as in former years. In January and February cyclamen and primroses occupied the Floral Display House, and during February the orchids were shown in the alcoves of the Aroid House. The exhibition of cinerarias and azaleas opened on March 23, and the Easter display was installed April 2. This year Croft lilies were shown for the first time, in addition to the Creole lilies. There were four strains in the collection which was sent to the Garden by the Pacific Bulb Growers' Association and H. E. Golisch of Harbor, Oregon, for the purpose of acquainting the public with this variety of Easter lily.

Flowering plants were sent to Christ Church Cathedral for the annual flower sermon preached on April 20. Pelargoniums were displayed May 11. The Henry Shaw Cactus Society held its show in the Floral Display House on May 17 and 18, and the St. Louis Horticultural Society its spring show on May 24 and 25. Hydrangeas were on display June 8, followed by

caladiums, abutilons, crotons, and other foliage plants.

The Greater St. Louis Dahlia Society held its show on September 27 and 28. The Queen's bouquet was exhibited on October 9. The annual chrysanthemum show opened on November 9, and the Christmas poinsettia show started on December 14.

The Garden staged an 850-square foot garden of tulips and azaleas in the Greater St. Louis Flower and Garden Show in the Kiel Auditorium, from March 17 to 23. A gold cup was awarded this exhibit.

The outdoor collections, together with the growing and arranging of the floral displays, continued to be under the direction of Mr. Paul A. Kohl, Floriculturist.

RESEARCH IN HORTICULTURE

Dr. Gustav A. L. Mehlquist, Research Horticulturist to the Garden and Associate Professor of Botany in the Henry Shaw School of Botany of Washington University, has continued his studies with Dianthus, Delphinium, Antirrhinum, and Chrysanthemum. The studies with Dianthus have centered around two distinct projects, one concerned with further studies of the tetraploid carnations derived from crosses between *Dianthus chinensis* and *D. caryophyllyus*, the other with tetraploid pinks derived from crosses involving the four species, *D. arborescens*, *D. chinensis*, *D. Heddewigii*, and *D. superbus*.

In the genus Delphinium the goal is the production of a red or pink flower of the *D. elatum* type. This project was started at the University of California with crosses between the native red-flowered *D. cardinale* and various types of *D. elatum*. Third- and fourth-generation hybrids from these crosses, as well as back crosses to *D. elatum*, were grown during the spring and early summer. Some very beautiful pinks and reds occurred among the seedlings, but none was sufficiently like *D. elatum* to be of any value as a garden plant. However, these reds and pinks were again crossed to varieties of *D. elatum* and it is hoped that eventually seedlings with the characteristics of *D. elatum*, but of pink or red color, will be available. In the meantime much data of both theoretical and practical interest is being obtained.

The Antirrhinum (snapdragon) project is concerned with a comparison of inheritance in diploids and tetraploids. The data obtained so far indicates both chromosomal and chromatid segregation in the tetraploids.

In Chrysanthemum the objective is to widen the range of colors in the cascade and basket groups so useful in the Chrysanthemum shows. Several interesting seedlings have been selected during the two years the project has been going on, one of which, a bright red, is definitely superior to existing

cascade varieties in its color group. On the other hand, no seedling has shown much promise for basket work, but there is good reason to believe that further selections will yield suitable seedlings of a wide range of color.

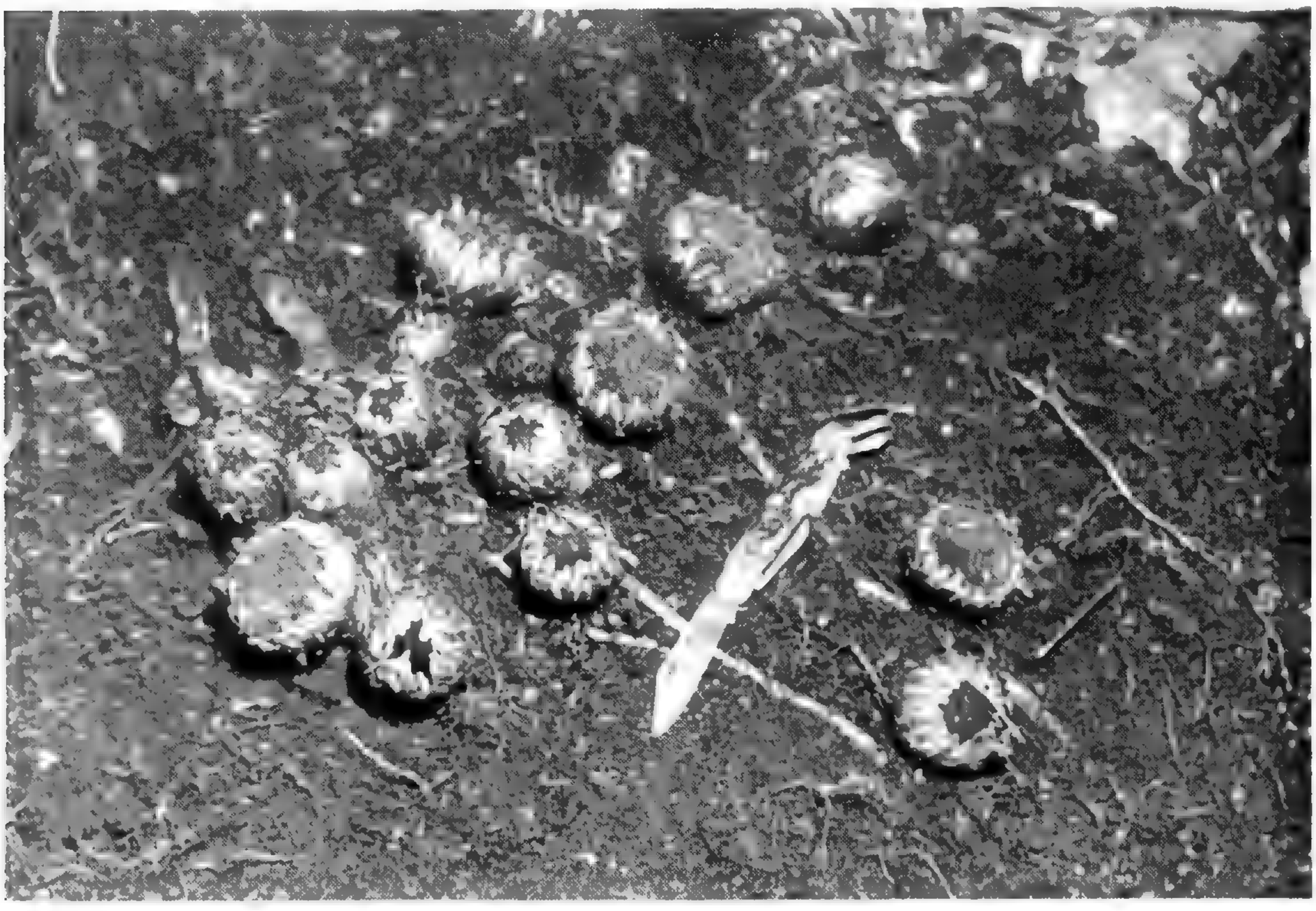
During the summer Dr. Mehlquist spent three months in England studying genetical and cytological aspects of orchid breeding. He visited most of the commercial establishments and many private estates where orchid collections were still maintained. The cytological work on materials donated by the growers was done at the John Innes Horticultural Institution where laboratory facilities were provided by the director, Dr. C. D. Darlington. The Royal Horticultural Society, through its secretary, General C. V. L. Lycett, and deputy secretary, Mr. A. Simmond, was most helpful in establishing contact with horticultural people, and in permitting the use of its excellent library. Extensive polyploidy was found in Cymbidium and Paphiopedilum. The results in Paphiopedilum were reported in the December issue of the BULLETIN and the results in Cymbidium will be reported later. The study was in part financed by a fellowship from the John Simon Guggenheim Foundation, and in part by a grant from the "Friends of the Garden Fund."

TROPICAL FIELD COLLECTIONS

Mr. Paul A. Allen, Tropical Collector for the Garden, has continued the project, begun in 1946, of studying and collecting plants for the "Flora of Panama," now published by the Garden. As in the past, some areas have proved to be considerably more rewarding than others. For example, several trips made along the highway through the dry Pacific lowlands resulted in extensive collections in the vicinity of Ocu, but which proved to be only new distribution records for common weed species. This was also largely true of collections made in the lowlands of Chiriqui Province, in the areas about San Felix, Gualaca, and on the isolated tableland known locally as the Galera Chorcha. Apparently so much clearing, burning, and grazing have taken place that little of the original vegetation remains. However, in extreme contrast, almost any locality on the Atlantic slope produced new genera, species, or records from the most casual collecting.

Since nearly all the Atlantic slope of Panama is inaccessible, full advantage must be taken of present available points of contact. Through study of the local rainfall records, it became apparent that plant populations in Panama are very largely determined by available moisture, so that particularly wet areas of the Pacific slope, which are often relatively accessible, may have representative associations of Atlantic forest species. High-rainfall Pacific drainage areas of this type visited during the past year have been: the

Normal leaf-covered ground in the highlands of Panama, showing two half-buried heads of *Langsdorffia hypogaea* Mart.



The same colony after excavation.

upper Rio Tuira and Rio Chico, in Darien Province; Cerro Jefe, in the wet mountains east of Panama City; the wet pocket northwest of Campana, on the upper slopes of Cerro Trinidad and Cerro Campana; El Valle de Anton, particularly the crest of Cerro Pajita and the forested hills to the north; and Cerro Tute, near Santa Fe, in Veraguas Province. Strictly Atlantic-slope localities which have yielded rich collections have been: Cerro Santa Rita, roads near Camp Piña, and the vicinity of Puerto Pilon, all in Colon Province, and the Atlantic slope portions of the Boquete—Robalo trail, the 5000–7000 feet zone of which, in Bocas del Toro Province, is the richest single accessible collecting area in present-day Panama.

Through facilities provided by those incomparable hosts and naturalists, Mr. and Mrs. T. B. Monniche, it was possible to do nearly a month's collecting in Chiriqui, with side excursions to the fabulously rich Bocas del Toro highlands over the Robalo trail. Although the area about Finca Lerida has been visited by innumerable collectors, surprisingly important finds continue to be made almost within sight of the house. For example, the common giant Cedrela, growing nearly everywhere on the grounds, seems to be as least unrecorded, and possibly new. Also, an extremely interesting colonial root parasite (*Langsdorffia hypogaea* Mart.), representing a new generic record for Panama, was found in quantity in woodlands fringing the coffee plantings (see illustration). The same stay yielded fruiting specimens of one of the exceedingly common clump bamboos which cover thousands of acres in the 5000–8000-feet zone, but which, due to its extremely infrequent fruiting cycle, had been previously uncollected, and a native species of Cinchona (Quinine plant), another previously unrecorded genus. Collections on Cerro Copete, an eastern spur of Chiriqui volcano having an elevation of about 9000 feet, provided an opportunity for further observations on the species comprising these highest vegetation zones.

The Missouri Botanical Garden has had a long history of orchid specialization in Panama, through the early collections made by Mr. C. W. Powell, Mr. A. A. Hunter, and Mr. G. H. Pring, supplemented in more recent years by material, mostly from El Valle de Anton, in Cocle Province. In spite of this long period of intensive effort spent on the Panama orchids, new species and records have continued to accumulate. The surest way to obtain an adequate idea of an orchid flora is to bring the plants in to a central location, where they are labeled as to locality, potted, and photographs, drawings, and specimens made from them when they flower. A considerable number of orchid plants were handled in this way, making excellent subjects for a series of pen-and-ink drawings by Mrs. Allen, which will provide much-needed illustrations for the final portion of the "Orchids of Panama" soon

to appear in the "Flora." At the same time, numerous photographs were taken to supplement the collection of permanent specimens which were dried or preserved in liquid. During the course of these investigations at least three genera previously unrecorded from Panama came to light (Cyrtopodium, Galeottia, and Polycycnis), and since some of the material is as yet undetermined it is very probable that other new or hitherto unrecorded genera as well as species may be represented.

During the preliminary studies of the local rainfall records, a beginning was made on a projected set of seasonal rainfall and vegetation maps, which must await determination of recent collections for completion. At present, it is believed that too much stress has been placed on elevation in delimiting vegetation zones in the tropics, since simple temperature differences may be profoundly modified by type of soil, and/or available moisture.

Of particular interest have been the continued observations on the extent and possible origin of the grasslands of Panama. Many casual visitors to the Canal Zone learn with considerable surprise that the exceedingly common rank Guinea Grass *(Panicum maximum)*, which today covers extensive tracts, is not a native species but an African forage plant deliberately introduced during 1916-17 for the establishment of a cattle industry, great tracts of forest being then felled for the purpose. Within the last five years another Asiatic species *(Saccharum spontaneum)* has begun to invade these established Guinea Grass stands, so that it now seems very probable that much of lowland Panama may eventually be occupied by these two exotic species. Although Oviedo's account of the region about Nata would indicate that some interior grassland areas have changed little since early Conquest times, it seems a highly suspicious circumstance that present-day grasslands coincide exactly with present or known past centers of population. It seems evident that most, if not all, of the now extensive grasslands of Panama have had their origin in agricultural clearing and fire, or have at least been very profoundly modified and extended by this process.

Field operations were concluded in October of the present year, return being made to St. Louis via Central America, with stops in Honduras, Guatemala, and Yucatan. Besides plant collections, advantage was taken of the return trip to bring Vaupes Indian ethnological material to the United States.

RESEARCH AND INSTRUCTION

Dr. Carroll W. Dodge, Mycologist to the Garden and Professor in the Henry Shaw School of Botany of Washington University, has spent much of the time available for research in identifying miscellaneous collections sent by correspondents, from Nyasaland, Burma, the Marshall Islands, the

Hawaiian Islands, Brazil, Cuba, Costa Rica, California, Utah, New Mexico, Texas, Oklahoma, the eastern United States, Quebec, Nova Scotia, Saint Pierre and Miquelon Islands, and Newfoundland, adding many species not previously represented in the herbarium and increasing our knowledge of geographical distribution. In October Messrs. George A. Llano and Marion T. Hall began the insertion of the accumulated specimens in the fungus and lichen herbaria. Routine determinations of pathogenic fungi of humans have been made as the various cultures were received. The study of the collections of the U. S. Antarctic Expedition (Admiral Byrd's Third Expedition) has been continued. Mr. Llano has been engaged in preparing a monograph of the Umbilicariaceae of the western hemisphere.

The usual courses of instruction at Washington University were given. Mr. Daniel McClary gave the course in general bacteriology during the summer session, and Dr. Richard R. Marsh has continued to give the course in general bacteriology in University College.

Dr. Edgar Anderson, Geneticist to the Garden and Engelmann Professor of Botany in the Henry Shaw School of Botany, has continued his general survey of the maize plant. With Dr. William L. Brown, of the Pioneer Hi-Bred Corn Company, he published a small monographic study of the old flint varieties of the northern United States in the February ANNALS. A similar study, with Dr. Brown, of the old dent corns of the South is well under way. Since practically all of the corn of the United States Corn Belt is derived from crosses between these two older types, these studies provide basic information for a number of questions of practical and theoretical importance.

For several years Dr. Anderson has been attempting to acquire collections of the maize varieties grown by various primitive hill people in the Orient. Thanks to the active interest of Dr. W. B. Turrill, Curator of the Herbarium of the Royal Botanic Garden of Kew, a collection of native varieties from the Naga tribes in the mountains of Assam was received in November. The varieties were collected and grown in Assam where they were photographed and measured and where herbarium specimens were made of the tassels. The ears, numbered to correspond with the specimens, were forwarded to Kew Gardens where careful photographs were made of each one. They were then shelled and the shelled corn was imported under one permit, and the labelled dry cobs were imported under another. At the moment of writing, the snapshots of the growing plants, the photographs from Kew, the labelled cobs, and the shelled kernels have all been reunited in St. Louis, but the herbarium specimens are still held up in quarantine in this country. The collection is of great theoretical interest; though obtained from relatively primitive tribes, the varieties are very similar to certain ancient kinds from

South America. When the collections have been exhaustively studied, it may be possible to draw far-reaching conclusions about early contacts between the Orient and the New World.

On November 1 and 2, a conference of several scholars interested in the history and classification of maize was held at the Garden. In addition to Dr. Anderson and Dr. Van Schaack of the Garden staff (and several of their students), the sessions were attended by: Dr. Paul C. Mangelsdorf of Harvard University, Dr. Henri Prat of Montreal University, Dr. Paul Weatherwax of Indiana University, Dr. Richard Laubengayer of Wabash College, Dr. O. T. Bonnett of the University of Illinois, Dr. Hugh C. Cutler of the Chicago Natural History Museum, Dr. William L. Brown of the Pioneer Hi-Bred Corn Company, and Dr. L. J. Stadler of the University of Missouri. The conference assembled on Saturday morning in the Museum at the Garden where ample space had been provided for demonstration material. From informal discussion a list of topics of general interest was drawn up and these were covered in the morning and afternoon sessions. On Sunday most of them spent the morning at the Garden's Arboretum at Gray Summit, where, among other things, they inspected some of the corn grown there this summer by Dr. Brown.

Mr. John Jay Finan's project, sponsored by the Pioneer Hi-Bred Corn Company, was completed during the year and his thesis on "Maize in the Great Herbals" is to be published soon by the Garden.

Dr. Robert E. Woodson, Jr., Assistant Curator of the Herbarium and Professor in the Henry Shaw School of Botany, has continued his teaching duties at the University. His research has been concerned chiefly with studies of natural populations of *Asclepias tuberosa*, with completion of his monograph of *Asclepias*, and with various problems of the tropical American Apocynaceae and Asclepiadaceae. He also has continued the preparation and editing, with Dr. Schery, of the "Flora of Panama."

Dr. Henry N. Andrews, Jr., Paleobotanist to the Garden and Acting Dean in the Henry Shaw School of Botany, spent four weeks during June and July on a collecting trip to Wyoming and Idaho, with Mr. Robert W. Baxter and Mr. Sergius Mamay, graduate students majoring in paleobotany. Additions were made to the Cretaceous petrified ferns (Tempskya), and a small collection of Jurassic cycads was obtained from the vicinity of Bairoil, Wyoming, as well as smaller miscellaneous collections from other localities. Work on the Tempskya ferns was brought up to date in a publication which appeared in the May issue of the ANNALS.

During the past few months appreciable quantities of coal-ball specimens have been received from Mr. Frederick O. Thompson of Des Moines, Iowa.

It is a pleasure to report that Mr. Thompson has again taken up fossil-plant collecting, and his co-operation in contributing this material to the Missouri Botanical Garden is deeply appreciated. Three graduate students, the two above-mentioned and Miss Constance Ogden, as well as Dr. Andrews, are now engaged in investigating the plants found in the coal balls collected and contributed by Mr. Thompson. Now that war-time restrictions are over and collecting in coal mines is possible we plan to continue for an indefinite period investigations of this productive source of fossil plants.

Dr. Robert W. Schery, Research Associate at the Garden and Assistant Professor in the Henry Shaw School of Botany, has worked at the Garden primarily on tropical floras. Collections made by him in Brazil during 1944-45 were organized and sent to appropriate specialists. Work has continued, in collaboration with Dr. Robert E. Woodson, on the editing and compilation of the "Flora of Panama," which is currently being published by the Garden. Dr. Schery's chief research during the past year has been concerned with the Mimosoideae and Caesalpinoideae for this "Flora."

Additional Garden activities of Dr. Schery included supplying spring-flowering dates to the allergy laboratory of the Washington University School of Medicine, incidental investigations on the efficacy of 2-4-D and 2-4-D plus fertilizer compounds in ridding St. Louis lawns of weeds, an evaluation of local hardwoods for fuel (firewood) purposes, and reporting on these matters for publication in the Garden BULLETIN. To a limited extent assistance has also been given Dr. Robert E. Woodson in certain phases of herbarium management.

The major duties of Dr. Schery during 1947 lay beyond the confines of the Garden proper, involving organization and instruction of botany classes in the Henry Shaw School of Botany of Washington University. Some of these classes, however, made material use of Garden facilities; the summer classes in Local Flora and Dendrology depended almost entirely upon use of the Missouri Botanical Garden herbarium, the City Garden, and Arboretum. Elementary Botany and Economic Botany classes have, on occasion, used the Garden library and its various collections.

Degrees.—At the June 1947 commencement, the degree of Doctor of Philosophy was conferred on Russell J. Seibert, A.B. and M.S., Washington University (Taxonomy), and Gerald B. Ownbey, A.B. and A.M., University of Wyoming (Taxonomy). The degree of Master of Science was conferred on Robert Baxter, A.B., Washington University (Morphology) and John Jay Finan (Romance Languages and Botany).

Graduates and Fellows.—The following graduate students were registered in the Henry Shaw School of Botany in 1947:

Graduate Assistants (half-time graduate students): Richard W. Holm, A.B. Washington University (Taxonomy); Daniel McClary, B.S. and M.S. Southeastern State Teachers' College, Durant, Oklahoma (Mycology); David J. Rogers, A.B. University of Florida (Taxonomy); Dennison H. Morey, A.B. Washington University (Horticulture); Constance J. Ogden, A.B. Coe College, Cedar Rapids, Iowa (Paleobotany).

Jessie R. Barr Fellow: Anna Caroline Raut, B.S. University of Illinois (Microbiology).

Burmese Government State Scholarship: Ko Ko Lay, B.S. University of Rangoon (Taxonomy).

Special Research Assistantship at Brookhill Farm: Alfred G. Etter, A.B. Washington University (Ecology).

Special Fellowship from Rockefeller Foundation: Felix Agramont, A.B. Escuela Nacional de Agricultura, Mexico; Lee W. Lenz, M.S. Louisiana State University (Cytogenetics).

Henrietta Heerman Scholars: Marion Trufant Hall, M.S. University of Oklahoma (Taxonomy); Sergius H. Mamay, A.B. University of Dayton (Paleobotany); Robert Baxter, A.B. and M.S. Washington University (Paleobotany).

Independent Students: John H. Ayers, A.B. Des Moines University, M.A. University of Cincinnati (Mycology); H. A. Hoffman, B.S. McKendree College, M.S. University of Illinois (Microbiology); George A. Llano, A.B. Cornell University, M.S. Columbia University (Mycology); Henry A. McQuade, A.B. Washington University, M.S. Missouri University (Genetics); Fred G. Meyer, A.B. and M.S. Washington State College (Taxonomy); Balaji D. Mundkur, A.B. University of Bombay, Indian Agricultural Research Institute, Delhi, India (Microbiology); George K. Richardson, A.B. Washington University (Taxonomy); Jonathan B. Sauer, A.B. University of California, Berkeley (Genetics).

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Anderson, Edgar: Better Forsythias for St. Louis. Mo. Bot. Gard. Bull. 35:125; Corn before Columbus. Publ. by Pioneer Hi-Bred Corn Co. Des Moines; Field Studies of Guatemalan Corn. Ann. Mo. Bot. Gard. 34:433-467; The Flower with Two Smells. Mo. Bot. Gard. Bull. 35:148; Missouri Gravel Bars. Mo. Bot. Gard. Bull. 35:166; *Narcissus gracilis*. Mo. Bot.

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Andrews, Henry N.: Ancient plants. Comstock Publishing Co. Ithaca, N. Y.; John Henry Britts—Physician and Fossil Hunter. Ann. Mo. Bot. Gard. 34:115-117; The King's Pines. Historical New Hampshire. pp. 1-14; Plants of Your Coal Bin. Mo. Bot. Gard. Bull. 35:138-141; Wisteria and Dogwood. Mo. Bot. Gard. Bull. 35:137; with Paul A. Allen: Epiphytes—Plants of the Tree Tops. Mo. Bot. Gard. Bull. 35:151-160; with Ellen M. Kern: The Idaho Tempskyas and Associated Fossil Plants. Ann. Mo. Bot. Gard. 34:119-186; with Lee W. Lenz: Fossil Polypores from Idaho. Ann. Mo. Bot. Gard. 34:113-114.

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Scientific and Popular Lectures.—

Dr. Edgar Anderson, Geneticist to the Garden: February 1, before seminar of Pioneer Hi-Bred Corn Co., at Johnston, Iowa, "Corn in Guatemala"; June 4, at the annual commencement luncheon of Phi Beta Kappa and Sigma Xi at University of Missouri, Columbia, "Corn before Columbus"; August 20, response to address of welcome given by the Rector of the Université de Montreal, at the summer meetings of the Botanical Society of America, before the general assembly, at the Montreal meetings, "The Hybridization of a Habitat"; December 2, before the Hybrid Seed Corn Division of American Seed Trade Association, "Correlated Development of the Tassel and Ear."

Mr. August P. Beilmann, Arboriculturist to the Garden: January 2, before Indiana State Nurserymen, at Indianapolis, "Shade Tree Fertilization"; April 14, St. Louis County Beekeepers Association, "Honey Plants"; April 22, Garden Club of Washington, Mo., at the Arboretum, "Function of an Arboretum"; October 29, Missouri Beekeepers Association, at the University of Missouri, Columbia, "Missouri Honey Plants—New and Old"; December 2, Lions Club of Washington, Mo., "The Daily and Hourly Growth of Trees."

Mr. Ladislaus Cutak, in charge of Succulents at the Garden: January 12, before the Henry Shaw Cactus Society, "Exploring Texas with Camera and Tripod"; January 14, the Couples Club of Pilgrim Congregational Church, "Plant Exploration and Plant Introduction"; April 2, Oklahoma Cactus and Succulent Society, at Oklahoma City, "My Recent Adventures in Old Mexico"; April 29, Midtown Kiwanis Club, May 19, Pilgrim Congregational Church Discussion Group, June 3, Forty-four Educational Group, November 10, First Ward Improvement Association of North Woods, "Plant Hunt in Old Mexico"; May 11, Henry Shaw Cactus Society, June 27, convention of Cactus & Succulent Societies of America, at Cincinnati, August 21,

Kiwanis Club of Richmond Heights, September 3, St. Louis Horticultural Society, September 12, Webster Groves Nature Study Society, November 11, Holy Name Society of Pope St. Pius the Fifth Church, "Mexico in Kodachrome"; May 6, Collinsville Woman's Club, June 11, Group I of Brentwood Garden Club, October 24, Pine Tree Garden Club, "Cacti and Succulents in the Home"; June 5, Cubs and Brownies of Washington District at West Mattese, Mo., September 24, Kiwanis Club of West End, "The Four Seasons at Shaw's Garden"; October 8, Maplewood Garden Club, Maplewood, Mo., "Gardens of Florida vs. St. Louis Gardens"; October 15, Wright District Garden Club, "Gardens of Florida"; October 12, Henry Shaw Cactus Society, "Virginia Gardens vs. St. Louis Gardens"; October 29, Intermediate Girls' Auxiliary of Compton Heights Baptist Church, "Food Plants of Mexico"; October 30, East-Central Region Federated Garden Clubs, "The Culture of Succulents"; November 20, Ferguson Circle of the Rosemary Garden Club, "Vagabonding in the Southwest."

Mr. Paul A. Kohl, Floriculturist to the Garden: January 24, before the Normandy Garden Club, "Roses"; February 3, Belleville Women's Club, "A Tour of the Missouri Botanical Garden" (with the "Four Seasons" films); March 28, Clayton Garden Club No. 2, and October 1, Ladue Garden Club, "Roses"; October 17, Webster Groves Garden Club, "Bulbs"; December 9, St. Clair Garden Club, Belleville, Ill., "The Missouri Botanical Garden."

Dr. Gustav A. L. Mehlquist, Research Horticulturist to the Garden: January 16, before the Greater St. Louis Consolidated Flower Growers' Association, "Carnation Breeding"; February 18, St. Louis Garden Club, "Pinks and Carnations"; March 3, Belleville Women's Club, Belleville, Ill.; "Factors Influencing Plant Growth"; March 25, Cymbidium Society, at Pasadena, Calif., "Production of Early-flowering Cymbidiums"; March 13, Illinois State Flower Growers' School, at University of Illinois, Urbana, "Looking to the Future in Carnation Growing"; March 26, at seminar of botany and agriculture staff, University of California, Los Angeles, discussion of work on carnations and delphiniums; March 31, Orchid Society of Southern California, Los Angeles, "Supplementary Nutrients for Orchids"; April 16, Washington University Faculty Womans Club, "Four Seasons in the Garden" (moving pictures); November 6, Greater St. Louis Flower Growers' School, "Factors Influencing Plant Growth."

Mr. George H. Pring, Superintendent of the Garden: January 13, before the Jacksonville Garden Club, Jacksonville, Florida, January 14, Federated Garden Clubs at St. Petersburg, Florida, January 16, Fairchild Tropical Garden, "Four Seasons at the Missouri Botanical Garden"; January 17, Florida Orchid Society, Miami, "Development of Orchids from Seed to Flower";

February 20, Men's Club, Shaw Avenue Methodist Church, "Spring Planting"; February 21, Greenbrier Hills Garden Club, Kirkwood, Mo., "What to Plant in Your Garden"; March 4, St. Clair County Garden Club, Belleville, Ill., "Mr. Shaw's Garden"; March 12, television broadcast over Station KSD, "A Preview of the St. Louis Flower Show," using the Garden orchids; March 14, Webster Groves Garden Club No. 14, "Orchids"; March 25, residents of Olivette, Mo., "What to Plant in the Garden and Its Care"; April 1, Kirkwood Kiwanis Club, "Collecting Orchids in the Andes"; April 5, Normandy Presbyterian Church Women's Association, "Four Seasons at the Missouri Botanical Garden"; April 10, South Side Lions Club, April 22, North St. Louis Lions Club, May 11, Fireside Club of Pilgrim Congregational Church, May 29, Cosmopolitan International Club, June 4, Downtown St. Louis Lions Club, June 6, graduating exercises of the Rose Fanning School, and Lions Club of Carondelet, "Mr. Shaw's Garden"; November 16, Young People's Group of the Forum and Tyler High, "Development of the Orchid from Seed to Flower"; November 21, Group No. 5 of Webster Groves Garden Club, "Pruning and Transplanting of Shrubs."

THE HERBARIUM

The activities of the herbarium during the year of 1947, as in previous years, have been concerned primarily with receiving, recording, sorting, mounting, and inserting of new specimens in the general herbarium. Together with specimens which have accumulated during many past years, material is provided for intensive plant study. A considerable part of the plants received are undetermined, and frequently the identifications involve critical study by the specialist.

It is worth while to place on record the collections which constitute the new additions. The scientific worth of a size of the collection is not always valued in terms of number of specimens. The following enumeration indicates the regions whose flora has been augmented by plants recorded during the year 1947. It is also notable that the representation of the flora of Mexico, Central America, South America, and the Hawaiian Islands, has been supplemented by a substantial number of specimens.

New Accessions: Paul Allen, *Mussaenda erythrophylla* from horticulture; E. Anderson, 23 plants of Indiana and Guatemala; B. Autin, 4 plants of Missouri; J. T. Baldwin, Jr., by R. J. Seibert, 9 specimens of Hevea of Peru; F. A. Barkley, 121 plants of Mexico; Bishop Museum, 407 lichens of Hawaiian Islands; L. Bonar, 54 lichens of California; R. R. Brinker, 40 plants of Illinois; Butler University, 127 plants of Indiana; California Academy of Sciences, 277 plants of California and Australia; Manuel Quiros Calva, 7 lichens and fungi from Costa Rica; K. S. Chester, 35 lichens of

Oklahoma; Chicago Natural History Museum, 311 plants of Missouri, 109 plants of South America, and 617 photographs; L. Cutak, 3 plants of horticulture; Dias de Rocha, 31 lichens of Brazil; Division of Rubber Plant Investigations, Bureau of Plant Industry, U.S.D.A., by R. J. Seibert from Peru and Bolivia, 376 specimens of *Hevea* of Peru; W. H. Duncan, 6 *Asclepias* of Georgia; A. T. Erwin, 3 plants of Guatemala; J. H. Faull, 2 *Phoradendron* of Texas; Escuela Agricola Panamericana, by L. O. Williams, 591 plants of Honduras and Guatemala; Brother Fabius, 19 lichens of Quebec; T. H. Goodspeed, 86 plants of South America; Gray Herbarium, Harvard University, 1709 plants of Virginia, South America, etc.; Charles Heiser, 17 plants of Illinois, Missouri, and California; L. C. Hinckley, 3 plants of Texas; C. L. Hitchcock, 1067 plants of Montana and Alaska; R. A. Howard, 30 plants of Dominican Republic; J. H. Hunziker, 128 plants of Argentina; Iowa State College, by Ada Hayden, 218 plants of Iowa; H. S. Jackson, *Martensella Corticii* from Ontario; L. R. James, *Jasminum humile* of Tennessee; Jardin Botanique, Montreal, 35 lichens of Quebec; G. L. Jones, *Iris virginica* of Alabama; Marie Knauz, 19 plants of Mexico; A. Krapovickas, 152 plants of Argentina; B. A. Krukoff, 1035 plants of Australia and Africa, 234 plants of Singapore, 662 plants of Porto Rico, and 20 plants of Brazil; R. Latham, 3 lichens from Long Island, New York; C. Le Gallo, 7 lichens of Quebec, Canada; O. S. Ledman, *Cicer arietinum* from horticulture; E. L. Little, 1 plant from Ecuador; F. Meyer, 2,000 plants of western United States; New York Botanical Garden, 237 plants of western United States, 67 lichens of Bahamas and Nyasaland, and 439 plants of Guiana (Surinam); New York State Museums, Albany, 100 plants of New York; G. Ownbey, 40 plants of western United States; H. B. Parks, *Periploca graeca* from Texas; Rancho Santa Ana Botanic Garden, 575 plants of California; W. F. Rapp, Jr., 7 plants of Illinois; V. Räsänen, 75 lichens of Finland; Mrs. P. Rau, 2 plants of Missouri; B. Rosengurtt, 125 plants of Uruguay; Royal Botanic Garden, Kew, 2 photographs of types; C. Sbarbaro, 28 lichens of Italy; R. W. Schery, 40 plants of Brazil; B. S. Skinker, 8 plants of Texas; Edward Teas, 2 plants of horticulture; W. L. Tolstead, *Asclepias Nuttaliana* from Nebraska; United States National Herbarium, 17 lichens and 25 flowering plants from various localities; University of California, by H. L. Mason, 2 *Asclepias cryptoceras* of California; University of California at Los Angeles, 46 plants of New Mexico and California; University of Georgia, 11 Asclepiadaceae of Georgia; University of Helsingfors, "Lichenes Fenniae Exsiccati, Fasc. XVIII, XIX, XX, 151 lichens; University of Iowa, by W. A. Anderson, 1096 plants of Iowa collected chiefly by the late Professor B. Shimek; University of Minnesota, 79 plants of Minnesota; University of Montreal, 654 plants of Quebec; University of Oklahoma, 109 plants of

Oklahoma; University of Texas, 618 plants of Texas; various sources, 53 photographs of types; U. T. Waterfall, 248 plants of Oklahoma and Texas; W. Welch, 4 fungi and 1 alga from Indiana; E. Whitehouse, 110 lichens of Texas; L. O. Williams, 27 Apocynaceae and Asclepiadaceae of Honduras; R. E. Woodson, 2 plants of Panama.

Mounting and Insertion of Specimens: The mounting of over 10,000 herbarium specimens has been completed during the year by Miss Violet Bauer; she has also assisted in recording loans. The request for inter-herbaria loans is increasing every year, so that more clerical assistance in recording, packing, and shipping is needed.

The filing and insertion of new specimens in the general herbarium has gone forward; but it has been possible only by shifting a large part of the herbarium. In this work the Curator has been assisted by Mr. Fred Meyer. Even with this shifting, many of the cases are overcrowded; and the overflow remains in storage, awaiting the installation of new herbarium cases. Dr. C. W. Dodge, assisted by Mr. George A. Llano, has inserted 2172 specimens in the herbarium.

Exchange: The number of duplicate herbarium specimens obtained during 1947 was 5,088, somewhat in excess of previous years. However, the number includes Garden publications sent in exchange for herbarium specimens. We have sent in the same period 564 specimens to correspondents.

Use of the Herbarium: It is gratifying to report that visiting botanists continue to use the herbarium in relatively large numbers. In this respect the past year has been about normal. But the requests for loan of herbarium material for floristic, monographic, and other critical studies are increasing from year to year. The loan of herbarium specimens which makes mass-material available to the qualified student is reflected in the number and quality of taxonomic publications.

Statistical Summary (For the year ending December 31, 1947):

Number of specimens received during 1947:		
By purchase	3,446	
By gift	1,751	
By exchange	8,088	
By field work	2,003	
By transfer	1	
Total	15,289	
Number of specimens mounted and incorporated in 1947		13,088
Number of specimens carried forward from 1946		1,435,586
Total		1,448,674
Number of specimens discarded during 1947		3
Total number of specimens in Herbarium		1,448,671

LIBRARY

The greatest accomplishment in the library during 1947 was that we were able to carry on in spite of many difficulties. In the spring preparations were begun for the installation of an elevator. Since it was to be situated in the main part of the library building, a working space of about 180 square feet on the two library floors had to be cleared for the builders. Where to put the books removed was a question, for there was no vacant space on any of the floors. The only possible solution was to place the bookcases closer together, which sometimes reduced the width between the book stacks to less than three feet and in one instance the case filled the aisle. In consequence some of the books have been practically inaccessible for months, but if obtaining a book became a necessity it could be accomplished by reaching through to the other side or next case, after a little study as to what the location might be. To call this state of affairs inconvenient would be an understatement, especially since the Shaw School of Botany now has 21 students, the largest number in its history, and most of them starting their first year of graduate work.

The time for the completion of the elevator was originally set at three months, and we had planned to spend part of the summer getting the library back in shape. However, in the last week of December the installation is still not completed, and since September several more trials have been experienced. One was the after-effect of fumigating the building, everything on both floors being covered with a fine white dust. Another condition was due to the installation of a new electric cable in the basement. All the books in the southeast corner had to be removed, and since there was no place to put them they are piled on tables. The last unpredicted event was in December when the Washington University department of botany returned to our library about 400 books that had been sent them on an indefinite loan. They are still in packing cases beneath a table in the card catalogue room.

Like many upheavals, those the library has experienced has brought about plans for later improvements. Already the walls of the basement have been painted white, which makes it many degrees lighter. Space is also being cleared to form an alcove to contain our valuable horticultural folios. Efficient lights will be placed between the cases, and small tables will be placed wherever there is room. A steel map case has been obtained for the larger maps, and one of the old wooden cases formerly used for chemicals, which contains many drawers, will be used for the smaller maps. With so many new students using the library the realization of the need for a simpler organization is very apparent, and when the books are finally moved into their permanent position a new system of arrangement will be adopted.

One of our visitors during the year was our foreign book-dealer, Mr. Walter Nijhoff, of the firm of Martinus Nijhoff, of the Hague, Netherlands. Mr. Nijhoff and his employees are directly responsible for the Garden having one of the most complete collections of European botanical periodicals published during the war years.

Publications.—Volume XXXIV of the quarterly ANNALS and Volume XXXV of the monthly BULLETIN were issued during the year. The volume of the ANNALS consists of 473 pages, 48 plates, 21 maps, and 99 text-figures. Some of the papers included were: Anderson's two corn papers, Andrews' Idaho Tempskyas, Seibert's and Ownbey's doctoral dissertations on Hevea and Corydalis respectively, Woodson's study on leaf variation in the Butterflyweed, and Mehlquist's third installment on inheritance in the carnation. The BULLETIN contains 236 pages and numerous illustrations. The March number was devoted exclusively to Kohl's "Rose Growing in St. Louis," and the December number to Mehlquist's studies on cytogenetics in orchids. A recent notice about the Rose bulletin in one of the national rose magazines brought requests for the booklet from rose-growers in thirty-four states. The edition of the BULLETIN is now higher than it has ever been, due to the "Friends of the Garden" receiving complimentary copies.

The ANNALS exchanges, of which a great part is made up of foreign institutions and which had dwindled considerably during the war, is now back to almost normal status. The Smithsonian Institution's Bureau of International Exchanges is now accepting shipments to all the foreign countries except Rumania and Yugoslavia. Publications for German countries are acceptied only on condition that if undeliverable by reason of destruction of the library, dissolution of the society, etc., "they may be delivered to appropriate active institutions in the zone of original address." This does not sound very satisfactory, so the Garden will not begin to send publications to Germany until it has definite information about the institutions which were formerly on the exchange list. The acceptance of Japanese exchanges is left to the discretion of U. S. Military Headquarters in Japan. Of course, some of the societies and academies, especially those in Europe, may not publish again for years, if they ever do, but this will be compensated for by new exchanges. Among the new exchange relations established in 1947 were the following: Egyptian Academy of Sciences, Cairo Egypt; Universidad Nacional, Medellin, Colombia; Universidad de Santa Domingo, Trujillo, Republica Dominicana; Escuela Agricola Panamericana, Tegucigalpa, Honduras; *Science and Culture,* Calcutta, India.

The ANNALS and BULLETIN are also sold on subscription, the cash receipts for which, during the year, was $1,846.53. The sales from individual

numbers and reprints of both publications, of "Spring Flora," etc., amounted to $3,735.00.

Library Accessions.—The most noteworthy acquisitions during the year were probably the missing volumes of two old serials—Edinburgh Philosophical Journal, vols. 1-27 (1826-1839), and Bulletin de la Société Linneéne de Normandie, Ser. 1-4, 36 vols. (1856-1895). Also, through Dr. Andrew's interest, several valuable paleobotanical works were obtained. Among these were Jongman's "Fossilium Catalogus. Pars. II. Plantae." Parts 1-23 (1913-1938); and four of Mathews works on fossil botany of China. Two new serials were subscribed to—*Economic Botany* and *Evolution*, the first volumes of both containing papers by members of the Garden staff.

Other accessions, in addition to current publications that one would expect to find in a botanical and horticultural library, were the following: Bamber, C. J. Plants of the Punjab. 1916; Burkill, I. H. A dictionary of the economic products of the Malay Peninsula. Vols. 1-2. 1935; Charlesworth's orchid catalogue for 1937; Brew, John Otis. Archaeology of Alkali Ridge, Southeastern Utah. 1946; Demerec, Advances in genetics, Vol. 1. 1947; Cold Spring Harbor symposia on quantitative biology, Vol. 11—Heredity and variation in microorganisms. 1946; Grant, Julius. Wood pulp and its allied products, 2nd ed. 1947; Henrici's Molds, Yeasts and Actinomycetes. 2nd ed. rev. by Skinner, Emmons and Tsuchuya. 1947; The New World—The first pictures of America made by John White and Jacques Le Moyne and engraved by Theodore de Bry, with contemporary narratives of the Hugenot settlements in Florida and the Virginia colony. Edited and annotated by Stefan Lorant. 1946; Lund, E. J., and collaborators. Bioelectric fields and growth. 1947; Massalongo, C. L. L'opera botanica. ed. by Mattirolo et al. 1929; McKelvey, Susan Delano. Yuccas of the southwestern United States. 1947; Nelson, Alexander. Principles of agricultural botany. 1946; Ordonez, Ezequiel. El Volcan de Paricutin. 1947; Pledge, H. T. Science since 1500. 1947; Memoires de la Société Linneénne du Calvados (Normandie). Années. 1824, 1825, 1828; and Vols. 6, 8, 10. 1834-55; Stern, F. C. The study of the genus Paeonia. 1946; Sternberg, G. Essai d'un exposé geognostico-botanique de la flore du monde primitif. 1820-26; Wettstein, R., et al. Tratado de Botánica sistematica. (Translation into Spanish of fourth edition of "Handbuch der systematischen Botanik"); Withering, William. An arrangement of British plants according to the latest improvements of the Linnean system. 3rd ed. 1796; The World of Learning. 1947.

Many large maps were also purchased, especially of Central and South America.

Visitors.—Among the visitors during the year who spent from a few days to several months consulting the Garden Library were: Mr. Paul Allen, of La Lima, Honduras; Prof. P. S. Daviess, of the University of Louisville; Dr. Carl C. Epling, of the University of California; Dr. L. J. Geir, of William Jewell College, Liberty, Mo.; Mr. Gordon Haskell, of John Innes Horticultural Institution; Dr. Charles B. Heiser, of the University of Indiana; Mr. Orrin Henbest, of the University of Illinois; Dr. W. F. McDonald, of Ohio State University Columbus; Dr. Antonio Marino, of Sec. Agricultura y Fomento, Mexico City; Dr. Carl O. Sauer, of the University of California; Dr. Russell J. Seibert, of the Division of Rubber Plant Investigations, Turrialba, Costa Rica; Dr. Louis O. Williams, of the United Fruit Co., Tegucigalpa, Honduras; Dr. T. G. Yuncker, of the University of Indiana.

Other out-of-town visitors include the following:

Sr. Alfredo Amesana, of Mexico City; Mr. Irving F. Ahlquist, of the University of Illinois, Urbana; Dr. R. C. Allen, Secretary-Editor of the *American Rose Society;* Mr. Walter H. Bangham, of the Goodyear Rubber Plantations, San Jose, Costa Rica; Mr. Frank Barger, of Monrovia, Calif.; Dr. Joseph Becquaert, of the Museum of Comparative Zoology, New York; Mr. W. J. Booth, of St. Petersburg, Florida; Mr. Arno H. Bowers, of Pasadena, Calif.; Mr. K. M. Braman, of the Royal Botanic Gardens, Hamilton, Ont.; Dr. William L. Brown, of the Pioneer Hi-Bred Corn Co., Des Moines, Ia.; Dr. J. P. Carabia, of the Universidad de la Habana, Cuba; Mr. Robert Casamajor, of the California Horticultural Institute, Pasadena; Sr. Jose Castro, of Guatemala, graduate student, Iowa State College, Ames; Dr. Barry Commoner, of New York City; Dr. H. S. Conard, of the University of Iowa, Iowa City; Miss Thelma Cox, of McKee Jungle Gardens, Vero Beach, Fla.; Mr. Sala Dasanandra, of Chula University, Bangkok, Siam; Maj. and Mrs. R. S. Davis, of Dayton, Ohio; Dr. Carl George Deuber, of Ardsley, N. Y.; Miss Alice Dustan, of New York, Garden Editor of *House Beautiful;* Dr. Maurice Errera, of the National Cancer Institute, Bethesda, Md.; Mr. Edgar L. Evinger, of New York City; Dr. David C. Fairburn, of the McKee Jungle Gardens, Vero Beach, Calif.; Dr. Seymour Fogel, of Queens College, Brooklyn, N. Y.; Dr. Ernst Gäumann, of the Technische Hochschule, Zurich, Switzerland; Dr. H. M. Good, of the University of Toronto, Canada; Dr. George J. Goodman, of the University of Oklahoma, Norman; Dr. J. P. Greenstein, of the National Cancer Institute, Bethesda, Md.; Mr. John C. Hahn, of the University of Illinois; Mr. Eric Halbinger, of Mexico City; Mr. Norlan C. Henderson, of the Carrier Mills High School, Illinois; Mrs. J. Norman Henry, Horticulturist; Mr. Raymond Hogshead, of North Miami, Fla.; Dr. George Thomas Johnson, of Massachusetts Institute of Technology,

Boston; Mrs. Francis King, horticultural writer, of New York; Father George H. Link, of Michael, Ill.; Dr. G. W. Martin, of the University of Iowa, Iowa City; Dr. L. C. Newell, of the Nebraska Agricultural Experiment Station, Lincoln; Mrs. Iva Newman, of San Mateo, California; Dr. Gerald B. Ownbey, of the University of Minnesota, Minneapolis; Mr. E. J. Palmer, of Arnold Arboretum, Jamaica Plain, Mass.; Miss Patricia Poindexter, of the University of Arkansas, Fayetteville; Mrs. A. J. Proebstle, of Brazoria, Texas, Assoc. Editor *Orchid Lore;* Mr. G. T. Robbins, of Oklahoma Teachers College, Ada; Dr. Carl O. Sauer, of the University of California; Mr. Richard D. Schein, of De Pauw University, Greencastle, Ind.; Dr. Martha Springer, of the University of Indiana, Bloomington; Dr. A. C. Smith, of the Arnold Arboretum, Jamaica Plain, Mass.; Mr. B. C. Smith, of Dept. of Floriculture, Cornell University, Ithaca, N. Y.; Dr. Julian A. Steyermark, of the Chicago Museum of Natural History.

Groups visiting the Garden library were: the biology classes of the Community High School, Carrier Mills, Ill.; graduate students in botany from the University of Iowa, Iowa City; and the biology classes of Harris Teachers College, St. Louis.

Another use of the library is through interlibrary loans, 190 such loans to 34 institutions having been made during the year.

Statistical Information.—There have been donated to the library or received in exchange during the year 472 books valued at $1,123.92, 1393 pamphlets valued at $280.10, and 1 manuscript valued at $2.00. There were 189 books bought at a cost of $890.18, 87 pamphlets at a cost of $200.68, and 7 maps at a cost of $5.00. The library now contains 57,978 books, 99,627 pamphlets, and 357 manuscripts. The number of Index cards now totals 1,113,067, of which 5,095 were added during the year, 860 having been written by Garden employees and 4,235 purchased at a cost of $100.54. There were 132 books bound during the year.

ANNUAL BEQUESTS

The Annual Flower Sermon "On the 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 at Christ Church Cathedral, on Sunday, April 20, by the Rt. Rev. Austin Pardue, Bishop of Pittsburgh.

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

ATTENDANCE FOR 1947
(Not including visitors to Arboretum)

	Week-days	*Sundays*
January	2,748	2,582
February	6,025	12,450
March	5,149	6,847
April	10,904	14,865
May	20,490	13,070
June	11,806	9,770
July	16,207	6,090
August	12,014	6,299
September	10,231	8,724
October	11,997	7,175
November	12,928	17,742
December	4,778	4,789
	125,277	110,403
		125,277
Total		235,680

Respectfully submitted,
GEORGE T. MOORE, *Director.*

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MISSOURI BOTANICAL GARDEN BULLETIN

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Volume XXXVI February, 1948 Number 2

Cover: The large palmate-leaved *Begonia Macdougallii*, with a flower stalk nine feet high.

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Please: Do not discard a copy of the Bulletin. If you have no further use for yours pass it along to a friend or return it to the Garden. Return postage will be guaranteed.

Missouri Botanical Garden Bulletin

Vol. XXXVI FEBRUARY, 1948 No. 2

JOURNEY TO A RAIN FOREST IN CHIAPAS

LADISLAUS CUTAK

The rain forest in Chiapas is located in an almost-unexplored mountainous region in or near the Isthmus of Tehuantepec—part of the "Forbidden Land," taking in corners of Oaxaca, Vera Cruz, Chiapas, and Tabasco—where men have been swallowed up or never heard from. It is a plantman's paradise, from which new species will undoubtedly be introduced in years to come. Already Tom MacDougall of New York City, well-known plant collector and landscape gardener, has penetrated its outer confines and discovered many plant novelties. For the past eighteen years he has been spending four months out of each year in Oaxaca and Chiapas. It was my good fortune to have him as companion on my 1947 plant-hunting trip.

The picturesque Zoque Indian town, Ocozocoautla, was the headquarters of MacDougall and myself during our botanizing expedition in Chiapas. It is directly west and one hour's drive by bus from Tuxtla Gutiérrez, the capital of that Mexican state. The town nestles in a valley at the base of some high mountains and sometimes becomes shrouded in misty fogs that descend from the montaña. Without these fogs much of the epiphytic and xerophytic flora could not survive during the season of drought.

On the main thoroughfare of the town is a small inn operated by Doña Paulita. Here we secured a room that had no windows, and the only ventilation came from the wide crack left by unevenly matched doors. When we opened the doors wide for better ventilation a small crowd of children was always found, gathered about intent on watching the normal antics of two *gringos* from Uncle Sam's country. Adults were curious also, and they never seemed to sense that they might be a nuisance, or that we might often be embarrassed by their attention. The walls of our room were whitewashed and the earthen floor tamped as smooth as cement. The furnishings consisted of a bed, cot, small table, chair, wash-basin, water-bucket and a kerosene lamp. It was surprisingly cool, even during the hottest part of

the day, and one cold, fog-blanketed night I even asked for a heavy *serape* for cover.

The region about Ocozocoautla is primarily a cattle country, and up in the *montaña* were located the many *ranchos* of the townspeople. On our exploring trip we planned to reach Lisandro Maza's ranch to the north of town from where preparations for a trip to a typical rain forest could be made. We left the highway in the vicinity of Ocozocoautla's quaint cemetery, the trail leading through a fairly level grassy parkway until the near-by hills were reached. At the edge of town hedges of the thorny *Bromelia Pinguin* were conspicuous, often being used around native yards to keep pigs and fowl from straying.

Tom MacDougall and I walked briskly with packs on our backs for the first hour before we realized that we were climbing to higher ground. Then a short descent brought us to a small stream bordered by a thicket of trees on the branches of which were quantities of epiphytic bromels. A little farther on a large tree, arching over the trail, came to our attention—its trunk and branches laden with orchids and bromels. From then on this was to be a common sight. Up in the grassland two species of Lantana were prominent. One seemed to be the red-and-yellow flowered *L. camara*, which is often used in window-boxes and hanging-baskets. The other, with light blue or lavender blooms, I was not acquainted with. I collected a few of its seed which have since germinated, and a few plants will be grown for determination and possible cultivation at the Garden. Still another striking plant was a kind of thistle with pale silvery green foliage and lavender to purple flower-heads. Although seed was collected nothing has come of it so far.

The sun was shining brightly as we continued on our way. Our throats were becoming parched, and we had not taken a canteen because we thought that by noon we would reach the Maza ranch where there was a cool spring. However, midday passed without any sign of the ranch. The terrain began to appear unfamiliar to MacDougall, and I began to tire and called for frequent halts. A pack train passed but the leader could give us no information as he was unfamiliar with the ranchers in this part of the country. We then turned back to find a certain landmark that had eluded us. After we had walked two miles we found it, and then there was no difficulty in locating the ranch, where we arrived nearly exhausted. Lysandro's daughter-in-law prepared an *olla* (clay jar) of a cool Tamarindus drink of which I drank two or three glasses and was much revived. Tamarindus is an East Indian tree, commonly planted in tropical Mexico, producing long pods or beans in which seeds are contained in a juicy reddish-brown pulp. The pulp is acidulous and greatly esteemed for flavoring beverages and ices.

While I was resting in the shade of the front porch there was a sudden commotion in the bushes near the chicken-pens. The rancher reached for his muzzle loader and, together with the rest of the household, departed in the direction of the noise. In a few minutes the report of the gun was heard, and shortly after the hunting party hove into sight, carrying a small familiar black-and-white furry animal which I recognized as one of the many tropical species of skunk.

Late that afternoon MacDougall and I decided to go down to the thicket bordering the creek to investigate the flora. Here, for the first time, I came in contact with many of the wild plants which are cultivated as exotics under my care in the Garden. What a thrill it was to come face to face with friends in their natural habitat! Clambering up the side of a tree trunk was the Ceriman, *Monstera deliciosa*. This aroid vine, with large ragged and perforated leaves, is frequently to be found in store windows throughout America as a pot plant. The flower is like that of the Calla Lily, only much larger. This develops a fruit about 8 inches long, containing a juicy pulp that is most delicious, tasting like a combination of pineapple and banana. For this reason it is often called "Fruit Salad Vine." Another climber was a small, leather-leaved Anthurium, greatly resembling a Peperomia. However, its small spadix with a light greenish spathe revealed that it belonged to the aroids rather than to the peppers. Stems of this plant were collected but the long journey home proved too much for it. Unfortunately, many of our collections from the rain forest of Chiapas suffered and such tender plants as aroids, bromels and peperomias were practically a total loss.

At least ten species of orchids were counted in the thicket. Among the genera represented were Maxillaria, Pleurothallis, Oncidium, and several others not easily recognizable. In the trees, numerous bromeliads were perched like birds on the branches. Stemless herbs of Catopsis with yellowish-green leaves and spent flowers were perhaps the most conspicuous. Several species of Tillandsia were likewise seen, the most spectacular being *T. streptophylla*, a curious and beautiful plant with a dense pseudobulb formed by the leaf sheaths. Its leaf blades are wide at the base, tapering into an acuminate tip, and have the habit of twisting and curling. The reddish, imbricated, bract-like leaves of the inflorescence nearly hide the purple flowers. *Tillandsia Butzii* is a much smaller plant, its seven or eight leaves forming a small inflated pseudobulb which is oddly and attractively spotted. Three other relatives of the "Spanish Moss" were noticed. Their identity was not determined since they bore no floral stalks, but one appeared to be *T. tenuifolia*.

Attached to another tree trunk by means of aerial roots sent out along its stem was a slender bright green Selenicereus, with seven ribs and areoles containing eight or nine acicular spines and a few bristles. Another cactus,

which hung in small clusters from bromel-studded trunks, proved to be *Rhipsalis cassutha*. This cactus is a Pan-American species, specimens having been collected in Florida, Mexico, West Indies, Central America, and South America. It has also been found in Africa, in the jungle forests of the Belgian Congo and other places, but whether it was brought there by the birds or is truly a native has never been determined.

A typical ranch-house in Chiapas is generally a small, adobe, tile-roofed structure with a porch running the full length. At one end of the building is the kitchen containing an earthen bench, about three feet high, on which bricks are arranged to serve as a stove, a big *olla* filled with water, a table, and perhaps a cupboard to hold the few utensils and some food. A corn crib usually occupies the other end of the home. In between may be one, two, or three rooms, chiefly used for sleeping quarters and for storage. Such was the home we found at Rancho Recuerdo. It should be remembered that the ranchers lead a simple life in the country and that most of them own a town-house which is more elaborately furnished. At the Mazas there were two beds in the men's quarters. The one in which MacDougall and I slept had neither spring nor mattress but plain wooden boards upon which a straw mat or *petate* was stretched. A thin sheet served as our only cover. I took my shoes off but otherwise slept fully dressed the first night, for a "norther" had descended upon the countryside and it was really cold. Mornings were cool but as soon as the sun appeared it warmed everything.

Early in the morning my partner and I left Rancho Recuerdo for the rain forest farther north, with Jesus Maza as our guide. MacDougall had politely refused an offer of horses for the trip but had I known what kind of journey was ahead I would have certainly insisted on them. Jesus himself rode, for ranchers do not usually walk if they don't have to, and his trusty steed, besides carrying his master, had all our food and collecting supplies hung from the saddle. Three bottles of lemonade were included, since no drinking water would be available until Pico Carrizal was reached in the rain forest. We went along nicely for two hours through hilly open country and then we hit mud—mud that was knee deep in places. And this was the dry season! I'd hate to make the trip when the rains came. Sometimes we could avoid the slushy holes by skipping from one sun-hardened crest to the next as if crossing a creek on stepping stones, but occasionally the seemingly hard crust would give way and we found ourselves mired. The dense vegetation bordering the trail on both sides proved a salvation for by holding on to the shrubbery we were able to avoid stretches of soft road.

The muddy road continued for miles, but around one o'clock our guide turned off from the *camino real* (main road) and plunged into primeval wilderness—domain of the jaguar, deer, and monkey. What a spectacular

forest it was! In a few places the sun was completely shut off by dense verdure overhead, but generally light was able to penetrate the green world about. Hundreds of Armor Palms, *Hexopetion mexicanum*, sent up wickedly armed trunks from the jungle floor. In our Palm House at the Garden this palm always attracts attention, and here was a forest of them, each trunk beset with formidable, stilleto-like, steel-gray thorns, two inches long. Three or four species of Chamaedorea were also noticed. One was the climbing type, one of the few palms that can be classed as a vine. A "Shingle Vine" with silvery splotched leaves, apparently a Monstera of some

The ornamental *Begonia imperialis*

sort, pinned itself to tree trunks. Other aroids sent runners up the tall trunks and often hung in festoons from the uppermost branches. A green-leaved "Dumb Cane" was found in many places throughout the forest. As we plunged deeper into the jungle, strange new plants came to our attention —plants that would be an addition to any botanical garden. Yet getting them out is another story. One of the most striking of foliage plants was *Begonia imperialis*. Sometimes it climbed near-by trees, or it grew on moistened rocks; then again it preferred old fallen logs or just hugged the ground, forming colorful mats. Several varieties of this beautiful species

were to be found in the rain forest. One with wholly bright green leaves is referred to variety *smaragdina*, while another with bright emerald-green leaves spotted with silver is variety *maculata*. *Begonia imperialis* is truly one of the handsomest of tropical species, having leaves four inches wide, dark green to greenish-brown with irregular bands of silver-green along the veins, and the whole surface thickly set with plush-like hairs.

Now and then we encountered fallen logs, their rotting mass littered with epiphytes; on this account we were able to get at plants that naturally grew high above the ground and which would have gone unnoticed so far up. One huge monarch supported a number of orchids, among them an *Arpophyllum giganteum*. Its long-petioled, strap-shaped leaves made up a huge clump from which arose several brownish-red stalks supporting many small flowers of lilac and crimson-purple. A brownish-and-yellow flowered Maxillaria was its companion, but there were Epidendrums also inhabiting the log. On another fallen tree we noticed a slender-stemmed Rhipsalis, apparently *R. Purpusii*, with nearly terete stems and thin, leaf-like branches. On still another log we found clumps of Pitcairnia with large leaves and spiny petioles. Until then I had believed Pitcairnias were all terrestrials, but was soon convinced that they grow equally as well on trunks of tall trees and on rocks. Other bromels were seen everywhere in endless varieties. Tillandsias predominated but there were also Vriesias, Catopsis, Billbergias, and Aechmeas. The forest appeared to be resplendent with ornamentals, and it would take weeks to collect and identify the material.

For more than an hour we continued through the primeval forest without sighting an animal or human being. Occasionally when a noise would emanate from some clumps of bushes or a bird would flit through the canopy above, MacDougall and I would become frozen in the path while our guide would stealthily stalk the game. Sometimes a report of the gun was heard but most of the time the creatures of the woodland outdistanced the hunter or became swallowed in dense brush. Once we heard an ominous sound like that made by a raging forest fire and saw billowing smoke above the tree tops. Upon closer approach we noticed that an area was being cleared and that two black-bearded young men, armed to the teeth, were supervising the fire. They hailed a greeting to us, one of the boys being a brother of Jesus Maza.

Shortly after our farewell to the "jungle blazers" we reached an isolated Indian *ranchito* in a little clearing at the base of Pico or Cerro Carrizal. A few citrus and banana trees were planted about and a small spring oozed from the rock. The hut, built about one year ago, was a tile-roofed structure, and served as living quarters for three women and two men, while a smaller thatch-roofed lean-to was used as a storeroom for the family. We

Indian hut in the Rain Forest.
Rancho Aguajito, where food and lodging were secured.

An Epiphyllum collected near Ocozocoautla

were offered the use of this narrow room during our stay. There we slept on the ground, stretched out on a *petate* or straw mat, and covered with a thin sheet.

Short excursions were taken into the woods surrounding Rancho Aguajito where the two of us collected an array of miscellaneous ornamentals, particularly those that were overlooked earlier in the day. Occasionally we came across the common Broadleaf Cactus, *Epiphyllum oxypetalum*, which is often erroneously called "Night Blooming Cereus." This is perhaps the most common of the Epiphyllums in cultivation and is readily distinguishable from all other species. The joints are rather flat and thin, somewhat wavy; and from them white flowers are produced that are curved above the ovary, somewhat resembling a saxophone in shape. This Epiphyllum was growing as a terrestrial, while another species was epiphytic. Even though the latter bore no flowers at the time it is safe to assume that it is *E. pumilum*. Its mature joints are quite thick but the juvenile growth is often thin. We have *E. pumilum* from another section of the Isthmus (collected by MacDougall) which flowered for the first time at the Garden in July. Its blooms turned out to be the smallest recorded for that genus, being only three inches long. An Acanthaceous shrub with purplish flowers was evident on the slopes, apparently a Justicia of some sort. A delicate, creeping Tradescantia grew in small patches in sheltered nooks. Peperomias were also present, as well as other carpeting plants.

About 200 yards up the steep north side of Cerro Carrizal is located a cave not yet fully explored. Dr. Matthew W. Stirling of the Smithsonian Institution visited the subterranean chambers in 1946, descending by means of a notched tree trunk which was still in place during our visit. According to Dr. Stirling's account in the February 1947 *National Geographic Magazine*, this cave is littered with pottery vessels and ornate incense burners. In one of the rooms Dr. Stirling assumes that there are more than a thousand complete vessels buried in the loose earth of the floor. This alone would be a great temptation for exploration, but being botanists rather than archeologists we decided to devote our time to the flora.

Cerro Carrizal, or Pico Carrizal as Dr. Stirling calls it, is a high promontory which rises from the jungle floor like the Alpine Matterhorn. The ascent was made at an angle of 45 degrees and loose rocks and deep leaf-mold made the going tough. Hopes of reaching the top were frustrated by thickets of *carrizo* and sheer walls of stone overgrown with lichens and ferns. Our guide had to hack at the vegetation and prepare a path so we could proceed.

The vegetation up the slope of the conical peak was little different from that of the jungle floor. The colorful silver-streaked *Begonia imperialis*

smothered patches of ground everywhere. A palmate-leaved Begonia with a flowering stalk nearly nine feet high was found but the white flowers were inconspicuous (see cover). Last year MacDougall sent it to Mr. Ziesenhenne, a Begonia specialist in California, who pronounced it a new species and named it *B. Macdougallii* in his honor. The tremendous height of the flower stem makes this plant very unique. Different kinds of ferns, including a Selaginella looking like the cultivated Golden Club Moss, S. *denticulata* of our greenhouses, were quite prominent among weathering stones. A curious fern with linear to linear-lanceolate leaves about a foot long hung in masses from tree trunks. Apparently it was a species of Vittaria, a semi-tropic tree-dweller commonly known as "Grass Fern." Many kinds of orchids also inhabited the trees, but the air plants which interested me most were the bromeliads, some of them in flower. Tillandsias excelled in the number of species but there were Vriesias with flattened elliptic inflorescences, Aechmeas with spinose leaf margins, and an occasional *Billbergia pallidiflora*. Then, too, a large species of Pitcairnia was encountered, either hugging trunks of trees or growing in soil. Chamaedorea palms were abundant, one species sending up slender stems that climbed for great lengths up the shrubbery.

When confronted by an inaccessible stone wall, we retraced our steps in the direction of the cave entrance and skirted the east side of the peak. Hanging down from a rocky ledge was a very slender cactus vine which resembled some species of Rhipsalis, but on closer examination proved to be a Selenicereus, possibly S. *Murrillii*, although not in flower in April. It is unlike any of the typical forms, the bright green stems only a quarter of an inch in diameter and practically spineless. The same species also was found on lichen-covered trees in the vicinity. In semi-shade was noticed a beautiful, velvety Anthurium with an inconspicuous tail-like inflorescence. The large cordate leathery leaves are dark green with prominent veins of seafoam tinge. The rocky hillside was literally plastered with plant life of every description. An interesting find was a deeply lobed Epiphyllum about twenty feet long growing on a slender tree. The mature joints measured six inches across and the lobes extended nearly to the midrib, giving it the appearance of a fishbone. Only two other Epiphyllum species are lobed like this one, *E. anguliger* and *E. Darrahii*. The former has a more pronounced midrib, with shorter rounded lobes, while the lobes of the latter are more triangular and usually pointed or acuminate. Placing the rain-forest plant next to either of these two makes me feel that here perhaps is another new species for it seems to have different vegetative characters. MacDougall had previously collected this plant in Chiapas a few years ago but it has not flowered as yet. Naturally it will be a thrill if our plants come into bloom to reveal their true identity.

Selenicereus Murrillii, a pendent Night-blooming Cereus

On one occasion we came to the lair of a jaguar. Only fresh tracks on the moist ground were evidence that the king of the rain forest had left his hiding place when he sensed our coming. As a rule, picturesque tropical creatures were very seldom met with but their presence was known by the song or weird sounds that reverberated through the wilderness. Lizards and spiders scurried hastily across the forest floor or over rocks upon our approach. Snakes, supposedly present, were never seen; however, I was always wary about thrusting my hand through brush or between rocks to pick up flowers or small plants. Now and then we came across seemingly endless parades of giant leaf-cutting ants—each carrying its burden of a piece of green foliage.

Days upon days could be spent exploring the rain forest but a halt had to be called some time, so after partaking of a frugal meal consisting of eggs and tortillas secured from the Indians we began our trek back to Rancho Recuerdo. First, we filled our three bottles with water from the cool spring, for no other drink would be available until we reached the ranch. The walk through the forest was done at a brisk pace as we wanted to reach the *rancho* before nightfall. Soon we found ourselves on the *camino real*—the road that connects Quechula with Ocozocoautla. Part of the mud route was dried up but there still remained sections that were slippery. About halfway between the rain forest and ranch a pair of deer crossed our path and the guide took off after them. Shortly after, the gun went off and then another report was heard in the thicket, giving me visions of venison for the night meal. MacDougall followed Jesus into the thicket to bring out the carcass while I guarded our belongings and kept an eye on the horse. A half-hour elapsed before my companions hove into sight—empty-handed as usual. The deer got away but the guide assured me that he wounded one of them. This was the second occasion that deer meat was denied me. It appeared that *tortillas* and *frijoles* were to be the chief diet wherever we went. Tortillas are the basic foodstuff throughout Mexico. They are made from unleavened ground corn, pounded into thin flat cakes and cooked in a shallow earthenware vessel. They are quite palatable when fresh but I was tiring of the same menu day after day. Frijoles are made from beans, whether ground into paste or cooked in any form.

As dusk began to fall three tired fellows entered the ranch for a good night's rest. Then a heavy fog descended upon the countryside and a chilly norther forced us indoors. The fog saturated everything. Trees and bushes were dripping moisture just as if a light rain had fallen. In the morning the fog still enveloped everything but the sun would dissipate it as it rose higher into the heavens. We busied ourselves with the plants that were collected and after packing all our belongings securely in our *morrals* (shoulder bags) we bade adieu to our hosts and started for Ocozocoautla. The fog had not yet lifted but MacDougall had insisted on leaving by nine o'clock in the morning so that we could reach our destination by late afternoon and do a little collecting on the way.

Along the road a very compact bluish Maguey with dark red tip spines and marginal teeth grew in open ground. This species would make an excellent pot plant but I have never seen it utilized for this purpose. Small suckers were taken and are now growing at the Garden. I have not determined what it could be unless it be *Agave chiapensis*. Among huge rocks and in a ravine overlooking Ocozocoautla's quaint cemetery in the distance we paused to photograph and collect xerophytic plants. Clambering over a

huge boulder was a seven-ribbed Selenicereus with about seven radial spines and one to four centrals. It appeared in a starved condition and looked more like the common Rattail Cactus, Aporocactus, than a true Night-blooming Cereus. In more favorable locations the stems were greener and plump. Orchids were also seen in abundance, especially *Laelia rubescens* which grew plastered to the rocks. There was also a Pitcairnia with long grass-like leaves hugging the precipitous walls, and nearly every plant was resplendent with a reddish stalk that bore orange-red to scarlet flowers. A very ornamental cut-leaf Philodendron was the most prominent aroid noticeable. It grew at the bottom of sandstone cliffs and climbed to the top like a huge monster with outstretched perforated leaves. A neat little hairy Peperomia, its small leaves marked by three prominent purple-red veins on the underside, was collected and should make an excellent pot plant. On a small tree overhanging a precipice I spotted a huge cluster of an unknown Epiphyllum with long thick flat joints twenty-two inches long and up to three and one-half inches broad. What MacDougall thinks to be the same species is cultivated in Tuxtla Gutiérrez and also grows wild along the road above Chiapa de Corzo, but as flowers were not seen it is hard to say what it might be. Bromels of all kinds were abundant on rocks and trees. The common coastal Spanish Moss, *Tillandsia usneoides*, was heavily draping trees in this locality. The curious *T. streptophylla* was rather common and there was also a dwarf narrow-leaved Tillandsia covered all over with silvery scales and from its centers sending up short stalks of yellow tubular flowers.

The *Home Garden* for December, 1947, publishes the results of the contest on "How I Succeed With African Violets," giving reports from six prize-winning growers which can not but be helpful to any one interested in growing Saintpaulias.

Quite as interesting in another way is the disagreement among successful growers as to the best way to handle these plants. The following quotations emphasizes how difficult it is to give advice to gardeners and how there is always some one to disagree.

> Among the Reports (many hundreds) as a group the following utter contradictions have been noted, all, mind you, with gardeners who *succeed* with their plants: Pure compost only—All compost fatal. Keep plants pot-bound—Never let get pot-bound. Keep outdoors in summer—Always keep indoors. No water on leaves—Be sure to spray leaves. Expose cut leaves to air overnight before propagating—Place cut leaves in water immediately. Never move pots—Turn pots every few days or transfer from sun to shade. Avoid excess watering—Keep an inch of water in pot saucers. Leaf blade must touch soil in propagating—Keep leaf blade above rooting medium.

STARTING SEEDS FOR THE SPRING VEGETABLE GARDEN

ROBERT W. SCHERY

As this is written, St. Louis is in its "several-th" day of sub-freezing weather, and we of the county have noted a sub-zero mercury two mornings running. The postman, after a thumb-numbing ring of the doorbell, couldn't restrain a friendly "dig" or two as he handed over a bulging package of blatantly labeled "Spring Vegetable and Flower Seeds." The coal bill mounts and the winds may howl, but the successful spring gardener already is preparing for 1948's planting.

St. Louis is normally blessed (or is that quite the word for it?) with a scorching July and August. Few vegetables, especially the delicacies among them, can "take it" during such St. Louis summers, even where ample watering is possible. We find, then, that the way to outwit the weather is: (1) to plant early, (2) to plant quick-maturing varieties. If we can harvest before July blisters everything but the weeds, we can usually expect good growth during April, May and June, giving ample yield.

Of course, Old Man Weather is still unpredictable. In 1946 he gave us a March full of balmy breezes and spring flowers, while in 1947 he treated the same month with cold contempt. About 4-weeks difference existed between 1946's early spring and 1947's late spring, and almost as much difference could be noted between first successful outdoor planting dates in these respective years. Vegetables started under glass had to be kept in flats and under cold-frames longer in 1947 than in 1946. Yet our seeding dates in both years were essentially the same, and with few exceptions gave about the same harvests.

Let us then examine a schedule for a few common vegetables for pre-spring seeding (under glass, of course) that has given satisfactory results in St. Louis proper. We must assume in this schedule that the gardener has access to a greenhouse of sorts—if nothing more than a heated cold-frame or well-lighted corner of the home. If the crop is to mature before July many plants must be started under glass so that they will be in an advanced stage for planting outdoors with the advent of suitable spring weather.

Jan. 15–Feb. 1. *Onions.*—This is the time to start most varieties of onions from seed. Seeds may be "broadcast" in flats and the plantlets later thinned (by pulling out and discarding unneeded ones) to about one-half inch apart; or they may be planted in pots and in about two or three weeks the seedlings transplanted to flats with more ample spacing. We have found heavy watering and some "feeding" to be helpful in readying the seedlings for outdoor planting as early as April 1 (in 1946).

Feb. 1–Feb. 15. *Broccoli, Cauliflower, Cabbage.*—These may be seeded

in flats and thinned, as with onions, but transplanting seedlings from a seeding pot to ample spacing in a flat is probably better with these rank, fast-growing types. They are best "hardened-off" in a cold-frame, and will have to be kept cool to restrain growth if spring is late. In 1946 planting outdoors was possible by March 27, and first harvests were available less than one month later. Select the quick-maturing varieties suggested by your seed catalogue.

Feb. 15–March 1.—*Bibb Lettuce, Peppers, Broccoli, Cauliflower,* and *Cabbage* can still be started to advantage under glass. The Bibb variety of lettuce is slower to mature than Simpson, but seeded under glass can produce leaf lettuce by mid or late April. Peppers are slow to grow and need warm weather; they will probably not be ready to set outdoors until mid April. With an early spring it may be possible to plant outdoors beets, carrots, chard, Simpson lettuce, radishes, spinach, peas and onion sets. In 1946 all of these survived from an outdoor seeding of February 27, to be harvested in April, May and June.

March 1–March 15. *Tomatoes.*—Treat as with broccoli, cauliflower, and cabbage. Depending on the season numerous outdoor seedings as listed above may be possible during this and the following periods.

March 15–April 1. *Squash, Tomatoes.*—Both tomatoes and squash are warm-weather plants, and little advantage is obtained from early outdoor planting unless the weather is quite mild. Before such weather occurs the squash plants may attain sizable proportions in the greenhouse in individual pots. Yet the early indoor start seems to give yields before borers and wilt do away with plants in late spring and early summer.

April. *Corn, beans, squash, melons,* etc. — General outdoor seeding and transplanting. In favorable years outdoor seeding in April of many of the vegetables listed above may still give adequate harvests before onset of killing summer weather.

A small city garden may be brightened up during the winter months by the discrete use of artificial materials. Little red berries (the kind which are sold at 15 cents a bunch for tying up gift packages) can be fixed to a bare shrub in a few moments, yet seen from the house they will look like the genuine article. Small evergreens in a small formal garden can be decorated with larger Christmas tree ornaments.

Winter is a good time to study botany. How many of the trees which you know in the summer-time can you recognize in the winter? The branching patterns of trees are quite as distinctive as their leaves and they are most fully revealed during the winter months.

NOTES

At the annual meeting of the American Society for Horticultural Science, held in Chicago, December 31, Dr. G. A. L. Mehlquist, Research Horticulturist to the Garden, was elected chairman of the section for floriculture and ornamental horticulture.

Among the visitors to the Garden orchid collection at the City Garden and Gray Summit were Mr. L. M. Abrahms, President Chicago Orchid Society, and Dr. David H. Brown, of the California Institute of Technology, Pasadena.

The biology classes from Harris Teachers' College, conducted by Dr. Lillian Nagel, head of the department, visited the Garden library and herbarium recently.

The following members of the staff and students in the Henry Shaw School of Botany attended the meetings of the Botanical Society of America held in Chicago, December 27-30: Dr. Edgar Anderson, Dr. Henry Andrews, Dr. G. A. L. Mehlquist, Dr. R. W. Schery, Mr. M. T. Hall, Mr. Richard Holm, Mr. KoKo Lay, Mr. Lee W. Lenz, Mr. Fred G. Meyer, Mr. Dennison Morey, Mr. David J. Rogers.

Recent visitors to the Garden include: Mr. José Castro, of Guatemala, graduate student, Iowa State College, Ames; Mr. John Jay Finan, of Iowa State College, Des Moines, Iowa; Dr. Seymour Fogel, of Queens College, Brooklyn, N. Y.; Dr. George J. Goodman, of the University of Oklahoma, Norman; Dr. Charles B. Heiser, of the University of Indiana, Bloomington; Mr. Leslie Hubricht, of Dallas, Texas; Dr. J. J. Miller, of McMaster University, Hamilton, Ontario; Dr. B. Sahni, of Lucknow University, Lucknow, India; Dr. E. R. Spencer, of Lebanon, Ill.; Dr. Delbert Swartz, of the University of Arkansas, Fayetteville; Dr. M. J. Thirumalachar, of Malleswaram, Bangalore, India.

Weisia viridula, a tiny little moss of the St. Louis area, is known by name to only a few botanists. It grows on dry rocky hillsides, under cedar trees, and in such like places. During February and March it makes broad sheets of brilliant green in the winter landscape.

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 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. 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 bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

THE MISSOURI BOTANICAL GARDEN

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MISSOURI BOTANICAL GARDEN BULLETIN

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Volume XXXVI March, 1948 Number 3

Cover: Goldband Lily (*Lilium auratum* var. *platyphyllum*)

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Missouri Botanical Garden Bulletin

Vol. XXXVI MARCH, 1948 No. 3

WE CONSIDER THE LILIES

DENNISON H. MOREY, JR. AND RICHARD W. HOLM

It is unfortunate that the people of the Middle West are not offered more lilies which will thrive and flourish here. Nothing can give quite the thrill or satisfaction that good lilies do. Some types provide the finest of cut flowers. Spikes of more than twenty flowers may be cut when the first buds open, and they will remain fresh until all have bloomed. One of the finest lilies for cutting, *Lilium Shuksan*, will frequently last over a month.

That more lilies are not grown is probably attributable to the fact that many people have tried them and suffered failure. Losses usually are not the result of neglect, but rather of planting diseased and improperly handled bulbs. Bulbs of seed-grown strains, kept free of aphids (virus-carriers), and bulbs of resistant varieties are remarkably successful in the average garden. The difficulty is in obtaining bulbs of this character. The cheaper bulbs are usually most sought by the average gardener, but cheap bulbs are usually virus-infested. Good bulbs are available but dealers hesitate to stock them because they are more costly. Seed-grown strains, clean bulbs, or resistant varieties of American origin are the only answer if one desires success with lilies. In those instances where good strains are available, the buyer should be careful to see if they have been properly stored and handled.

For several weeks during the month of July, 1947, we were privileged to observe the lily-growing operations of the Oregon Bulb Farms, at Sandy, Oregon. This wholesale firm is well known for its comprehensive collections of daffodils and other spring bulbs. The fact that it maintains the largest commercial plantings of garden lilies in America makes it especially interesting to those concerned with lilies horticulturally or scientifically. We are indebted to Mr. Jan de Graaff, president, John W. Heyer, and Earl Hornback for their aid and hospitality during our visit.

From the very first it was apparent that one of the greatest difficulties in growing lilies is the myth that all lilies are inherently tender garden sub-

jects. That this is a myth was clearly illustrated at the Oregon Bulb Farms where these plants are grown in full sun, in fields of many acres each. The soil, a rather light clay, is a far cry from that advocated by most lily specialists. The secret of raising lilies as a field crop lies in using only those plants which have been bred and selected for hardiness. This includes freedom from disease, especially the dread mosaic, of which all gardeners are aware. On the farms where lilies are treated as is corn in Missouri or Iowa, careful cultivation is combined with complete isolation of virus-free strains, and only resistant varieties are grown. The results are slight loss from disease and the production of superior bulbs.

The development of clean and resistant strains is of considerable interest. A desirable plant that has mosaic is frequently able to produce seed, and strange as it may seem, the virus is apparently not present in the seed of an infected plant. By saving and planting the seeds of infected plants many valuable types may be perpetuated. However, because of the fact that seedlings vary, each will be somewhat different from its parents. This has led to the introduction of seed-grown strains of lilies such as the Olympic Hybrids or Fiesta Hybrids, which may vary in color and size but maintain a given type of flower and blooming date.

Resistant strains may be built up by hybridizing resistant species with susceptible ones. New forms often result which are superior to both parents in color or size and which are immune to mosaic. Hybridization has led to other equally important gains. The trumpet lilies, for example, are best known through the Regal Lily. However, the day of the true Regal Lily has passed. In its place is coming a host of hardier, larger, and more colorful trumpets. Strains are being built up which will include deep pinks, light pinks, clear yellows and apricots, besides the usual white flushed with purple. In addition to the trumpets there are new, hardy, brightly colored "Turk's Caps," aptly called the "Fiesta Hybrids," which range in color from orange to deep mahogany red. The upright umbellatum-type lilies may also be had in improved strains of red and orange, as well as in clear unspotted yellows and oranges, the "Golden Chalice" strain.

In selecting his bulbs the gardener should remember that lily bulbs are never completely dormant, and hence they should be kept out of the ground for as short a time as possible. Furthermore, the large basal roots of lilies are part of the food storage system of the plant. If these roots are removed or dried out, the bulb will have lost much of its strength. *Such a bulb is almost a certain failure.* Bulbs displayed for sale should be more or less covered with damp peat or sphagnum moss. If in good condition the roots and bulb will be firm to the touch. Once obtained, the bulbs should be planted as soon as possible.

The size of the bulb is a poor guide to its quality. Some of our nicest lilies grow from very small bulbs. As a matter of fact, certain lilies have been developed with enormous bulbs, but they produce little top growth and few flowers. Once again, a good variety of a known source is the best guide.

Some lilies make considerable root growth in the fall; hence early fall is the best time for planting. The culture and planting varies to some degree, depending upon whether or not the lily produces stem roots. Some lilies, for example, *L. candidum*, the Madonna Lily, produce no stem roots and require relatively shallow planting—about four inches deep. Contrasted with this are such species as *L. formosanum*, which bear roots along several inches of the stem and consequently should be covered with eight or ten inches of soil. One of the many excellent lily books now available may be consulted for exact information about planting and culture of specific varieties.

Some of the lilies which have been found to do well and may be recommended for this area are: *Lilium auratum, L. candidum, L. Hansoni, L. Henryi, L. Maximowiczii, L. regale, L. Shuksan, L. tigrinum, L. umbellatum.*

THE LAWN—TO MOW OR NOT TO MOW

ROBERT W. SCHERY

I might as well confess in the very beginning that this article records but one man's experience, over an interval of only little more than one year. Hence it cannot offer any general proof or conclusions. The observations were made mostly during the 1947 growing season, in St. Louis County, on an "experimental plot" consisting of the author's lawn. Deciding factors as to whether or not similar "tests" will continue in 1948 or in subsequent years lie perhaps more in the realm of diplomacy than science. But, in any event, we present the drama of the "Lawn, 1947."

CHARACTERS AND SETTING

The lawn components.—In the Spring 1947 the lawn was "typical" of many moderately cared-for lawns of the St. Louis area. Perhaps a little more blue-grass was evident than may be usual, but just as many weeds were there as in anybody's yard. The chief grass was Kentucky blue-grass; rye and redtop were present in small quantities; crabgrass was frequent (crab-grass is an annual, dies in winter, grows anew from seeds the following summer). The commonest weeds were plantain (narrowleaf and broadleaf), dandelions, chickweed, some sorrel, and verbena. White clover was moderately present.

The lawn position.—The lawn occupies a moderate slope southward and southwestward. It thus experiences accelerated drainage and the most intense summer heat possible. Light shading from two river-birches and a young sycamore is afforded roughly one-half the lawn area.

The lawn history and treatment.—The lawn was established by the original owners on poor, infertile clay thrown up from foundation diggings. Some effort must have been expended in order to establish a rather good stand of blue-grass. A second owner gave the lawn little attention for a period of about three years. During the winter of 1946-47 a light application of leaf mold was given by the present incumbent, followed in the spring with one of chicken-manure plus wood-ashes. Little or no new seeding was attempted. Recommended concentrations of 2-4-D (about 0.1 per cent solution; roughly 1–2 teaspoons of commercial solution to the gallon of water) were applied twice to kill broad-leaved weeds, being quite effective on plantains and dandelions, only mildly so on chickweed, sorrel, and verbena. During late summer an occasional heavy watering was given.

THE FIRST ACT: SPRINGTIME

Kentucky blue-grass starts growing rapidly early in the spring. The application of a nitrogenous fertilizer (the chicken-manure) made the grass grow at least half again as rapidly as did control plots (backyard and neighboring yards left untreated). It was decided, as an experiment (that's my story and I'll stick to it), not to mow—at least not until neighborhood pressure should demand otherwise. Grass leaves became long and weak from rapid growth and soon fell over, giving a "wind-blown" appearance to the lawn. Also, probably because of the nitrogenous fertilizer, the blue-grass never "went to seed" (sent up unsightly seed stalks). Total grass height was not more than 6 inches above soil level because of the bent-over above-ground portions. By mid-spring most weeds had been eliminated, by hand or through the use of 2-4-D, and thereafter never had much of a chance, since dense "tresses" of blue-grass guickly smothered any seedlings that developed. Significantly, crab-grass, for the same reason, had little chance to make inroads at its normal late-spring germination time. Only one or two of the barer areas ever developed noticeable quantities of crab-grass. Passers-by, accustomed to a close-clipped turf, undoubtedly considered the yard, shall we say, "unkempt"? Every day or two boys armed with lawn-mowers appeared at the door confident of employment, and you can guess the prices mentioned.

THE SECOND ACT: SUMMER

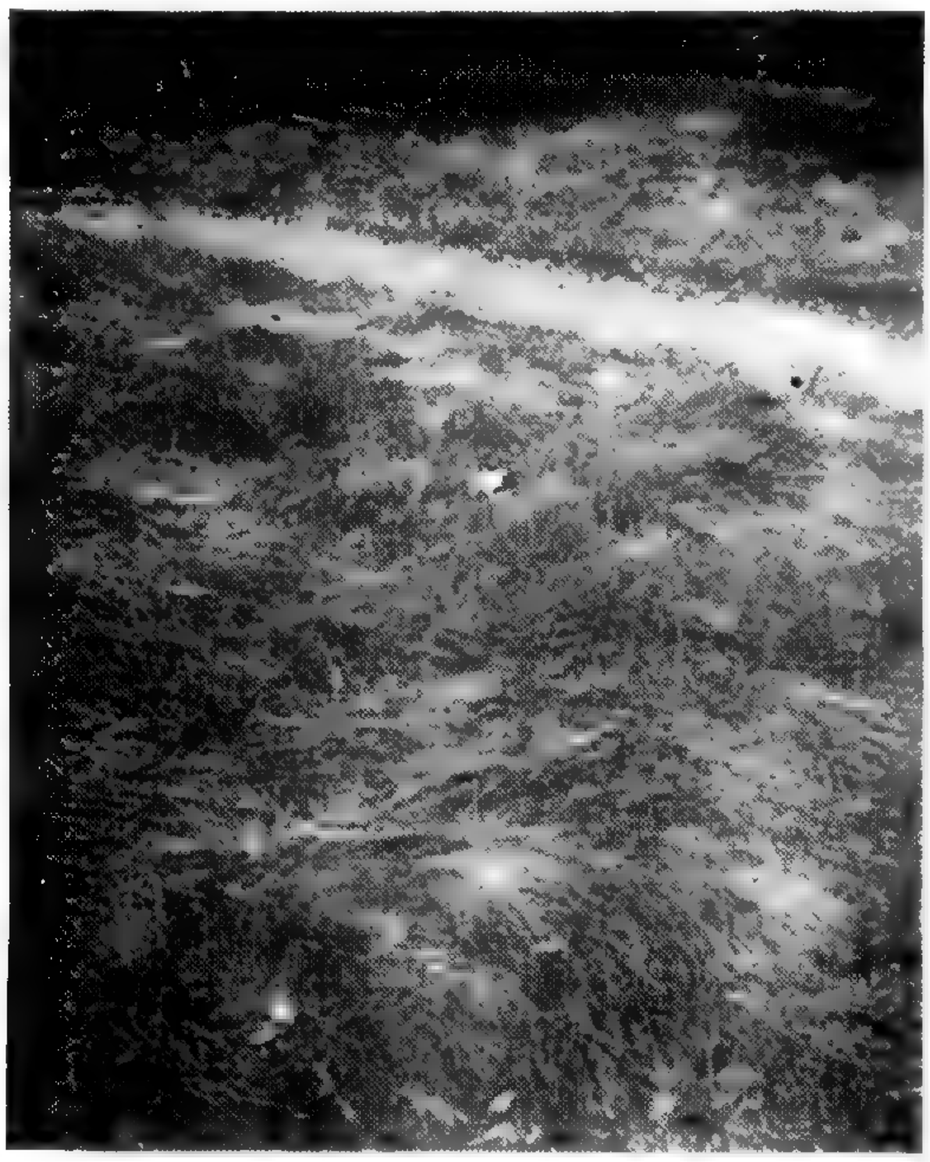
Blue-grass doesn't grow much in summer, nor can it stand high soil temperatures. My thick stand of blue-grass plus minor quantities of rye and redtop went into summer lush and green, came out bedraggled and brownish. My lawn (mostly devoid of crab-grass) was handsomer in June than were the neighbors'; the neighbors' lawns (mostly crab-grass, which does well in summer) were handsomer by the end of August. The blue-grass seemed to have fared neither the better nor the worse for having been left uncut. As is normal for blue-grass during a St. Louis summer, it simply "curled up" to await cooler, more moist autumn weather. One feature, perhaps objectionable, was that vigorous clumps of blue-grass had apparently smothered the less vigorous clumps as well as the crab-grass. With the withering of the long grass leaves during the intense heat and drought of August, brownish (dried grass leaves) areas were noticeable between greenish clumps. Thus an uniform but less vigorous stand seemed to have been sacrificed for a "clumpy" (but more robust?) one. This effect, however, was not very noticeable from a distance. The illustrations show the unmowed lawn area as it appeared in mid August, 1947.

THE THIRD ACT: AUTUMN

With the onset of cool autumn weather and renewed rainfall blue-grass comes to life again, becoming green and vigorous but growing only slightly. The autumn lawn left unmowed did not appear unusual. Obviously some of the Kentucky blue-grass had been a casualty of the unusually hot and dry summer, but what remained was sufficient to give a good green lawn cover, enduring until the prolonged freezing of January, 1948. Neighboring lawns, heavy in crab-grass, were brown months sooner, for crab-grass dies with first frosts. And now the perennial Kentucky blue-grass is ready, at the first sign of spring, to start rapid expansion and growth and to recoup any losses suffered during the 1947 summer. Similarly ready is chickweed, but other weeds seem to have found the blue-grass competition and 2-4-D too severe.

CRITICISM AND APPRAISAL

Kentucky blue-grass put on a pretty good show. Its weakest performance was during the second act, Summer. In spite of a disadvantageous south slope and a very severe summer in 1947, it managed to pull through the shabby second act to a good final performance in Autumn. For its performance in Autumn and Spring it seems worthy of consideration as the outstanding lawn component.



Unmowed blue-grass lawn in August. From a distance, the lawn on the other side of the sidewalk (some 20 feet from the photographer) does not appear too unkempt.

Close-up of section of lawn pictured above (camera about three feet from grass), which may clash with inveterate close-clipper's idea of tidiness.

Kentucky blue-grass's performance seemed in some ways abetted and in some ways hindered by lack of mowing. Certainly lack of mowing gave it a decided advantage over crab-grass and late-spring weeds. Even had occasional mowing been practiced it is likely that a taller blue-grass would have made it necessary for crab-grass and other nearly prostrate weeds to grow more upright so that their seeding portions could have been cut by the lawn-mower. Also lack of mowing perhaps enabled robust clumps of

blue-grass to withstand severe summer conditions. Adverse effects in not mowing included an "unkempt" spring appearance, a non-uniform appearance of the turf due to robust blue-grass clumps smothering the weaker ones, and obvious difficulty in mowing if this should be decided upon after spring growth. Moreover, had not nitrogenous fertilizer been applied, unsightly seed stalks of blue-grass would likely have appeared in late spring. From our experience we can tabulate the advantages and disadvantages of not mowing the lawn as follows:

ADVANTAGES	DISADVANTAGES
Better weed control	Poorer appearance to most people's taste
Better crab-grass control	Difficult late mowing
Blue-grass withstands summer better?	Encourages "clumpy" autumn turf
More vigorous blue-grass clumps	Smothers some blue-grass, as well as weeds and crab-grass
Better conservation of soil	Allows unsightly seed stalks or tall weeds to develop
More time saved for golf	Human complications from being "different"

The Paper Mulberry.—For some years the small trees which formed the foundation planting at the St. Louis Public Library have attracted attention, not so much because of their soft dark green foliage, which contrasts well with the dull white of the stone building, but principally because of the orange-colored balls that in July hang on a few of the trees. These trees are the Paper Mulberry *(Broussonetia papyrifera)*, a relative of the common Mulberry but a native of China and Japan where the bark has been used in the making of paper. The specimens at the Public Library were, so far as we know, the first female trees of this species to be used in municipal plantings anywhere in the country. Groups of Paper Mulberries may now be seen at various places throughout the city, though many of them are male trees which do not bear the peculiar and attractive fruits in midsummer.

Like the Tree of Heaven *(Ailanthus altissima)*, the Paper Mulberry is tolerant of adverse atmospheric conditions and is not too particular about the soil and its drainage. In St. Louis the tree may attain a height of fifty feet. The arching branches form a broadly rounded crown, and the dense shade underneath makes it difficult to establish grass there. The tree has a tendency to form suckers and must be kept within bounds. However, it is to be prized for its lovely foliage, and if planted at the edge of a wooded area its shade and shallow roots will not interfere with herbaceous or shrubby plants. While the trees at the Garden are generally hardy the branches sometimes freeze back in a severe winter.

THREE EVERGREEN BARBERRIES

A. P. BEILMANN

Barberries are as much a part of Middlewestern horticulture as boxwood is of the Southeast. The varieties most commonly planted are the Purple, the Red-leaf, the Japanese, or some of the newer and patented types, but there are other evergreen species which would add interest to the landscape. The three species which have been tried out in this region and proven satisfactory are described and illustrated in the following paragraphs.

Three-spine Barberry *(Berberis triacanthophora)*

The smallest is the Warty Barberry *(Berberis verruculosa)*. This is a very compact shrub well suited for the small garden. The leaves are most attractive, the glossy dark green of their upper-surfaces contrasting strongly with the snow-white underneath. The flowers are of a golden yellow color and rather large for so small a plant.

The Three-Spine Barberry *(B. triacanthophora)* is a very hardy evergreen. It is reported to reach four and a half feet in height, but it seems unlikely that it will grow so tall here. The plant is armed with slender spines

Warty Barberry *(Berberis verruculosa)*

Wintergreen Barberry *(Berberis Julianae)*

about one inch long, growing in clusters of three. The flowers are especially interesting since they are white tinged with red, rather than yellow as are most Barberries.

The Wintergreen Barberry *(B. Julianae)* is probably the largest as well as the best known of the evergreen types. It forms a mound of foliage five feet high and nearly twice as broad. The flowers are very conspicuous, brilliant yellow in color, but they set few fruit.

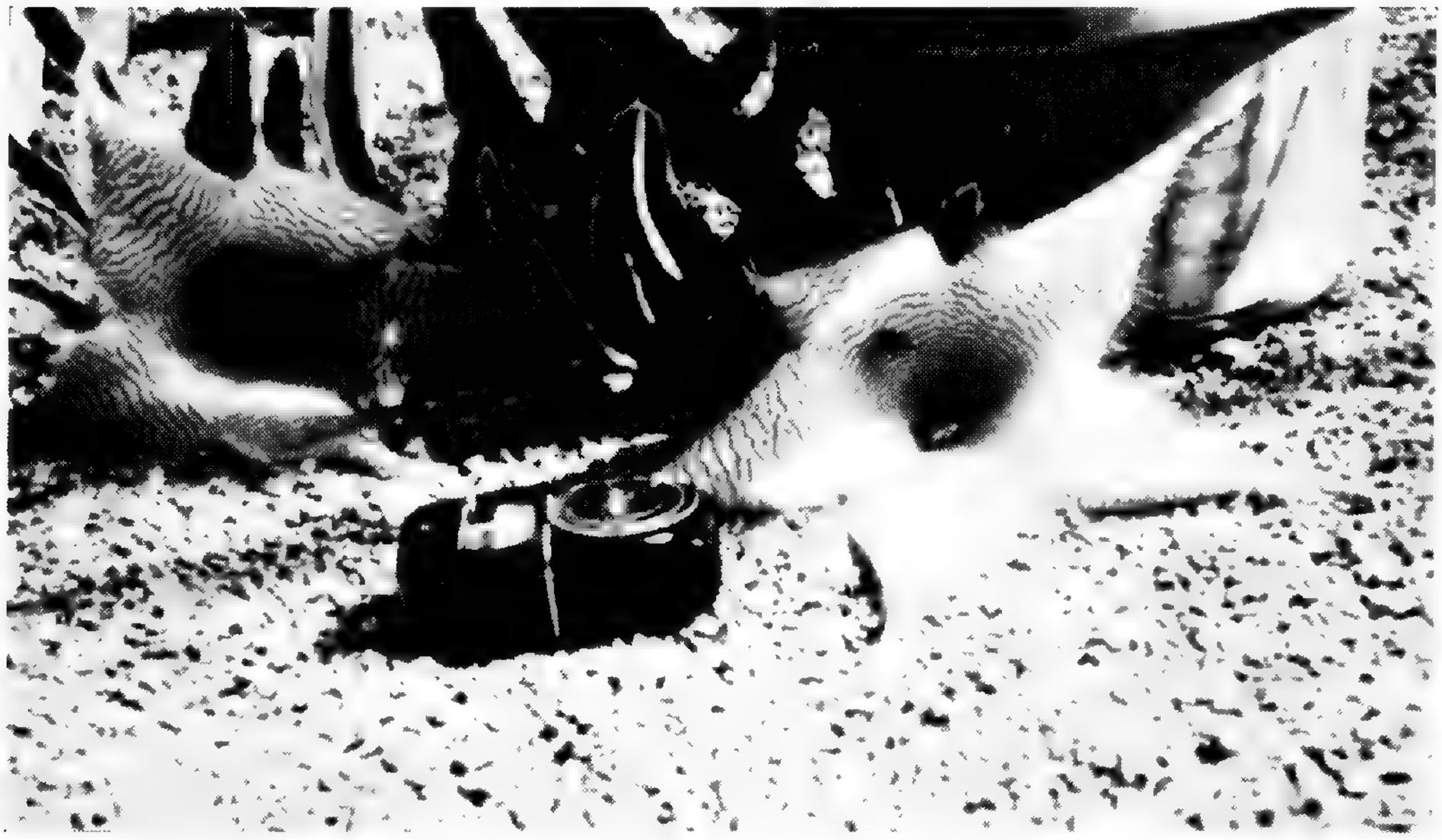
These new plants have many of the good habits of the more common Barberry. They are happy during our dry summers and they are rarely injured in wintertime. They can stand full exposure to sunlight and what they lack in brilliantly colored fruit is more than made up by the handsome flowers in spring. Aside from any other good qualities, the lustrous evergreen foliage should find a welcome in most gardens.

THE GIANT CARRION PLANT

DENNISON H. MOREY, JR.

One of the most interesting things about plants is their habit of doing seemingly un-plantlike things. An excellent example of such behavior is demonstrated by the Giant Carrion Plant, *Stapelia gigantea.* Its natural home is the desert, and it looks as though it belonged there. True leaves are virtually absent, as with cacti and other drought-resisting plants. The stem is thick, fleshy, and specialized for water storage. The food-making processes are carried on in the outer layer of the stem, and since this is greatly enlarged and the desert sun intense there really is no need for leaves. In habit the plant is prostrate, rooting at the nodes as it creeps along the ground. It is a native of Africa and one of the many desert representatives of the Milkweed family, the Asclepiadaceae.

Generally the plant grows only about eight inches tall, but the flower may be more than ten inches across. Instead of the heady, almost overpowering sweet scent of our native North American milkweeds, this grotesque child of the desert emits an odor that is unmistakably that of decaying flesh. When the plant flowered in the greenhouse this summer the scent of carrion in the early morning hours was so strong as to be sickening. Not only does the flower smell like rotting flesh, but its general appearance suggests putrefaction. The petals are a sordid, gooey cream color and transversely striped with liver-red, ridged lines. The entire surface is covered with long mouldy-looking hairs that emphasize the somewhat putrid air of the flower. The center of the flower, where the reproductive



The Giant Carrion Plant *(Stapelia gigantea)* showing female fly in flower at right.

parts are located, is the exact color of coagulating, but still wet, blood. The nectaries that secrete the carrion-like odor are located at the base of the petals beneath this red mass. It is not surprising to find that flies are completely fooled by the scent of the flower, and do not hesitate to lay their eggs on or about the red center. At least five batches of flies' eggs were deposited in the three flowers under observation. All these eggs hatched without mishap, and the second day after the flowers opened they resembled carrion even more closely by having maggots crawling about the nectaries. The illustration shows the female fly in the process of laying her eggs. At least two species of flies were tricked by the flower.

In its native habitat the Carrion Plant utilizes its odd scent and coloration for its own benefit and not that of flies, since it is undoubtedly pollinated by any of a large number of carrion beetles that abound in the arid sections of Africa. In the greenhouse, as far as could be determined, the flies did nothing for the plant. They were merely victims of the hoax that the plant has developed through the ages to entice certain insects to participate in its pollination.

In spite of its unpleasant odor the plant is very graceful in growth and makes a fine potted plant for the window-sill or the hanging basket. Some of the smaller species are very popular with succulent enthusiasts. Moreover, any one who has the skill and good fortune to flower the Giant Carrion Plant will find that he has a curiosity that is well worth his attention.

THREE NEW WATER-LILY HYBRIDS

GEORGE H. PRING

"AMERICAN BEAUTY," A TROPICAL DAY-BLOOMING WATER-LILY

With the introduction of *Nymphaea colorata* from Africa, the writer obtained a fertile species which he could use as a parent in crossing the early sterile hybrids of *N. gracilis* and *N. capensis*. Early experiments in breeding water-lilies at the Garden showed that three such hybrids, the pink "Stella Gurney" and "C. W. Ward" and the blue "William Stone," were not only from the same parents but also from the same seed-pod. By crossing "William Stone" with the blue *colorata* a very small amount of viable seed was obtained which produced only dark pink progeny. However, when the plants were dried for herbarium specimens the pink pigment disappeared and the dark blue of the two parents was in evidence. In general appearance the plant resembles hybrids of *N. gracilis* but with much smaller leaves and petioles. The flowers are small, and brilliantly colored, hence the name "American Beauty." The inner rows of stamens and the stigma show the bright yellow of *colorata*. The plant is easily propagated from tubers but the parent plants do not produce the multiple crown formation typical of *N. gracilis*.

Description.—Flowers 6–10 inches across, opening 4–5 days in August; sepals 4, 3–3½ inches long, 1½ inches wide, lanceolate-acuminate, slightly hooded, pale green outside, Light Mallow Purple* inside; petals 3–3½ inches long, ¾ inch wide, lanceolate-acute, Light Mallow Purple; stamens 145–150, outer whorl 1½ inches long, whorls increasing in length towards the center, somewhat darker Mallow Purple than the petals, Lemon Chrome at the base, innermost whorls Lemon Chrome; styles 25–30, incurved, Lemon Chrome. Mature leaves orbicular, irregularly sinuate, 12–15 inches in diameter, upper surface bright green, lower surface brilliant red, veins green; lobes overlapping; petiole terete, brown, 3–4 feet long.

"JAMES GURNEY," A NIGHT-BLOOMING WATER-LILY

During September, 1945, a large deep pink night-blooming Nymphaea flowered in the pools in Tower Grove Park. It was apparently a sport from a light pink, the result of a tuber propagation during the winter, an occurrence quite common with night-bloomers. For a test at the Garden, two bulbs were cured and grown in our propagating tanks in October. The five plants resulting were planted out during May, 1946, and during the summer

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* Color terms used are those of Ridgway's "Color Standards and Color Nomenclature."

Nymphaea "James Gurney"

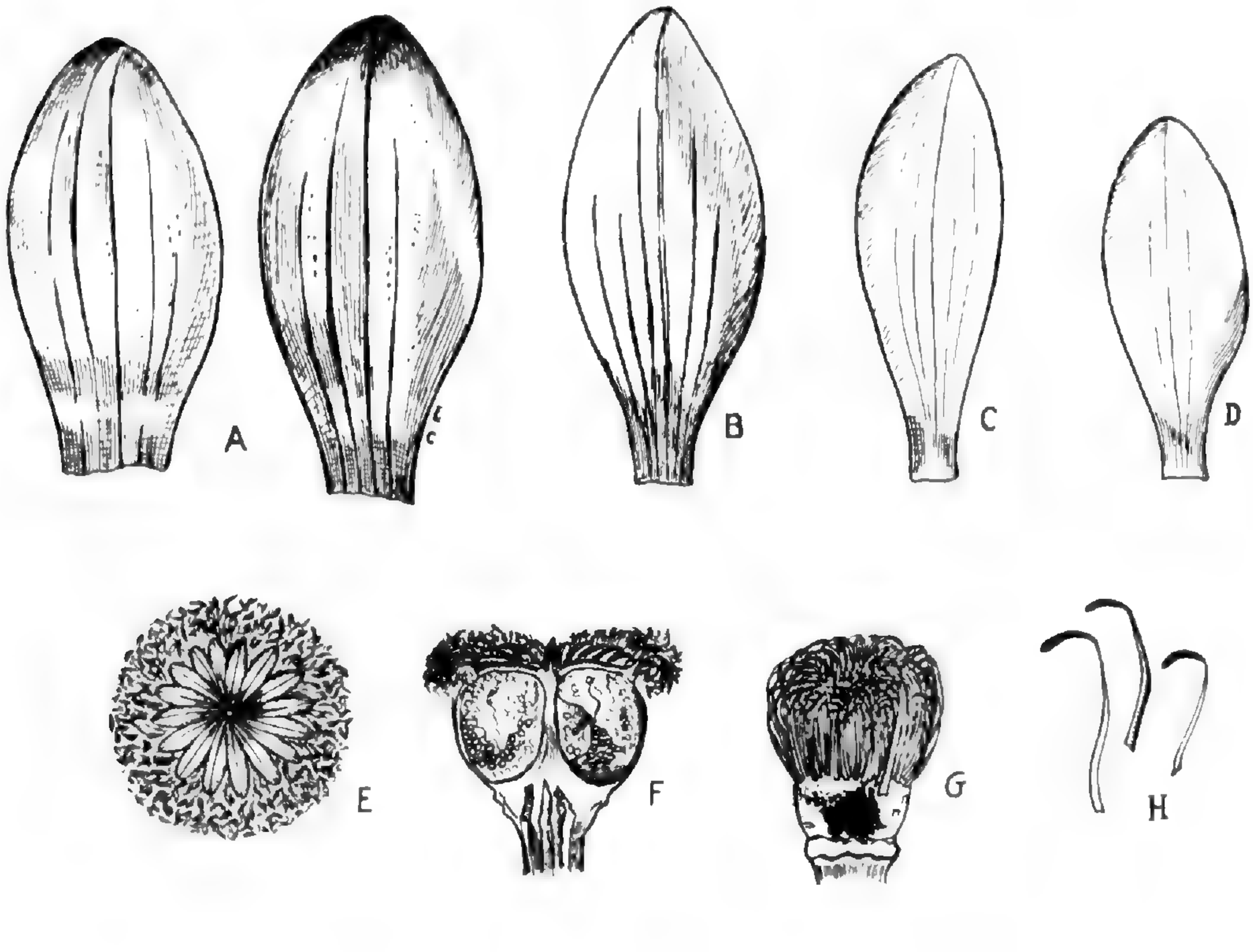
four of them produced light pink flowers and one the original deep pink. This dark form developed into a clump with massive flowers, which, when dug up in October, was divided into three specimens. In addition, two small propagating tubers were removed from the parent plant. The division plants soon established themselves in pots in the heated propagating tank, and during the winter thirty young plants were obtained. In May, 1947, ten plants were set out, resulting in dark pink flowers one foot in diameter, suggesting descendancy from the large hybrid *Sturtevantii*. This new hybrid is named in honor of Mr. James Gurney, head gardener to Henry Shaw and the first superintendent of Tower Grove Park, who early popularized the tropical water-lilies in Saint Louis.

Description.—Flowers nocturnal, fragrant, 10–12 inches across in August; peduncle terete, light brown, rising one foot above the water; sepals 4–5 inches long, 2½–2¾ inches wide, Deep Rose Pink, copperish

brown on the outside, with prominent lighter-colored veins; petals 30–34, 4 to 5 inches long, 2½ to 2¾ inches wide, Deep Rose Pink, the outer three tinged with copperish brown on the back like the sepals; stamens 98–100, outer row 2¾ to 3 inches long, Lemon Chrome fading towards the swollen base; anthers Deep Rose Pink; styles 23–25, Rose Pink, incurved. Leaves 12–18 inches across, orbicular, with fluted margins, copper-brown at first, copper-green with age, purplish brown underneath; lobes open one-third; petioles terete, 4–6 feet long, purplish brown.

NYMPHAEA GIGANTEA "ALBERT DE LESTANG" FROM AUSTRALIA

Two plants of *Nymphaea gigantea* forma *alba* (described in the February 1947 Garden BULLETIN) germinated from seeds sown at the Garden during August, 1946, and were kept growing in the greenhouse propagating tanks during the winter. The following May they were planted in the outside pools. In July the first plant came into bloom, having the typical blue flowers of *N. gigantea*. In August the second plant bore a flower which was white flushed with blue the first day but later bleached to pure white.



Nymphaea gigantea

A, sepals; B, outer petal; C, inner petal; D, innermost petal; E, top view of center of flower (third day); F, longitudinal section of seed-pod, showing reflexed stamens (third day); G and H, showing incurved stamens (first day).

Nymphaea gigantea "Albert de Lestang"

To prevent insect pollination with *Nymphaea gigantea* the plants were kept dormant. Seeds were germinated by Mr. Alfred Proebstle, in Brazoria, Texas, and at the Garden, the resulting plants bearing both kinds of flowers—the white (forma *alba*) and pale blue bleaching to pure white. Since the white form is not fixed it becomes necessary to propagate it by tubers in the same way that many hybrids of the Brachyceras group of Nymphaea are perpetuated. This intermediate form between the white and blue is named in honor of Mr. Albert De Lestang, who sent the seeds of the white form from Australia.

Description.—The plant is like the white-flowered form of *Nymphaea gigantea* (see February 1947 BULLETIN) except that the flowers are flushed with blue the first day, later bleaching to pure white. The stamens of both varieties are characterized by a ring of purplish-red at the base.

NOTES

Mr. George H. Pring, Superintendent of the Garden, acted as one of judges at the Fourth International Orchid Show, sponsored by the South Florida Orchid Society, held in Miami, Florida, February 20–22.

The first number of Volume XXXV of the ANNALS OF THE MISSOURI BOTANICAL GARDEN was issued during the month, consisting of Part V, Fascicle 1 of Woodson's and Schery's *Flora of Panama* (Lauraceae-Cruciferae).

Recent visitors to the Garden include Mr. Henry J. Freyman, orchid enthusiast of Kansas City, Mo.; Mr. Nelson M. Wells, Landscape Engineer, of Albany, N. Y.; Dr. Hugh C. Cutler, of the Chicago Natural History Museum (Field).

Mr. William F. Langan, Engineer at the Garden, died February 11, 1948. Mr. Langan faithfully served the Garden for thirty-six years, having charge of the central heating plant since its erection in 1912. During two wars, labor and fuel shortages, unanticipated changes in weather, and storms of unprecedented violence, no plant in any of the numerous greenhouses has ever known what it was to suffer for lack of heat, due to the unfailing interest and constant alertness of William Langan. This is a record of which we are proud.

Dr. Julian A. Steyermark, Associate Curator of the Herbarium at the Chicago Natural History Museum, has been appointed Honorary Research Associate to the Missouri Botanical Garden. Dr. Steyermark will devote such time as may be available from his duties at the Natural History Museum to a study of the flora of Missouri of which he is an authority. He is the author of "Spring Flora of Missouri," with E. J. Palmer "An Annotated Catalogue of the Flowering Plants of Missouri," and many other papers dealing with plants from Missouri and elsewhere.

In St. Louis spring comes first to the tree tops. The silver maples flower abundantly all over the city in February, though few St. Louisians ever notice them, and in early March the elm buds gradually open their red-brown flowers.

Only preliminary results are in, but indications are that spring this year will be "normal," that is, not so early as in 1946 but not so late as in 1947. Crocus, snowdrops, hazels, and silver maples were first seen in flower the last week in February, while first flowerings of similar things were early in February in 1946 and not until late March in 1947.

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August P. Beilmann ..... Manager of the Arboretum, Gray Summit
G. R. Lowry ..... Orchid Grower
Paul H. Allen ..... Tropical Plant Collector

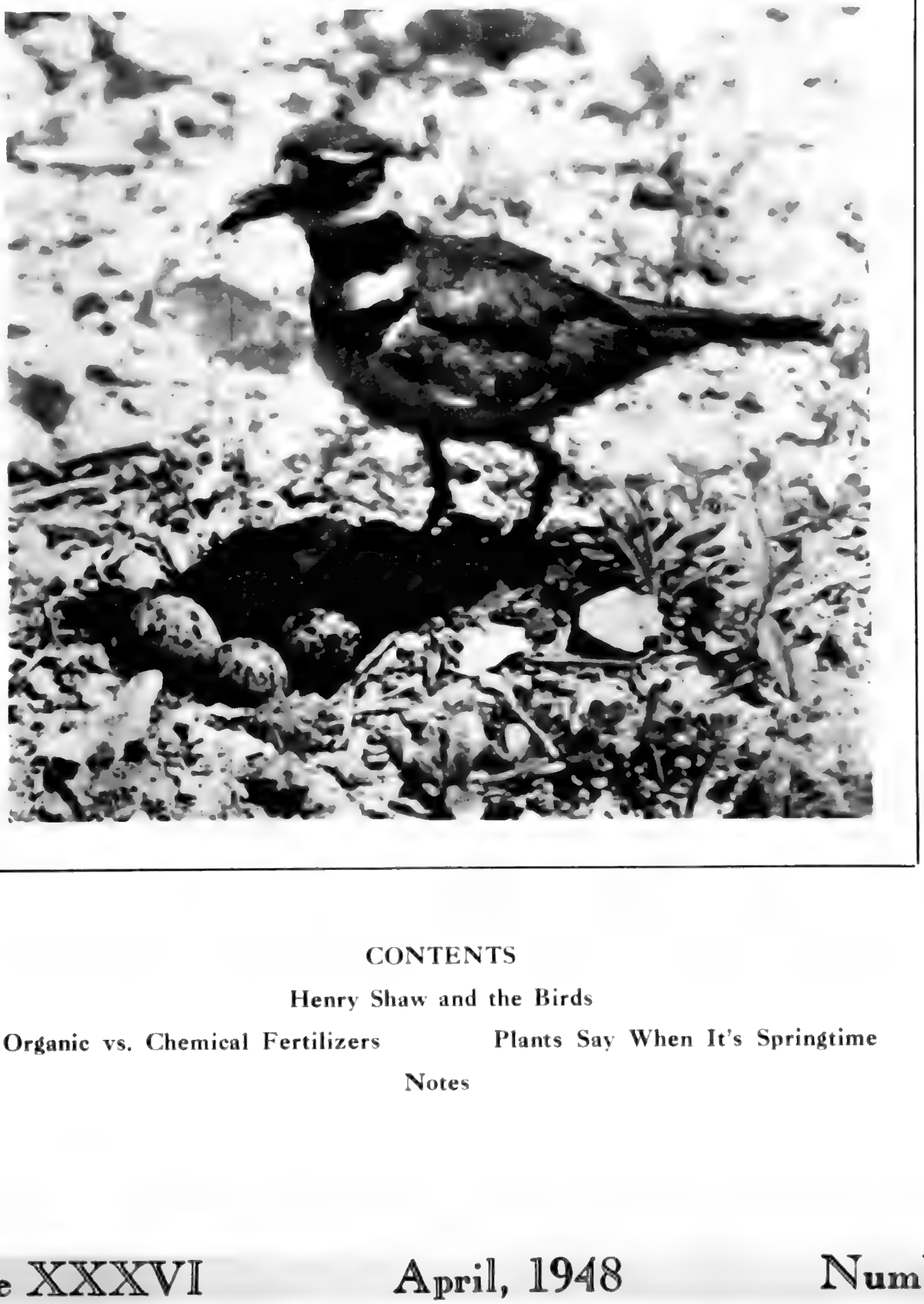
SOME FACTS ABOUT THE GARDEN

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 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. 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 bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN



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Missouri Botanical Garden Bulletin

Vol. XXXVI APRIL, 1948 No. 4

HENRY SHAW AND THE BIRDS

That Henry Shaw loved flowers and was interested in plants to such a degree that he founded the Missouri Botanical Garden is universally recognized. But that he also had a keen interest in the bird life of the Garden and recorded his observations is not so well known. Among the comparatively few manuscripts left by Mr. Shaw are some twenty pages of legal-cap size in his own copper-plate writing, listing his "observations on the usefulness and habits of birds frequenting the Garden during my thirty years residence at Tower Grove." This was about 1880 when Mr. Shaw was eighty years old. In the latter half of the manuscript he devoted "a few pages to an abbreviated life of Alexander Wilson to show how industry, perseverance, and application in youth lead to success and renoun in after life." A portrait of Wilson which Mr. Shaw had had copied hangs in the old Museum building. There is also a brief note about Audubon, but since these biographical sketches are not original but abstracted from the works of others they are not reproduced here.

No attempt has been made to correct the scientific names given the birds, although there have been changes during the past sixty-seven years. Also the somewhat flowery introduction is printed as written:

"What tender emotions swell within us at the coming of spring. Link'd as it is with all that is fresh and pure, with budding leaves, opening flowers, and the singing of birds, emblematic of Love, and immortal Hope, our hearts cling to it, as to no other season of the year. The flowers and swelling buds that have been so long buried in a sepulchre of their own withered leaves, again perfume the air of woodland prairie, and garden; and closely linked with the flowers and budding renaissance of nature is the arrival in our midst of our feathered friends, who left us with the fallen leaves of autumn to seek for warmer southern climes. They have scented from afar the fresh verdure of our April woods and meadows. Something has told them, pretty things, that spring is waiting for them, and winging their way with dauntless

energy through illimitable spaces of air, they arrive fast and thick from the commencement of April, the month of smiles and tears.

"One of the earliest of the little aerial travellers to reach us is the Blue-bird, and is not unfrequently seen flitting about its old haunts before the winds and snows of March have quite subsided. Early in April the cheerful note of the Cardinal Redbird is heard from the top of the tallest trees; and at the same time the friendly Robin is seen industriously seeking his food of earth worms from the newly upturned soil.

"About the 10th to the 20th of April arrives the ever welcome Swallow, after its long journey from the swamps of Lower Louisiana, or the shores of the Mexican Gulf; urging its course through the trackless air without chart or compass, to the country of its birth, and by a marvellous instinct to the very nesting place of the previous season; which as every one knows is under the roof of barns and sheds, or under the eaves of our dwellings. Dogwoods and Redbuds may bloom, and shrubs deck themselves in softest green, but not until the Swallows have come, do we feel that it is really spring. How charming is it to watch them darting through the balmy air of spring in their never-ending chase for insects; turning, twisting, coursing, and chasing each other with joyousness of heart; now swooping the cool bosom of river or pond, dipping in the water, and dashing the spray aside, but not for a moment ceasing in their aerial flight.

"And with the sweet days of spring come back to us the song birds, that deserted us in the fall; the males making their appearance first in small parties. The Brown Thrush or Thrasher, the familiar Catbird, and the American Nightingale or Mocking Bird, singly one by one, and early in the merry month of May we are almost sure to hear among the fresh green trees, and in our gardens the notes of the welcome songsters, especially the Mocker in his nuptial bower, running over the modulations of his matchless song, as if he were fearful that an April night would be too short for him to utter forth his love chant, and disburden his full soul of all its music!

"Birds as insect devourers are the great preservers of forests or planted trees from the disastrous ravages of caterpillers, grasshoppers, beetles etc. on the foliage, and boring worms on the trunks and branches. The following are my observations on the usefulness and habits, of birds frequenting the garden, during my thirty years residence at Tower Grove; joined with the more accurate experience of Mr. W. E. Sanders, the Canadian ornithologist, and the learned American naturalists, Nuttall, Wilson, and Audubon. Mr. S. A. Forbes, State Naturalist of Illinois, who has made elaborate observations of the food of birds in that state, estimated the number of summer-birds in Illinois at three to the one, and that two thirds of their food consists of insects, and of insects' eggs, giving a total of 7200 insects per acre for each

bird, or two hundred and fifty Billions for the whole State. The average food of the Thrush family, including the Robin, Cat-bird, and Mocking Bird shot at Galena, Bloomington, and Normal, from Spring to Autumn was, spiders 1%, micropods 2%, various other insects 61%, blackberries 10%, cherries 8%, grapes 5%, currents 1%, grain 4%, and ants 8%.

"*Crow Black Bird, Quiscalus versicolor* (Vieill.), comes early in the spring, as the Crows disappear, feeds its young on insects, and devours the farmers' corn, as well as the grubs and slugs turned up by the plow.

"*Red-wing'd Black Bird*, or *Starling, Sturnus praedatorius* (Wilson), feeds largely on beetles, caterpillers, and larvae, the deadly enemies of all vegetation, also depredates the farmers' crops.

"*Cow-bird or Cow Bunting, Emberiza pecoris* (Wilson), remains in the garden all summer, indicated by its peculiar crowing, is injurious by destroying the young and eggs of insect-killing birds, to lay its own eggs in their nests, like the Cuckoo of Europe; it consumes grasshoppers to a limited extent and is commonly called the *Storm Cock*.

"*King Fly Catcher, Muscicapa tyrannus* (Linn.), and the *Pewee, Muscicapa fusca* (Gmel.), should never be disturbed. They live entirely on insects, and catch their food on the wing, are seldom seen before the first of June. The Pewees once made their nest on the rafter of a shed in the garden.

"*Night Hawk, Chordeiles Virginianus*, catch their food on the wing, and may be considered as highly beneficial to gardeners and fruit growers.

"*Swallow, Hirundo rustica*, and *Swift, Hirundo pelasgia* (Wilson). The former make their appearance at Tower Grove from the 15th to the 20th of April; both Swallows and Swifts live entirely on insects. The Swifts, smaller than the Swallow and entirely black when they come to the garden, select the large chimney of the Museum as a resting place, and at sunset of the calm mid-summer evenings assemble in great numbers, circling over and around the building, darting one by one, as many as twenty in a minute down the chimney. In the early morning they take their departure in the same mysterious way, to appear again in the twilight of evening. Before chimnies were built they made their roosting and breeding places in the hollow trees of the forest.

"*The Purple* or *House Martin, Hirundo purpurea* (Linn.), is of the same family, but is seldom seen at Tower Grove.

"*Warblers, Sylvia* (Wilson), yellow birds of several species, live entirely on insects until the fruit season comes on. These little birds are the *Vireos* of Audubon.

"*Blue Bird, Sialia Wilsoni* (Swainson). The earliest harbinger of Spring, seen the first five days of March, a welcome visitor, and a destroyer of insects injurious to Gardens and Orchards.

FROM WILSON'S PASTORAL VERSES TO THE BLUE BIRD

He flits through the orchard, he visits each tree
The red flowering peach, and the apple's sweet blossoms
He snaps up destroyers wherever they be,
And seizes the caitiffs that lurk in their bosoms;
He drags the vile grub from the corn it devours,
The worms from the webs, where they riot and welter;
His song and his services freely are ours,
And all that he asks is—in summer a shelter.

While spring's lovely season, serene, dewy, warm,
The green face of earth, and the pure blue of heaven,
Or love's native music have influence to charm,
Or sympathy's glow to our feelings are given,
Still dear to each bosom the bluebird shall be;
His voice like the thrillings of hope is a treasure;
For through bleakest storms, if a calm he but see,
He comes to remind us of sunshine and pleasure!

"*Wood-pecker, Red headed, Picus erythrocephalus* (Linn.), takes his food from decayed trees, and will also destroy fruit.

"*Wood-pecker, Golden winged, Picus auratus* (Wilson), lives on insects, and is common in Tower Grove Park.

"*Wood-pecker, Red belley'd, Picus Carolinus* (Linn.), is commonly denominated the *Sap-sucker*, and is injurious to trees by boring. The bark of young pine trees, are frequently bored by him at Tower Grove.

"*Brown Thrush* or *Thrasher, Turdus rufus* (Nuttall), eats its food on the ground, and destroys many insects and caterpillers while feeding its young; when pears and grapes ripen the thrush takes a moderate share.

"*Cat Bird, Turdus lividus* (Wilson), raises two broods in a season, and feeds them on insects and caterpillers, will also peck ripe fruit.

"*Mocking Bird, Turdus polyglottis* (Linn.), feeds on insects and wild berries, raises two broods in a season.

"*Robin, Turdus migratorius* (Linn.), arrives in the spring before the previously named Thrushes; draws worms from the humid, soft ground, which he will abandon, when attacked, to the pugnaceous English Sparrow.

"*Loggerhead Shrike* or *Butcher Bird*, impales mice, grasshoppers, and small birds on thorny bushes, was a common bird in the vicinity when St. Louis was a village, has a bad reputation from his habit of killing small insectivorous birds.

"*Oriole, Baltimore*, and the *Orchard Oriole, Icterus* (Linn.), come every season, and build their hanging nests in the garden, living mostly on the insect tribes.

"*American Field Sparrow, Fringilla pusilla* (Wilson). This timid little bird comes every spring and is constantly picking up seeds and insects.

"*Song Sparrow, Fringilla melodia* (Wilson), comes in winter and early spring, and sits slowly chanting its sing-song on the bushes.

"*Snow Bird, Fringilla nivalis* (Wilson), makes his appearance the first cold days of October from the northern regions of Hudson Bay and Lake Winipeg, approaching and picking up crumbs around the house in the severity of the winter's storm. On the first approach of mild spring weather in April, they leave us for the North. Hearne, the Hudson Bay traveller, 1770, crossed Snow Bird Lake, Lat. 62° North, and describes them as breeding near the trading posts of Hudson Bay in summer.

"*Red* or *Cardinal Bird, Fringilla Cardinalis* (Nuttall). This lively red plumaged songster remains in the garden nearly the whole year round. They feed on insects, bees included, corn, and seeds.

"*House Wren, Sylvia domestica* (Wilson), favours us with his friendly visits every summer, and feeds entirely on insects, singing and fluttering around his young brood, and the whole family taking their departure on the first signs of cold weather.

"*English Sparrow,* . This bold intruder feeds about equally on insects, grain, and fruit. To his credit he also feeds on the seeds of the Canadian Thistle, as the writer has witnessed on Grand Avenue, near Tower Grove Park. Whether his fast increasing numbers are to result in a benefit or an injury to the country, remains an undecided question.

"*Meadow Lark, Alauda magna* (Wilson), makes appearance early in spring and remains most part of the year; they are great preservers of meadows, by destroying thousands of larvae, for which they are constantly seeking among the grass.

"*Turtle Dove, Columba Carolinensis* (Wilson), returns early in the spring, making its presence known by its peculiar mournful note; the Dove is of no value as an insect destroyer, as it feeds on seeds, and later in the season, on the berries of the Poke, the Holly, and the Cranberry tree. After raising two broods, which the loving doves unite in feeding, at the first frost they depart for the south.

"*The Crow, Corvus Americanus* (Audubon), frequents the country in flocks of hundreds west of the city, for food in winter; may be seen in the evening flying east, over the river to roost in the tall trees of the American Bottom, or as I am informed on Arsenal Island, below the city, returning in the morning at break of day, alighting at times to pick his wintry meal in Tower Grove Park. This hardy bird resists the cold and starvation of winter to depart in pairs, at early spring to seek a breeding place in distant forests. He destroys myriads of worms, moles, mice, caterpillers, grubs, and beetles, but blackens his character by being detected in robbing hens' nests, pulling up corn, and killing young chickens, but in a park or plantation of trees he may be considered a benefactor, and a benefactor of small birds, for two or three together will fly after, and drive away the hawk.

"*Screech Owl, Strix asio* (Wilson), whose peculiar hooting may be heard in the garden, in the evening twilight of summer and autumn. He lives on large beetles, grasshoppers and mice which is useful; but has the bad propensity of killing small birds—for which he should be driven away.

"*Pigeon Hawk, Falco Columbarius* (Linn.). This small hawk and several other kinds occasionally make their appearance, killing birds. Must be got rid of by shooting.

"*Blue Jay, Corvus cristatus* (Linn.), is seen in the garden mostly in the autumn, and in winter, in his brilliant plumage of blue, his presence announced to all by his loud notes. He devours chestnuts, acorns, and Indian corn, and occasionally bugs and caterpillers. He is a bitter enemy to the owl, attacking and driving him away; but is often a plunderer of birds' nests himself, destroying the eggs, and tearing up the callow young.

"*Ruby throated Humming Bird, Trochilus Colubris* (Linn.), frequents the garden from June to September, inserting its long beak into the flowers of the honey suckle, and trumpet vine.

"The occasional visitors to the garden and not seen every season, are the Blue plumed *Indigo Bird, Fringilla Cyana* (Wilson), the *Summer Red Bird, Tanagra aestiva* (Gmel.), *Cedar Bird* or *Waxwing, Bombycilla Carolinensis* (Briss.), are some winters seen feeding on the berries of the red cedar, which gives that peculiar flavour to their flesh, so admired by epicures. Warblers of various unknown species are occasionally seen.

"The *Bat, Vespertilio Noveboracensis* (Pennant), American Bat, is classed by naturalists with the Mamalia. Bats are sometimes found with their young adhering to the breasts of their mother. Insects are their favorite food.

"The beautiful plumaged *Parroquet* formerly so destructive to orchard fruit in Missouri, has never been seen in the Missouri Botanical Garden and may now be considered as extinct, or killed off, at St. Louis."

A dual-purpose shrub for the St. Louis garden is *Prunus tomentosa*. Its snowy white flowers bloom at about the same time as the Forsythias, though they do not stay in flower quite as long. In May, even in a city backyard, they are followed by sourish red cherries, only a little smaller than the sour cherry of commerce. They make excellent pies and are particularly good in jams and marmalades. A five-year-old bush usually yields more than a quart, and a ten-year-old one, four or five feet high, may yield several quarts. They are particularly attractive to birds, and if one wants to use the cherries himself they should be picked as they first start to turn color and allowed to ripen in the kitchen.

ORGANIC VS. CHEMICAL FERTILIZERS

R. W. SCHERY

Is the use of manures and composts the only safe way to fertilize a soil and maintain its productivity? Do chemical fertilizers, consisting mostly of simple inorganic salts from a variety of sources, "poison" the soil? Are crops which are grown on soils treated with chemical fertilizers less valuable nutritionally? Do cultivated soils deteriorate with the lack of organic fertilization? In recent years such questions have been given considerable and perhaps disproportionate publicity by the "organic-gardening" school of thought, backed by such prominent writers as J. I. Rodale *(Pay Dirt)* and the late Sir Albert Howard *(An Agricultural Testament)*. The magazine *Organic Gardening*, edited by Rodale, champions the belief that organic matter (and earthworms) are sufficient and the only means for salvation in matters of the soil. I believe professional soilsmen would hold this view to be extreme, although the ubiquitous and fundamental need for organic matter in the soil cannot be denied.

Organic matter, from decaying plant or animal remains (composts and manures), is important to soil fertility for a great many reasons, some of them obvious and easily proven, others theoretical and difficult to demonstrate. For one thing, organic matter in the soil generally improves the soil structure. It serves as a "binding" for small mineral particles, thus encouraging granulation; it presents a tremendous surface suitable for attraction and retention of certain elements; it absorbs and permits ready penetration of water; it encourages micro-biological activity (soil bacteria, Actinomycetes, etc.). Organic matter also has important chemical implications. It serves as a buffer against strong acids or alkalis; it releases valuable "plant foods" as they decompose; it partially controls availability of soil elements needed by growing plants; it serves as a storehouse of plant foods over prolonged periods of time. These factors make organic matter as important a component of the soil as is the complex of mineral particles.

Is an organic fertilizer the only suitable fertilizer?—The answer here depends partially upon the soil in question, but in general it must be "No." Depending upon the climate (especially the rainfall and temperature), only a certain organic content can be economically maintained in the soil. Quantities of organic matter in excess of this are quickly decomposed, serving as a source of chemical fertility but lending little additional benefit to the already suitable physical nature of the soil. We know that organic matter is an expensive source of chemical constituents for the soil, since essential mineral components constitute such a small percentage of organic matter. Thus, if needed minerals can be more economically added in an inorganic

chemical form to a soil already adequate in organic matter, it would seem pointless to apply the relatively more expensive manures or composts. One caution is necessary, however: the specific minerals of the soil should be known, so that only the proper chemical compounds be applied. Fortunately to-day there are fairly serviceable and relatively simple means of ascertaining approximate mineral deficiencies (colorimetric soil tests, in which changes in color of standard test solutions applied to a soil extract indicate the approximate percentage of the element being tested for). A soil deficient in organic matter can best be brought to a higher level of productivity by application of organic material. Other soils, if already adequate in organic content (which, incidently, may rather infrequently be the case under continued cultivation) may be brought to the same level of productivity more cheaply by addition of the proper inorganic fertilizer.

Do chemical fertilizers "poison" the soil?—The answer here seems to be a qualified "No." As a rule, chemical fertilizers sold by reputable manufacturers are reliably labeled as to contents and recommended application strength. The use of such fertilizers as directed, or under experienced guidance, should give no harmful results. Sometimes a home-owner will apply too much of a concentrated chemical fertilizer to the garden or lawn. The result may be (temporary) "burning" of plants, soil structure affected, and some useful soil micro-organisms killed. Yet within a few months the over-dosage will be washed and leached away, resulting in no after-effect that could be thought of as poisonous to plants. It is conceivable that unreliably made chemical fertilizers could contain arsenic or other impurities that might, in the course of time, poison the soil for normal plant growth. Research indicates that such poisoning has occurred, for example, with orchard soils over which arsenical sprays have been repeatedly applied. Likewise, repeated applications of chemical fertilizers not balanced to meet soil needs (i. e. not containing chiefly the elements in which the soil is deficient) might cause severe disorganization of the normal biochemical processes of the soil, giving decreased productivity if not actual "poisoning." Too much of an unneeded element carried with the needed one may cause more harm than the needed element gives benefit. Again the caution must be given: for definite results with chemical fertilizing determine first the elements needed by the soil, and then apply only these in the proper concentration.

Are crops organically fertilized apt to be (nutritionally) better than those chemically fertilized?—The answer here may well be, on the whole, "Yes," but there is little evidence one way or the other on this question. Doubtless the specific organic and chemical content of the soil on which a crop is grown exerts the deciding influence, either because of, or in spite of, any given method of fertilizing. Theoretically, it seems reasonable that in

applying organic fertilizers man puts into the soil all elements which plants need, and in comparatively proper proportions (since the organic fertilizer came directly or indirectly from plants gown on the soil). One might thus expect the soils rich in organic matter to contain all the "building stones" needed for formation of the different proteins, vitamins, minerals, etc., characteristic of the growing plant. On the other hand, soils fertilized with inorganic chemicals may carry an abundance of the few important elements, but might be shy or unbalanced with respect to minor elements perhaps essential only for formation of a few types of proteins or vitamins. There seems to be some evidence that in certain cases stock prefers and benefits more from pasture organically fertilized than from that chemically fertilized. Some people claim that vegetables grown on soil organically fertilized taste better and are "more nutritious" than similar vegetables inorganically fertilized or unfertilized. There are indications that plants organically fertilized are better able to withstand disease and unfavorable environmental conditions than are their counterparts not so treated.

Do soils deteriorate with loss of organic matter? The answer here is "Yes," if organic content is low, "No," if organic content is high and above the normal level for the climate in which the soil had formed. For one thing, low organic content tends to cause poor soil tilth and decreased water absorption, and under such conditions loss through erosion is apt to be excessive. Both the physical and chemical conditions of the soil are affected by the organic matter present in various ways, some of which were mentioned in an earlier paragraph. Since insufficient organic matter can directly affect the growing plant, it becomes desirable to keep the organic content of the soil at a reasonably high level. With cultivation this may be difficult but it can usually be accomplished by plowing-under immature plants (green manuring), by leaving crop residues on the ground, and by adding whenever possible compost or manure. Lack of organic matter in the soil can have serious effects, and usually there is little danger of applying too much. If doubt exists as to need for organic matter, it is safest to apply at least some organic fertilizer. For the home-lot lawn or garden obtaining sufficient organic fertilizer is usually not difficult, since only relatively small quantities are needed. Manures, although expensive, can still be purchased. And any amateur gardener can easily compost autumn leaves and the vegetable wastes from foods.

The organic-gardening school of thought seized upon an extremely valuable and irrefutable basic premise, the need and usefulness of organic matter for the soil. Its many attacks on the use of chemicals, biased and usually without the backing of objective experimentation, have caused the group as a whole to be discredited by professional soil scientists. The

valuable and fundamental truth they espouse tends to be minimized by those most needed to effect the spread of knowledge concerning organic fertilizers.

Far wiser has been the approach generally taken by the chemical-fertilizer industry. No attempt has been made to ridicule the obviously invulnerable merits of organic fertilizers, but instead propaganda is confined to the solid ground of explaining the benefits and virtues of inorganic fertilizers. While in most cases organic fertilizers, if available, might be preferable to inorganic ones, there is certainly room and necessity in the national economy for astronomical quantities of both. To keep America's high peak of productivity from decline, proper soil management becomes a necessity, including supplementing the composts and manures with commercial chemical fertilizers.

PLANTS SAY WHEN IT'S SPRINGTIME

R. W. SCHERY

For three years now, we have been watching the arrival of spring in St. Louis—and recording the announcement of its arrival through the flowering of its heralds, the spring-blossoming plants. The bears and the meteorologist may be at odds as to severity of a St. Louis winter, but I think most folks will concede it is never spring until crocuses and daffodils, golden-bells and maple-squirts, and a host of other spring flowers are with us. These plants, responding to temperatures, rainfall, day length, and a multitude of other factors which collectively are "spring," will concede only to the migratory birds an equal right in announcing the onset, regardless of how the calendar may read, of our favorite among the seasons.

Compared to 1946 and 1947, our yet-young spring of 1948 appears to be strictly normal—neither precocious as was 1946 nor retarded as was 1947. Only in thrusting upon us an additional miserable few days of wintry weather in early and late March, after having started to ring up the curtain at the end of February on the spring scene, have we been betrayed by 1948. It's pleasant to be able to record that something is "normal," even spring-time, in such disturbing times as these.

Looking to the records from the chart of the following page, we find that, on the average, this year's spring came about twelve days earlier than that of 1947. Not a single plant so far recorded has flowered as late as it did last year. Two of the trees were more than three weeks earlier than in 1947, while another was only in front by a mere day.

Compared to 1946 we are quite backward this year. On the whole, 1948 averages about twelve days behind 1946—just about the distance we

are in front of 1947. Again there is unanimity in the record—not a single plant so far recorded has flowered as early this year as in 1946. Some plants, as chickweed and magnolia, are almost three weeks behind the 1946 record, while others are only a few days in arrears. So, barring the unexpected (always possible with the weather), the spring-flowering plants have said to you St. Louis gardeners that unless your garden seeds are in the ground and nicely sprouted by the time you read this, you no longer respond well to the ancient spell of the springtime.

SPRING-FLOWERING DATES

Plant	First flowering			Days earlier (—) or later (+) than:	
	1948	1946	1947	1946	1947
Silver Maple *(Acer saccharinum)*	Feb. 28	Feb. 11	March 24	+17	—25
Hazel *(Corylus)*	Feb. 29		March 24		—24
Snowdrop *(Galanthus nivalis)*	March 2	Feb. 27		+ 3	
Crocus, early yellow *(Crocus)*	March 2				
Cornelian Cherry *(Cornus mas)*	March 17	Feb. 28	March 18	+17	— 1
Elms, American and others *(Ulmus* spp.)	March 17	Feb. 18 to March 11	March 24	+ 6	— 7
Fragrant Honeysuckle *(Lonicera fragrantissima)*	March 18	Feb. 28	March 24	+18	— 6
Daffodils *(Narcissus)*	March 21		April 2		—12
Golden-bell *(Forsythia)*	March 21	March 4	April 2	+17	—12
Japanese Andromeda *(Pieris japonica)*	March 22	March 18	April 1	+ 4	—10
Fragrant Sumac *(Rhus aromatica)*	March 22	March 21	April 7	+ 1	—16
Shepherd's Purse *(Capsella bursa-pastoris)*	March 22				
Chickweed *(Stellaria media)*	March 24	March 5	April 1	+19	— 7
Magnolia *(Magnolia Soulangeana)*	March 24	March 5	April 7	+19	—14
Burning-bush *(Cydonia)*	March 25		April 1		— 6
Cottonwood *(Populus deltoides)*	March 26	March 21	April 7	+ 5	—12
Boxelder *(Acer Negundo)*	March 26	March 8	April 7	+18	—12

P.S.—A cold week ending March and starting April, with killing frosts reported from some localities, has further "prolonged" 1948's spring. Flowering dates in early April may recede slightly from those for 1946 and approach closer to those for 1947. On the whole, however, the intermediate position of 1948 is maintained.

Noticed in flower in the valley of the Current River (150 miles southwest of St. Louis), April 1, were the following wild flowers: *Amelanchier* sp. (shadbush), *Alnus rugosa* (alder), *Anemonella thalictroides* (rue anemone), *Antennaria* sp. (pussy toes), *Benzoin aestivale* (spice bush), *Carpinus caroliniana* (blue beech), *Claytonia virginica* (spring beauty), *Castilleja coccinea* (Indian paint-brush), *Cercis canadensis* (redbud), buds coloring, *Dentaria laciniata* (toothwort), *Hepatica* sp. (liver-leaf), *Houstonia* sp. (bluet), *Ostrya virginiana* (hop hornbeam), *Prunus Persica* (peach),

Sanguinaria canadensis (bloodroot), *Verbena* sp. (vervain), *Viola* sp. (violets and Johnny-jump-up or wild pansy). Most of these were out before March 20 (St. Louis area) in 1946, and not until mid April in 1947. They can be expected to flower in the St. Louis area in early April this year.

The maples are easiest to tell apart when they flower. In the full leaf of summer our native Sugar Maple and the introduced Norway Maple are confusingly similar, but the latter has small waxy flowers in broad panicles held crisply erect while those of the Sugar Maple scarcely look like flowers at all to the ordinary eye. They are greenish yellow and hang down from the branchlets in lax tufts.

The flat seed-pods of the Scotch Elms hang on the bare branches for a long time before they turn brownish and drift about the garden like oversize snowflakes. Picked while they are still a brilliant light green they are most effective with cut flowers. A bouquet of magenta-pink azaleas and chartreuse-colored elm seeds is something to remember and repeat each year.

NOTES

Groups visiting the City Garden and Arboretum recently were the students in floriculture from the University of Illinois, and the students in the garden course sponsored by the Landscape and Nursery Men's Association of Greater St. Louis.

Dr. R. M. Tryon, formerly of the University of Minnesota, Minneapolis, who has been appointed Assistant Curator of the Herbarium at the Garden and Associate Professor of Botany in the Henry Shaw School of Botany, arrived April 4 to assume his duties at the Garden and the University.

The first gold medal of the St. Louis Garden and Flower Show has been awarded the Missouri Botanical Garden. In the form of a resolution sent to the Garden the committee stated that the medal was given to the Garden for its outstanding research in horticulture, for its assistance to the various flower shows since 1904, and for the fund provided for flower shows in Henry Shaw's will. The face of the medal bears a profile of Henry Shaw, and the reverse a spray of Hawthorn, the Missouri State flower.

Recent visitors to the Garden include: Mr. John J. Finan, formerly graduate student in the Shaw School of Botany, now graduate student and instructor at Iowa State College, Ames; Dr. Fanny Fern Davis (Mrs. Everett F.), formerly turf consultant to the National Parks Service, Washington, D. C., now of Chicago, Ill., where her husband Dr. Everett F. Davis is research coordinator for Medical and Biological Sciences, Office of Naval Research, Midwest Territory. Both Dr. and Mrs. Everett Davis received their doctor's degrees in the Henry Shaw School of Botany.

THE MISSOURI BOTANICAL GARDEN

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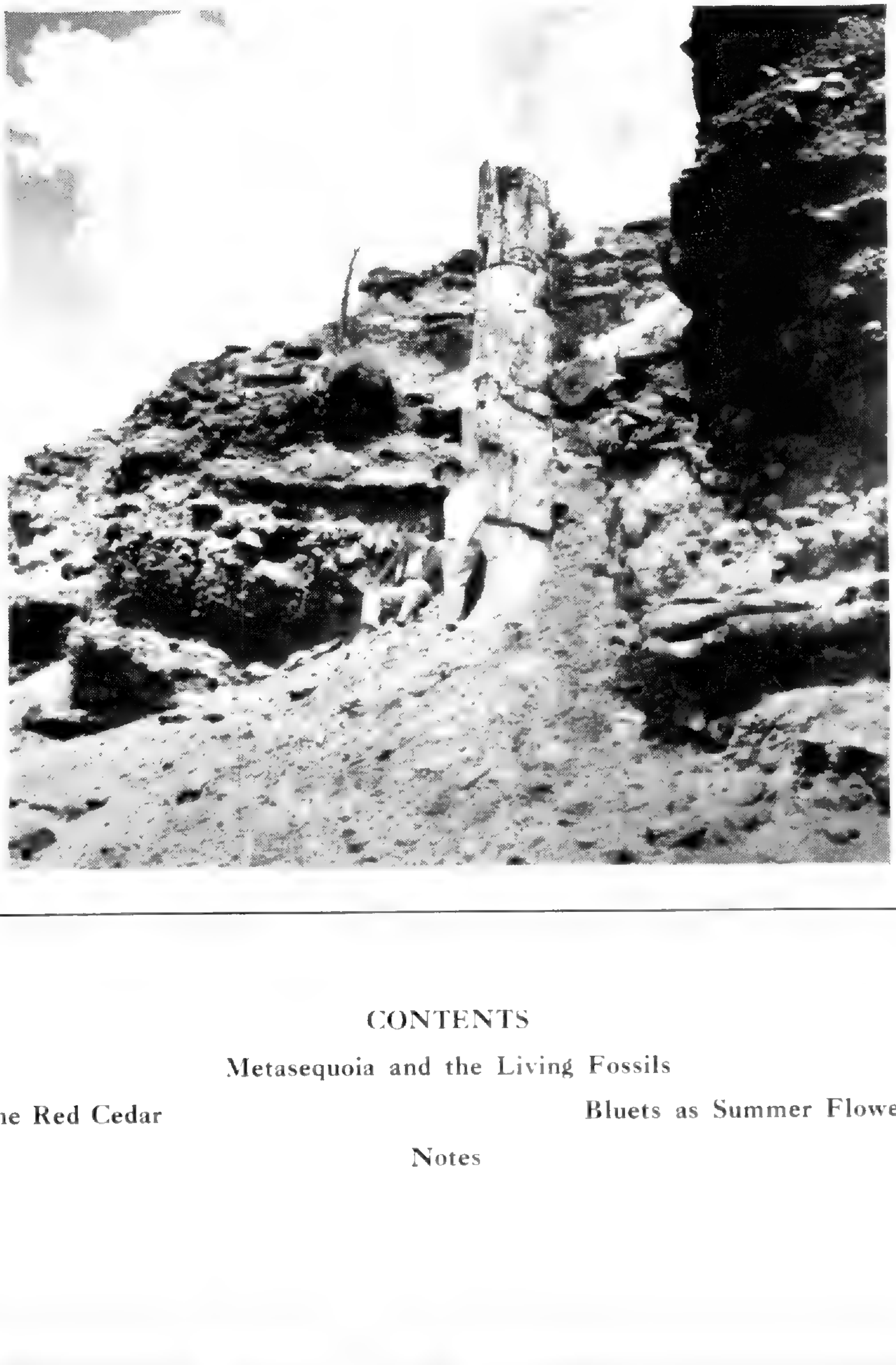
SOME FACTS ABOUT THE GARDEN

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 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. 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 bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN



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Cover: In the northwestern corner of Yellowstone Park the eroded hills reveal the petrified remains of forest trees that were entombed by volcanic eruptions in the Miocene period.

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Missouri Botanical Garden Bulletin

Vol. XXXVI MAY, 1948 No. 5

METASEQUOIA AND THE LIVING FOSSILS

HENRY N. ANDREWS

Shortly after last Christmas the Garden received a small packet of seeds from Professor Wan-Chun Cheng of the Arboretum of the National Central University in Nanking. These are the seeds of a new conifer recently discovered growing in eastern Szechuan and southwestern Hupeh provinces of central China. Its discovery was rather noisily announced a few months ago in the daily press as a "living fossil," and while it is an appropriate term it seems to be somewhat less deserving of that title than many other modern plants, a few of which will be mentioned below. It is, nevertheless, an interesting and significant discovery. By name this new member of the conifer order is *Metasequoia glyptostroboides*, and the initial interest centers around the fact that the genus Metasequoia was founded in 1941 by a Japanese paleobotanist for certain fossil remains excavated from clay deposits of his country. Two species were described in that year, *M. disticha* and *M. japonica*, from foliage and cones that had been preserved for some few millions of years, and not until four years later (1945) was the living representative found growing in China. It is a special tribute to the paleobotanist Shigeru Miki that he should have recognized in his fossils the remains of a distinct genus of conifers before his fellow botanists found it actually growing on the hillsides of central China.

It is fascinating indeed to find that a group of plants supposed to be extinct still lives on, in a part of the earth remote from the searching eyes of botanical explorers. There is something of the "Lost World" motif about it that is attractive to all naturalists, and irresistible to the popular science writers who may find it profitable to mix the facts with their fancies. And one may wonder whether the Metasequoia stir would have had as much appeal if the sequence of discovery had been reversed. The answer is almost certainly in the negative for reasons that will be pointed out presently.

As yet we are by no means adequately informed on the structure and life habits of this living species of Metasequoia. Professor Cheng writes that it "is a big tree up to 35 meters [114 ft.] tall and 2.3 meters [7.5 ft.] in diameter. It is manifestly allied to the American genera Sequoia [Coastal Redwood] and Sequoiadendron [California Big Tree], but differs from both in the deciduous habit and in the opposite branchlets, leaves, flowers and cone scales. It seems to be an intermediate link between Taxodiaceae [conifer family including the Redwood, Big Tree, and Bald Cypres] and Cupressaceae" [including Arbor-Vitae, Juniper and others].

In a recent account in "Arnoldia,"[1] Professor E. D. Merrill presents the only readily accessible description of this interesting oriental relative of the American Redwood and Bald Cypress. Following the original discovery in 1945, later field work revealed more numerous specimens in the Shui-sa-ka Valley of Hupeh Province. In all, some 1,000 trees of varying size have been located "on slopes, along small streams, and near rice paddies . . . . between the altitude of 900 and 1,300 meters," and as some of these are known to have been planted it may be seen that its foothold on the soil of China as a native plant is by no means a strong one.

Even though it were appropriate, it is not possible to present here a detailed description of Metasequoia, but judging from the still meagre amount of information available it is rather closely comparable, in gross appearance at least, to the Bald Cypress which is native to southern Missouri and southward and commonly cultivated in parks and gardens about St. Louis. Like the Bald Cypres, Metasequoia, as well as the Tamarack of our northern bogs, is deciduous, dropping its foliage during the winter months.

Fortunately the seeds that were sent from Nanking reached the Garden in excellent condition; germination was practically 100 per cent and most of them are now vigorous seedlings five or six inches high. At least in their infancy, they appear to be taking kindly to a sudden shift of some 7,000 miles. How long they will continue to thrive of course remains to be seen. The climate of the St. Louis region is not overly kind to the conifers. We have no reason to be too optimistic, yet if its culture should prove successful the addition of another "evergreen" to our none-too-abundant list would be most welcome. Seeds have been distributed to other botanical institutions throughout the country, and perhaps in some of them we may successfully naturalize a new American.

Metasequoia glyptostroboides has been hailed as a "living fossil"—a phrase that makes good headlines but one which is notably lacking in precision as far as the time element is concerned. The fossil specimens described

[1] Merrill, E. D. Metasequoia, another "living fossil." Arnoldia, Vol. 8, No. 1.

Metasequoia seedlings grown at the Garden, 2 months old.

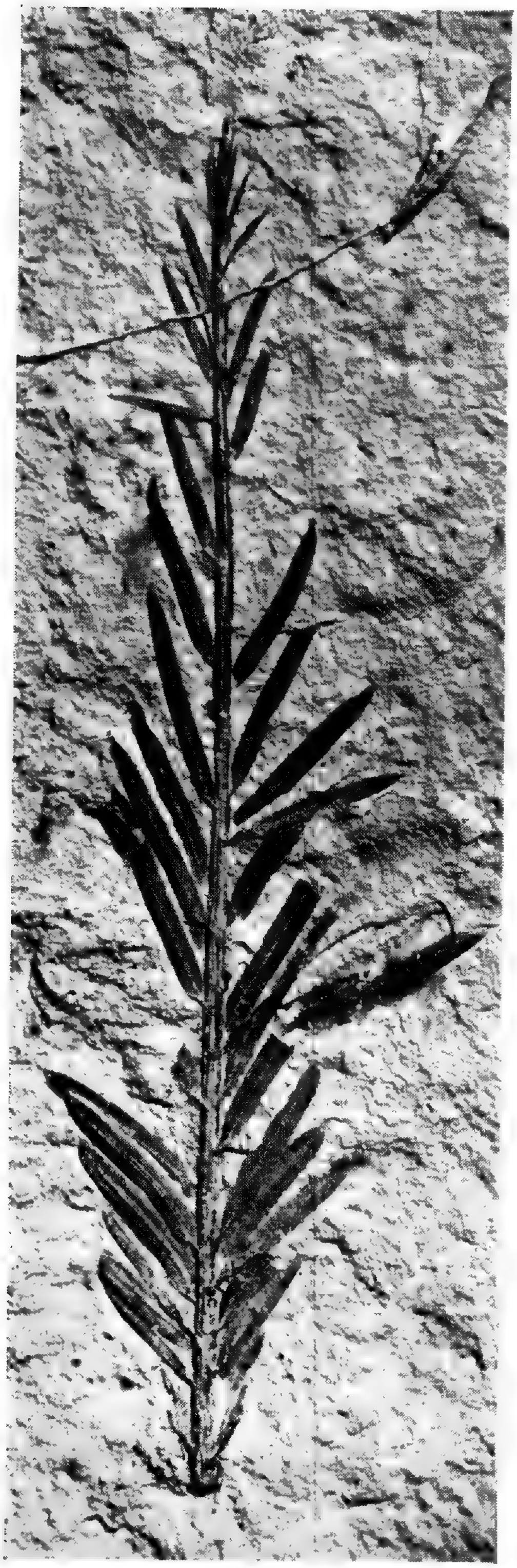
Metasequoia seedlings 3 months old.

by Miki were found in clay beds of early Pliocene Age in Japan. The Pliocene period is generally accepted as having begun some 7 or 8 million years ago. Thus it may be appreciated that accounts of this new conifer which appeared in the daily press, hailing it as "a tree believed extinct for 100,000,000 years," may be commended for their enthusiasm but not their accuracy! One is tempted to believe that news writers keep in stock a special supply of type bearing the inscriptions "dinosaurs" and "100,000,000" with which liberally to season all of their copy dealing with life of past geologic ages. We do know a good deal about the more ancient history of the conifers; we know that as a group they were abundant and well developed in the dinosaur age, but we do not know that *Metasequoia glyptostroboides* itself dates back that far. It is possible that such may be the case, but a careful review of the many fossil Sequoias described in botanical literature will be necessary before significant conclusions can be drawn.

As a brief passing commentary on geologic times and the origin of various forms of living things, it may be of interest to note that large forest trees (not Metasequoia!) are known to have existed on the earth more than 300 million years ago; more primitive plants were established on the land some 375 million years ago; highly developed invertebrate animals existed in the seas in excess of 500 million years ago; and still simpler forms of life such as the algae go back much farther. Metasequoia is a real living antique but it cannot be ranked among the most ancient by a long shot.

While Metasequoia will undoubtedly prove to be a significant link in our knowledge of the evolution of the conifers and very possibly a valuable horticultural acquisition it is overshadowed as a living fossil by the ancient and honorable genealogies of plants growing in our own back yards. A few of these may be of interest—to dispel the illusion of the far-away and justly to recognize the plants we live with every day.

There are very few plants that have served man to greater advantage than the pines. From the great forests of colonial New England came masts and ships' timbers which were responsible in a large degree for the power of the British navy and the growth of the Empire. So highly esteemed were these White Pines that in 1722 the colonists were prohibited from cutting them without permission of the King's agents. We have put their readily worked wood to innumerable uses since that time but our appreciation of their grandeur and continued growth has been less noticeable. Eventually those forests were slaughtered to the last few acres and the process continued in the South and Northwest. The vast sea of pines that existed in this country a century and a half ago very likely has never been excelled in extent by any other forest tree, yet the pines, not their distant relatives but



A fossil Sequoia from Miocene-age clays near Spokane, Wash. This is closely related, or possibly identical to, the living Metasequoia from China. Slightly enlarged.

pines as we know them today, may be traced well back into the Cretaceous period—at least 90 million years ago, and into still earlier periods their ancestral derivatives trail back for at least another 130 million years. There is no reason to believe that it is still an actively evolving group of plants but its retention of great virility through the ages is equalled by very few other living things and, like the modern forests, their fossil remains are widely scattered. Here is one of the greatest of all living fossils.

Numerous other existing members of the conifer order are known to have originated far back in the past, and among those of particular interest to the present discussion are the Sequoias —the California Redwood *(Sequoia sempervirens)* and the Big Tree *(Sequoiadendron giganteum)*. Although these giants are at present confined to a small area in California and Oregon, their fossil remains are found widely scattered through Tertiary and late Cretaceous rocks of the northern hemisphere—from England, Greenland, Alaska, Italy, Spitzbergen, and numerous other localities come the records of their past distribution. In the petrified forests of Yellowstone Park are great stumps indicating trees in excess of 14 feet in diameter that grew there in Miocene times. These were closely related to the modern Redwood as well as Metasequoia.

Plants such as the Redwood and Big Tree are sometimes regarded as being on the verge of extinction simply because they are racially old

and confined to a small native area. As a matter of fact, we know very little about the distribution of these trees at any point of time in the past. It is very possible that in their fossil record there are represented small and isolated colonies such as exist today in coastal California. While the influence of man has come along to upset any future normal escape that the Sequoias might have made from their present confinement it is interesting to note that both the Redwood and Big Tree do very well in many parts of the British Isles, trees up to 100 feet tall having been grown during the first half century following their introduction in the late 1840's.

The highly prized forest tree *Taxodium distichum* (Bald Cypress) of our southern swamps presents a fossil record that is not unlike that of the Redwood. In fact, our understanding of the past distribution of these two is not always perfectly clear since they are closely related and the foliage of the two is so similar that they are not always readily distinguished in the fossil forms.

Among the Garden's collection of living plants, the cycads, housed in the north wing of the central greenhouse group, constitute a most unique display. These plants, palm-like in appearance, are found today from Florida and Mexico through the Indies into northern South America, in South Africa, and in the tropical Pacific isles from Japan to Australia. Our only native American species, *Zamia floridana*, is common in the sandy open pine woods of Florida. It is not a showy plant, with its underground stem and smallish palm-like leaves, but it is a lingering remnant of a once large and diversified group which apparently attained the zenith of its evolutionary powers in the Jurassic period some 140 million years ago, and there is reason to believe that its more remote ancestors originated from the Coal Age Seedferns still farther back in the past. From a clay bed exposed along a wave-swept beach in northeast England the leaves, as well as the seed and pollen-bearing cones, of a plant seemingly closely related to Zamia have been excavated. And from the Black Hills of South Dakota and the sun-scorched Ferris Mountains of Wyoming come beautifully petrified plants belonging to the great cycad complex—bearing evidence not only of diversity and former distribution of the cycadophytes but of changing climates and topographies. These are only a few of the many localities in which the fossil cycads have been found.

It is not necessary to look to the rare and exotic members of our modern flora for plants of ancient lineage. Many of our common native trees date back to early Tertiary times, and some of them even into the late Cretaceous. Noteworthy among these patriarchs are the willow, poplar, alder, the birch, oak, sycamore, hackberry, magnolia, tulip-tree, red-bud and chestnut. These, too, by virtue of very ancient ancestry, are living fossils.

Among the ferns we have many cases of even more ancient lineage than the above-mentioned seed plants. With the possible exception of the bracken, the most common ferns of the eastern states are the three members of the Osmunda family—the Cinnamon, Interrupted, and Royal Ferns. They are all common in swamps, dense woods, along lake shores and shaded country roads. In spite of the fact that their direct ancestors go back to the Permian period, more than 200 million years ago, they are still a dominant and highly successful element of our modern fern flora. The fossil history of the Pine Fern *(Anemia adiantifolia)*[2] reveals a still more ancient record. Although not living north of extreme southern Florida and Texas today, fossil remains almost identical with the modern species have been found in Upper Cretaceous rocks of Wyoming, and its still earlier forebears have been traced back into the much earlier Upper Carboniferous period of Illinois and even into the Lower Carboniferous of England, presenting a lineage unexcelled by any other living plant.

Many other instances of exceptional racial longevity might be cited. Perhaps such well-known plants as the ginkgo and the clubmosses should at least be mentioned in passing, but since these have been considered in detail by many previous writers we have chosen to consider some of those plants whose ancestry has been somewhat less publicized.

Under the title, "Have we any botanists among us?" there appeared in *The Horticulturist* for 1868 an interesting commentary on a situation which, while improved, is not altogether without point even eighty years later. Botanists, perhaps the least aggressive of the scientists, have always suffered from the tendency to ascribe to other sciences, particularly chemistry, the credit which really belonged to botany and could only be answered by a knowledge of plants. Perhaps the splitting off from botany of such applied branches as forestry, bacteriology, chemurgy, etc., has something to do with it.

"In looking over the last Report of the Department of Agriculture, nothing is so encouraging as the progress in scientific *phraseology* visible over the entire volume. Whether the information itself is reliable, it is not now my purpose to inquire. On the regular staff of the department there is a chemist and entomologist, but we see no record of a botanist. Is botanical science, then, of third-rate importance toward the development of the agricultural resources of this wide continent?

"The chemist, however, does up the botanical matter in addition to his chemical labors, for we have a chapter on the 'Grape Disease in Europe.' He states that the literature of the grape disease is meager and enumerates several sources from which he has collected material, but we fear he has not been very assiduous in his search; we could point him to many much more prolific sources of information.

"The deductions respecting the probable identity of several distinct forms of parasitic fungi may do very well coming from an amateur in botany but they will appear absurd to those who give some attention to the study of cryptogamic plants. In three separate parts of the Report the subject of fungi is treated with the same absence of scientific knowledge. Can no botanist be found to contribute to the Report?"—*Horticulturist* 22:313. 1868.

[2] See Garden BULLETIN, April, 1946.

THE RED CEDAR

FELIX AGRAMONT, ROBERT BUSKING, JEAN MITCHELL, AND ELOISE ENZINGER

Introduction

Cedars are of general interest in the St. Louis region, not only because they grow here in abundance but because they are the only native conifer. North and east of us there are many kinds of such evergreens—hemlocks, spruces, firs and pines. Just a little to the south, the southern pines are a distinctive part of the landscape but with us it is only the cedars which supply a welcome green contrast during the winter time. They provide durable wood for fence posts; they are manufactured into a variety of souvenirs and sold to motorists along our main highways; on rocky hillsides they form dense stands which shelter flocks of robins and bluebirds through the winter months; they were transplanted to the dooryards of old farmhouses and are sometimes planted as a kind of super hedge. They are indeed a very typical part of life here on the northeastern edge of the Ozark Plateau, and it is hard to imagine what the St. Louis region would be like if all the Red Cedars were to vanish overnight.

Instead of just taking them for granted, this year's class in field botany in the Henry Shaw School of Botany tried to see what they could find out about these common trees. Seemingly there is little more than passing mention of them in most botany books; if one is going to understand the Red Cedar he will have to find out something for himself and not merely consult the authorities. The following short papers are the result of a few weeks of elementary study and observation. They are only a beginning. One might ask himself in many more ways: "What are these trees, anyway?" "What are they doing here?" "What is the nature of their strange and fragrant heartwood?" At any rate, these three short contributions will tell you a little. Best of all, they may set you to wondering for yourself about these interesting plants which come right up to the city's doorstep.

EDGAR ANDERSON

The Distribution of Red Cedar in the St. Louis Area

Juniperus virginiana, Red Cedar to most of us, comes up to the very back door of metropolitan St. Louis. This native cedar is found to some extent just outside the city but many more and better specimens grow farther out. Cedar Hill is in the heart of the cedar country, which extends over to Gray Summit and in general takes in that whole area.

As one drives out Gravois Road the sight of a single old cedar tree growing in front of an old farmhouse is noticed again and again. Aside from these dooryard plants, the distribution of cedars makes very little sense until

one understands their preferences. They seem to be doing equally well on hill tops and along valley bottoms, as well as on the sides of the hills. They are just scattered over the landscape, clusters being found here and there. If one puts in a barbed-wire fence, it seems inevitable that in a few years it will be bordered with cedars on one or both sides, particularly near the fence-posts.

If cedars just grew evenly all along the fence, we might suppose that they tended to persist where the land had not been plowed. Their tendency to come up in clusters around each fence-post suggests rather that they come up along fence rows mainly because the seeds are planted there unintentionally by the birds who had been feeding on cedar berries and who used the fence-posts as perches. If we keep this idea in mind as we travel through the countryside, we find many facts to support it. When an old field or meadow is abandoned, cedars do not come up in it for some years, but when the weeds and bushes get tall enough to make good perching places for the birds, then little cedars may begin to appear. Seldom or never, in this area, can one find young cedars except in places where birds might have planted them. Furthermore, any one who has visited the cedar-covered hills near St. Louis in the winter knows that these dark blue berries are much relished by many kinds of birds. Cedar waxwings are so named because of their preference for this resinous fruit; robins and blue birds flock to these heavy stands of Red Cedar and often stay there for weeks at a time in January and February, enjoying the protection from the wind among the dense foliage of the cedars and feeding, day after day, almost exclusively on the dark blue berries.

Birds are one of the reasons why Red Cedars are distributed as they are in the Missouri landscape but there are other factors which are important. *Juniperus virginiana* is a sun lover. This is very evident after examining two trees, one that has been growing in full sun and the other in deep shade. The one found out in the open has heavy, dense branches, and it grows vigorously. The one in the shade is weak and straggling, and when the shade gets heavy it may die altogether. Seldom or never will it be heavily laden with berries like those trees out in the open.

Where cedars are found growing in the woods with other trees as tall or taller, they are not very attractive. The lower part of the trees is almost bare except for dry limbs. The upper part, which is literally reaching for the sun, is often very vigorous. Then, too, where another tree is found growing very close to the cedar, that side of the cedar tree is usually crippled. Also, young cedars growing out in fields where there is a lot of underbrush will have the side branches brown as high as the weeds surrounding it.

When we understand two things about the Red Cedars—that they are planted by the birds and that they are intolerant of shade, we can understand very much better their distribution in the St. Louis area. They can live to be old trees only where they are permanently safe from being overshadowed. They do well on fertile lands if they are planted in a dooryard, but without man's help they are soon overtopped by oaks and other large trees and persist for only a few years. The ancient cedars in our landscape therefore are all in places either where they have been protected or where they have been able to find a refuge not accessible to other kinds of trees. The Red Cedar is drought-resistant; it can grow in the cracks of a limestone cliff; it can do well on stony ridges where no other native tree will survive. It is in such places that we find masses of large cedars in our Missouri landscape. It is not that cedars prefer hot cliffs and rocky ridges; it is rather that in such places they can grow where other trees develop imperfectly, if at all. Red Cedars do even better on a rich soil than on a poor rocky one but without man to help them they cannot compete with other vegetation in such a place.

Understanding such things as these, a ride through Missouri in the winter time takes on new meanings. We see how when a field has been abandoned for several years and the weeds have become tall enough to make perching spots for birds, the Red Cedars begin to come up. A few years later, when the oaks and hickories grow up around them, the lower branches of the cedars die and eventually the trees become thinner and weaker. The cedars are hungry for sun; anything which brings more sun into a woodland will probably increase their number. If an oak wood is heavily pastured for a decade or so till most of the under-brush is gone and there is a good deal of sunlight between the trees, then little cedars will begin to come up here and there through the woodland.

As we stand on a Missouri hilltop and look across the winter landscape, the dark green patches of cedar take on a new meaning. We see how the cedars have been better able to survive on the hot southern slopes of rocky hills where they had little competition; we see how the cutting down of other trees and pasturing the land encourages cedars close to farm buildings. Understanding a little more about Red Cedars brings us a fuller understanding of the St. Louis area in which we live.

The Red Color in the Heartwood of the Red Cedar

When we first examined a Red Cedar stump the feature that struck our eyes immediately was the sharp distinction in color between the sapwood and the heartwood. The former is cream-white and the latter purple-red. In the approximate center of the log the red heartwood forms an irregular

pattern which varies with each tree. Although there is a sharp dividing line between the heartwood and the sapwood one can find a fringe of pink where they join.

To find out why this pink was present we put slivers of wood in a warm solution of 10 per cent nitric and 10 per cent chromic acid (a mixture called Jeffrey's macerating solution) and let them stand for several days. This compound dissolves the substance that holds the cells together, allowing them to be pulled apart. We put our slices of wood under the microscope and gently teased the cells apart with needles. It was then easy to see the differences in their shape and color. The most frequently occurring kind is the long, thin fibre-tracheids, which run parallel to the long axis of the stem in company with its fellows. The fibers form overlapping sheets of cells, each sheet one cell thick and ten to twenty cells long, the cells all ending at the same place. The other most common cell is the ray. The rays, in groups of two to many, one on top of the other, long sides touching, take their place between the sheets of fiber-tracheids. The tracheids have a grape-red color in the heartwood but in the sapwood they are white. The rays in the center of the stem are deep burgundy, darker than the fibers they cross. The rays are also white in the periphery of the sapwood, and in the fringe region, where the streaks of pink are visible, they are lighter red. They carry their color beyond the dividing line.

The pattern of color distribution, then, shows the longitudinal cells purple-red in the center and suddenly white in the sapwood. The transverse rays change from wine-red to lighter red and they carry their color into the sapwood.

When Red Cedar wood is freshly cut it is bright and attractive, but if left in the sun for a while it will become brown and dark. We left some wood in a drawer and noted that it dulled but did not turn. By slicing off a part of the dull surface we saw the original deep red beneath. The protected wood turns very slowly.

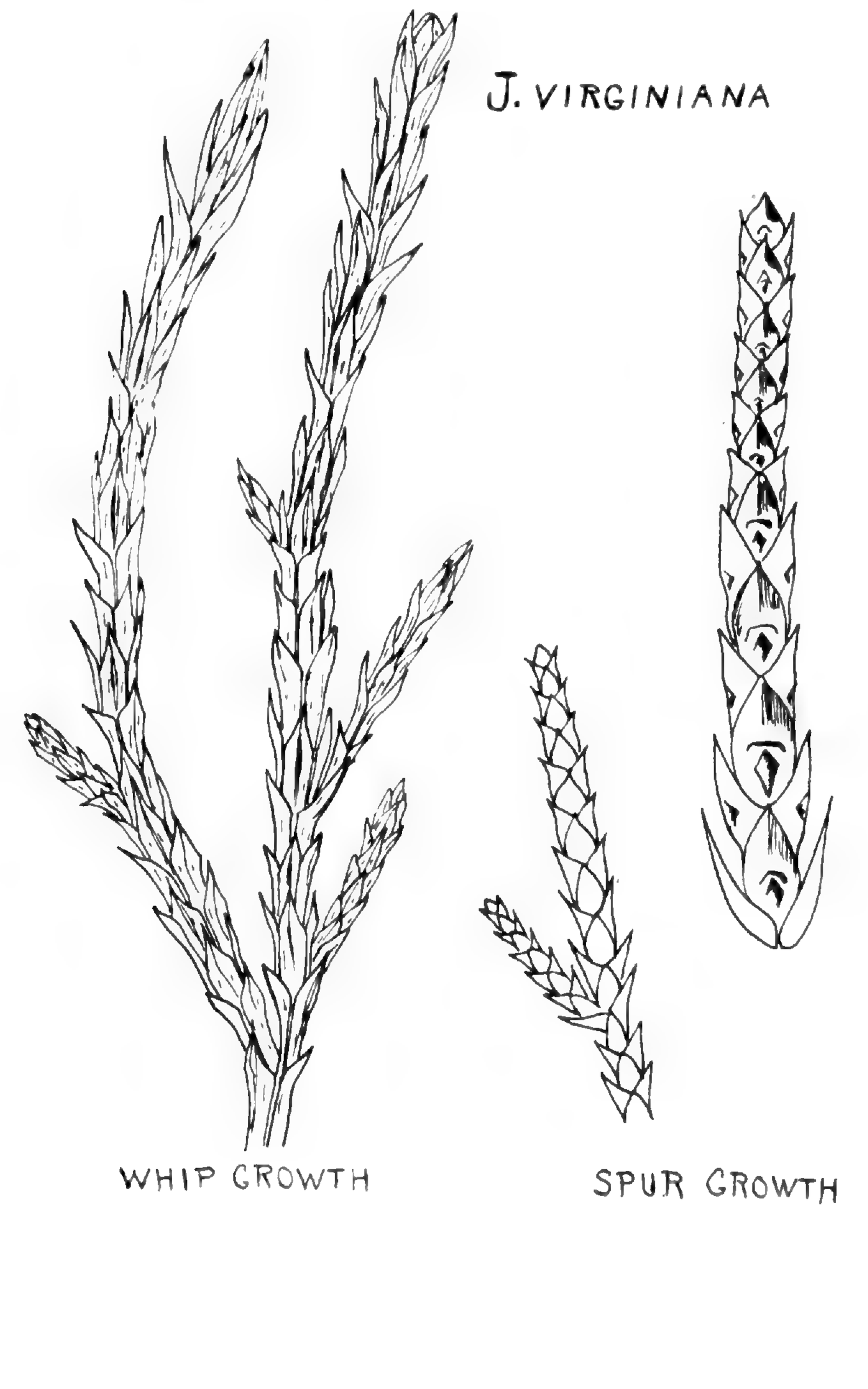
To learn a little about the chemical nature of the color in the heartwood we placed shavings of the wood in three bottles—one containing alcohol, one ether, one water. The color dissolved only in alcohol. We took our extract to Dr. Commoner, who showed us the absorption spectrum of the solution which was similar to auxin. He said the pigment resembled that found in Sequoia.

Leaf Variation in Junipers

The branches of Junipers are covered with leaves, but they are so small and scale-like that they do not remind us at all of the leaves of a radish plant or an oak tree, for instance. Nor are they of one type. They vary

not only from one species to another but also on different parts of the same tree. If one examines a healthy cedar tree growing out in the open, he will find that it exhibits two extreme leaf types with various intermediates between them.

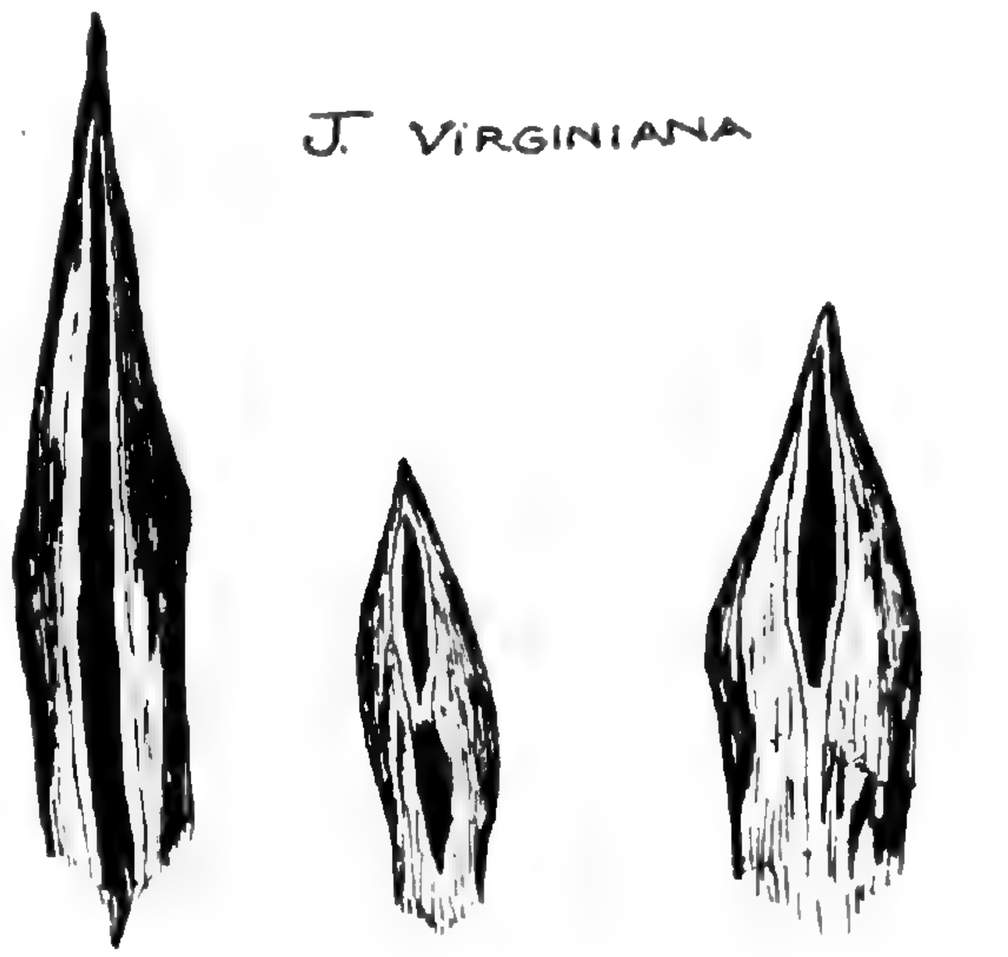
When one looks for the leaves on a branch of a juniper tree, the most obvious candidate is the part that is green. There is a great deal of green that seems to cover the little side branches completely, and if one looks closely he will see that the green resembles a tight, smooth braid. Hooking a finger nail under the point of a division of this braid, a little arrow-shaped object can be pulled off. This is a leaf, one of the three kinds found on a Red Cedar. It is about 4 cm. long and grows opposite another leaf. Ninety degrees around the stem, at the next level, grows another leaf which



also has a partner opposite (see diagram). This arrangement is called "decussate." We refer to this kind of foliage as "spur growth."

If, by chance, the branch picked off has an actively growing tip end, a second kind of leaf may be found. These leaves are more like needles and a little easier to find since they are spread out along the branch, giving it a rather elongate appearance. These needles are reddish-brown and fully twice the length of the little green ones. By pulling off all the needles at one level, it can be seen that they are often arranged in three's, but may occur in two's. We called this foliage type, "whip growth."

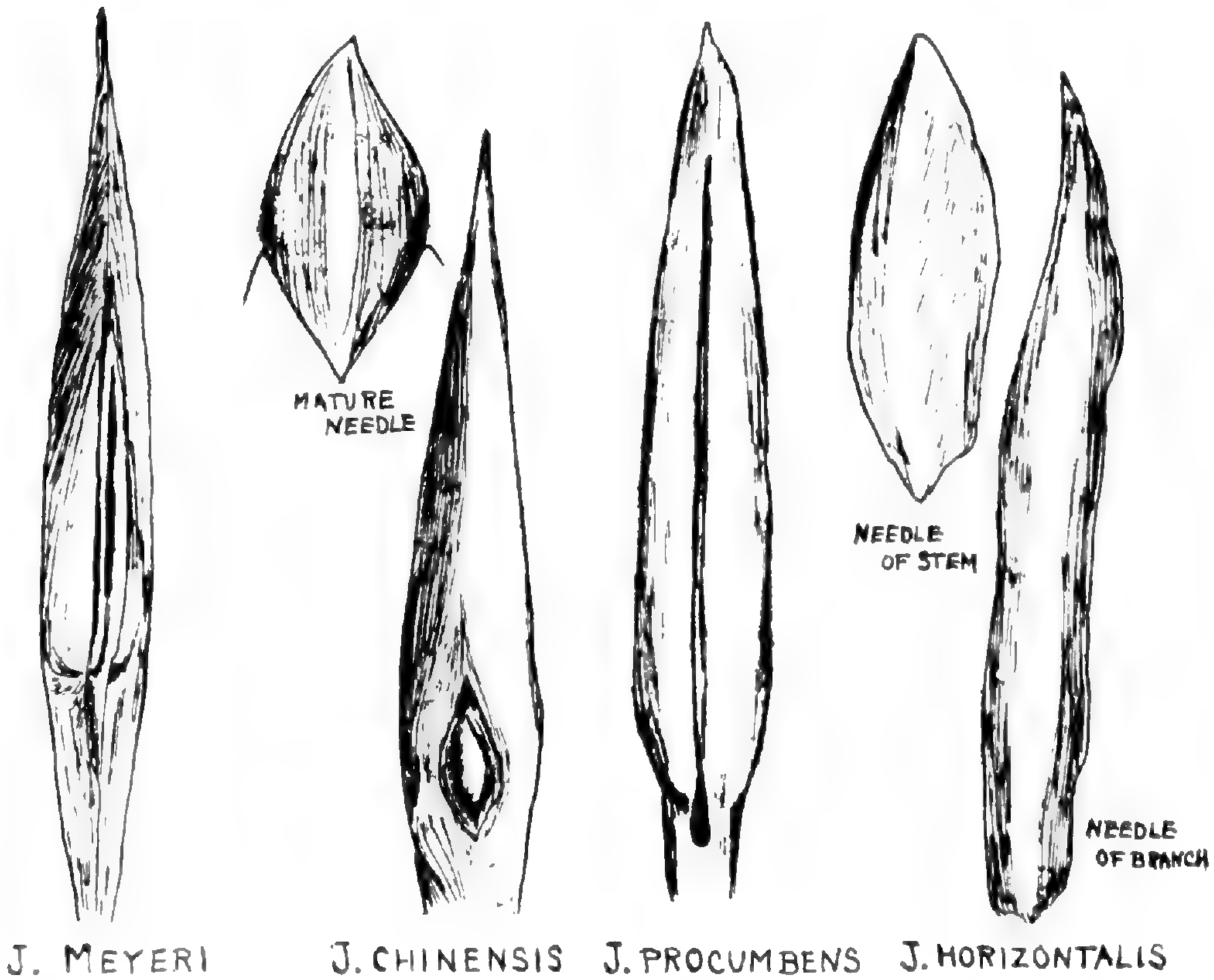
These two kinds of leaves are the extremes, but if one finds a spiky-looking branch or happens to recognize a cedar seedling, he will have another leaf type. These needles are known as juvenile foliage since they are the first leaves to appear. They are dark green and jut out from the stem at right angles. They usually come in three's and form a bristly contrast to the smooth juniper branch. A mature cedar may have juvenile foliage, too, usually on short side branches, especially on the shady side of the tree.



This common Red Cedar, *Juniperus virginiana*, has a lot of close relatives which resemble it, more or less. When one sees a bank of these different junipers, as we did, the different colors of the foliage are first most striking. Closer examination of the branches shows differences in leaf size, shape, arrangement upon the stem, and the number of kinds of needles per species, too.

The rather unkempt-appearing relative with the brownish look is *Juniperus communis*. It has only one kind of leaf, which resembles the juvenile leaf of *virginiana*. It is about the length of a *virginiana* whip-growth leaf, has a green back with brown tips and sides, and a silver-white stripe down the center of the inner side. The leaves are arranged in three's around the stem at a 90° angle.

Juniperus squamata var. *Meyeri*, a bristly blue-green shrub, also has but one type of leaf, which resembles *J. communis* but is of a uniform green color and is attached by a long heel to the stem. *J. procumbens*, a shorter, lighter-green bush, is distinguishable from *squamata* var. *Meyeri* by the



lesser angle of the needles, the more silvery inside and the somewhat shorter length of the leaf.

Juniperus chinensis is very like *virginiana*, having three types of leaves. The whip-growth occurs upon the most actively growing branch tips. Its needles are long with points turned outward and are set in three's. The spur-growth leaves are small, decussate, and curve inward at the point whereas those of *virginiana* curve out. The juvenile growth has leaves arranged at a 45° angle in two's around the stem. All foliage is blue-green.

Juniperus horizontalis, which gets its name from its prostrate position, has a whip growth like *virginiana*, although its needles are shorter and brownish-green with a lavender tinge.

Environment affects leaf types, too, we observed. Whip growth is found to be more prevalent upon the outward, sunny side of a tree and upon broad rather than pointed trees. Juvenile foliage appears mostly upon the shady protected side of the juniper. Some cedars which grow completely in the shade are found to have only juvenile foliage.

Scutellaria parvula is the common Skull-cap Mint of rocky glades in this region. It has curious food-storage organs on its underground stem, one right after another, like little green beads on a string.

BLUETS AS SUMMER FLOWERS

J. A. STEYERMARK

When spring comes to the Missouri Ozarks, among the first wild flowers to greet us are the Bluets or Quaker Ladies. These belong to the genus Houstonia, of which three dwarf species may be found within the state, *H. minima*, *H. pusilla*, and *H. coerulea*. The first of these is by far the commonest, usually occurring in pastures and open soils throughout the southern half of Missouri. It and *H. pusilla* are both winter-annuals; that is, the seed germinates late in the year, the tiny rosette formed remains over the winter, and the plant flowers the following spring, completing its life cycle after forming mature seed. On the contrary, *H. coerulea* and all other species of the genus in Missouri are true perennials, enduring for more than two years. *Houstonia coerulea* resembles *H. minima* and *H. pusilla* in its dwarf habit, but has larger and showier, although paler, blue flowers. It is also much rarer, occurring only in the southeastern portion of the state. In the eastern United States it is a much more common plant.

Ordinarily, *H. coerulea*, also known as Innocence, starts blooming in Missouri in April, and there are no records of its flowering season continuing past June. However, it is possible to extend its blooming period well into late summer by transplanting the plants to cooler or more humid climates. On May 3 of last year the writer dug up some clumps of this species from the southern part of Missouri and transplanted them to a sandstone habitat in his wildflower garden forty miles northwest of Chicago. There they bloomed continuously for 102 days, finishing this phenomenal stretch on August 15, the latest flowering date observed. A week later one of the plants bloomed again, the pale blue blossoms being prominent for several days. Although we usually think of *H. coerulea* as a spring flower in the Chicago region, being found in bloom as early as April 27, Mr. Floyd Swink has recorded it as flowering as late as July 26.

In a comparison of flowering dates, the same species of plant is generally found to bloom in southern Missouri from one to three months earlier than in northern Illinois. Beginning with the Vernal Witch Hazel *(Hamamelis vernalis)*, in late January or early February, the floral parade in the Missouri Ozarks continues brightly up to the first part of June, during all this time maintaining a lead of from one to two months over the region around Chicago. However, towards the end of summer and early autumn, the seasons in the two areas begin to approximate one another until finally the same species is blooming about the same time in both regions. Some of the autumn flowers in Missouri may be blooming during the first of November, while the same species in northern Illinois had bloomed in middle and late September.

The Pin Oak Planted by Henry Shaw.—When the large Pin Oak opposite the entrance to the Floral Display House was removed on April 15, a count of the growth rings showed it to be 102 years old. Evidently it was one of the first trees planted by Henry Shaw in his original Arboretum. The trunk was 14 feet in circumference at the base and the encirclement of the Garden by homes and factories was reflected in the growth of the tree, its diameter having increased only 5 inches during the last 46 years. That the tree made excellent growth in its youth was shown by fourteen radial branch roots, 1 foot in diameter, which kept the main trunk secure through three cyclones. In 1906 it was still a good specimen towering to 70 feet in height. However, during the storm of 1928, it was so damaged that the top had to be removed, leaving a trunk only 20 feet high. Subsequent growth in the form of several leaders brought its height up to 53 feet, but the severe storm of September, 1946, damaged it to such an extent that its removal was necessary as a measure of safety. Two of the Pin Oaks planted by Shaw in the old Arboretum are still alive, both growing outside the Garden on Alfred Avenue on each side of Castleman Avenue.

NOTES

A party of forty botany students from the Springfield High School, Springfield, Illinois, accompanied by their teacher, Miss Ruth M. Woods, visited the Garden library and herbarium, May 7.

Mr. Lee Wayne Lenz, graduate student at the Garden who holds a special fellowship from the Rockefeller Foundation, has received an appointment as Geneticist at the Santa Ana Botanic Garden, Anaheim, California.

Dr. Gustav A. L. Mehlquist, Research Horticulturist to the Garden, spent two weeks in southern California during April, where he addressed various orchid groups and attended the Cymbidium Show at Santa Barbara and the Southern California Flower Show at Pasadena.

Recent visitors to the Garden include: Dr. Lincoln Constance, Acting Curator of the Gray Herbarium of Harvard University, Cambridge, Mass.; Miss Bea Haberl, of the De Young Museum, San Francisco; Mr. Francisco D. Gueco, Sugar Planter, Waiahua, Oahu, H. I.; Dr. Walter B. Welch and Dr. Margaret Kaiser, of Southern Illinois Normal University, Carbondale, accompanied by two of their graduate students in botany; Dr. E. Percy Phillips, Head South African Scientific Liaison Office, Washington, D. C.; Mr. L. M. Abrahams, president of the Chicago Orchid Society.

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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 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. 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 bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN

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Volume XXXVI June, 1948 Number 6

Cover: Climbing rose on wall in Linnean Garden.

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Missouri Botanical Garden Bulletin

Vol. XXXVI JUNE, 1948 No. 6

WATERING THE HOME LAWN

ROBERT W. SCHERY

Watering the lawn is considered quite a simple operation. How is it, then, that a great many people water the lawn with the best of intentions but do it little good and sometimes may even harm it? The answer is that they have never thoughtfully considered the objectives of watering nor analyzed it in conjunction with the fundamental processes of lawn maintenance. Perhaps a brief discussion here will call attention to facts that will enable even the botanically inexperienced to formulate a particular plan of watering rather than just to "follow custom." With this in mind, let us try to correlate watering procedure with: (1) the type of soil, (2) season of the year, and (3) the components of the lawn.

1. *Adapt watering to the soil.*—At one extreme soils may be porous or absorptive, and at the other extreme impervious or scarcely absorptive. Most soils fall somewhere between these extremes, with St. Louis soils generally approaching more the latter condition. A great many factors control the porosity and absorptiveness of the soil. Of special importance are (a) content of organic matter, and (b) soil particle type and size. If the soil is high in organic matter (humus: the remains of decayed vegetation or manure) and/or has a "crumby" rather than a "pasty" feel (affected by amount of clay and silt and the way these particles lump together), it will likely absorb water quickly and well. When abundant organic matter is present the soil acts as a sponge, absorbing water and holding it for future use. If, on the other hand, the soil contains little organic matter (generally indicated by light color) and possesses a high percentage of clay particles which "puddle" as soon as wet, getting water to penetrate into it becomes extremely difficult, especially on sloping ground.

As has been mentioned, much soil of the St. Louis area unfortunately tends toward the relatively impervious type. We find in the residential

area, especially of the county, mineral soils high in clay and low in organic matter. Generally such soils have been formed through the ages under oak forest, and now present a leached topsoil and a near "clay-pan" subsoil. Not overly rich originally, they have become poorer by removal of organic matter (deforestation; raking and burning leaves; cleaning out decaying twigs and logs; plowing and cultivating.) Moreover, in homes constructed on these soils, the very poor subsoil is frequently dug from the foundation and spread over the topsoil where the lawn is to be. Other soils of the area may be "loessal", i. e., carried in by the wind, probably during glacial times. Such soils are apt to be of better structure than the residual soils just described, but they also are poor in organic content. A few bottom-land soils, notably to the north and south of the city and east of the Mississippi, are high in organic content and quite absorptive.

The desired objective in watering the lawn is, of course, to allow the water to penetrate to all grass roots, i. e., to a depth of several inches in the topsoil. In lawns where surface soil cannot be cultivated as can flower or shrub beds, penetration of water may be quite difficult except in the more absorptive soils. But with most St. Louis area soils, only prolonged and gradual application of water will give adequate penetration. Sloping lawns, under heavy application of (unabsorbed) water, have much run-off, which carries with it at least a little of the valuable topsoil. Usually, then, instead of sudden, heavy watering, we should sprinkle with a fine spray, or with a canvas "seepage" hose, allowing smaller quantities of water to reach the soil surfaces over a considerable length of time. A fine spray, applied in one place for about two hours, then moved elsewhere, and reapplied a few hours later to the original area for a second two-hour soaking, will generally wet the topsoil to a depth of several inches. If, during the spraying, there is any significant run-off from lawn to gutter or sewer, water is being applied more rapidly than desirable. Mechanical devices designed for subsurface application of liquids, such as the "Root Feeder" (taped metal cylinder, perforated near the tip, thrust into the soil and attached above-ground to the garden hose), are scarcely usable for lawns, especially on heavy soils. Such a device usually washes impervious clay soil from lower soil levels to the surface at point of penetration, under any effective water pressure.

We might recommend, then, for most St. Louis soils: (a) improvement of soil absorptiveness when starting or remaking a lawn, especially by appropriate addition of organic matter (top-dressing of compost or manure); (b) watering slowly and gradually, in staggered periods of a few hours duration; (c) using a fine hose-nozzle or other means to insure against washing or gullying of the soil, especially on thin or newly seeded lawns where the soil is exposed.

2. *Adapt watering to the season.*—Established lawns in the St. Louis area will normally not need any watering except in July and August (and perhaps part of September). These are the months of high temperatures and rapid and excessive moisture evaporation, and any watering that will insure moisture penetration into the soil and minimum evaporation to the air will be of benefit to the lawn. A lawn cannot be mulched to conserve water as can a shrubbery bed, but water should be applied efficiently. Avoid sprinkling any distance through the air with a fine spray, as a great deal of the moisture will evaporate before it reaches the soil. Sprinkle as much as possible in the evening or morning, to avoid excessive water loss through evaporation.

During midsummer we frequently observe home-owners giving the lawn, as a matter of course, a daily ten- or fifteen-minute "drink", often with a heavy stream of water. These brief wettings are disadvantageous for two reasons: First, a great deal of water is expended which does relatively little good; and second, as will be discussed under lawn components, such a practice may even be detrimental to the better grasses. Sprinkling the lawn for ten or fifteen minutes cannot do more than moisten the surface, and most of this moisture is lost to the air within a few hours. It is better to water more thoroughly and less frequently. A weekly or even bi-weekly soaking to a depth of several inches will maintain more moisture in the soil than frequent light sprayings, and is usually sufficient to keep lawn grass alive during the summers.

3. *Adapt watering to the kind of grasses in the lawn.*—In general, two kinds of lawns can be postulated for the St. Louis area: those in which the most abundant and dominant grass is Kentucky blue-grass (with perhaps lesser quantities of rye and redtop), and those usually less cared-for, in which the dominant grass is the weedy crab-grass. Technique of watering can encourage the lawn towards one or the other of these types, even though the turf may be a mixture of blue-grass and crab-grass. To understand the reason for this, we must examine the growing cycle of these two grasses.

Kentucky blue-grass is a perennial: it keeps growing year after year from underground stems, and once established does not need to seed. It grows moderately in the autumn, staying green well into the winter, and resumes luxuriant growth in the early spring. However, it cannot stand a hot, dry summer. If soil temperatures rise too high, it dies. Normally it remains more or less dormant during the late summer months, and all the water in the world could not make it luxuriant then. Thus, for a blue-grass lawn there is no advantage in supplying more water to the lawn than is needed to keep it alive until autumn.

Crab-grass, on the other hand, is an annual: it must mature seeds before winter, for with the first frosts the plant dies, and only its seeds will carry the grass over to the next season. In many ways this grass is ths one best adapted to St. Louis climate. However, it has some serious disadvantages. In the autumn crab-grass becomes brown with the early frosts, and in spring, because the seeds do not germinate until late, the lawn is without a thick green cover of young plants. It is more shallowly rooted than is blue-grass, and coarser later in the season. But for surviving a blistering summer it has no peer. Crab-grass can eke out an existence in the hottest weather, with no encouragement and only a meager supply of water.

If we are striving for a blue-grass lawn, then, we should water (and fertilize) so as to encourage this grass at the expense of its competitors during its active growing season, i. e., chiefly in spring and autumn. Normally St. Louis rainfall is adequate for lawn needs in spring and autumn. During summer blue-grass is semi-dormant and needs to be watered only enough to keep it alive. Watering more than this tends to encourage its competitors (crab-grass and weeds) which are not dormant at this season. Hence, excessive watering in summer does the blue-grass lawn no good, but greatly encourages the crab-grass and weeds.

Infrequent, but thorough and deep watering keeps the blue-grass alive in summer, while not encouraging its competitors any more than can be helped. Shallow-rooted crab-grass, on the other hand, thrives under the frequent, light, summer sprinklings so often observed in the St. Louis environs. Moreover, such light sprinklings moisten only the surface of the soil and the deeper blue-grass roots tend to grow towards this zone of moisture rather than into the lower topsoil and subsoil. If, as usually happens within a day or two, the moist surface layer dries out and cakes, the roots may die and the plant be weakened. Both kinds of watering help the shallow-rooted crab-grass. Deep watering helps only the blue-grass, while shallow watering may actually be detrimental to it.

We can summarize the correlation of the watering plan with the lawn components by suggesting: (a) that the plants of your lawn be examined to determine their particular habits and growing seasons; (b) water in such a fashion as to benefit, during its growing season, the type of grass or plant you wish to encourage.

Many of the evergreen kinds of Euonymus make attractive summer arrangements. A few sprays cut at this time of year will remain glossy and green for two or three weeks. A bouquet of this sort requires almost no attention and looks appropriate during the hot weather.

BARK INSTEAD OF NAILS

ROBERT W. SCHERY

In the modern United States, with hardware stores in even the smallest of towns and a 20th-century tradition of dependence upon mechanical gadgetry, it is difficult to visualize construction of homes without nails, screws, and various steel fastenings. We who have visited Salt Lake City have rightly stood in awe before the magnificent tabernacle, built without the aid of a nail. That tourists are quickly informed of this feat and are scarcely credulous of it only serves to accentuate how taken for granted is our omnipresent dependence upon steel fastenings.

But not all peoples have nails, nor are all homes constructed, even in the middle 20th-century, with the aid of steel fastenings and steel implements. In parts of Africa, Asia, the Pacific Islands, and South America there is no such thing as a local hardware store. Many inhabitants, although considerably above the level of savagery (perhaps being able to read and write a little) must build their dwellings from strictly local materials. This usually means sticks and small timbers, sod, palm leaves, mud, crudely made bricks, and the like. And usually some sort of fastening of the beams to uprights becomes necessary if the habitation is to be anything more than a lean-to. Such fastening is commonly vines or strips of bark. Figure 1 shows how a cross-beam was lashed to an upright in a modest dwelling in southern Ceara,

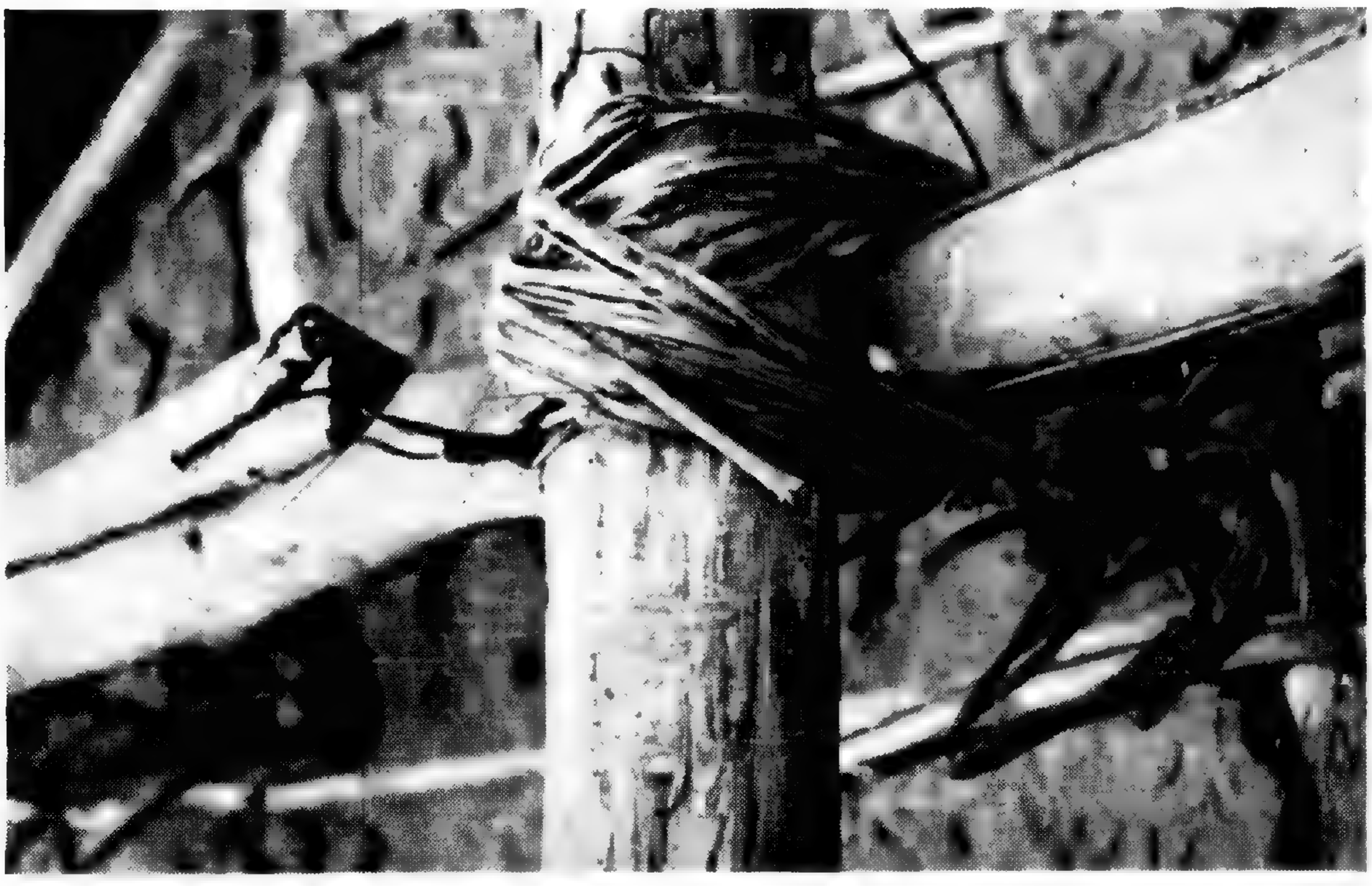

Fig. 1. Cross-beam in a Brazilian hut lashed to an upright by strips of Helicteres bark *(sacarolba)*.

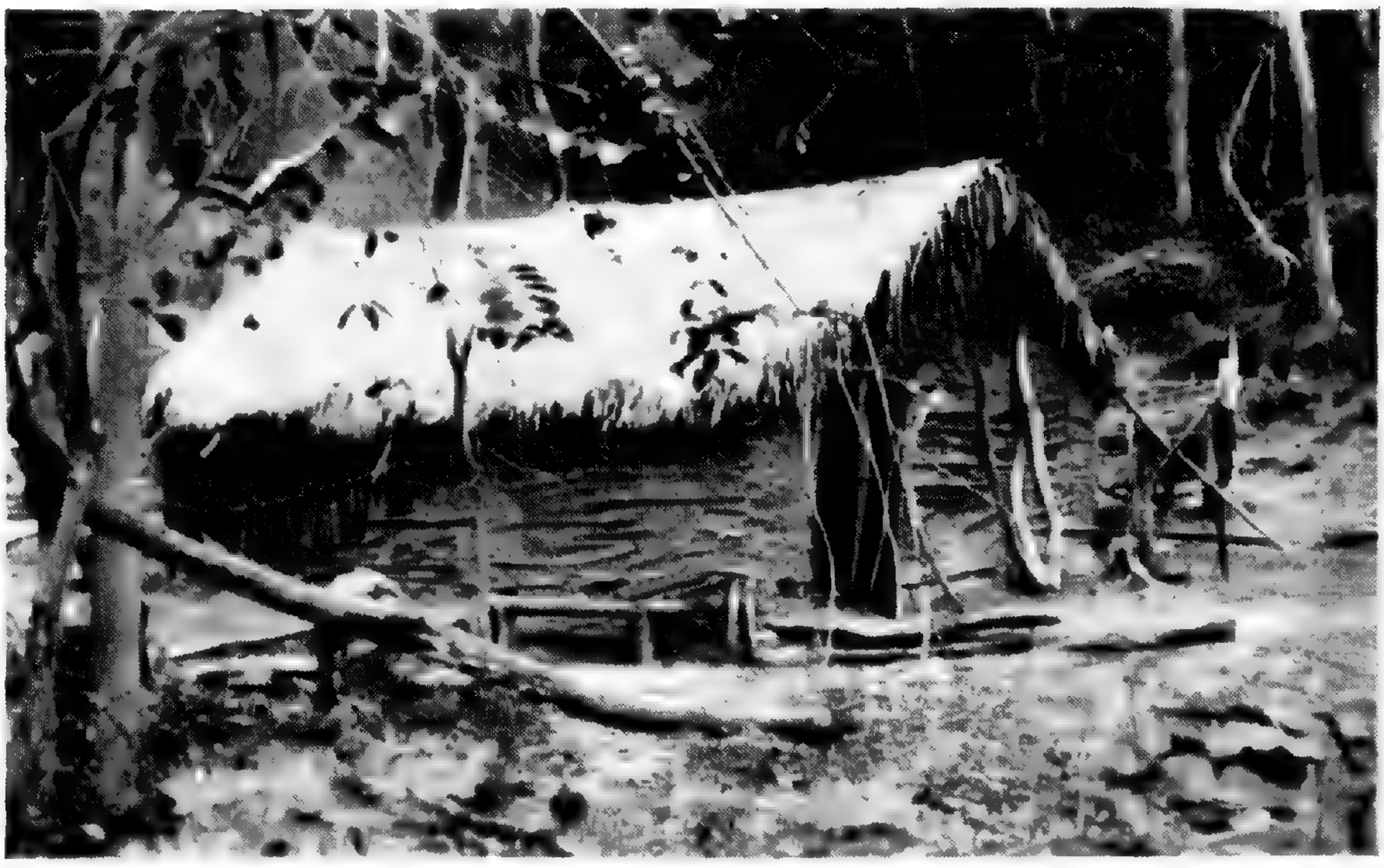

Fig. 2. Hut in Ceara, Brazil, built without use of nails.

Brazil; and this dwelling (fig. 2) is scarcely a two-day trip by horse from the southern terminus of the wood-burning railroad line.

The bark pictured above, which is the one generally used for binding purposes in interior regions of northeastern Brazil, is that of the *sacarolba*. It is a clambering or sometimes erect shrub or small tree embracing various species of the genus Helicteres. Helicteres belongs to the cacao or chocolate family, the Sterculiaceae, and has also as its relative the cola tree. The *mutamba*, Guazuma, is another member of the Sterculiaceae whose bark is utilized for binding but not so commonly as is Helicteres. In this family and the neighboring mallow and linden families (which include cotton, jute, Urena and Hibiscus), there usually occur in the inner bark bundles of heavy-walled fiber cells. These fibers, though flexible, are extremely tough and have remarkable tensile strength. It is their presence that makes bark stripped from the *sacarolba* eminently suited for lashing or binding.

Helicteres is quite an interesting plant aside from its usefulness in providing bark for binding. It is named Helicteres (*helix* meaning a snail or twisted, and *teres*, rounded or cylindric) because of the unusual, spirally coiled fruit. The fruit, when seen on the ground, reminds one of robust worms coiled about each other (fig. 3). It is perhaps the most unique fruit in a family of plants noted for unusual fruits. (Cacao, Theobroma, has a "pod" like a small football growing directly from the trunk; Byttneria has a small bur-like fruit resembling a sea-urchin). The flower of Helicteres is also unusual. It consists of an elongated, tube-like calyx covered with star-

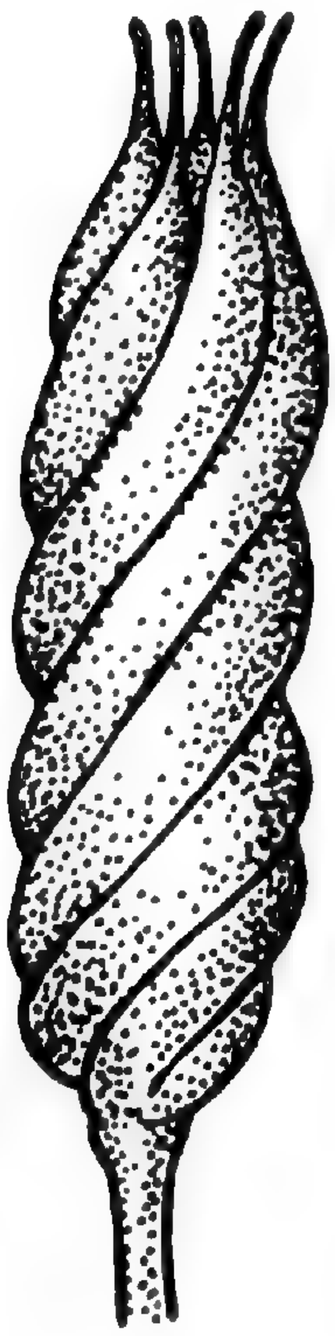

Fig. 3. Fruit of Helicteres.

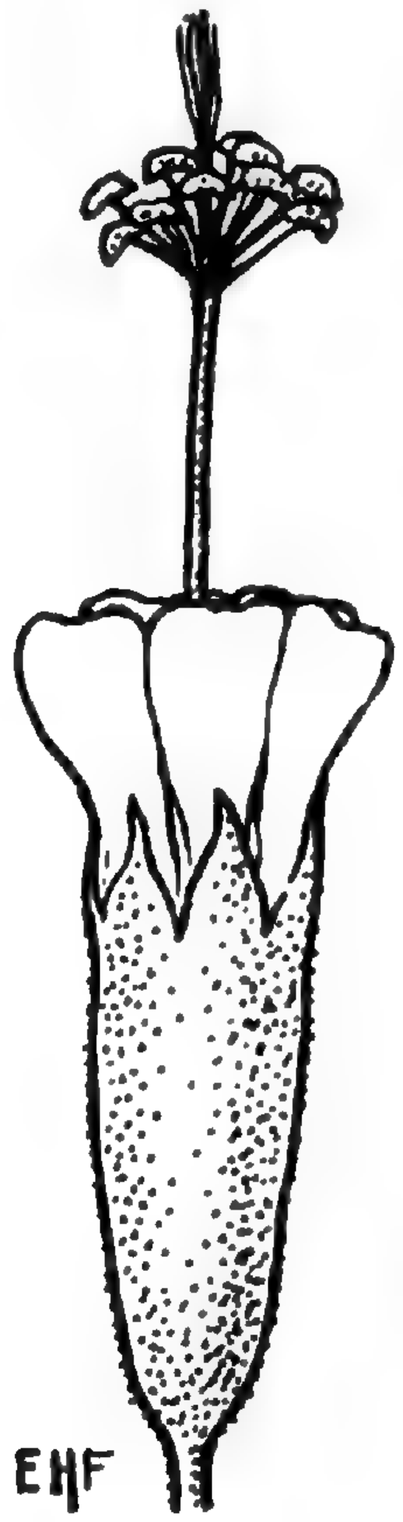

Fig. 4 Flower of Helicteres.

shaped hairs, from the top of which protrude a few short petals; from the center of the flower extends a long stalk bearing the sexual structures (fig. 4). The leaf is much the shape of that of our elms and hackberries but is usually covered with star-shaped hairs.

Of course, barks or fibers from a great many other plants can and do serve for binding. Hard fibers from the *coroa* (Neoglaziovia) and the *piassava* (Attalea and other palms) are extensively used in Brazil. Barks of Bauhinia and of the *cortezo* (Apeiba) are used frequently in Central America for rope substitute. Other plants, too numerous to mention, such as those belonging to the mulberry and lily families, have barks which are utilized in cordage and for cloth in various parts of the world.

For thousands of naturalists who have noticed Danthonia there are few who know it by name. It is the low grass with dry curly leaves which in Missouri is most commonly seen on dry hillsides under cedars or scrub oaks. Its scientific name is *Danthonia spicata*, and the books say its common name is Wild Oat Grass. Maybe so, but if common names belong to the people, this does not pass the test since it most certainly is not current in Missouri. Danthonia is an almost certain indicator of poorish soil. On better sites it cannot stand the competition of stronger-growing turf-formers.

HOW PLANTS GOT CLASSIFIED

DENNISON H. MOREY

Many persons are totally unaware of the complex background and the almost romantic evolution of plant "taxonomy" (classification). Ordinarily when one thinks of classification he conjures up an image of dried-up scholars inhaling the dust of ageless dried specimens of all kinds of plants. Even were this the case taxonomy would still be a vital and living science. The theories and practices of modern plant classification did not suddenly appear upon the horizon. They are the result of eras of thought and study by a number of men all of whom in some way and some degree enabled taxonomy to develop from a system by which a few thousand plants were classified according to use to a natural system of plant relationships in which about 300,000 species of plants are placed.

For ages men had noted that there seemed to be a likeness between certain distinct plants, but until Prince Frederich Cesi (Caesius) published his *Phytosophicarum Tabularum* in 1628 no one had offered any sort of explanation. In this work it was proposed that all plants were related in a chain-like fashion from the lowest forms to the highest, and even though the word "evolution" was not there the thought was obvious. The gradual development of this idea was a constant feature in the writings of natural historians after 1650. Botanists were coming to realize that certain plants appeared to be related and that these groupings of related individuals also appeared to have affinities for one another. Understandably, the men most acutely aware of this effect were the directors of the botanical gardens that were the prides of the various crowns of Europe. The way in which the plants of these gardens were arranged depended entirely upon the whims of the director, who would have considerable ability as there was much competition between the heads of nations even when it came to botanic gardens. Such a man would certainly have noticed that the resemblance could hardly have been a thing of chance and he may also have noticed that groups of these related individuals were related on a higher level as well. The consequence of these observations would be that the botanical gardens would come to have a certain amount of natural arrangement. Fortunately, a great many of these directors were able to write memoirs in which they invariably propounded the superiority of their "natural" systems over the "use" classifications of the old herbals. These works were widely read considering the few educated men of the time, and it was not long before the idea of natural groups and the natural system had taken a firm hold.

It is not surprising that the earliest groups of related plants to be noticed were those closely allied. The situation must have been complicated by the

lack of concept of a genus or species. However, the idea would be in men's minds long before it was defined, and from this Idea of groups of related individuals the genus concept arose. Originally the word genus had much the meaning as the word species to-day, early writers frequently placing several genera under a prime genus. As it became obvious that there were immense numbers of these groups (genera) and that all seemed to have subdivisions, the concept of the species was born. At nearly the same time, the fact that these genera were also allied sometimes became embarrassingly obvious—embarrassing because the why's and wherefore's became increasingly difficult to describe and were apt to be something the botanist *felt* when he looked at the plant.

As the ideas of genus and species developed, technique and theory came as a matter of course. It had become necessary to find some feature which would enable the separation of the large groups of plants into smaller and smaller natural groups. The word "natural" threw a good-sized wrench into the machinery because a perpetual argument was, and is yet, raging upon what is and what is not natural. The first substantial step was made by Andrea Cesalpino, with the publication in 1583 of *De plantis*. In this guide to the northern Italian flora the fruit and the seed were used in the identification of plant groups. Previously, about 1550, Conrad Gesner had put forward the idea that flowers were the most useful part of the plant for diagnosis, an idea that we accept as an established fact to-day. Unfortunately, he did not put his ideas into practice. Happily Cesalpino did. Gesner cannot be condemned for not going further, for his idea was very revolutionary, and, as it was, he was probably looked upon with a feeling of pity by the wise men of botany of 1550.

Until the advent of Cesalpino the systems of plant arrangement were essentially the same as those employed by the ancient Greeks, i. e., according to use. Plants were medicinals, aromatics, purges, wines, and poisons. By using seeds and fruits as a basis of division Cesalpino broke away from the artificial past, and although his system would be considered very superficial by modern standards first things are frequently inadequate (e. g. the airplane or automobile). Cesalpino did not attempt to correlate any of the other features of the plant with those of the fruit and seed. We know, of course, that even within a genus there may be a great variety of seed types so that as the knowledge of plants increased, and especially as the numbers of known plants grew, many people began to realize that there was something greatly amiss. The germ of the idea of a natural system had grown so strong by this time that every one who had serious interest in plants set about to discover its secret and consequently correct the flaws in the system of Cesalpino.

One of the earliest advocates of the natural system was Robert Morison, a Scot whose fortunes followed those of Charles II and resulted, for a time, in Morison's banishment to Paris. In his book on the natural history of plants (1689) he expressed the idea that trees and herbs were natural groups of a high order—an idea which still persists in British botanical thought. However, it has been determined to be of relatively little importance in the separation of larger groups, although it does have considerable weight in the division of families and genera. The current thought, well supported by palaeontological evidence, is that plant evolution is from woody to herbaceous habit. This idea of Morison's is basic to modern analysis, but evidently the original application was inexact. Nevertheless, while using Cesalpino's seed-fruit system as a basis for his own, Morison correlated the seed and fruit characters with other features of the plant and produced a system with a distinctly natural flavor. He used types of flower clusters—giving us such words as Umbelliferae—also petal numbers, and anatomical characters such as latex. Since he had no system of subordination of characters it is little wonder that the system appeared a bit hectic even as early as 1845, a fact we learn from the French botanist, Adrien de Jussieu.

In the twenty years that followed many systems were devised, each of which contained certain invaluable and noteworthy innovations. Bachman (Rivinus), in his system, published in 1690, emphasized the perianth (petals) and pointed out that there were simple and compound flower sprays. These features seem rather obvious to us, but the first man with any new idea or observation must be appreciated as such. Bachman used the irregularity of flowers as a means of separating large groups. His error was essentially the same as Morison's; he did not have sufficient knowledge to employ his observations exactly.

A consequence of the attention given the flower as a means of classification was the obvious discovery that it consisted of more than petals. Burckhard, in writing to the German botanist Leibnitz, in 1702, pointed out that there were many interesting things to be found in the stamens. Thus, by the addition of bits of essential material, the evolution of a natural system of botanical classification took place and at the same time the idea was developed that plants are related in an ascendent or descendent pattern. Each of these bits was essential as the very complexity of plants themselves will attest.

As the detailed knowledge of plants increased the classification in a natural system became much easier, since there was a great deal more that could be correlated to show relationships. One great flaw yet remained in the treatment of the natural systems. All of the sundry characters of a

plant might be listed and all those with a majority of like characters placed together, but some plants have unusual combinations of characters and would thus be very difficult or impossible to place correctly. Another and equally upsetting practice was that of selecting a character and dogmatically stating in a key that all plants with that character belonged in a certain group. Again, there are instances when this would not work, certain plants of a group being unwilling to accept the key character of the others and by this system falling into another and an unrelated group. The solution to the problem came in 1789, when A. L. Jussieu proposed that all the characters must be considered but that in each group there were certain ones that should be regarded as more important than the rest. He maintained that the various features of the plant should be weighed and not merely counted. From this observation modern theory is almost entirely derived. We have continued to add more and more features to be weighed and we have altered the features that are to be considered subordinate but the idea is fundamental and because of it we acknowledge Jussieu as the father of the natural system. He didn't think of it all by himself, but he fixed it so that it would work. Modern taxonomists, using all of the knowledge of the past with continuous study, are constantly perfecting the natural system and adjusting past theory to fact as it appears in the light of current learning. Plant classification is neither dry nor dull and hardly dusty but a vigorous and vital feature in the development of our knowledge of botany.

During this same time some very important but different botanical evolution was in progress. The Swedish physician, Carl Linné (*Species plantarum*. 1753), and Augustin de Candolle (*Prodromus systematis naturalis regni vegetabilis*. 1824-1848) were busy making taxonomy more of an art and a much more facile one than had been the case previously. Prior to 1750 the name of a plant was apt to be a phrase containing a general description of the place in which it was growing plus some of the commoner uses to which it was being put in its native clime. Also there was no way in which affinities were to be shown nor any rules or principles of naming plants. Taxonomic free-will was the vogue. For his own convenience Linnaeus devised the binomial method of naming a plant; that is, by genus and species. Before Linnaeus, the potato, *Solanum tuberosum*, was *Battata Virginiana sive Virginiarum, et pappus*. This is an isolated instance of cumbersome naming to be sure but there were many others as bad or worse. The result of Linnaeus's work is the simple and concise binomials that we encounter in modern botany. There have been many modifications upon Linnaeus's original proposals but his were fundamental and made taxonomy a much neater device.

Simultaneously another device was evolving that was to be of inestimable value, the dichotomous (divided in pairs of subordinate parts) key. This type of key can be either natural or artificial and is very essential in modern taxonomy. Without it, one would have to know virtually every plant by sight, and while that would be a laudable state it would be very difficult of attainment since the number of plant species is rapidly approaching a half million. This device, Linnaeus's binominal nomenclature, and Jussieu's natural system were all improved, and rules for their application in plant taxonomy expounded by de Candolle. His work was of such magnitude, so convenient and logical, that few people cared to differ with his views. De Candolle was essentially a systematist; that is, he was interested in the ordering up of his herbarium, in the naming of new plants, and in the proper placement of the old. He desired, above all else, to have plants treated in a uniform manner so that any one anywhere would be able to identify a specimen of any plant that had been previously described. Also, if one found that the plant had not been named before he should name it in such a way that it would be named but once. De Candolle is undoubtedly the father of modern systematics.

The birth of modern systematics in no way ended the debate that revolved around the natural relationships of plants. The directors of the botanical gardens were still primarily interested in plant affinities. In this branch of plant taxonomy the process of evolution continued, and still continues to be, the slow accumulation of new ideas. The evolution of taxonomy is progressing today much as it did in 1750. However, it is with greater accuracy and insight, with the result that new ideas, instead of disrupting the scheme as they were apt to do in 1750, usually strengthen the foundations and assure the advancement of the natural system.

A small garden conifer, *Thujopsis dolabrata,* has been growing at the Arboretum for about fifteen years and is now thirty-eight inches high. It has frond-like, horizontally spreading branchlets which have a tendency to droop at the tips. While it has graceful foliage it is not particularly ornamental, but it is of special interest to the collector of coniferous species. It requires partial shade, a fairly good soil, heavy mulching, and will succeed in about the same situation as Arbor-vitae. The common name of this conifer is Hiba Arbor-vitae but it is not a true Arbor-vitae. Its generic name "Thujopsis" means "like Thuja" (the generic name of Arbor-vitae), and both belong to the family Pinaceae. It has been used extensively in European gardens where over a long period of years it attains considerable size. There is but one known species with three varieties. The one called "Hondai" is supposed to be hardier and more satisfactory than the rest.

AN ALUMINUM GREENHOUSE BENCH

DENNISON H. MOREY

With the advent of the war and post-war lumber shortages the standard cypress or redwood greenhouse bench has gone the way of all good things. The disappearance of this sturdy and practical horticultural companion is not due to any failure of cypress or redwood benches to fill their jobs suitably, but rather to the virtual disappearance of cypress and redwood lumber from the market and its consequent prohibitive price. Also, of late, the wooden greenhouse bench has met with considerable competition from concrete or semi-concrete benches. When properly designed, there is no question that the concrete type is quite satisfactory for general purposes, and, once built, little short of blasting, pneumatic drilling, or use of a sledge hammer can affect its durability. However, the concrete bench requires considerable expense in initial construction since skilled labor must be employed if the forms are to be built properly.

The obvious desirability of an easily and cheaply constructed permanent bench will be unquestioned by any one concerned with growing plants under glass, especially if the bench is also flexible and readily handled for moving or dismantling. Such a bench appears to be completely realized in the corrugated aluminum bench recently constructed in the greenhouse of the Henry Shaw School of Botany at Washington University. It was constructed by unskilled labor (under experimental conditions, a situation usually associated with great expense) at a cost of 24 cents per square foot,

Fig. 1. Aluminum greenhouse bench.

which is less than the current cost of concrete. The pilot bench is 29 inches wide, 21 feet long, and 4 inches deep. It was constructed in 8 hours by one man.

The materials for the bench consisted of three sheets of corrugated aluminum, 12 feet by 26 inches, and a 10-cent box of ½-inch split brass rivets. (The aluminum is available in other sizes as well.) The bench was fitted over a standard greenhouse frame upon which additional supports were placed 20 inches apart (see fig. 1). The main section was made by bending the sheets along the long axis to form the front and back edges. Two full-sized sheets formed the back section and the two halves of one split sheet formed the front section, providing a working breadth of 39 inches. The edge was bent up at an angle of 60 degrees to provide proper resistance to the pressure of the gravel with which the bench is filled. The front edge was bent similarly, but enough material was allowed in the bend to afford a facing.

The finished bench is shown in fig. 1. The angles and the distances are shown in profile in the diagram (fig. 2). The construction of ends and

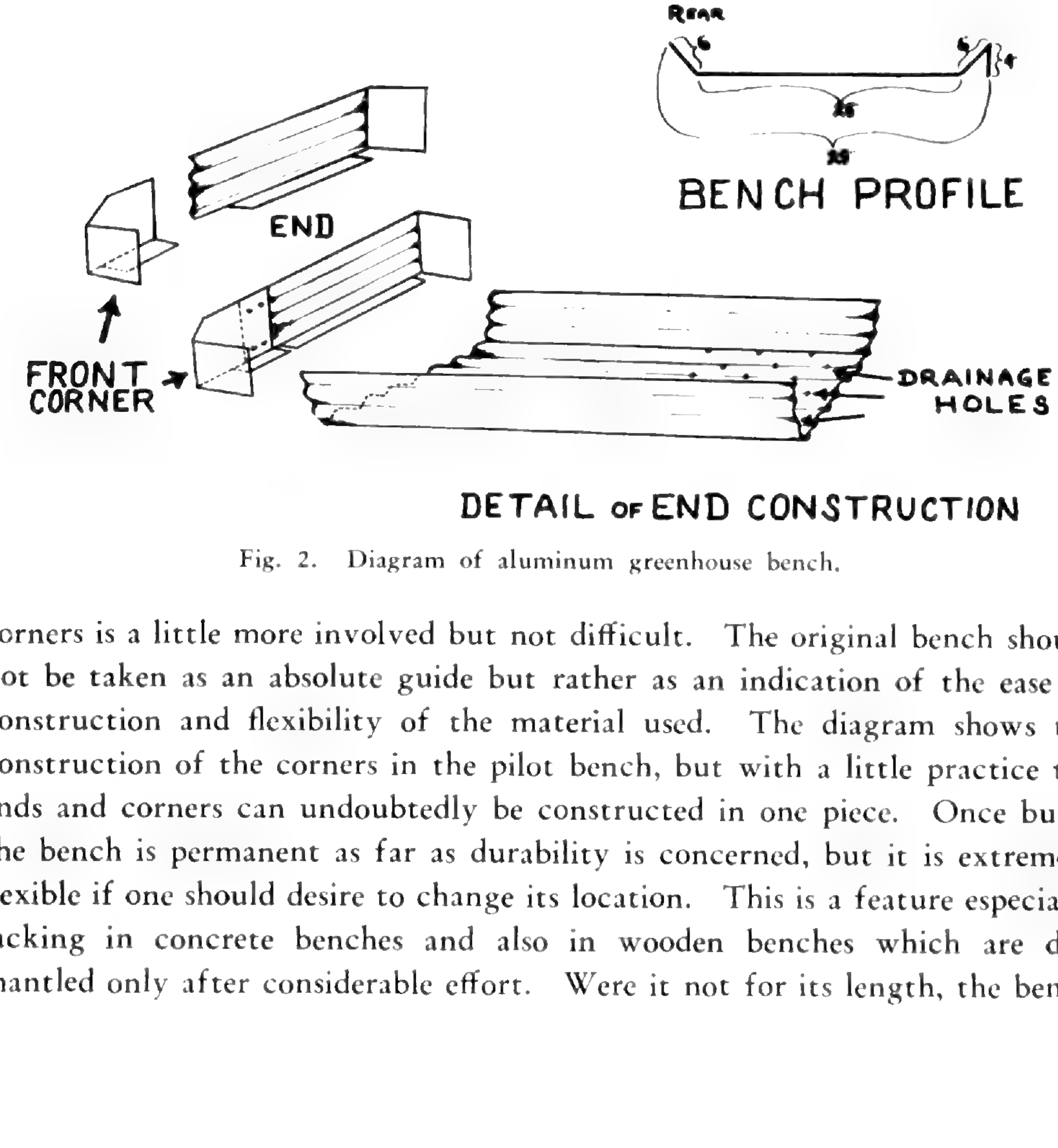

Fig. 2. Diagram of aluminum greenhouse bench.

corners is a little more involved but not difficult. The original bench should not be taken as an absolute guide but rather as an indication of the ease of construction and flexibility of the material used. The diagram shows the construction of the corners in the pilot bench, but with a little practice the ends and corners can undoubtedly be constructed in one piece. Once built, the bench is permanent as far as durability is concerned, but it is extremely flexible if one should desire to change its location. This is a feature especially lacking in concrete benches and also in wooden benches which are dismantled only after considerable effort. Were it not for its length, the bench

could easily be moved by one man. To move the pilot bench when assembled, three men are used, one at each end and one in the middle where the aluminum sheets are joined. By using a very few rivets the bench is virtually hinged in the center and navigates corners with little difficulty.

Since wet feet are one of the worst possible greenhouse conditions superior drainage was provided in the bench simply by punching holes in every other valley from front to rear. The rows of holes were punched every ten inches and as they were alternated in every other valley of the corrugated metal the strength of the structure was little affected. (See fig. 2 for pattern of holes).

Before the bench was started, chemists and plant physiologists were questioned about the toxicity and solubility of aluminum. It appears that the aluminum quickly covers itself with a relatively insoluble and impervious oxide and is wholly inert except when subjected to strong acids or alkalies. Because some of the work in a botanical greenhouse involves unusual chemical solution, the bench was painted with asphaltum, an operation requiring ten minutes and virtually no cost. This rendered the bench absolutely inert. However, the asphaltum would not be required for general use although it might increase the life of the bench a little. In normal use, the life of the bench should exceed that of the greenhouse by far; thus the value of protecting the bench from other than strong chemicals is questionable.

Combined in the aluminum bench are cheapness, flexibility, durability, and ease of construction, all of the features desired but never before so completely or satisfactorily attained.

NOTES

Dr. Robert W. Schery, Assistant Professor in the Henry Shaw School of Botany, will teach botany at the University of Wisconsin during the summer.

Mr. George H. Pring, Superintendent of the Garden, acted as one of the judges at the Kirkwood Flower Show, May 10.

The students in the Henry Shaw School of Botany who received advanced degrees at the Washington University commencement, June 8, were the following: Lee Wayne Lenz and Anna Caroline Raut—Doctor of Philosophy; Richard W. Holm, Ko Ko Lay, Sergius H. Mamay, and Jonathan D. Sauer—Master of Science.

Among the visitors to the Garden during May were: the students in biology from Harris Teachers' College; the class in biology from Carson College, Fairfield, Iowa, accompanied by their teacher, Mrs. F. W. Van

Ohlen; Mr. N. C. Moss, orchid grower, Zenith, Wash.; Dr. H. C. Heiser, Assistant Professor of Botany, University of Indiana, Bloomington; Mrs. Iva Neuman, of San Mateo, Calif., rose enthusiast and garden editor of *Peninsula Life*.

The second number of Volume 35 of the ANNALS OF THE MISSOURI BOTANICAL GARDEN was issued during the month, containing the following papers: A Dicotyledonous Wood Found Associated with the Idaho Tempskyas, by William Spackman, Jr.; The Uses of Hevea for Food in Relation to Its Domestication, and The Use of Glands in a Taxonomic Consideration of the Family Bignoniaceae, by R. J. Seibert; Gynandropsis, Cleome, and Podandrogyne, by Robert E. Woodson, Jr.; Maize in the Great Herbals, by John J. Finan.

Of the graduate students in the Shaw School of Botany during 1947-1948: Mr. Richard W. Holm will give the course in botany at the summer school in Washington University; Mr. Dennison H. Morey has been awarded a special DeGraff fellowship to study and work at the Oregon Bulb Farms, Gresham, Oregon, during the summer; Mr. Ko Ko Lay will spend part of the summer at the Marine Biological Laboratory, Woods Hole, Mass.; Mr. Marion Trufant Hall will be Assistant at the Audubon Nature Camp, Kerrville, Texas, during the summer; Mr. Sergius H. Mamay and Mr. Robert Baxter will accompany Dr. H. N. Andrews on a fossil-collecting trip, June 9-June 18, to the coal mines of southern Illinois and West Virginia; Mr. George A. Llano has accepted a position for the coming year as Associate Curator, Division of Cryptogams, U. S. National Museum, Washington, D. C.; Mr. Fred G. Meyer and Mr. David J. Rogers will spend the summer on a plant-collecting trip in northern Mexico; Mr. Balaji D. Mundkur will work next year under Dr. Carl C. Lindegren at Southern Illinois Normal University, Carbondale, on the genetics of microorganisms; Dr. Anna Caroline Raut has been appointed Assistant Professor at the Southern Illinois Normal University, and Dr. Lee W. Lenz Geneticist at the Santa Ana Botanic Garden, Anaheim, California.

Previous notes in the BULLETIN as to the usefulness of the Nanking Cherry *(Prunus tomentosa)* as a bush fruit for the home garden have led to correspondence with several gardeners who have been growing this shrub in the Middle West. It has done well for all of them but some find the cherries too small to pit by conventional methods. Fortunately, this is not necessary since the fruit can be prepared in just a few minutes by stewing it in a small amount of water and then forcing through a collander. The flesh is so soft that it can be extracted from the stones very easily by this method.

THE MISSOURI BOTANICAL GARDEN

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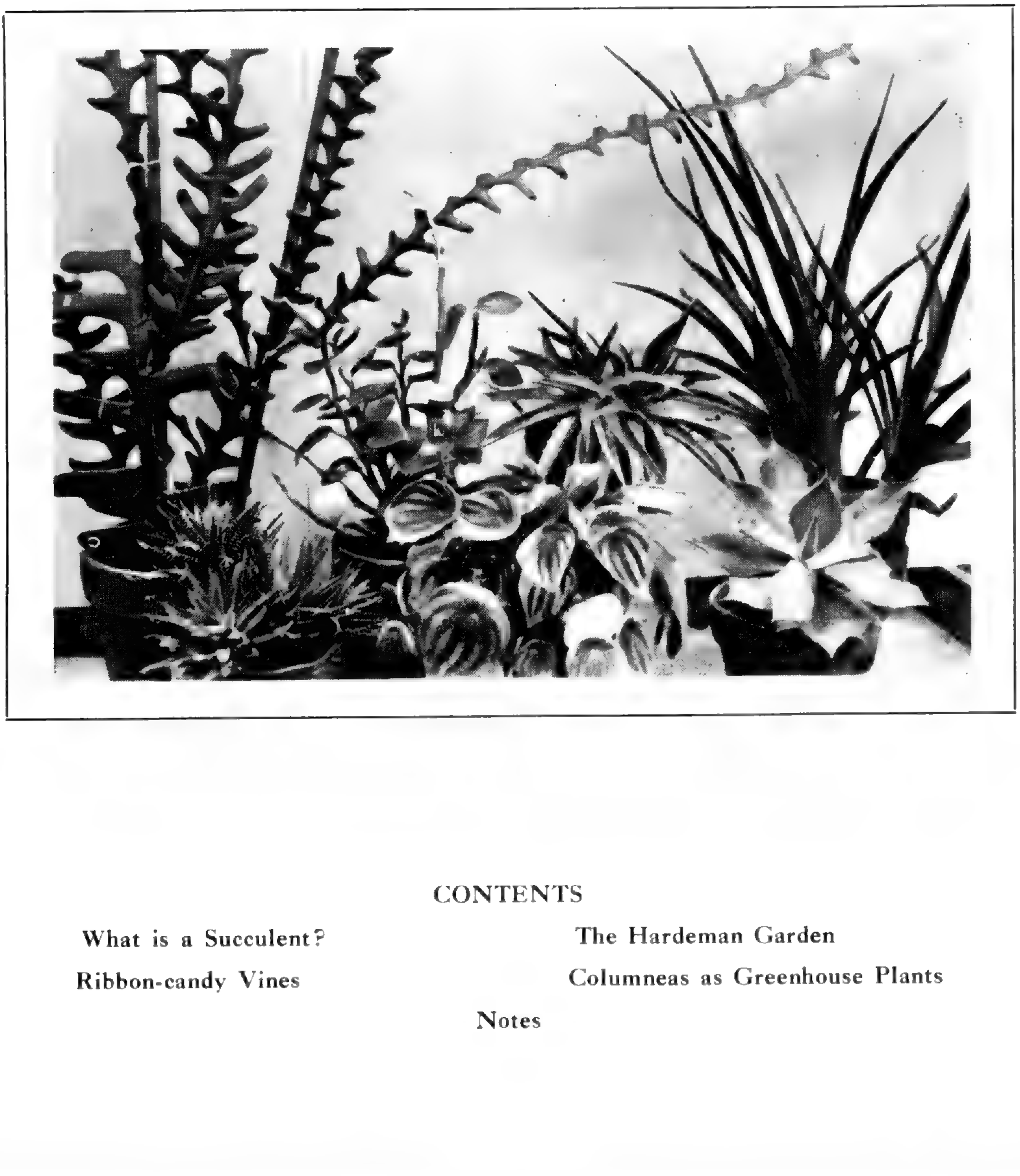
SOME FACTS ABOUT THE GARDEN

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 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. 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 bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN



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Cover: Types of moderately fleshy succulents, five families represented: Cactaceae, Liliaceae, Piperaceae, Bromeliaceae, Amaryllidaceae.

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Missouri Botanical Garden Bulletin

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WHAT IS A SUCCULENT?

LADISLAUS CUTAK

Succulents are now an essential feature of almost every flower and garden show that is staged in this country. However, it is only within the last few years that they have become popular and that their suitability to so many purposes has been appreciated. Yet the term "succulent plants" is still somewhat misunderstood, even by professional flower growers. Exhibitors and judges at St. Louis flower shows often consult the writer about what constitutes a plant of the "succulent" class. Now the writer does not claim to be an established authority but without any semblance of boasting he has acquired sufficient knowledge about succulents, both in the cultivated and wild state, to have an unbiased mind about what should be included in the group. Furthermore, having had direct and long-range contact with growers, commercial dealers, and specialists he has learned what is generally to be recognized as a succulent.

First, it is well to know the origin and meaning of the word "succulent." It is derived from the Latin *succulentus*, meaning juicy, pulpy, and thus is an apt term to describe plants with juicy stems, branches, or leaves. However, we must remember that there are a great many juicy individuals in the plant kingdom which, horticulturally speaking, must be excluded from the succulent category for a number of reasons. For instance, many of the Begonias possess fleshy stems and leaves but usually they require a great deal of moisture to keep them alive. Also, they are ruled out as succulents because they do not possess the general character of stiffness, spininess, or grotesque elegance usually associated with succulent plants.

A true succulent is a plant which has leaves and stems of greater thickness than the average and which can withstand prolonged periods of drought. Usually the appearance is rigid and sculptured, weird and grotesque, and, to use a modern expression, "strictly out of this world." Succulents generally are exposed for the greater portion of the year to extra-

ordinary dryness. They prefer arid sandy and stony plains, waste rocky plateaus, and crevices of rocks which are almost completely wanting in soil. Succulents are capable of hoarding water from infrequent rains in special storage tissues and rely upon it during periods of need.

One reason why succulents differ from other plants in appearance is that they have developed thickened or fleshy organs so that the transpiring surface would be reduced to a very small area. Plants transpire just like people, and unless they modify their structures to meet abnormal conditions of the deserts the excessive heat and dryness would soon cause the moisture from within to evaporate and the plants would die.

Arbitrarily, succulents can be divided into two classes: thick-leaved and fleshy-stemmed. The former have modified their foliage so that it is unusually fleshy, more or less cylindrical in shape, and often of firm and leathery texture. Good examples can be found in Sedums, Kleinias, Gasterias, and Mesembryanthemums. In the fleshy-stemmed (usually referred to as cactiform) group, best exemplified by cacti, spurges, and stapeliads, the plants have discarded foliage almost entirely or reduced it to a rudimentary state. In this group the greatly thickened and fleshy stems have assumed the function of leaves. It is an established fact that a thickened organ has less surface exposed to the air than a thin flattened one of the same bulk. To make this point clearer, take a small ball of meat or dough about an inch or two in diameter; now roll it out in a flattened cake, and the surface area will have been increased many fold. Thus the plump forms typified in succulents were designed to reduce surface and lessen water loss by evaporation.

The more or less massive stems of succulents, particularly of cacti and leafless candelabrum-like tree spurges, are further rendered grotesque by being ribbed, fluted, or tubercled (warty), which allows for expansion and contraction during periods of abundance and want. When water is available the stems become very turgid but when the supply is used up the contraction brings out the ridges and tubercles. Were it not for this accordion-like function, stems of these succulents would burst their skins in hoarding moisture. Leafy succulents are well adapted to the constant swelling and shrinking and they need not be tubercled, nippled, or ribbed as are the fleshy-stemmed kinds.

The storage organs of most succulents are usually a series of cells confined in the interior tissues and are almost hidden by the surrounding vascular bundles. The water in the storage cells is often viscous, mucilaginous, or impregnated with salts, which enables these plants to withstand drought for months. In some succulents, bladder-like cells protrude from the epidermis which sparkle in the sunshine like crystal, conspicuously so in the common Ice Plant (*Cryophytum crystallinum*).

A discusssion of the many modifications and exceptions that occur in the various succulent plants would take many pages, but a few of the essential ones have already been mentioned. We are now concerned with facts that will enable us to recognize a succulent and to learn in what plant families they can be found. Give a thought to the following features, and I am sure that the question, "What is a succulent?" can be answered by an affirmative nod or a negative gesture.

1. *High Succulency.*—Any plant that is conspicuously fleshy and that is able to survive dry periods.
2. *Moderate Succulency.*—Any plant with a certain amount of fleshiness in either leaves or stems and possessing several of the following characteristics:
   a. Member of a family which is known to contain a good proportion of succulent plants.
   b. Unusual appearance. Either globular or cylindrical, or at least fleshy, this form or condition having been adopted in order to offer the least surface to the sun and to enable the plant to catch, absorb, and retain all the moisture available under abnormal conditions, such as in deserts or in alpine regions where rarefied atmosphere and intense cold are physical handicaps.
   c. Unusual covering. Plants covered with various protective devices to lessen evaporation. This may be a hard parchment-like epidermis, waxy skin, a layer of wax superimposed upon the skin, white or bluish powder sprinkled over the surface, thick felted hairs, etc.
   d. Spininess. Plants bearing a conspicuous armor of spines which serve not only to shade the plant body from direct sun but also protect it from browsing animals.
   e. Grotesque elegance. All plants more or less sculpturally modernistic and with coloration running to pastel shades.
   f. Rosulate habit. Rosette-shaped plants with leaves packed either closely or loosely on more or less elongated stems.
3. *Low Succulency.*—Any plant that requires the cultural methods of desert plants and that by tradition and long-established usage has been classified as fleshy by collectors.

Succulency is not confined to just one plant family; in fact, there are nearly twenty which boast members of succulent nature. In one or two families the entire membership is succulent; in others it is divided; and in some only a few succulent species are recognized. Too, the succulent flora does not belong to any particular region but is found in all parts of the world, in montane districts, desert wastes, and tropical forests. The plants vary in size from minute Mesembryanthemums to tree-like Euphorbias, Cacti, and Aloes. Between these extremes are all the thousands of species and varieties to which belong the weirdly beautiful and fascinating pot plants so prized by succulent fanciers. Following is a brief summary of plant families which contain our best-known succulents:

CACTACEAE (Cactus Family).—A very distinct group in the plant kingdom, endemic to the Western Hemisphere but now cultivated or found semi-wild in other parts of the world. Over 1500 species and varieties are recognized in more than 125 genera. All are perennials with simple or branched stems which are more or less fleshy, spiny, cylindrical, globular, or flattened and constricted at intervals. Areoles (cushion-like outgrowths)

Types of highly fleshy succulents, six families represented: Compositae, Cactaceae, Aizoaceae, Liliaceae, Euphorbiaceae, Crassulaceae.

Types of xerophytic plants doubtfully succulent but generally classed as succulents: Yucca, Dasylirion, Beaucarnea, Tillandsia, and Testudinaria.

are the characteristic feature of the family from which branches, flowers, spines, glochids (bundles of fine spines), leaves, hairs or glands originate. Every member of the family is considered succulent, although Pereskia, considered to contain the most primitive types, may not be any more succulent than a lemon tree which it superficially resembles. However, since Pereskias belong to the Cactaceae, an almost exclusively succulent family, they are given the succulent status. The largest cacti are veritable behemoths with trunks 50–60 feet in height and individual specimens weighing several tons. Others are very tiny, about the size of a thimble or marble.

EUPHORBIACEAE (Spurge Family).—One of the largest families of flowering plants, comprising about 250 genera and 4000–6000 species of herbs, shrubs, and trees, with an acrid and often milky sap. Only those which are strikingly cactus-like and which usually inhabit desert regions in various parts of Africa, India, and the Canary Islands are classed as succulent. Most of the succulent spurges are found in the genus Euphorbia, but Monadenium and Synadenium are also wholly succulent. Strangely, succulent Euphorbiaceae, which greatly resemble Cactaceae, are far removed from that family, but the two have worked out water storage and heat resistance problems practically on the same principles. Pedilanthus is the only strictly American genus of Euphorbiaceae which is wholly succulent. The flowers of the Spurge family are generally insignificant, without sepals or petals, but sometimes made conspicuous by their number and the colorful bracts which surround the flower-heads. In the entire family only 300–500 species can be classed as succulents.

ASCLEPIADACEAE (Milkweed Family).—Another very large family of flowering plants widely distributed from tropical to cold-temperate regions, with over 2000 species. The succulent members are mostly African and belong to the tribe Stapelieae, which numbers about 400 species in 20 genera. The Stapeliae assume many of the shapes found in Cacti but their texture is usually rather soft and they never attain a very large size. They can be likened to miniature Cactaceae. The flowers of stapeliads are very characteristic, being essentially star-shaped and containing an intricate pollen chamber devised for insect pollination. They are frequently luridly colored and some possess a disagreeable odor like that of rotting flesh, for which reason they are commonly called "Carrion Flowers." The stapeliads include such genera as Stapelia, Caralluma, Duvalia, Huernia, Hoodia, Tavaresia, Trichocaulon, Stapelianthus, and Edithcolea. Other succulent groups in the family are those belonging to Hoya, Sarcostemma and Ceropegia, which include climbing, twining, or creeping plants.

CRASSULACEAE (Orpine Family).—This family is almost entirely succulent and is widely distributed in temperate and warm regions of the world. It is divided into six tribes, in which are to be found the vast majority of the most popular leafy succulents in cultivation. The best-known genera are Crassula, Rochea, Bryophyllum, Kalanchoe, Adromischus, Cotyledon, Aeonium, Greenovia, Sempervivum, Monanthes, Aichryson, Echeveria, Dudleya, Pachyphytum and Sedum. The rosulate habit is very pronounced in the Crassulaceae, particularly in Sempervivum, Aeonium, Echeveria and Dudleya. A most entrancing coloration often characterizes the species of this large family. Roughly, there are over 500 species listed.

AIZOACEAE (Fig-marigold Family).—Unquestionably most of the members of this family are highly succulent, as they chiefly inhabit deserts and sandy seashores and therefore are able to store much water in their leaves. At one time most of the species were included in one genus, Mesembryanthemum, which botanists now have split into more than 100 genera. The "Mesembs" can be subdivided into two classes: stemless and bushy. The stemless include all the "mimic" species (usually reduced to two plump leaves), camouflaging as pebbles, stones, and rocks, among which they grow in South Africa. The bushy kinds are up to two feet in height, or are creepers that carpet sand dunes, rocky places and cliffsides. The Ice Plant is a member of the family of Fig-marigolds.

PORTULACACEAE (Purslane Family).—Most members of this family are classed as succulent, sometimes shrubby, herbs; however, for esthetic reasons some of the weedy kinds, as *Portulaca oleracea*, are ruled out of the category. The common Rose Moss (*Portulaca grandiflora*) and species of Talinum and Calandrinia are American members of the group. The African *Portulacaria afra* and species of Anacampseros are unquestionably the most succulent of the Purslanes.

LILIACEAE (Lily Family).—This is perhaps the most representative family of Monocotyledons, whose members grow from bulbs, corms, root-stocks, or a woody caudex. They are usually of herbaceous habit, although some become woody and tree-like. The succulent species mostly hail from Africa and include such genera as Aloe, Gasteria, Haworthia, Apicra, Bulbine, etc. From a strict standpoint the American genera of Yucca, Hesperaloe, Nolina, Beaucarnea, and Dasylirion are only slightly succulent, yet because they are of xerophytic habit we do not hesitate to call them succulents. Aloes are the most ornamental for outdoor plantings in warm sections, but Haworthias are often considered the "darlings" of all the succulents irrespective of the family to which they belong.

AMARYLLIDACEAE (Amaryllis Family).—Over 800 species are found in this family but only the Agavoids, popularly called "Century Plants," are classed as succulents. These plants grow mostly from rhizomes and bear thick, hard, rigid leaves (sometimes thinner and narrow) frequently close to the ground but occasionally with definite trunks. The leaves of the Agaves and Furcraeas are fibrous and several species are cultivated for the fiber used in the manufacture of rope, cordage, bags, etc. The succulent members are all native of the two Americas while the Aloes, their Lily relatives which they resemble, are distinctly African.

COMPOSITAE (Daisy Family).—This is one of the largest families of flowering plants, embracing about 13,000 species of world-wide distribution. The majority occupy moist to arid habitats but only Othonna, Kleinia, and Senecio can be classified as true succulents. One would never guess their affinity to the Daisies were it not for the typical daisy-like flowers in Othonna and the thistle-like flowers in Kleinia and Senecio. Othonna makes a good ground cover, similar to some species of Sedum, and its leaves look like miniature pickles. In Kleinia are to be found some of the handsomest of succulents. The mottled, pencil-like stems of *K. stapeliiformis* look like sticks of candy.

BROMELIACEAE (Pineapple Family).—This family is of American origin except one species said to have been found in Africa, and it includes both epiphytes and terrestrials to the number of 1000 or more species. The xerophytic kinds, like the South American Puyas, Dyckias, and Encholirions and the Mexican Hechtias, may well lay claim to inclusion in the succulent category, for they are rigid, spiny, rosette-forming, with a degree of succulency in the leaves akin to Agaves which they somewhat resemble. The same kind of culture is given them as for other succulents.

GERANIACEAE (Geranium Family).—Mostly herbs of more or less succulent nature, but because they take considerable watering and do not present a stiff, spiny, grotesque appearance, they must be excluded from the succulent class. However, in Pelargonium, there are a few species, as *P. echinatum*, with fleshy caudex armed with persistent spine-like stipules that are definitely succulent. The odd genus, Sarcocaulon, is also in the succulent class.

CUCURBITACEAE (Melon Family).—Some 800 species are included in this family of chiefly tropical, coarse, herbaceous vines. However, only four or five could be called succulents, and as yet they are not generally available. The genus Xerosicyos contains two succulents which promise to become great favorites. They are native to the arid, rocky or sandy localities of Madagascar.

VITACEAE (Grape Family).—In this large family of ornamentals are found a number of succulent stem oddities. The most interesting is *Vitis quadrangularis* with peculiar 4-winged stems looking like a spineless Cereus of the Cactus family. Several species of Cissus produce fleshy bottle-like stems which yearly enlarge their bases and bear at the top fuzzy deciduous fleshy leaves. Specimen plants may be many years old.

DIOSCORACEAE (Yam Family).—In this tropical family of twining, slender, herbaceous vines which grow from large solid-fleshy or woody rootstocks there is a curious plant, *Testudinaria elephantipes*, much prized in succulent collections. The globular rootstock studded with angular woody protuberances may weigh as high as 100 lbs.

APOCYNACEAE (Dogbane Family).—This family contains the remarkable genus, Pachypodium, with about 15 species of succulent shrubs, native to Madagascar and South Africa. There is often a succulent cactus-like spiny trunk producing several branches at the top. Pachypodiums are curious features of localities where they grow.

PIPERACEAE (Pepper Family).—In this family is included the genus Peperomia, which contains a large number of tropical herbs of succulent nature. The fleshy leaves of these attractive plants enable them to endure the dry air of most homes much better than other common house plants. In Mexico a number of Peperomias can be found growing in companionship of Cacti and Bromels.

Above I have tried to list those families with the greatest number of succulent species but there are others, for instance, Oxalidaceae and Commelinaceae, which cannot be overlooked. Many new succulents have been introduced in recent years and there is a possibility that several other families contain succulents that will become as popular as those mentioned above.

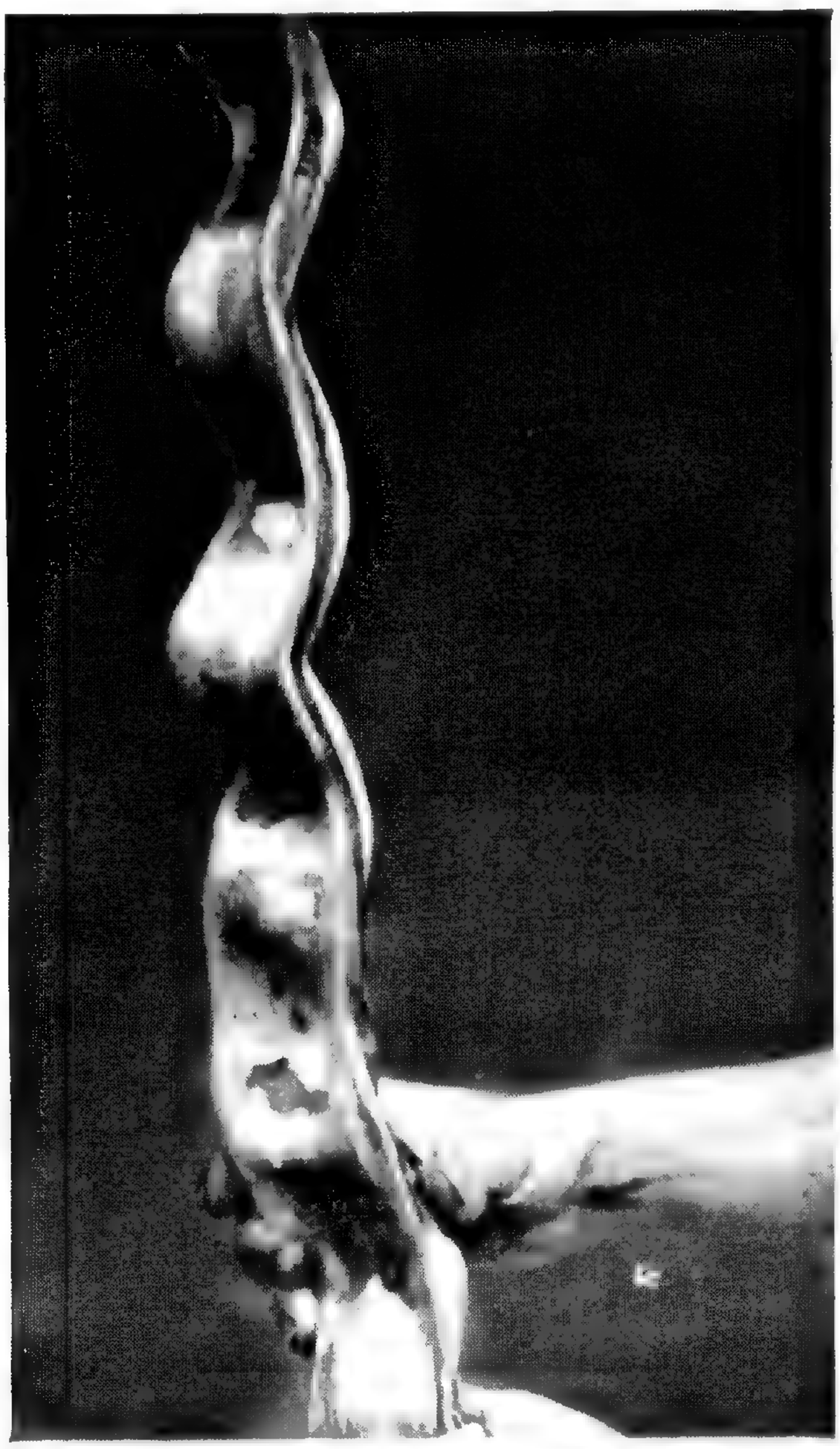
Early September finds Missouri's meadows and pastures beginning to blaze with the bright yellow blossoms of Beggars Ticks and Spanish Needles. They are among the showiest of the autumnal wild flowers but they last a very short time, seldom looking attractive for more than two weeks. Though at least a dozen different species are known in Missouri, most of the mass displays are made by only two or three, of which *Bidens involucrata* is one of the commonest.

RIBBON-CANDY VINES

ROBERT W. SCHERY

In the tropics of this hemisphere, and undoubtedly in the Old World as well, there occur certain vines with very odd-shaped stems. Often the stems of these lianas are flattened, fluted, or perforated, and appear as weird zig-zag or even spiral "chains" or "ribbons" hanging down from the tops of the tall jungle trees. If one uses his imagination, he might liken them to old-fashioned ribbon candy. A section of one such liana is illustrated, the photograph having been taken under a rain-forest canopy in the state of Maranhão on the north coast of Brazil.

Generally such tropical vines are believed to belong to the genus Bauhinia, a member of the Leguminosae or pea family. However, identification



Stem of a Ribbon-candy Vine

of the plants is seldom certain unless one has leaves or flowers. Walking or riding on horseback through the tropical forest one sees many a ribbon-candy stem, but seldom a leaf, the reason being that the leaves are borne high up on the lianas which clamber up to the tops of trees for support. The flowers and fruits are likewise formed high in the sunny "second-story" of the jungle and are seldom collected for detailed study by the botanist. We know that some species of Bauhinia are ribbon-candy lianas, but it well may be that genera of other families likewise produce such odd-looking stems.

The twigs of the high-climbing ribbon-candy lianas, when young, are not of unusual appearance. It seems that with age the cambium tissue becomes stimulated or localized primarily at a single margin of the twig. As a result the secondary tissues, those formed by the cambium and responsible for increase in girth of woody plants, are produced essentially in a single plane. Moreover, a rather regular pattern of unequal growth results in the convolutions apparent in the ribbon-candy stems.

The unusual appearance of the stems of these lianas, to which I have here given the name "ribbon-candy" following a lead from Dr. Orland White communicated to Dr. H. K. Svenson of the American Museum of Natural History, has resulted in a series of intriguing local names in various parts of tropical America. In Spanish-speaking Latin America the lianas are frequently called *bejuco* (vine) with various defining descriptive adjectives. Thus we have in Panama *Bejuco de cadena* (chain vine) and *bejuco do mono* (monkey vine). In northern Central America other species are called *pie de venado, pata de venado, pata de vaca*, etc. (deerfoot, cowfoot, etc.). In Brazil we find species of Bauhinia expressively called *cipo de escada de macacos* (monkey-ladder vine).

Not all Bauhinias are lianas, or with the peculiar stem formations above discussed. Altogether there are known about 200 species of this genus, in both the Old and the New World, of which many are small trees or large shrubs. Quite a few of the species are armed with prickles or thorns, and a few with formidable spines. The leaves are quite distinctive, having an outline appearance much like the track of a cloven hoof (hence the names *pie de venado*, deerfoot, previously mentioned). In others the leaf may be completely divided into two separate leaflets. The flowers are large and attractive in a few species ("orchid"-like), rather inconspicuous in most, usually white. All in all, the Bauhinias constitute a rather striking and extremely interesting component of the tropical jungles and semi-jungles.

When the Korean Lespedeza comes up on a gravel bar it often makes a prostrate mat which looks very different from the crowded upright plants one sees along the roadsides.

THE HARDEMAN GARDEN (1819-1835)

A. P. BEILMANN

The Hardeman garden in Franklin, Howard County, was one of the earliest gardens in the new country beyond St. Louis. It was begun by Mr. John Hardeman, who was born in Virginia in 1776 and with his family moved westward through Tennessee and Kentucky, until, in 1817, he became a resident of Carondelet. Two years later he settled in Howard County, in the new town of Franklin. This little village, the eastern terminus of the Santa Fe Trail, at that time included among its inhabitants such illustrious citizens as Kit Carson and Dr. John Sappington. In this busy little community accustomed to the arrival and departure of travelers, Mr. Hardeman slowly turned from his legal profession and became a gentleman farmer and agricultural experimenter. He set aside a square containing ten acres which was to be devoted exclusively to horticulture. The center of this tract was laid out as a maze, closely following a very popular European form of gardening. There were two small pools outside the maze, which, along with additional beds, followed the traditional geometric pattern of the formal garden. Surrounding this and possibly serving as a windbreak, was a complete enclosure of grapes and bush fruits. We cannot tell from the records just what plants were used as a hedge in the maze, nor can we tell exactly where some of the roses were planted. However, a planting list which was made available to the writer by Mr. Glen H. Hardeman indicates that his grandfather grew Dwarf Box, Hemlock, and Longleaf Pine. The plant list shows that about the same emphasis was placed on the growing of fruits as on purely ornamental plants. The selection of plants would indicate considerable ability on the part of the planter. In a frontier town such as Franklin it is only natural that the fame of these well-kept grounds should spread far and wide, and tradition has it that the garden was visited by Mr. Henry Shaw. Mr. Hardeman died of yellow fever in New Orleans in 1829, and about six years later the entire town of Franklin, including his garden, was washed away by a Missouri River flood.

Amateur botanists would do well to take an interest in the common sunflower of dump heaps and vacant lots. It is a typical member of the Compositae family in everything but size. Details which are difficult to examine in an aster or a goldenrod are clearly visible in any sunflower head. You may not care for sunflowers, but if you will gather a few and study them carefully the other members of the Compositae will be easier for you to understand.

COLUMNEAS AS GREENHOUSE PLANTS

GEORGE H. PRING

The November 1947 BULLETIN contained an account of a new greenhouse plant, *Columnea Allenii*, which had first flowered at the Garden in September of that year. This June another species of Columnea, *Columnea arguta*, flowered and is even more showy than the first plant described. The two species are very much alike when in flower, but *C. arguta* is more floriferous than *C. Allenii*. It may also be distinguished by its bristly stems, its rounded opposite leaves, and by the spear-shaped, scarlet-flushed sepals. The leaves are dark green with age becoming reddish-tinged, paler green with purple veins beneath. Both species are easily propagated from cuttings, being rooted in a Wardian case containing equal parts of finely chopped sphagnum moss, peat, and sand. All species of Columnea require heavy shade during the summer months.

The genus Columnea belongs to the family Gesneriaceae which also includes Gloxinia and Saintpaulia (African Violet). Of the Columneas collected by Mr. Paul H. Allen in Panama during 1940 and 1941 and sent for determination to Mr. C. V. Morton, of the Smithsonian Institution, nine were described as new species (Ann. Mo. Bot. Gard. 29:35-58. 1945). Among them were *C. arguta* and *C. Allenii*, the latter named in honor of Mr. Allen.

NOTE BY PAUL ALLEN

"When on routine collecting trips for the Missouri Botanical Garden in the mountains north of El Valle de Anton in Coclé Province in Panama, two of the frequent and handsome plants found in the wet, forested regions of that area were *Columnea arguta* and *Columnea Allenii*. Both species were frequently found on the sides of trees in dense shade and tended to thrive on old mossy logs in clearings. Although the plants prospered for some time after the trees had been felled, they were doubtless maintained in good condition largely due to the very heavy rainfall in the area and the accumulation of wet moss on the tree trunks. From my experience in Panama, neither species is found elsewhere.

"During 1946 a few small cuttings were forwarded to the Missouri Botanical Garden in the hope that they might possibly be grown in the Garden greenhouses for ornamental display. The plants were propagated at Gray Summit in the Orchid Houses and upon my return to the United States, in 1947, I was considerably surprised to find that they had not only prospered, but apparently flowered much more freely in cultivation than they did in the wilds. I have never seen any in the wilds to compare with the *Columnea arguta* carrying forty five flowers at the Missouri Botanical Garden."

The damp summer has made several weeds more prevalent than they have been in several years. Among the grasses the Muhlenbergias, particularly the weedy little ones known as "Nimble Will," are quite abundant. These are easily recognized by their delicate, wiry stems. They are no thicker than common string but are constructed like the bamboo of a fishing-pole.

Columnea arguta

Woodcocks at the Arboretum.—The Arboretum, functioning as a wildlife preserve, is becoming increasingly attractive to the American Woodcock. One pair is known to be nesting on the property this year, and there are apparently two others. These chunky, snipe-like birds were long prized by expert wing shots but for many years have been on the protected list of game birds. Their chief diet is earthworms, and the humus-rich top-soil created at the Arboretum by its extensive program of erosion control is probably one of the main reasons for the increase in the woodcock on the area. The flight song of the woodcocks has been heard frequently this spring at the Arboretum. The male bird sings at dusk when spiralling up into the air, so that relatively few observers have actually witnessed the flight. Ordinarily only a rush of wings is heard but when the song does come down it is a clear bubbling noise almost like that of a child's whistle, and lasts for a moment or two. The romantically inclined have pictured it as a comforting song to his mate on the nest. More probably it is a warning to other woodcocks that this is his territory and they had better stay out.

Tar Grass.—A tall, rank, weedy-looking grass which is common in Missouri during the fall has the English name of "Tall Redtop" or "Purpletop," according to the books. Country people who really know the plant refer to it as "Tar Grass," a much more appropriate name. During the late summer and fall it develops an oily substance along its tall stems which eventually becomes so heavy that it brushes off on the clothes of passers-by and leaves a really impressive smooch. Most people who make its acquaintance for the first time assume that they have gotten an oil stain off an automobile or some other piece of machinery and are surprised to learn that the greasy spot came from an innocent-looking grass with a plumy tassel. In many Missouri pastures the plant grows so thick that by mid-September the whole pasture may have a dull purple cast from its purple tassels. It has coarse leaves which the stock leave untouched, and the open branching tassels ride almost waist-high above the lower pasture grasses among which it grows. Tar Grass is botanically classified as *Triodia flava* or *Tridens flavus*. Some botanists have puzzled as to how the specific name *flava* or *flavus*, which means yellow, could have ever been hitched to such a definitely purple grass. However, after the first hard freeze the color disappears almost at once, and the grass becomes pale straw color for the rest of the fall and winter. Perhaps it was from a specimen collected late in the year that the species first got its name.

NOTES

Dr. R. M. Tryon, Assistant Curator of the Herbarium, spent part of the summer at the University of Minnesota Biological Station, Lake Itasca, where he gave a course in "Summer Flora" and in "Aquatic Plants."

Dr. G. A. L. Mehlquist, Research Horticulturist, attended the meetings of the Missouri State Florists at St. Joseph, June 13–16, and the American Society for Horticultural Science, at Cincinnati, September 8–11.

The September number of the ANNALS OF THE MISSOURI BOTANICAL GARDEN (Vol. 35, No. 3), which was issued during the month, contains the following papers: Contributions to Our Knowledge of American Carboniferous Floras. X. An Osmundaceous Stem from Iowa, by Henry N. Andrews and Robert W. Baxter; A Crossotheca from Northern Illinois, by Henry N. Andrews and Sergius Mamay; Note on *Fomes idaboensis* Brown, by Henry N. Andrews; A Study of the Vegetative Anatomy of the Genus Sphenophyllum from American Coal Balls, by Robert W. Baxter; Miscellaneous New Apocynaceae and Asclepiadaceae, by Robert E. Woodson, Jr.; Quantitative Determination of the Pigment Content of Single Cells by Means of a New Microspectrophotometer, by Barry Commoner; The Southern Dent Corns, by William L. Brown and Edgar Anderson.

Among the botanists or horticulturists visiting the Garden during the summer months were the following: Ing. Julian Acuña, of Estacion Experimental Agronomica, Habana, Cuba; Mr. Paul H. Allen, of the United Fruit Co., Golfito, Honduras, C. A.; Mr. Stephen Berczik, Horticulturist, Santa Barbara, Calif.; Dr. Earl E. Berkley, of the National Cotton Council of America, Washington, D. C.; Dr. Jacob Bjerknes, of University of California, Los Angeles; Dr. Cox, of Agnes Scott College, Atlanta, Ga.; Mr. J. Eric Cuthbertson, of Hobart, Tasmania; Prof. W. W. Dowdy, of Lincoln University, Jefferson City, Mo.; Mr. Joseph Ewan, of Tulane University, New Orleans, La.; Mrs. Charles Gray (Julia R. Lawrence), of Greenwich, Conn.; Dr. Charles Heiser, of University of Indiana, Bloomington; Dr. Harlan Lewis, of University of California, Los Angeles; Mr. Mas Yamada, formerly Lt. U. S. Army, and formerly graduate student Shaw School of Botany; Mrs. Iva Newman, rose enthusiast, of San Mateo, Calif.; Dr. Gerald B. Ownbey, of the University of Minnesota, Minneapolis; Prof. Kenneth Redman, of the University of Georgia, Athens; Dr. Hampton C. Robinson, amateur orchid grower, of Houston, Texas; Dr. Lloyd H. Shinners, of Southern Methodist University, Dallas, Texas; Dr. J. Proskauer, of the University of California, Berkeley; Mr. John J. Finan, graduate student in history of science, Harvard University.

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 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. 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 bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

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MISSOURI BOTANICAL GARDEN BULLETIN

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Cover: The Dove Orchid (*Peristeria elata*).

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Missouri Botanical Garden Bulletin

Vol. XXXVI OCTOBER, 1948 No. 8

COMMERCIAL ORCHID CULTURE IN THE UNITED STATES THE DEVELOPMENT OF AN INDUSTRY

RICHARD KUYKENDALL

The story of the development of the orchid industry is one of the most fascinating ones in the annals of horticulture. To the layman, the tales of the search for these plants in the steaming jungles of the tropics, where the collectors had to combat disease, wild animals, and native superstition, read like a novel. To the scientist, the development and spread of knowledge of orchid culture mean endless patience and exacting experimentation, orchids being one of the most diversified and tricky groups with which the plant scientist has ever worked.

In the early days the rare orchids of the tropics were sought mostly by private collectors for their interest and pleasure. Owners of large estates, both in England and in America, sent collectors into the native habitats in search of rare and unusual forms. Gradually, as orchids became better known, commercial growers began to take an active interest in the plants and to gather them in even greater quantity.

Orchids are naturally distributed over almost the whole world except for the Arctic regions, and including the arid desert areas of the continents. Orchids of commercial interest, however, have mostly come from the tropic and semi-tropic regions, a great majority from Central and South America. The Blue Vanda *(Vanda coerulea)* from Burma, White Moths *(Phalaenopsis)* from the Philippines, Lady-slippers (Cypripediums or Paphiopedilums) from Burma and southeastern Asia, Cymbidiums from India, Burma, and Annam, and Butterfly Orchids (Oncidiums) from Mexico and tropical America, are but a few examples of important commercial orchids which were made known to the world through the activities of the orchid hunters. These men lived precarious lives, and not a few perished in the jungles which they explored. The weather was chronically bad for northerners. Native superstitions often prevented a fine orchid from being obtained. In addition,

there were all the snakes, jaguars, bats, spiders, scorpions, midges, gnats, flies, rats, and other tropic discomforts to hamper them. When the collectors did survive it was still no easy matter to get the plants out of the jungles and back to the greenhouses of Europe and America.

Many of the early collectors had chiefly in mind the advancement of science and horticulture, but very quickly the collecting of orchid plants became an extremely profitable business. After only a comparatively few years of intensive collecting, all but the most rare orchids had been brought out of large sections of the tropical jungles. The danger arose that many species would become very scarce or even extinct in their native habitats, and some of the Central and South American countries began to place high export duties on orchid plants. The trade thus became less profitable both to the collectors and to the growers.

By 1880 there were considerable numbers of wealthy and titled Englishmen who had become very active in raising orchids in their greenhouses, and it was about this time also that some of the larger nurseries began to grow them on a commercial scale. Even though native orchids were still coming to the capitals of Europe, the cultivation of the plants became more and more a hobby for the wealthy and a business for the commercial grower. While many of the importations were for private owners who had sent their own men into the tropics to hunt for the precious plants, the importations were mostly made by two or three large commercial growers. In an article in the British horticultural journal, *The Gardeners' Chronicle* (Vol. 142, p. 144. 1937), entitled "Orchids and Orchid-Growers Fifty Years Ago" [1887] there appeared the following:

> "I remember the names of many of the buyers, and the keenness there was to possess anything of outstanding merit, as well as to purchase dry plants from a fresh importation. The sale room would be quite full of wealthy private cultivators and trade growers. Among the former would be Sir Trevor Lawrence, Lord Randlesham, His Grace the Duke of Marlborough, Mr. Buchanan (of Scotch Whisky fame), and the Rev. Kineleside, of Tunbridge Wells, dressed to the nines, smoking a fine Havana cigar, and looking more like a wealthy city magnate than a clergyman; and there were many others . . . . ." [A rather typical description of the sorts of persons who were the pioneers in the development of orchid culture.]

Perhaps one of the most famous and largest of the London importers of orchids was the firm of Messrs. Sander, of St. Albans. The article quoted above goes on to say:

> "What a giant in the Orchid world was Mr. F. Sander. He would not be denied in securing importations of any new or rare species. Wherever the plants were likely to be found, thence he would send a collector and some months afterwards there would be held a sale which would bring not only the English growers, but cultivators from Paris, Brussels, Ghent and other continental centres. All were eager to buy the dry specimens in the hope that, when they flowered, something would appear of outstanding merit, either a new natural hybrid or a new type of the species."

And further in the same article a note regarding the first importation of one of the most important orchids used in early commercial hybridization work:

> "Messrs. Hugh Low and Company, whose nurseries were at Clapton, introduced the profitable *Cymbidium Lowianum*, so extensively grown to-day by the trade for market purposes. . . . . This firm was one of the earliest to collect. I well remember the chief collector, Mr. White, who went out to one of the South American regions to seek some orchids, but never returned, and was, I believe, never heard of again; possibly killed by some wild beast or bitten by a venomous snake."

Still another important pioneer in the development of the orchid industry was the firm of James Veitch & Sons, Royal Exotic Nursery, Chelsea, England. Besides maintaining collectors in the field for native orchids they were the first successful hybridizers of orchids. In fact from about 1853 until 1868, they dominated this field, and Mr. Dominy, their orchid grower, produced hybrids of Cypripedium, Cattleya, Laelia, Calanthe, as well as the bigeneric hybrid *(Cattleya labiata* × *Laelia crispa)*. "A Manual of Orchidaceous Plants," published by James Veitch and Sons in 1894, contains much information concerning the early days of orchid growing in England.

It was from these three commercial orchid establishments in England, and several others, that the private collections and commercial growers in America got their start. Actually the first reported orchid collection in the United States was one started by John Wright Boot, of Boston, in 1838. From about 1850 on there began to appear an ever-increasing number of private collections, mostly built around importations from the large commercial growers in England. During the period from 1850 until 1880, a handful of commercial florists and nurserymen began to raise orchids on a small scale as a side-line to supply owners of private collections. In 1880, the English firm of Sander & Co. established an orchid nursery at Summit, New Jersey, but this proved too far away for proper management, and in 1896 it was sold to the American nursery firm of Lager & Hurrell. However, there was another firm which was selling orchids on a commercial scale before the founding of Lager & Hurrell. This was the nursery of Pitcher & Manda, at Short Hills, New Jersey, where Mr. Lager worked before he joined with Mr. Hurrell to form a new company. At the time Mr. Lager was working for Pitcher & Manda (1889-1896) this firm was selling some orchid flowers in New York, and Mr. Lager quickly realized that there was a very prosperous future for growing orchids for the cut-flower trade. It was Pitcher & Manda who actually sent Mr. Lager on his first collecting trip to South America in an attempt to fulfil their ambition of having the largest collection of orchids in the country—one which they never seemed to have achieved.

The firm of Lager & Hurrell developed one of the most varied commercial collections in this country. The main interests of the firm have been in providing private estates and public conservatories throughout the country with a wide variety of genera and species. This great variety is due primarily to the efforts of Mr. Lager, who spent much of his time in South America on collecting trips. Mr. Hurrell, who came to the firm with orchid-growing experience dating from 1872, took over the management of the greenhouses and cultivated the orchid plants which were received from Mr. Lager's South American expeditions. Mr. Lager was particularly interested in white orchids which were then becoming much in demand for wedding bouquets and corsages. On one of his trips to South America he brought back the first white "*Cattleya gigas alba*" (now known as *Cattleya Warscewiczii* var. *gigas* f. *alba*), later sold it to an English firm for a reported $10,000.

Before 1900 there were comparatively few orchids grown in the United States either for plants or for cut flowers. However, with changes in the economic situation, many of the larger private collections were sold, and with the increasing demand for cut flowers a number of nursery firms went into the orchid-growing business. To bring the development of the commercial orchid industry in the United States up to the present time, one should mention briefly a few of the larger nurseries which were pioneers in growing orchids, both for plants and cut flowers.

Lager & Hurrell, of Summit, New Jersey, has been described as being one of the pioneers among the modern commercial orchid-growing establishments. This firm, which now is under the management of John E. Lager, Jr., has grown a wide variety of orchids, but particular emphasis seems to have been placed on hybrids of Cattleya and Laelia.

Another pioneer in the commercial field in America is the firm of Butterworth's, of Framingham, Massachusetts, which was established at the turn of the century. Edward A. White, author of "American Orchid Culture," reports of his first acquaintance with the founder of the firm, Mr. J. T. Butterworth, in 1906. "At that time Mr. Butterworth was supplying practically all the cut orchids sold in the Boston market. In addition his trade included many plants sold to orchid growers on private estates."

Joseph A. Manda, the founder of the present firm of Edward A. Manda, Inc., of West Orange, New Jersey, got his start in the orchid business working for Pitcher & Manda. Mr. J. A. Manda began business for himself in 1906, and since then the firm has built up a large trade. They specialize in species and hybrids of the genus Cattleya which are comparatively easy to grow yet unusual in quality and beautiful in color, and which can be purchased at fairly low prices. With them the cut-flower business has been secondary to the growing of plants for private estates and the amateur grower.

A digression must be made at this point to refer to "Quarantine 37" set up by the United States Department of Agriculture in 1919. This was primarily for the purpose of controlling plant diseases and pests which might be introduced into the United States with plant importation. "Orchid plants, cuttings, and bulbs from any foreign country (Canada is the only exception) may be imported only under a special permit, or Regulation 14 permit. These special permits must specify an authorized port of entry, through which your plants clear." Any one grower could import not more than 400 plants a year, and those which were imported could enter the country only through two ports (New York, and San Francisco) where they were subjected to a thorough fumigation by the Bureau of Entomology and Plant Quarantine. Naturally such regulations greatly curtailed the shipment of orchid plants into this country, and it was not until 1943, when certain modifications were made in the act, that there was a revival in orchid hunting and collecting, particularly in Central and South America. American growers seized upon the opportunity to replenish their stocks with fresh native material, chiefly for breeding purposes.

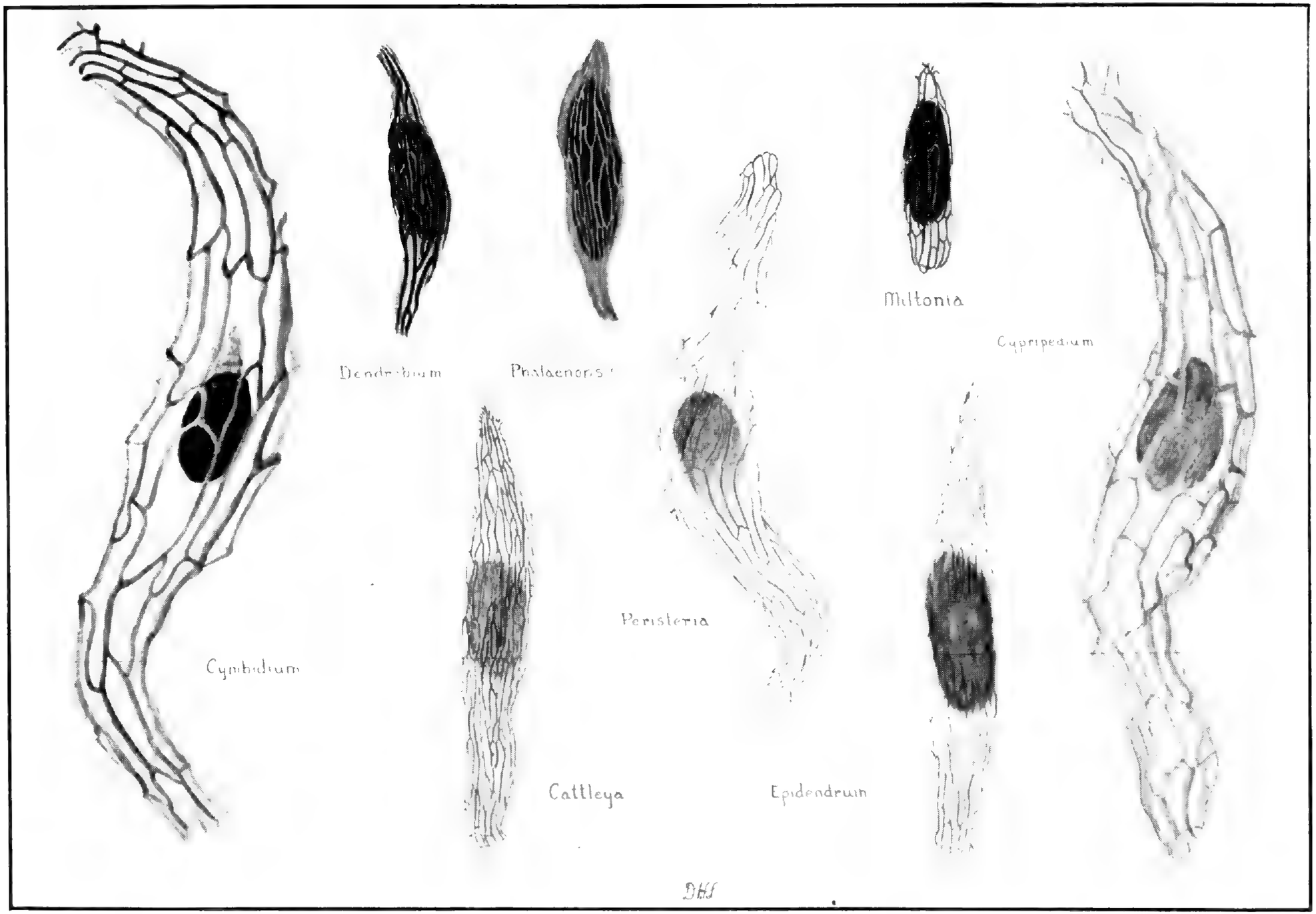
The quarantine had another rather far-reaching effect on the commercial growing of orchids. With the restriction on importations American growers were forced to try new methods of propagation. There are several methods of propagating these plants, one by seed and the others vegetative. In some orchids, such as Dendrobiums, new plants develop at the nodes of the stem of the parent plant. These develop their own aerial root system, and when this is large enough, the new plant can be severed from the parent and potted. This is known as the "offset" method. For such genera as Cattleya, Laelia, Oncidium, and Coelogyne, one method used by growers, commonly referred to as "propagation by back bulbs," might better be described as "propagation by front bulbs." The genera mentioned above develop an upright growth known as a "pseudo-bulb" from the end of a heavy creeping rhizome. After the plants flower one or two of these front bulbs can be severed from the parent rhizome and potted to form new plants. The parent plant develops new leads which can again be grown into new plants. "Back-bulb" propagation, in the more strict sense of the term, is generally applied in producing new plants of such genera as Cymbidium and Calanthes, in which the older leafless bulbs are the ones removed to produce new shoots. In Laelia and Cattleya, back-bulb propagation is often effected by removal and separate potting of the back section. These back sections of two or more pseudo-bulbs should have at least one leaf for best results.

Production of orchids from seeds is a slow process compared with most other plants, and when new plants could be obtained easily from their native habitat, the commercial orchid-grower manifested little interest in this method. However, when Quarantine No. 37 went into effect, and at the same time the demand for orchids as cut flowers increased, many commercial growers began to show intense interest in seedling orchids. Orchid seeds are almost microscopic in size, and the number of them in a single seed-pod may be anywhere from tens of thousands to over a million. Although nature seems to have been very lavish, relatively few seeds germinate and develop into plants. The growing of plants from seed to flower is a lengthy process, taking anywhere from four to seven or even ten years. In the early days of orchid culture this meant that none but the most patient and skillful of the growers was ever able to produce plants of a marketable size, and the difficulties encountered made the price of the flower prohibitive.

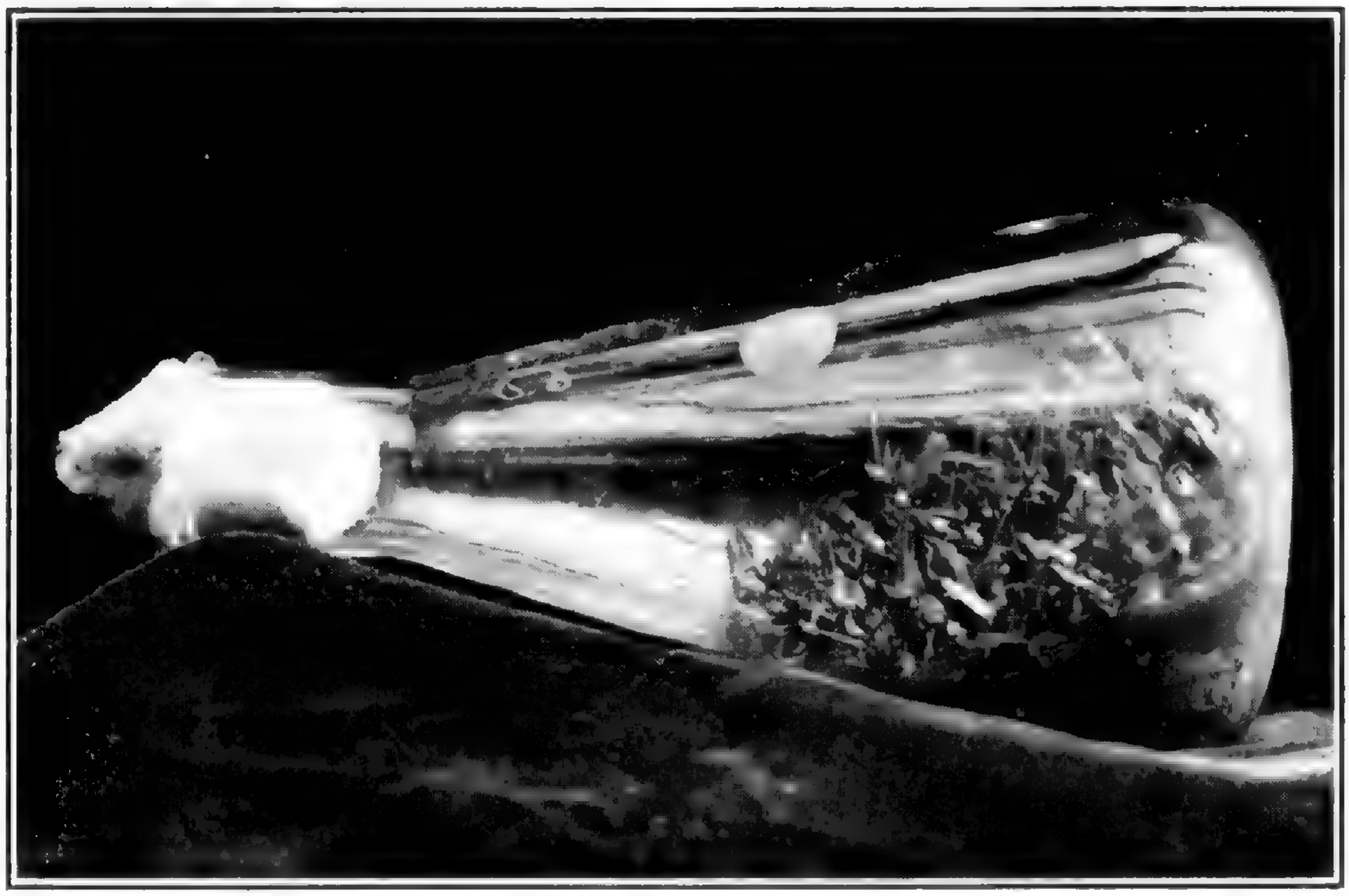
Orchid investigations during the early 1900's had a marked effect on the commercial growing of orchids. Dr. Hans Burgeff, in Germany, and Noel Bernard, in France, began in 1909 to publish the results of studies on the symbiotic relationship between orchids and certain fungi (Rhizoctonia). It was Bernard who first demonstrated the role of this fungus in the growing of orchids from seeds. The hyphae of this fungus penetrate the seeds and in some manner, still not clearly understood, stimulate their germination and growth. Mr. Joseph Charlesworth, of Charlesworth & Co., England, in coöperation with Dr. J. Ramsbottom, was among the first growers of orchids to use the information of Burgeff and Bernard and, employing the symbiotic or fungus-culture method, the firm started raising seedlings on a commercial scale. The method consists essentially of preparing a pure culture of the fungus to be used and inoculating a culture medium with the fungus, then "planting" the orchid seed on this "fungus medium."

Charlesworth's wonderful success in the regularity and rapidity of germination obtained by this method led to extensive research into the physiology of orchid seed germination. In 1922, Dr. Lewis Knudson, of Cornell University, announced that the fungus was not necessary for orchid seed germination and that the difficulty lay in the orchid seed which is inadequately supplied with reserve food. For continued growth he supplied the embryo with sugar and mineral nutrients in the absence of fungi and other microorganisms. Dr. Knudson's method involves essentially the same techniques as those used by bacteriologists, and has been adopted by most of the commercial growers in this country and in Europe.

With large-scale importations cut off by Quarantine No. 37 and with the development of pure-culture methods of growing seedlings, another phase of commercial orchid culture expanded tremendously, namely, the



Seeds of different genera of orchids showing the characteristic structure of the seed-coats.



Dendrobium hybrid seedlings, 4 months old.

hybridization of orchids. To quote White again: "Up to the year 1860 there are records of but four hybrids having flowered. In 1890, 200 had been recorded and in 1898 the number had increased to 800." With the improved seedling method of culture the collectors had to bring out of the jungles only the choicest of orchid plants to be used as stock in breeding. These plants were hand-pollinated to make desirable crosses, and the seedlings produced plants in sufficient quantity to keep up with the rapidly expanding demand for orchid flowers. It was not only easier to develop large quantities of plants, but the resulting hybrids often exhibited a greater vigor and size than did the native species and there was a variety and intensity of color in the flowers.

There are two phases involved in the modern commercial orchid industry. One of these is the production of plants for the private collector, and the other is the ever-increasing cut-flower trade.

Much of the previous discussion has dealt with the development of the industry as a result of the interest in orchids shown by private collectors. There have been several important factors in recent years which have helped to develop the current popularity of orchids in America. One of these was the founding of the American Orchid Society in 1921, with its main purpose the promulgation of a wider knowledge of orchid culture and a greater appreciation of the beautiful and exotic flowers. It was the forerunner of a great number of small orchid societies throughout the country. People who

have only small hot-houses in which they had previously grown a rather miscellaneous selection of plants have discovered that it is not difficult to grow orchids. Several of the orchid societies publish bulletins in which a permanent record is kept of the experiences and successes of the members. The *Bulletin of the American Orchid Society* has been one of the best means of distributing information on various cultural methods and techniques, and has done much to introduce and spread information on new plant importations and the latest developments of the hybridizers.

The cut-flower phase of orchid culture has become in the last fifteen years more than a million-dollar business. The American public has learned what this exotic flower can do for the wearer, through the ever-increasing use of the orchid in fashion shows and advertising. The word "orchid" has now become almost synonymous with glamour.

The supply and demand for orchids tend to run in seasons, centering around the periods of greater social activity and holidays such as Christmas, Valentine's Day, Easter, and Mother's Day. In between and during the summer months the demand drops off, with a consequent effect on prices.

With the tremendous increase in orchid growing all over the country, the prices have been gradually lowered to the point where the man of average means can now afford to buy an occasional orchid for his wife or sweetheart. It is interesting to note that some of the larger orchid growers are located near college towns, particularly near women's colleges, where the growers can always be assured of a demand for corsage orchids.

Brief mention should be made of some of the most popular types of orchids. The large purple Cattleyas are of course the showiest and the most widely grown, and will probably always be the most popular for evening wear. Recently spray orchids have become more abundant and are vieing with Cattleyas in popularity. Certain choice species of Phalaenopsis, particularly white-flowered ones, are in increasing demand, especially for wedding bouquets. One of the best orchids for keeping quality is some species of the genus Cymbidium which, if handled properly, will remain fresh for a month. Cypripediums (Lady-slippers) are popular and are also known for their good keeping quality. Today growers are trying to persuade the orchid-loving public that although Cattleyas are fine for formal evening wear Cypripediums and Cymbidiums are better for daytime wear, and that such spray orchids as Dendrobiums, Phalaenopsis, and Vandas are well suited as hair ornaments.

The cutting of orchids for market is one of the most exacting phases of the industry. Orchids, unlike many other types of flowers, will not develop or mature after being cut and so must be left on the plants until they have fully opened. The flowers are cut in the early morning before the moisture

stored in them has had a chance to escape. They are then placed in individual tubes of water in a cool room for a conditioning period of two to three hours. After they have been graded, each flower has its stem inserted into a rubber-capped and water-tight glass tube filled with water. If the flowers are to be shipped any great distance, the shipping boxes are lined with newspaper and then a layer of shredded waxed paper is placed on this to protect the backs of the flowers from bruising. The tubes are then fastened securely with string or Scotch tape to the bottom of the carton, being placed far enough apart that the individual flowers do not touch each other. When the proper number of flowers, in their tubes, have been fastened into the shipping boxes, they are carefully surrounded with shredded waxed tissue paper, and the box wrapped in several thicknesses of newspaper. For shipments to distances up to a thousand miles, rail express has proved most satisfactory, and if the flowers are packed in good condition they will remain fresh for days to weeks depending on the species. One of the most important factors in the distribution of orchids today is the airplane. There is quite a brisk business being done now in shipping orchids from Hawaii by fast air express to all parts of the North American continent. Flowers leaving Honolulu at 7:00 A. M. will be delivered in New York the following noon. There are even reports of air express shipments from St. Louis to Sydney, Australia, in which the flowers arrived in perfect condition and stayed fresh for nearly a week.

In 1935 the following comment regarding the future of the orchid industry appeared in a lengthy article on Thomas Young Orchids, Inc., in *Fortune*:

> "People like orchids because of their high price. . . . . High price is inevitably and indispensably involved in the orchid. Manufactured at a rough cost of eighty cents per blossom, and produced in great masses, it could profitably sell for a lot less than it does, and who would be the buyers? . . . . . Plenty and plenty of people who can't touch it now. . . . . The only reasonably predictable fact is that if the orchid became anywhere near as cheap and abundant as the rose, few of its purchasers would be those several sorts and degrees of ladies and gentlemen who at present so satisfactorily enjoy the privilege of supporting it."

This statement was made over thirteen years ago. Today the growing of orchids for their flowers has become a tremendous business, and nearly all retail florists in all parts of the country can supply the buyer with a fair selection of orchids. In fact, orchids have become a "must," and if the present-day florist doesn't specialize in orchids he at least carries them as a necessary side line. It is doubtful that orchids will ever become so generally used that their popularity will diminish.

To the question, "What is it about orchids which has made them so popular?", no better answer can be found than in the words of Virginia S.

Eifert, in her article "The Story of Orchids," which appeared in the October, 1938, issue of *Natural History* . . . . .

> "The answer lies in all these things which have come before—in the insect-infested jungles where men dared malaria and anaconda; in the superstitions of primitive lands; in the test-tube which is the incubator for modern orchids. The answer lies also in the luminous deceptive fragileness, in the siren-like allure of the orchid. Yet, in addition to all this, there is a more elusive quality which is the secret of the mystery of orchids. It is the secret of that listening look, that silent gaze, that fierce splendor, of the orchid's flower. Its personality and history make it far more than a flower. It is a grail that lures strong men into jungle and laboratory in a life-long search for the orchid-mystery."

JEWELS OF THE LEGUMINOSAE

ROBERT W. SCHERY

Time was when neither ten-cent-stores nor exclusive jewelers dotted the Indian trails of the western world—not the trade routes of Central America nor even Manhattan's potential Fifth Avenue. Yet primitive peoples before experiencing the "benefits" of Old World "culture" had access to many a glittering jewel of their own. There were, of course, always available teeth and bones and shells from the animal kingdom and minerals and shiny stones from the vast wealth of the earth. But the vegetable kingdom was able to supply striking embellishment, in addition to the very food upon which man's existence, directly or indirectly, depended. Aborigines of the American tropics seeking striking adornment needed turn no further than to the forests and fields among which they dwelled. There grow plants of many kinds and belonging to many plant families, producing bright and shiny seeds conveniently sized for ornamentation. Perhaps none are more striking than the highly colored seeds of certain species belonging to the Leguminosae, the pea family.

For sheer size and variety the pea family has scarcely a peer in the American tropics. True, the grasses are common in certain plains localities; orchids festoon the trees of the higher-altitude rain-forests; palms are notable for their abundance and economic importance; and members of the coffee family are the "weeds" of the rain-forest. But all in all, the ubiquity and diversity of plants of the Leguminosae family are seldom to be challenged. The nearly bare sands of the sea-strand harbor the formidably armed *Caesalpinia crista*, with its spiny pods containing smooth, gray seeds the size of a buckeye. The lowland forest near the sea houses the unique *Entada gigas*, bearing seeds among the largest the world has known, and certainly the largest pod known to the pea family, which sometimes reaches a length of seven feet and a width of several inches. The seeds are the redoubtable "sea beans," as much as two inches in diameter, of flint-like hardness, and able to

be transported by ocean currents for hundreds of miles to germinate on some distant shore. The rain-forest offers habitat for the giant buttressed *Mora oleifera*, a tree producing in its pods a single gigantic seed about ½ foot in diameter, perhaps the largest dicotyledonous seed in the world. Other forest trees, such as species of the genus Piscidia, produce winged pods quite unlike any pea pod known to temperate climes, the seeds of which can be used to poison fish. Yet others, such as Enterolobium, have pods that coil around to form a nearly complete "doughnut" full of flat brown seeds no bigger than a dime. The diversity and unusual appearance of Leguminosae pods and seeds are unending, and members of the immense pea family are found from the upper levels of the volcanos and mountains to the steaming lowland forest, and are prominent even on the savannahs and coastal barrens.

Among the most striking of the Leguminosae seeds are those that are brilliantly colored. They are mostly of bead size, and have been and still are used to form amulets, bracelets, and necklaces. Four fairly common genera and species supply such seeds, mostly in brilliant reddish-orange or vivid scarlet, with edgings of jet black. Indeed, so striking are their colors in the usually somber forest that when the pods are splitting they usually outshine the flowers, commonly thought to be the most attractive feature in plants. As with many cultivated Viburnums, honeysuckles, and crab-apples of the temperate regions, such Leguminosae may be planted in the tropics for the ornamental value of their fruit. These bright-seeded plants are perhaps worthy of brief comment.

Abrus precatorius.—This slender "bead vine," as it is sometimes called, is scattered here and there throughout all of tropical America, and in Asia and Africa as well. The seeds are no more than ¼ inch long, and remarkably uniform in size and weight. Because of this uniformity they are reported to be used as weights by jewel merchants of the Orient, and it has even been suggested that the carat was based upon the weight of an Abrus seed. The seeds are bright scarlet, with a large black spot at one end (the hilum). This combination of black and scarlet is perhaps responsible for another expressive common name of this species, "crab's eyes." The coloration is exceedingly permanent, being almost as bright after several years as when collected. These handsome seeds belie their beauty for they contain several poisonous substances, including "abrine." They are said to have been criminally employed in the Old World for poisoning of human beings. The entire plant is reputedly poisonous when eaten by stock. Nevertheless, it is frequently cultivated for its exceedingly ornamental seeds. In southern Florida, where escaped in the fruit orchards, it has sometimes become an aggressive and objectionable weed.

Rhynchosia pyramidalis.—This rather robust vine looks like our cultivated pole beans. The pods usually occur in clusters, and although each is only about 1 inch long with but 2 or 3 seeds, collectively they catch the eye at time of shedding of the seeds. As with *Abrus precatorius*, the seeds are scarlet and black, but here the black often predominates (although there is considerable variability in relative abundance of each color) and the luster seems less enduring. Whether deservedly or not, the seeds of this species also have the reputation in Central America of being poisonous. The vine is found from Mexico to northern South America, and in the West Indies. At least one other species of the same genus contains all-scarlet seeds, but most of its brethren have seeds devoid of any bright coloration.

Erythrina sp.—Most but not all of the hundred or more species of Erythrina have highly colored seeds, some a brilliant reddish-orange, others scarlet, and a few red-and-black. The pods are usually fairly large, several inches long, and contain a number of seeds which are typically almost ½ inch long. Clusters of these pods at time of seed shedding give an exceedingly decorative appearance to the tree. The trees occur wild but are also cultivated (often for coffee shade) in both the Old and New Worlds. Perhaps the most common species in the American tropics is *Erythrina Berteroana*, known from Mexico to northern South America and in the West Indies. Its seeds are scarlet, usually with a short black line on one side. New growth and particularly flowers are not infrequently consumed as a vegetable, being sold on a number of markets. The seeds, however, are poisonous, and are utilized by man for ornamentation or perhaps occasionally as an ingredient of fish poison. The trunk commonly serves for living fence posts, and the bark yields a yellow dye.

Ormosia sp.—Ormosia is a rather complex genus of both the Old and New Worlds. Its species are imperfectly known, but seemingly all have seeds that are lustrous and brilliantly scarlet or scarlet-and-black. The genus is, on the whole, not so common as is Erythrina, but its seeds are equally large, colorful and attractive. The pods may be several inches long, may occur in clusters, and contain a number of seeds. Perhaps the most common species in Central America are *Ormosia toledana* and *Ormosia panamensis*. The wood of the former is reported much utilized in Mexico. No information is available as to whether the seeds are poisonous or not, and the species appear to be little cultivated.

Amsonia Hubrichtii, one of the rarer Missouri wildflowers, is nearly as lovely in leaf as in flower. After it has finished blooming in late spring, long wand-like branches grow out from beneath the flower cluster. Closely set with graceful narrow leaves they look almost fern-like in the late perennial border.

HENS AND ROOSTERS OF THE PLANT WORLD

JULIAN A. STEYERMARK

Some of our cultivated species of Sempervivum and Sedum are often referred to as "Hens-and-chickens," but in the Missouri Ozarks country folk usually call our two kinds of *Viola pedata* "Hens" and "Roosters," instead of "Pansy Violet" or "Bird's-foot Violet," as the plants are often known elsewhere. It will be recalled that one type of *Viola pedata*, common in Missouri, has all the petals more or less the same color, which may be pale to dark lilac or lavender-blue (the "Hens"), and the other has the upper two petals dark violet (the "Roosters"). In some localities the "Roosters" are dominant, in others the "Hens" have it. Sometimes, a particular area harbors just "Hens," while in another the two types are equally common. In some parts of its range outside of Missouri, the "Roosters" are very rare or absent.

One could not ask to see a lovelier violet than this large-flowered one. Especially, from April to June, it adorns our hillsides and glades with its showy masses of color, pale lilac in some spots where "Hens" predominate, dark violet in others where the "Roosters" are more common. Apparently, the more sunlight and open ground this species has, the better it likes it. However, as common as it is, it is an indicator of a sour or acid soil. Where there are flint or chert, sandstone, or granitic substrata outcropping near the surface, as is often the case in the Ozark region, this little plant finds its home. The cherty open cuts along highways are often inhabited and sometimes completely covered by thousands of these violets. In other parts of Missouri, especially in the northern half of the state, eroded clay slopes or sterile open soil in thin woodlands or upland open prairies are chosen by these "Hens" and "Roosters" of the plant world.

Given sunny locations and good drainage with plenty of sand or gravel or any kind of rock that weathers into an acid soil (limestone in general should be avoided), this violet will prosper in a garden. It is easily grown if the conditions of sufficient sunlight and acid soil, combined with adequate drainage, are provided. One could not wish a choicer addition to the rock garden. Sometimes, a prolonged autumn with renewed rains or warm weather may induce this pretty gem to flower again between September and November.

Fertilizing your lawn with cow manure certainly does bring in certain weeds but it may also bring in pasture mushrooms. There is nothing quite like looking out into the garden on a cool autumn morning and finding that there are enough mushrooms in the lawn to dress up the meat course.

VEGETABLE GARDENING IN HONG KONG

EDGAR ANDERSON

An unusual book about tropical gardening was recently received at the Garden. It is "Vegetable Cultivation in Hong Kong" and was written and illustrated by G. A. C. Herklots, most of the drawings being made while he was interned during the war. He tells of his difficulty in getting seeds and drawing materials while in the internment camp but philosophically concludes: "However, such a life presented an unique opportunity for studying plants and their habits and compelled the gardener to be self-reliant; there was no *fah wong* to do the digging, no coolie to do the carrying of the earth and water, no store from which to buy seeds and tools, insecticides and fertilizers. It is needless for me to add that this little book does not contain the last word on vegetable gardening in Hong Kong."

Actually his book is of interest for much more than the way in which it was written. The author's line drawings are both charming and accurate; they catch the essential features of the plants he was portraying. In a cross-roads of the West and the East such as Hong Kong, all sorts and kinds of vegetables may drift into cultivation. This book is full of pithy, first-hand observations and descriptions of various cultivated plants, some of which are not too well known to science. There are special notes as to the cultivation of each vegetable, with particular reference to the peculiarities of vegetable gardening in the tropics. There are recipes, combining both oriental and occidental techniques in the cooking of vegetables, and an introductory fifty pages on the general principles of tropical gardening. The book has an index of scientific and common names. Like Saint Paul and John Bunyan, the author seems to have put his imprisonment to excellent use.

One St. Louis crop which never gets in the newspapers is the brilliant red Cockscomb, so dear to Bohemians and south Germans. Many market gardeners in this area grow long rows of them along with the vegetables, and this time of year they can be found on sale at such places as the Soulard Market. Their big crimson heads remind one somewhat of a cauliflower made out of red velvet. They look as if they had been specially designed to go with overstuffed furniture.

The avenue of Pin Oaks on the campus of Washington University that leads from the quadrangle to the chapel is certainly one of the finest in existence. The trees are beginning to approach maturity and will probably begin to die out in the next decade. There may not be many more autumns when they will look as majestic as they do this year.

According to the books, one of our local wildflowers, *Eupatorium coelestinum*, is known as "Blue Mist Flower." Perhaps some people do call it that, but "Wild Ageratum" is certainly a much more common name. It has a beautiful blue flower which blooms in early September when there are not many things in the average St. Louis garden. It is a rampant weed but is easily controlled. Just let it bloom and then as it starts to go to seed remove all but a few plants here and there.

NOTES

The annual amateur dahlia show, sponsored by the St. Louis Horticultural Society, was held at the Garden on October 2 and 3.

The botany classes of Springfield, Illinois, High School, accompanied by their teacher, Miss Ruth Wood, visited the library and herbarium recently.

Mr. David Rogers and Mr. Fred Meyer, graduate students at the Garden, recently returned from an expedition to Tamaulipas and Nuevo Leon, Mexico, where they collected about 4,000 botanical specimens.

About sixty varieties of hardy chrysanthemums will be in full bloom at the Garden during October. Planted in small groups they may be found east of the Floral Display House, in the Linnean Garden, and along the diagonal walk between the Palm House and the Rose Garden.

Mr. G. H. Pring, Superintendent of the Garden, spent the summer in England. While there he visited the large orchid establishments, and attended two Royal Horticultural Society flower shows at which he was invited to participate at the meetings of the awards committees. During his visit to the Royal Botanic Gardens at Kew, his Alma Mater, he did some research work on the introduction of new species of Nymphaea for plant-breeding purposes.

Recent visitors to the Garden include: Mr. John Finan, graduate student in history of science, Harvard University; Miss Dorothy Harper, of the Kennedy School of Missions, Hartford, Conn.; Dr. Marcos Lindenberg, of Circulo Paulista de Orquidofilos, São Paulo, Brazil; Mr. Felix Agramont, of the Rockefeller Foundation, Mexico City; Dr. Rudolf Florin, Director Bergianska Tradgarden, Stockholm, Sweden; Dr. W. F. M. McDonald, of Ohio State University, Columbus; Dr. Emery Moore, of the Bailey Hortorum, Cornell University, Ithaca, N. Y.; Dr. Julian A. Steyermark, of the Chicago Natural History Museum; Dr. Ernest S. Reynolds, of the University of Miami, Florida.

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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 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. 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 bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN

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Cover: Big Bur Oak near East Prairie, Mo.—"the largest Bur Oak in the United States." [American Forestry Association].

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Missouri Botanical Garden Bulletin

Vol. XXXVI NOVEMBER, 1948 No. 9

MISSOURI'S OAKS

AUGUST P. BEILMANN

Perhaps no other tree is mentioned so frequently in the literature of all ages as is the oak (the genus Quercus). It has been endowed with all kinds of characteristics, having been called sturdy, towering, majestic, and mysterious, dark, and almost every other adjective. Perhaps the oaks have been revered less than some of the famous temple trees of Asia, but they have served man in more ways than any other family of trees. From the oldest times, the builders used oak timber, and intrepid sailors entrusted themselves to ships whose planking and ribs were made of oak. Every part of the tree has had extensive and specialized uses. Moreover, the use of oak is no less important today than it was in Roman galleys.

Primarily, the oak yields lumber for houses, whether as trees hewn when man first developed the ax, or as rough logs in pioneer days. Much of man's early food supply came directly and indirectly from the oak. The skin-clad hunter lived on the game that fattened on acorns, and even now men living in backwoods depend largely upon the production of acorns to fatten their cattle. The marvelous game-carrying capacity of pioneer woods was largely due to the food produced by the fruit of the oak. Perhaps the reduction of the once-vast quantities of acorns had as much to do with the passing of the carrier-pigeon as the ceaseless slaughter which is generally blamed for the extinction. The bark of some species produces corks, while tannic acid extracted from the oak has been used for tanning since the time man stopped producing leather by the simple process of drying a hide then chewing it to pliability. And it is not unusual to find Ozarkians cutting oak brush to sustain their cattle in long periods of drought.

While we are less dependent today upon the fruit of the oak as a source of protein, and we have stopped building with hewn oak-logs, nevertheless, the oak is still one of the most important woods in our every-day life. The fastest of land transportation, the railroad, lays its steel rails on a forest of

oak ties, and a new house isn't "new" unless it has hardwood floors. The uses of oak are limitless, but one of the larger uses is the storing and aging of one of our farm crops in distillery warehouses.

Missouri is particularly fortunate in its rich oak flora. Most of the Ozark uplift supports some species of this tree, and Crowley's Ridge, just west of Swamp-east Missouri, has grown to perfection as many species as can be found in any similar area, while the near-by swamp land boasts the biggest Bur Oak in the world. The state has also been fortunate in having a number of botanists who recognized the richness of this flora and gave it critical study. Chief among them was Dr. William Trelease, the first Director of the Garden, who described thirty-two hybrid oaks from the state. This, in addition to the eighteen native oaks, gives Missouri one of the largest oak floras of any state.

Beyond a doubt, the White Oak *(Quercus alba)* is head and shoulders over all its relatives, with one exception. It is not as satisfactory as Red Oak for creosote treatment under pressure. However, no other native tree approaches it in hardiness, few grow larger, and none are so resistant to storm damage. It is a species of wide distribution, and, as, one might suspect, has more than a little variation. Some individual trees produce acorns so free of tannic acid that they are edible, while in others the acorns are fit only for hog food. The tree is extremely long-lived and reaches gigantic size on good locations. It can grow from the bottom-land to more-exposed situations half up the hillside, and it may grow on the very top of the hill when the soil is deep and fertile. Even the leaves vary greatly. Some are coarsely lobed, and some are cut almost to the midrib giving the tree an extremely graceful appearance. The sturdiness of the White Oak is especially apparent in winter, and even in the fall the coloration of the leaves is generally better than other oaks.

The Bur Oak *(Quercus macrocarpa)* is found only on the better sites, in lowlands or stream valleys. The largest specimen of its kind in the United States is in the "Big Oak State Park" near East Prairie, in Mississippi County, Mo. The wood of this species is the hardest and heaviest of any. Some Bur Oak skidways at a sawmill, measuring 6 x 8 inches in length and width and 18 feet in length and supported only at the ends, regularly carry loads of over five tons each. This oak also has the distinction of producing the largest acorns, and in a "mast" year, the squirrel hunter, traveling by canoe, needs only to learn to identify the Bur Oak in order to keep in meat. The outstanding characteristic of the tree in the woodland is its immense dark green leaves. The bark differs from the White Oak in that it is not flaky but deeply ridged, and some specimens develop corky ridges on the small twigs.

As one might expect, the immense acorn covered by a large fringed cup is a favorite of all woodland animals.

The Swamp White Oak *(Quercus bicolor)*, at first glance, appears to be intermediate between the White and Bur Oaks, and there is one hybrid called *Q. Bebbiana.* The Swamp White Oak prefers the wet valley sites rather than the hills. It can be distinguished from both Bur and White Oak by its longer, somewhat pendent branches, and the presence of thin sheets of curling bark on the five-year-old branchlets. Ordinarily, the acorns are larger than those of the White Oak, and they are produced in great profusion.

The most common oak in the drier parts of the Ozark Uplift,—in fact, the one oak which almost competes with cedar on a dry hillside,—is the Chinquapin Oak *(Quercus Muhlenbergii)*. It is not ordinarily a robust or vigorous tree. It may reach 18 inches in diameter, but it always shows the effects of the struggle to grow in the shallow soil of the Ozark limestone regions. Its leaves are regularly toothed, a character which makes the tree distinguishable from most of the other species. The production of acorns is very erratic, some of the Ozark "weather," from flowering to late fall, being almost certain to have an adverse effect on seed production for the current or coming year.

In southeast Missouri the Cow Oak *(Quercus Prinus)* grows in wet woods. It has regularly toothed leaves much like the Chinquapin, but a little study will show that the leaf of the Cow Oak is wider across the upper half. It occurs sparingly in mixed woods and is known by the author to occur in a pure stand in only one place—about six miles north of Marked Tree, Arkansas.

There remains only one more Oak having a somewhat similar foliage to the Chinquapin and Cow Oaks, the identification of which should not be too difficult. This is the Scrub Oak *(Quercus prinoides)* of western Missouri, never more than a shrub in our territory.

The Overcup Oak *(Quercus lyrata)* is confined mostly to the Mississippi River bottom, and even there it is quite rare. It resembles the Bur Oak perhaps more than any other White Oak, but can be readily separated from it in the field by the deeply incised lobes of the leaf and the almost completely covered acorn. It is the "Forked-leaved White Oak" of the logger, and probably reaches its maximum size near the Angeline River in northeast Texas.

The list of White Oaks would not be complete without a description of the Post Oak *(Quercus stellata)*. It is an unusual tree in that it can be found throughout Missouri and is perhaps the best White Oak which can be grown on rocky thin soil. Generally, it is the coppice growth of Post Oak to which the city hunter refers when he talks of "Scrub Oak" in the

Ozarks. This tree is unusual in that it has the smallest acorns among the White Oaks. The crop is not dependable, but in good years it is extremely heavy and serves as food for wild ducks. The Post Oak is a somewhat variable tree, but most easily identified by the hairy branches and twigs, and the broad upper half of the leaves which approach the Bur Oak in outline. It is extensively logged for railroad ties, and the common name is due to its wide use for fence posts. There are two hybrids, one between it and the Scrub Oak called *Q. stelloides*, collected near Kansas City; the other a hybrid between it and the White Oak, collected by Dr. Trelease near Allenton, eight miles east of the Arboretum, and called by him, Fernow's Oak *(Q. Fernowii)*.

The lumberman included a great many species and varieties in his Red- or Black-Oak classification. They are all large trees of more than usual economic interest, generally of rapid growth, and perhaps a little less exacting in their requirements than the White Oak. The most common one is the Northern Red Oak *(Quercus borealis maxima)*. This tree grows throughout Missouri, and its size depends on the depth and fertility of the soil. It is much sought after for creosote treatment since it absorbs such preservatives very well. One of the best tests for identification is to take a block three inches long, immerse one end in a cup of water, place the other end in your mouth, and blow. If you can blow through the length of the block, you can be sure the tree is Red Oak. In river valleys, the tree will exceed 90 feet in height and 30 feet in diameter, in 120 years. The acorns are very large, produced regularly, and greedily eaten by squirrels.

The Scarlet Oak *(Quercus coccinea)* is a tree of sour soils of the eastern Ozarks. In many ways it resembles the Red Oak with one notable exception—its autumnal coloration is magnificent. Good specimens are none too common in Missouri, and at best it is only a medium-sized tree. It should make a good shade tree, however, and it is widely used for that purpose in the eastern states.

The Pin Oak *(Quercus palustris)* has proven one of the best shade trees, and it should be more widely planted as a street tree. This species is confined to the wet land along a water-course, and in such locations it grows just as large as the Red and White Oak. It reached its greatest development in the Ohio Valley. Since the Pin Oaks grow along water-courses and bear very tiny acorns, they are a favorite of migrating water fowl. Ordinarily, they produce no very large branches as do most of the other Oaks. Even when mature, the lowermost branches are short and the twigs very thin. This usually results in an extremely tangled mass of light branches which have been shaded out and which persist to the discomfort of the tree surgeon.

The first pruning of a mature tree must start with the lowermost branches; only in this way will a pruned branch fall free of the innumerable "Pins" and reach the ground.

The Red Oak *(Quercus Shumardii)* probably has more common names than any other Missouri Oak, and the recent change in scientific nomenclature has made both the forester and the logger reluctant to use the name Red Oak. Ordinarily, this is the big wet-ground Oak found in the river valleys, while the variety *Schneckii* advances into the drier and rockier hills. It is not easy to separate this species and its varieties from the Northern Red Oak, and all three find their way to the same sawmill. Only a good deal of field work and a satisfactory manual will help the amateur distinguish them.

The true Black Oak *(Quercus velutina)* is found throughout the state and is equally at home in the river valleys and the hill tops. It grows quite large and may reach 36 inches in diameter on the hills and exceed this considerably on good locations in the valleys. All Black Oaks have black bark and very large shiny leaves; the variety *missouriensis*, which occupies about the same range as the species, has a persistent hairiness on the underside of the leaves and twigs, while the species has small tufts of hair along the vein axis. This is an excellent timber tree and should also make a good lawn subject. Five hybrids of this and other species have been named. None of these are well known except Q. *Leana*, which is reportedly a cross between the Black and the Shingle Oak. Its leaves are intermediate between the two parents and may exhibit any degree of variation.

The Black Jack Oak *(Quercus marilandica)* is rated by the foresters as a weed in the Ozark region. It grows throughout the state, attaining a considerable size along the Missouri River bluffs and actively competing with better trees on the Ozark hills. It is perhaps better adapted to some of the degraded sites on our hill-land than any other species. The lumber is inferior and even from a sound tree checks badly while drying. In this respect, it is even worse than Pin Oak, but one-inch boards from either species may shatter into a dozen pieces as they leave the head saw in a mill. The Black Jack Oak is a persistent tree, sprouting well from stumps and occupying far too much space in the coppice growth of a cut-over forest.

An Oak supposed to be a parent of five different hybrids is the Shingle Oak *(Quercus imbricaria)*. This tree has a great many of the characteristics of the Pin Oak, producing an immense number of small branches, black bark, and very small acorns. Its leaves, however, are distinctive. It is the only oak in Missouri which has an entire (not lobed) leaf up to 2 inches wide and 7 inches long. It does not compete with Post Oak on dry hills, but it is very common along water-courses and wetter places in the hill country. It

is usually grouped with the Black Oaks and logged and lumbered along with them. The acorns are the principal food of ducks in the swamps of southeast Missouri and eastern Arkansas. It makes an excellent lawn tree and it can be used as a street tree along our wider boulevards.

There are just two more oaks likely to be encountered in Missouri, both of which are confined to the swamps. The first is the Willow Oak *(Quercus Phellos)*. This tree differs from the Shingle Oak in being smaller, having leaves like the willow in size and shape, and also producing very small acorns. It is hardy as far north as St. Louis, although the branch tips may be frozen back once every ten years. In the Tensas River basin in eastern Louisiana, it grows almost as large as any other oak. It too would make an excellent lawn and very satisfactory street tree.

The last Oak worthy of mention as a native tree is the Water Oak *(Quercus nigra)*. In the vicinity of St. Louis, it remains a shrub but becomes progressively larger the further south it grows. Near Beaumont, Texas, it reaches an immense size and is a semi-evergreen.

To the above list might be added the many hybrids on record. However, this would merely confuse the amateur since some of these trees have limited distribution and some are known only from a single specimen. If one browses through the timber near Poplar Bluff he can usually find some trees which do not fit any description. In the absence of acorns as an aid, the identity remains obscure and a desire to describe another hybrid is overwhelming.

Some reference has been made to the value of some of the oaks for street and lawn use. We cannot too strongly urge gardeners and tree planters to begin the wide use of these trees. Recent experience with the Elm has indicated what happens when a species is widely planted under subnormal conditions. The Oaks are native throughout Missouri and one or more species can be grown in practically every location where they will become a life-time investment in satisfaction and beauty.

The One-flowered Cancer-root *(Orobanche uniflora)* is one of the less common and very interesting wild flowers growing at the Arboretum. It is found on humus-rich, wooded slopes where, in mid-April, the leafless, straw-colored shoot rises from a knobby growth attached to the roots of other herbaceous plants. The botanical name Orobanche (from the Greek *Orobos*, meaning vetch, and *anchein*, to choke) was given because it is commonly parasitic on the pea plant, causing it to fail to flower. It is also known as the one-flowered Broom-rape because similar species are known to parasitize the Scotch Broom. The common name Cancer-root is because of the cancerous-like growth formed at the point of attachment to the host plant, and if the host plant loses vigor the parasite may fail to flower.

FORCING THE MADONNA LILY

DENNISON H. MOREY, JR.

With flowers, as with many other things, the public is all too frequently the victim of commercial convenience. It very often happens that a desirable plant is dropped from the trade because something nearly as good appears that is much easier to handle. Plants that are easy to grow quickly saturate the market and consequently become reasonable in price. The unhappy part is the disappearance from the market, and in some instances from gardens, of exceptionally beautiful plants that were at one time a common feature of every dealer's stock. An example of this sort of thing is the ancient Madonna Lily *(Lilium candidum)* which was replaced by the comparative newcomer to the florist's trade, the Easter Lily *(Lilium longiflorum)*.* Historically, the Madonna Lily is *The* Easter Lily, but since *L. longiflorum* is much superior from the growers' point of view it has somewhat fraudulently supplanted *Lilium candidum.*

The Madonna Lily is one of the oldest of cultivated plants. The ancient Assyrians grew it, or at least all evidence would indicate that they did. It was a very important element in their design, and, oddly enough, is not indigenous to any adjacent area. King Solomon must have liked it too since some of the columns in his temple were designed upon the form of the lily that we call the Madonna Lily.

The experts presume that the first home of *Lilium candidum* was in the semi-arid mountains of Georgia, near the Caspian Sea. As so often happens with plants that have been in cultivation for a considerable length of time, *L. candidum* has escaped in many regions and has become successfully naturalized throughout the Mediterranean lands. Since some of these escapes took place many centuries ago it is little wonder that no one claims to know exactly where the plant is most at home. Even so, it is certainly no orphan. Any one who has seen good specimens can easily understand why it has been so enthusiastically adopted by men since the dawn of civilization. In fact, by 1750, it was probably the most popular perennial in England, being found in virtually every garden.

At this point the reader may wonder what circumstances led to the displacement of this lily by *Lilium longiflorum.* The answer lies mainly with the arch-enemy of lilies, the virus complex that produces the lily mosaic. The Madonna Lily is so susceptible to this disease that some varieties have been almost eliminated. However, from the vigor and persistence that old and infected plantings of the lily appear to possess, it would seem that the

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*Introduced into England about 1819.

THE MADONNA LILY
From Curtis's Botanical Magazine. 1794.

whole blame does not lie on the mosaic. Rather it would seem that the disease reduces the vigor of the plant, rendering it susceptible to a variety of bulb rots which are especially serious when the bulb is first transplanted. With special care this disadvantage can be overcome, but the average gardener is not likely to indulge in the type of pampering that seems necessary. Therefore it would appear advisable to solve the problem by trying to control the virus infection.

Virus infection can be controlled, at least initially. Isolation of clean plants from all sources of possible contagion works very well, and though complete isolation is hardly possible it should be practiced to the greatest extent. The isolation of which we speak is directed against the insects that are responsible for the spread of the viruses from one plant to another. In lilies the viruses are spread by several species of aphids, and it is to keep these pests from moving from one infected lily (or other infected plant) to a clean plant that isolation is practiced. In sucking upon an infected plant the aphid takes up some of the virus, and if afterwards it feeds on a healthy plant it will infect the new plant. Vigilant control of aphids, and, for that matter, all insects, is one of the best methods to slow and even halt the spread of viruses in lilies.

A second method lies in reproduction by means of seed (seminal reproduction). For some reason most viruses do not infect the seed even though the plant producing the seed may be nearly dead with the disease. However, vegetative methods of propagation being easier and quicker than seed, they are the ones most extensively employed. Unfortunately, vegetative methods spread the disease, and, once started, viruses spread with unbelievable speed throughout a population.

The logical thing, it would seem, would be to raise bulbs from seed and to protect the seedlings from virus. In some cases this is possible and is being done with gratifying results. With the Madonna Lily, however, a very serious obstacle presents itself. During the ages that this lily has been cultivated each grower may be assumed to have selected those plants he felt to be superior, and apparently sterile as well as beautiful plants were chosen. Because vegetative propagation was much more rapid than seed propagation that was the method used with no bad results, at least for hundreds of years. Then came viruses, and with their world-wide diffusion the Madonna Lily virtually dropped out of the picture. *Lilium longiflorum*, which also is susceptible to mosaic disease but ordinarily is not so seriously affected, quickly presented itself as an apt substitute for the now-fragile Madonna Lily. Another point in favor of *Lilium longiflorum* is that it can be forced into bloom at almost any time and with relative ease, while the best that can be said of the Madonna Lily is that it may be induced to flower some time before

it ordinarily would. No wonder, then, that the commercial grower preferred to handle a lily that he could force at any time to one that, though good for Easter, could be flowered just a little earlier and only during the spring months. Moveover, the Madonna Lily was proving to be increasingly difficult to flower at all, since an alarming number of bulbs were rotting rather than growing, due to an increased amount of virus in the bulb stocks. Fortunately, however, not all the clones* of the Madonna Lily were sterile (a fact we have only recently learned), otherwise it would have become a very rare plant indeed. Fertility had been maintained or regained in a few clones, and in these it has been possible to obtain virus-free seed and consequently to develop cleaner bulbs.

A most serious obstacle with the Madonna Lily has been overcome by growing bulbs from seed, but there is yet another one that tends to make the supply of bulbs very short. During damp weather this lily is very apt to succumb to Botrytis rot. Botrytis is technically but one specific disease. In the field and in the garden, however, it often is the term for a myriad of closely allied pathogenic fungi that look very much alike when they attack a plant. It can be recognized by the formation of spots, generally on the leaves or on flower buds of its host. At the outset these spots are very small, and as the disease progresses they will appear as small, brown, moist, rotted lesions. If not stopped at once numerous spots will develop which later dry out except on the edges. Occasionally, there can be seen the fuzzy vegetative body, or mycelium, of the fungus, and even the dark spores that are produced in such abundance that the spot looks as if it had been powdered with a fine soot. These spores are spread by wind and rain and people passing by. When they alight the spores require a fine film of water if they are to germinate. It can be seen, then, that the lily leaves should not be wet unless conditions are such that the foliage dries off almost immediately. Once started, the disease may be controlled with Bordeaux mixture or micronized copper applied as a spray.

In commercial plantings where acres of lilies are grown the Botrytis disease may start in the center of the field and destroy practically the entire crop before it is detected and brought under control. Such a situation is now being corrected by intelligent field culture. Through the establishment of seed-produced or seminal strains and superior bulb-farming methods larger and larger amounts of Madonna Lily bulbs can be expected to be made available to the lily-growing public.

Because it is historically *The* Easter Lily and has some very noteworthy advantages over *Lilium longiflorum*,—namely, a delicate and exotic frag-

*Vegetatively produced progeny of a single individual.

rance, pure white, wide-open flowers of elegant form and texture, and a majesty of habit that well warrants the reverence in which it has been held for thousands of years,—a small test "forcing" was undertaken at the Henry Shaw School of Botany. The results would indicate that those interested in the true Easter Lily would enjoy procuring a few bulbs and bringing them into bloom at Easter. There are a few precautions that should be taken, however. Bulbs of a seminal strain should be used, otherwise one is almost certain to obtain a virus-infected bulb and at the same time a virtual guarantee of failure. The bulb should exceed six inches in circumference (two inches in diameter). Before planting it should be dusted with some one of the commercial fungicides such as Arasan or Fermate. The soil used should be a good loam free from fresh manure but with a high humus content. Pot shards and/or charcoal should be put in the bottom of the pot to insure good drainage which is very vital with lilies. The pot should be at least six inches in diameter, and until growth is evident should be kept in a cool (45–50 F.) dark place and watered sparingly. The rooting of the bulb, which will take place before the top growth starts, will require about two weeks. As soon as the leaves begin to show the plant may be moved into the light. The length of time from potting to flower will depend to a considerable extent upon the temperature at which the plant is grown, and the date at which the bulb is started. For best results the plants should be kept cool (around 50° F.) until the buds are visible in the crown of the plant. The temperature may then be increased to 70° to hasten flowering, but this must be done gradually or the buds may be deformed. If potted between about October 15 and November 1, the plant will flower in about sixteen weeks. Those in our experiment were potted October 23, 1947, and the first flowers opened February 10, 1948. The flowering period for the twelve bulbs tested extended more than a month.

Since the test bulbs were seedlings it was anticipated that there would be considerable variation among the twelve plants. To a certain extent this was true. The flowering time varied over a period of thirty-two days. However, at least one flower had opened on each plant that flowered within a nineteen-day period. Growth patterns were quite uniform, and the number of flowers seemed to be almost entirely associated with bulb size. For the most part, the bulbs were five and six inches in circumference and produced from three to eight flowers per bulb.

Three of the bulbs were failures, one as the result of root rot which has been attributed to faulty potting and the resultant improper drainage. Drainage must be essentially perfect for lilies or bulb rot is inevitable. Two plants were stunted by the application of hot rotenone-pyrethrum spray that was administered to determine the resistance of the lily to spray burn.

Since all the plants were sprayed and only two were adversely affected by a spray of very high burn-potential, it can safely be concluded that the plants are very rugged from this standpoint. Aside from the burn test, the more conventional aphid poison, nicotine, was used both as a spray and as a fumigant with absolutely no bad results. The plants were given no special attention, but, even so, they were fine plants when they flowered.

The table below provides a concise summation of the data. The bulbs used were procured July 15, 1947, and stored at 40° F. until October 23, 1947, at which time they were potted in six-inch pots.

SUMMARY OF DATA

	Plant No.											
	1	2	3	4	5	6	7	8	9	10	11	12
Number of flowers	3	5	7	4	0	8	3	6	5	0	0	3
Date of first flower	2/12	2/15	2/10	2/28		3/1	2/20	2/15	3/4			2/29
Date of last flower	2/27	2/27	2/28	3/10		3/18	2/27	3/1	3/13			3/10
Spread, days	15	12	18	11		17	7	15	9			11

In conclusion, we may observe that with seminal (seed-produced) strains there is no reason why *Lilium candidum* may not again assume its prominent role in general lily culture. Its occurrence in shops and gardens will be in direct proportion to the amount of seminal bulbs (seedling bulbs) that are available.

The lily gardener will find the lily much to his liking. With its strong stem, white, outward-facing flowers of good substance, and a nicely compact racemose inflorescence the plant is indeed striking. It is also lime-tolerant and will withstand hot *dry* weather. In St. Louis the only serious handicap is the almost universally prevalent poor drainage afforded by our clay subsoil. Where adequate drainage can be maintained the plant should be very successful.

Though its scientific name, × *Fatshedera Lisei*, is unattractive and cumbersome, this amazing hybrid between English Ivy and the Japanese shrub, Fatsia, should be better known. It grows slowly but makes a handsome evergreen plant for a large flower pot or small wooden tub.

NYMPHAEA "BOB TRICKETT"

GEORGE H. PRING

Nymphaea stellata var. *coerulea* × *N.* "Mrs. Edwards Whitaker," a new hybrid raised at the Garden, is named after Mr. Bob Trickett, of Ealing, London, England. For a number of years he has collaborated with the writer in locating new species of tropical water-lilies, as well as testing our new hybrids in England. The hybrid is an improved "Mrs. Whitaker," its flowers being more cup-shaped and carrying more petals and stamens. It may be distinguished also by its green buds, circular leaves, which are green above, red with green venation below. It has excellent growth response and is a good propagator.

Description. Flowers 10–14 inches across; bud ovoid, green; peduncle green; sepals four, about 5½ inches long and 1½ inches wide, ovate, hooded at the apex, green on the outside, pale Campanula Blue within, flushed with pink; petals 35–40, Campanula Blue merging into pale yellow towards the base, outermost row about 5½ inches long and 1¼ inches wide, hooded at the apex; peduncle Copper Brown; stamens 230–235, Light Cadmium Yellow tipped with pale Campanula Blue; carpels 30–35, Cadmium Yellow. Leaves suborbicular, up to 14 inches long, and 13 inches wide, margins undulated, light green above, red with green veins beneath; lobes overlapping, with age pushing up (see illustration), young leaves sparsely spotted red; petioles Copper Brown.

THE GOLDEN SEAL

LOUIS G. BRENNER

The Golden Seal *(Hydrastis canadensis)* is one of the herb plants which has made a surprising come-back in the wildflower reservation at the Arboretum. Early in April, the fuzzy, white, petalless flowers appear even before the leaves have expanded. Late in August the cone of bright red fruit is displayed upon the broad, deep-green leaves. Much sought for by herb-gatherers for generations, the tiny yellow roots yielded the alkaloids, hydrastine, berberine, and xanthopuccine, valued for their stimulus to mucous glands in treatment of various types of catarrah. The plant was used by the American Indian for sore eyes, and he also valued it as a source of yellow dye. Continued depredations of herb-gatherers and wood fires have caused this attractive herb to become rare or extinct over much of its range.

Newer alkaloids and new treatments for catarrah have caused a decline in the market for Golden Seal, and it should now become increasingly common. However, it grows on humus-rich forest slopes, and, as with many of its kind, it cannot endure the annual burning of forest lands so commonly practiced in the Missouri Ozarks. Forestry methods used in the wildflower reservation at the Arboretum are building a deep rich leaf mold on the forest floor. Under these conditions the Golden Seal has rapidly multiplied and spread in the last ten years.

NOTES

The Henry Shaw Gardenway Association gave an all-day picnic at the Arboretum, October 17.

The annual chrysanthemum show will remain in the flower house throughout November.

Mr. A. P. Beilmann, Manager of the Arboretum, has been elected president of the St. Louis County Beekeeper's Association.

The pupils in the Missouri School for the Blind visited the Garden October 21, when Mr. G. H. Pring, Superintendent of the Garden, spoke to them on "Plant Exploration in Central and South America." On the following day they were conducted through the greenhouses.

The annual meetings of the American Orchid Society were held at the Garden October 29 and 30. On October 30 the 125 visiting members were all-day guests at the Arboretum where they were shown the orchid houses in the morning, and after luncheon at the Trail House Dr. David C. Fairburn and Dr. Gustav A. L. Mehlquist presented papers on orchid growing.

In addition to those attending the meetings of the American Orchid Society on October 30, recent visitors to the Arboretum include: Mr. B. O. Mulligan, Director of the University of Washington Arboretum, Seattle; Dr. David C. Fairburn, of the McKee Jungle Gardens, Vero Beach, Florida; Mr. and Mrs. L. Sherman Adams, of the L. Sherman Adams Co., Orchid Growers, Wellesley, Mass.; Mr. Gorden W. Dillon, of the Botanical Museum of Harvard University, Secretary of the American Orchid Society and Editor of its *Bulletin;* ex-Governor Gore, orchid grower of Ft. Lauderdale, Florida.

Recent visitors to the Garden library and herbarium include the following: Dr. Walter H. Hodge, of the University of Massachusetts, Amherst; Dr. Norman C. Fassett, of the University of Wisconsin, Madison; Dr. William L. Brown, of the Pioneer Hi-Bred Corn Co., Des Moines, Iowa; Dr. Roland Harper, of the University of Alabama, Tuscaloosa; Dr. Henry Schmitz, Dean of the School of Agriculture and Home Economics, University of Minnesota, St. Paul; Dr. Julian A. Steyermark, of the Chicago Natural History Museum, Chicago; Mrs. Julian A. Steyermark (Cora Shoop), of Chicago; Mrs. George Elder, of the Lead Belt Garden Club, Arcadia, Mo.

The November number of the ANNALS OF THE MISSOURI BOTANICAL GARDEN (Vol. 35, No. 4), issued during the month, is a special number containing the papers which grew out of the Corn Conference held at the

Garden in November, 1947. The papers are as follows: Ear and Tassel Development in Maize, by O. T. Bonnett, of University of Illinois; A Comparative Developmental Study of a Dwarf Mutant in Maize, and Its Bearing on the Interpretation of Tassel and Ear Structure, by S. G. Stephens, of Texas Agricultural Experiment Station; Studies on the Structure of the Maize Plant, by Hugh C. Cutler, of the Chicago Natural History Museum, and Marian C. Cutler; Right-handed and Left-handed Corn Embryos, by Paul Weatherwax, of Indiana University; A Morphological Analysis of Row Number in Maize, by Edgar Anderson, of the Missouri Botanical Garden, and William L. Brown, of the Pioneer Hi-Bred Corn Co., Des Moines, Iowa; The Vascular Anatomy of the Four-rowed Ear of Corn, by R. A. Laubengayer, of Wabash College; General Features of the Epidermis in *Zea Mays*, by Henri Prat, of Université de Montreal, Canada; Comparative Histology of the Female Inflorescence of *Zea Mays* L., by Lee Wayne Lenz, of the Rancho Santa Ana Botanic Garden, Anaheim, Calif.; The Role of Pod Corn in the Origin and Evolution of Maize, by Paul C. Mangelsdorf.

Seasonal reminders: Plant bulbs; cut all peony stalks at the soil surface and burn them; protect hybrid tea roses by hilling the soil around the base of the plants; remove the tops of the hardy chrysanthemums and protect the basal shoots with a light mulch, or lift a few clumps of each variety and store in a cold-frame until spring.

Any garden plant with large, open seed-pods can be turned into an effective bird-feeding station. Large hybrid mallows are among the easier plants to use. All one needs to do is to melt up some suet, stir in sunflower seed, millet, etc., then go out into the garden before the suet congeals and drop spoonfuls of the mixture into the empty seed-pods. The suet hardens as it cools, holding the seed firmly in place. Bird feeding by this method has only one disadvantage—the birds seem to prefer it. If one had previously had them coming to ordinary food trays by the twos and threes, they arrive by the dozens when the same food is displayed in these more natural containers.

THE MISSOURI BOTANICAL GARDEN

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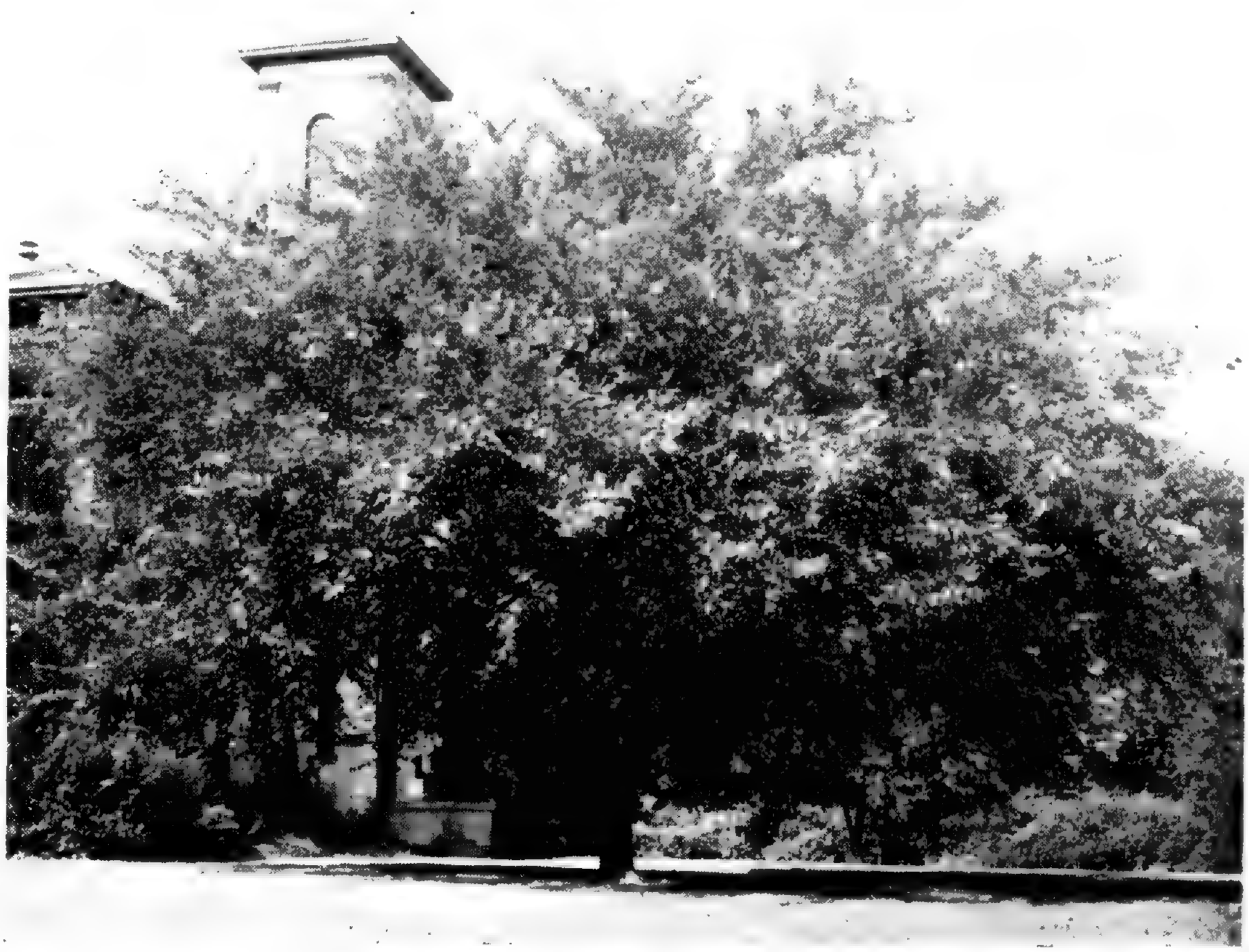
SOME FACTS ABOUT THE GARDEN

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 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. 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 bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN



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Cover: Seedling of Daniel Boone Elm, east of Old Residence at the Garden.

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Missouri Botanical Garden Bulletin

Vol. XXXVI DECEMBER, 1948 No. 10

THE DANIEL BOONE JUDGMENT TREE

G. H. PRING

Because of two serious diseases for which there is no known remedy the American Elm *(Ulmus americana)* seems doomed to extinction. Already throughout the eastern United States thousands of elms have died from the Dutch Elm Disease. In St. Louis and vicinity it is the so-called "Phloem Disease" that has been responsible for all the loss, the Dutch Elm disease not yet having appeared. That the Daniel Boone tree, an American Elm, has survived for approximately 200 years and is still in fair condition emphasizes the value of this tree and that its disappearance from the American landscape will cause quite a gap.

It was in October, 1921, that the writer was assigned by the Director the task of investigating the Daniel Boone Elm, under which Boone held court. It was finally located on the old Boone Homestead at Darst's Bottom, Femme Osage, the property then owned by Mr. Henry Bollmann. At that time the tree was 65 feet high and each branch measured 9 feet in circumference at the fork. The main trunk was 16½ feet in circumference two feet from the ground. The main branch to the west was badly decayed with large open cavities extending into the heartwood. The main branch on the east which grew more nearly upright was in fairly good condition. The entire tree, however, was in a poor state of preservation.

When Mr. Francie M. Curlee purchased the Daniel Boone Farm in 1925 he immediately started surgical operation on the tree, together with a program of continuous feeding. At the present time Mr. Curlee reports the tree in excellent condition considering its advanced age. Perhaps because of its isolated location and the care now being given it, it may survive for many more years.

As told in the report on the tree in the February 1922 BULLETIN, Boone visited Missouri in 1798, and liked the region so much that he decided to settle there. His first home was at Marthasville, but later he moved to

The Daniel Boone Elm as it looked in 1921

Femme Osage where he lived until his death. His house was apparently the first stone building in St. Charles County, all the stone used being hauled on ox-drawn sledges from another part of the farm. Wood for the interior was cut from black walnut trees on the place, and is of the hand-made wooden-pegged variety of the period. After the neighborhood was settled Boone was elected "Syndic" of the district, one of the duties of the office being to hold court from time to time. Offenders were not infrequently sentenced to a given number of lashes on the bare back. After the United States obtained control of this region, a courthouse was eventually erected at St. Charles. However, the habit of accepting Boone's opinions had become firmly fixed in the minds of the settlers and as long as he lived he continued to hold court under the elm tree in front of his house. Here the troubles and grievances of his neighbors were adjusted according to the principles of common sense.

In view of the age and the condition of the tree in 1921, it was felt that the Garden should attempt to perpetuate it by growing plants from its seed. Seeds collected by Mr. Bollmann were received at the Garden on May 15, 1922. They germinated well and seedlings from the Garden nursery were later distributed to various arboretums. In 1926 three seedling trees were planted south of the grove opposite the Henry Shaw Residence. The specimen on the east side of the circular walk (see cover) now has a branch spread of 75 feet with a circumference at the forked trunk three feet from the ground of six feet. Its height is 40 feet. The northwest specimen has less spread with a height to 50 feet. The smaller specimen is near the northwest corner of the residence.

WINTER ADVENTURE WITH MISSOURI SPRINGS*

ROBERT W. SCHERY

The Missouri Ozarks are resplendent in autumn, enchanting in spring, and a better-than-passable summer vacation-land for midwesterners unable to journey longer distances to cooler summer climates. Famed in story and legend for hillbillies, "feudin'," and Jesse James, noted as a hunting and fishing ground where deer, wild turkey and rainbow trout can be had, clothed in the scarlet and gold of autumn by their deciduous forest cover, the Ozarks remain all but forgotten in winter. Yet there is much to recommend mid-southern Missouri in the "off-season." When those same brilliant trees have shed their autumn glory new vistas are opened and rocky profiles hidden by summer verdure stand out with all their rugged individualism. Brisk and

*In view of the discussion now going on in the press concerning the effect on Missouri springs of certain flood-control measures, this article is particularly timely.

biting winds put a tang into life atop the accordant ridges, but down in the unending series of valleys, banks of leaves pile high where the spirit of the wind has been broken. All winter the Christmas fern holds its greenness, and in early March from among the fallen leaves will come forth the delicate hepaticas, toothworts, bloodroots, and anemones before ever an oak has unfolded its leaf to the new growing season. The fast-water, spring-fed rivers of southern Missouri are crystal-clear throughout most of the year, but they are a microcosm of enchantment in the winter for the hardy who will brave some cold and inconvenience to get off the beaten track. There is no more spectacular way to become intimate with the winter beauty of the Ozarks than to float or canoe down the upper Meramec, Current, Eleven Points, North Fork, Jack's Fork, Black, Cowskin, Gasconade, Piney, or St. Francis rivers from October to April.

Current River along its middle-upper stretches, north of Round Spring

The unusual feature of mid-southern Missouri is the large number of springs feeding the fast-water rivers. Big Spring, on the lower Current River, one of the largest in the nation, is particularly well-known and only too much defaced by the scores of seasonal visitors. Other accessible springs include Meramec Springs, at the headwaters of the Meramec, Alley Spring, the source of most of the Jack's Fork water, Round Spring, on the middle Current, Montauk Spring, at the headwaters of the Current, Greer Spring, the patron of the Eleven Points, and a number of others. It is the multitude of lesser-known springs along the waterways, however, that add real enjoyment to the downstream float by canoe or "long-john." All such trips on the fast-water rivers must be from an upper put-in to a lower pick-up, for

Along Pulltight Spring's outlet. Note watercress in background.

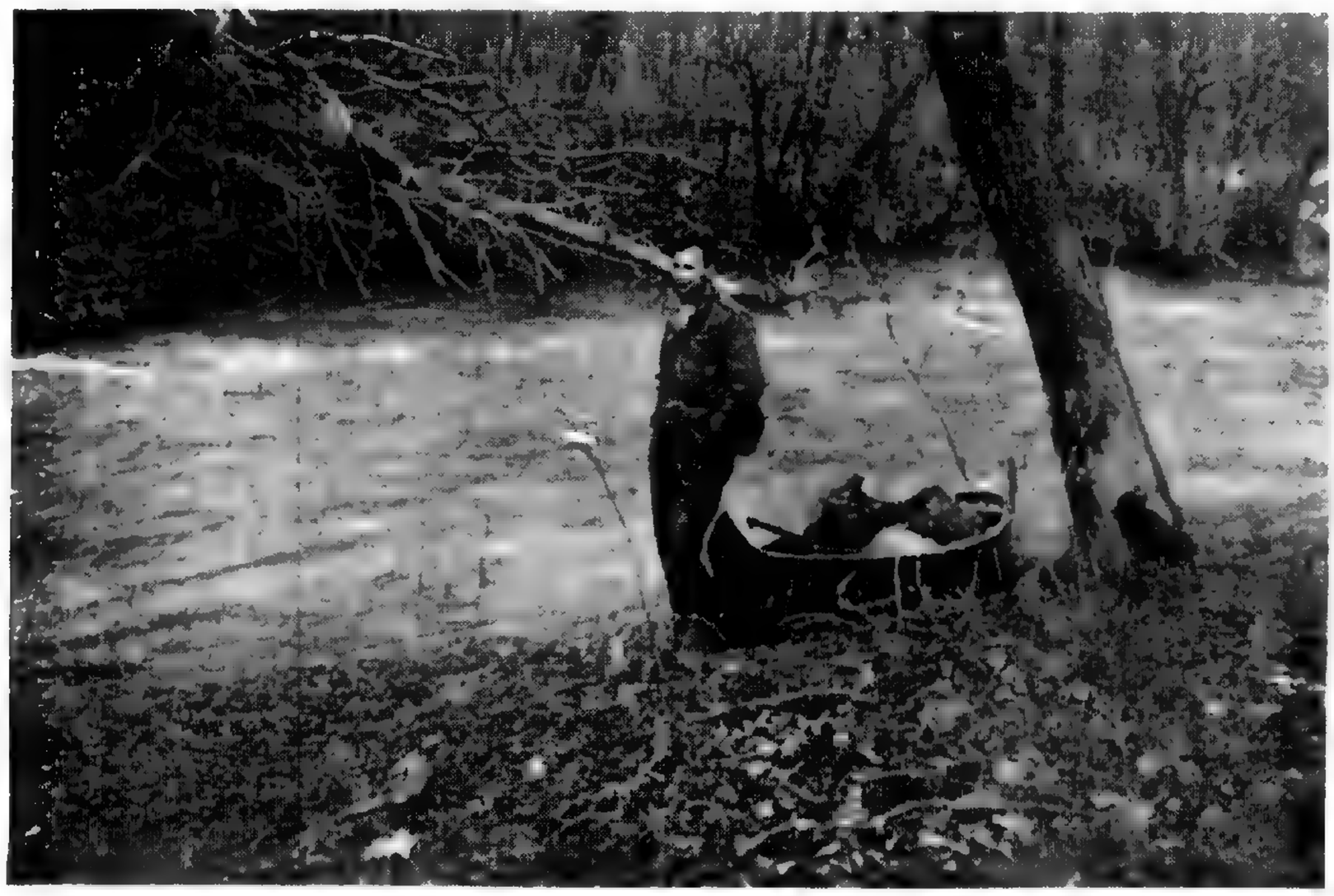
Pulltight Spring pouring forth from the base of a large bluff

even the most athletic among us could not make sustained progress upstream through the chutes and rapids so abundant in the upper reaches of these streams. The long-john boat, a particular product of Missouri's fast-water country, may be 20 feet long but barely 2 feet wide and is gracefully curved or bowed from bow to stern to cut water resistance to a minimum. It is never equipped with oars, but is poled from the stern by a man standing. Needless to say, some experience is necessary to handle a long-john in the currents and eddies of streams frequently flowing as much as 20 miles per hour. Guide-conducted floats in long-john boats are familiar to scores of Missouri and out-of-state fishermen who annually journey to Missouri's clear-water rivers for several days of excellent casting midst surroundings lavishly scenic. More maneuverable than the long-john is a canoe, but it is near to impossible not to scratch and scuff one's canoe during a 50 mile trip down any of the more picturesque rivers.

Outlet from the accessible and much-visited Round Spring

A stop for superlatively cold water at one of the less visited springs (not that most folk don't drink directly from the river), or an over-night camp near by, is to partake of nature's finest. Such springs are largely inaccessible except by river. Even in mid-winter they are margined with the green of many kinds of mosses, liverworts, algae, ferns, and crisp watercress. Above, in the gaunt oaks and sycamores, may be seen the winter green of mistletoe, perhaps reflected in perfect image in the mirror of the spring or pool. Looking downward to the floor of the spring, various aquatic plants are seen to sway sinuously in the current and to form a tracery of green unsurpassed in any man-planned aquarium. Perhaps, too, a trout or other fish

Looking up Blue Spring towards its source



A canoe on the Blue Spring outlet

will add interest. Herons, buzzards, kingfishers, ducks, and a host of smaller birds are usually encountered. The robin, traditional harbinger of spring, winters in immense flocks along the valleys of these clear-water rivers. The osprey is still frequent midst the bars and bluffs of Missouri's last touch of wilderness. And not least of all is the sheer beauty of the waters themselves. Looking into the deepness of Blue Spring, on the Current below Owl's Bend, the awe of unplumbed depths holds one fascinated. It is as if the unclouded sky were here projected downward. Pulltight Spring, in a ravine-like niche west of a bend of the upper Current, pours its waters forth with a gurgle and splash in a champagne toast to the last remaining wilderness of the Ozarks. Cave Spring, likewise on the upper Current, yields the secret of its source only to those who will invade by boat and flash-lamp the darkness of its recess. And similarly do many other springs, both named and unnamed, intrigue the winter visitor poking along the streams already mentioned—while distant ridge-tops of short-leaf pine and lichen-covered bluffs, brown except for the wily red cedar, add majesty to the winter scene. If perchance a few flecks of snow or fresh sleet further enhance this winter solitude it need cause no worry, for a sleeping bag, a poncho, and the leaves of a past autumn will help to afford a pleasant night's rest.

THE FLEETING FROST FLOWERS

GEORGE K. RICHARDSON AND ROBERT W. SCHERY*

Frost "flowers," fashioned not of the living stuff of true flowers but from the realm of the purely inorganic, are not uncommon of an October or November morn—yet they remain little observed in spite of their striking appearance. Because these balls of fluff seldom endure much beyond sunrise, and because the would-be observer must live with the land at the proper time of the year, in a location where proper plant species for the formation of frost flowers grow, most folk live a lifetime without first-hand knowledge of this autumn ornamentation. Perhaps the most exciting way to become acquainted with frost flowers is to have slept out in semi-wilderness on a cold, clear autumn night, beneath a full harvest moon. As the streaks from the hill-hidden sunrise merge with the pale of the fading moon, a timorous peek from out of the frost-covered sleeping bag may show a silvery landscape dotted with pearly-white fluff balls as large as grapefruits and appearing even larger in the half-light of morn. Much in this manner was the party of George Richardson introduced to frost flowers on a November day

*Robert W. Schery, with whom George Richardson worked, completed this paper from Richardson's notes and photographs.

Frost flowers probably on stems of *Cunila origanoides*

Frost flowers produced on stems of *Verbesina virginica*

in 1947, along the Current River in the Missouri Ozarks. Richardson's untimely death only a few months later prevented his further study of frost-flower problems, but we are indebted to him for his observations and the photographs accompanying these notes as well as a memorable friendship.

Frost flowers are a delicate structure of minute ice crystals, formed on all sides of the dead, dried stems of certain plants, given suitable atmospheric and soil conditions. Their surface is of the tenuous tracery familiar as frost design on the inside of a storm sash after a particularly cold winter night, but their structure is three-dimensional. Instead of spreading his design on a flat surface, Jack Frost here siezes aqueous mists from the plant stem and solidifies them immediately into thin crystals of ice. More water ascends the dead plant stem from the active roots and "pushes" outward the ice crystals already formed. Gradually there is built up around the stem a series of thin, fluted flanges or "potato chips" of frost which twist and curl to give a flower-like appearance. Each autumn-browned stem of the proper plant species usually bears, not far above soil level, few to many of these gleaming white potato-chip ridges of ice. Each curled ridge of ice tells something of its ephemeral formation, for lateral striations give witness of lack of uniformity in pore width along the slit in the stem from which the "potato chip" exuded. It is as though tooth-paste, forced through a slit with ragged edges, would be marked by ridges and striae where flow had been most greatly

impeded or least obstructed. Also, longitudinal growth lines indicate progressive ice crystalization through much of the night, and show that the freezing temperatures had not penetrated to the water-conducting core of the stem. The frost flowers are largely or entirely ice and air. If melted, only a few drops of pure water are formed. So delicate are the frost ridges that in the warmth of the sun the frost flower seems not to melt but simply to evaporate. Nor will frost flowers stand much jarring or handling.

Special conditions are obviously necessary for formation of frost flowers. First, the air must be crisply cold while the soil is yet warm—otherwise exudation of vapors and sap from the stem would result in drops of water or "dew" that might not freeze or might freeze so tardily that the delicate structure characteristic of frost flowers would be lacking. Clear autumn nights following sunny days permit radiation of heat sufficient to "quick-freeze" the very surface, but only the surface, of the plant stem. Second, the stem must be of a plant in which transmission of soil liquids is possible even though the tissues be dead. Apparently numerous longitudinal splits in the dead bark or epidermis allow exit of the water, while the internal tissues at this late season must still be physiologically active enough to conduct water. We know that the xylem (wood cells) of trees continues to carry sap long after the living cell content has disappeared, and doubtless the same condition holds in the herbaceous plants most noted for formation of frost flowers. Third, the root system of the plant must still be active, even though the above-ground parts are withered and browned. Root hairs need still supply soil moisture to progressively larger roots, according to some sort of osmotic gradient. It could not be the transpiration stream, or evaporation of moisture from the upper portion of a plant that draws the sap up the stem. Certainly root pressure here must "push" the water column up the dead stem from below the soil level. And fourth, the soil must be comparatively warm and moist. Were the soil to be frozen, as it of course is later, mobile water would be unavailable to the roots and indeed the roots themselves would be completely dead in the case of the annuals, dormant and no longer physiologically active in the case of perennials. Abundant and free soil water must be available during the frosty night to be sent by the roots to the "physiologically served" top, even as though the growing season had not ended.

More than thirty species of plants are known to form frost flowers at times, but the phenomenon appears most common in two plant families, the Labiatae (mint family) and the Compositae (daisy family). Among the mints the occurrence is frequent in the genus Cunila, and probably the frost flowers pictured on page 167 were developed on stems of the perennial *Cunila origanoides*, the stone mint or common dittany, a well-known species on dry

hillsides from New York to Georgia. Associated with Cunila on the hillside where Mr. Richardson obtained these photographs was also a member of the Compositae developing frost flowers. This second plant was probably Verbesina, the crownbeard, known from Pennsylvania to Texas. The frostweed, *Helianthemum canadense,* is probably the plant most famous for frost flowers, hence its common name. As a rule, frost weed frost flowers are less spectacular than the ones pictured here. Other plants recorded as productive of frost flowers include thistle and heliotrope, and even such trees as walnut, pawpaw, and Paulownia. Frost flowers have been noted during American autumns since as early as colonial times, and the famous botanical manuals of a century past offer comment concerning at least the frost weed.

SEEDS THAT RIDE LIVESTOCK

ALFRED G. ETTER*

I would have been somewhat embarrassed had any one seen me kneeling beside the old mud-caked sow pulling hair-filled fragments of soil from her plump sides. It would have been considered a rather unorthodox activity on the average farm. My curiosity, however, had got the better of me. In studying the distribution of weeds about Brookhill Farm I became interested in the manner in which their seeds might be distributed. When I saw the sows being moved up the lane from the orchard grass pasture to the woods pasture for farrowing their summer pigs, I could not resist the temptation to find out what kind of a flora was hidden in the clotted mud on their shaggy sides.

The exercise of climbing the hill on this hot August afternoon had put the sows in a lazier mood than usual, so that it was no trouble to collect a handkerchief full of dried clay. After returning home I stored it in an open container subject to outside temperatures until the following February. After this period of dormancy at low temperatures the material was taken inside and crumbled over a flat of sterilized soil. A control flat of similar soil was prepared, and both flats were watered and placed in the greenhouse side by side.

Within a few weeks it became apparent that a veritable garden had been aestivating on the sow's side. In Table I are listed the sixteen species found and the numbers of each which germinated. In all there were 81 plants which grew from the small handful of soil. It was obvious that this was a very real and effective manner of seed transport, especially for sedges

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and grasses, of which there were 66 plants, or more than four-fifths of the total. The other plants were weeds typical of hog trails and wallows.

At the same time that I collected the dirt from the sow's back I had collected a sample of hog feces. Under conditions similar to those of the first experiment, the plants listed in Table II germinated and were identified. Here again grasses were prominent, but relatively few plants and species were involved.

Some months after making the collections from the sow, I was walking through the barnyard pasture. On the ground was a thin wet snow. Two work mares were pushing it aside with their lips as they grazed the short grass beneath. As they walked from place to place I noticed that they accumulated pads of packed snow on their hooves. Mixed with these pads were all sorts of plant fragments, grass blades and leaves. Scattered over the pasture were pads which had already fallen off. My curiosity was again aroused. What kinds of plant seeds were enclosed in these pieces of packed snow? I took one pad home to the laboratory and stored it for a short time at below freezing temperatures. At the same time that the dirt from the sow was sown, I also planted this litter from the mare's foot. The variety of seedlings which appeared was as surprising as in the other planting. Table III lists the species and numbers of plants which were identified. Among a total of 28 plants 16 different species were found, of which almost half were grasses. Plants of white clover, though not listed in the table, were present in some quantity, but since white clover showed up in the control flat, this species was necessarily eliminated from the totals.

Obviously, these tests of transported soil are only a few of the possible tests which might be made. Soil and vegetable litter of many kinds are constantly being transported about a farm. It was interesting to find out specifically what plants happened to be in the samples selected for this test. It was of greater interest and importance to find evidence that the movement of weed seeds about a farm occurs in such a subtle but effective manner. Especially significant was the realization that as a result of the meanderings of stock, combined with movements of farm machinery and other farm activities, weed seeds must be distributed in very considerable quantity in a rather random manner. It suggests that a farm flora is not determined so much by what seeds are available, as by the factors which influence seed germination and seedling survival. Such a flora is therefore free to express specific environmental conditions in a very efficient manner. A study of its ecology is consequently apt to be especially illuminating.

TABLE I: PLANTS WHICH GERMINATED FROM DIRT FROM A SOW'S BACK

Number of plants	Species
7	*Glyceria striata*
1	*Poa annua*
11	*Poa pratensis*
6	*Dactylis glomerata*
2	*Agrostis alba*
1	*Phleum pratense*
21	*Carex annectens* var. *xanthocarpa*
17	*Carex Frankii*
2	*Juncus macer*
1	*Chenopodium ambrosioides* (?)
1	*Cerastium vulgatum* var. (?)
1	*Barbarea vulgaris*
1	*Cardamine parviflora* var. *arenicola*
1	*Leucospora multifida*
5	*Veronica peregrina* var. (?)
3	*Veronica* sp.
Total 81	Total number of species—16

TABLE II: PLANTS WHICH GERMINATED FROM HOG FECES

Number of plants	Species
1	*Poa pratensis*
1	*Muhlenbergia Schreberi*
1	*Eleusine indica*
1	*Chenopodium ambrosioides* (?)
Total 4	Total number of species—4

TABLE III: PLANTS GERMINATED FROM A PAD OF SNOW FROM MARE'S FOOT

Number of plants	Species
3	*Poa pratensis*
1	*Triodia flava*
2	*Muhlenbergia Schreberi*
1	*Sporobolus vaginiflorus*
5	*Aristida oligantha*
1	*Digitaria Ischaemum*
1	*Echinochloa crus-galli*
1	*Juncus macer*
2	*Maclura pomifera*
2	*Chenopodium album*
2	*Oxalis stricta*
2	*Euphorbia supina*
1	*Eupatorium* sp.
2	*Erigeron canadensis*
1	*Taraxacum palustre* var. *vulgare*
1	*Lactuca saligna*
Total 28	Total number of species—16

PRINCE MAXIMILIAN'S SUNFLOWER

EDGAR ANDERSON

One of our native Missouri sunflowers, *Helianthus Maximiliani,* was named in honor of Prince Maximilian, of Neuwied, Germany, a titled naturalist of the nineteenth century who travelled widely in the New World. It is an appropriate name, for of all the wild sunflowers it is the only one which is truly regal in appearance. It is a wide-spread and variable species, native to the Great Plains and the prairies, and getting into some rocky places in the Ozarks though it is seldom common there. Around St. Louis a superior strain is sometimes cultivated as a garden plant, and the following description applies specifically to it.

For the sunny garden, Prince Maximilian's Sunflower is an outstanding perennial for early October. Its wands of bloom are five to eight feet high. The single flower heads are nearly as wide across as one's hand and of a pure, golden yellow. The leaves are narrowish and graceful and the plant, as a whole, has little of the coarse look so characteristic of most sunflowers. If one has the room in his garden and can resist the temptation to tie up the plants, the stems bend over gracefully in late summer; and though a bit awkward at first they become increasingly picturesque as flowering time approaches until they finally make a great spreading bouquet of gold and green, six feet high and ten feet across. In south St. Louis, where the plant is fairly common, it is seldom given such free rein. Plants are made to know their places in this neighborhood and from midsummer onward the picturesque asymmetry of Prince Maximilian's Sunflower is restrained with string, rags, wooden hoops, and other aids to horticultural decorum.

NOTES

Dr. Edgar Anderson, Geneticist to the Garden, will spend the month of December in Guatemala and Honduras, where he will study Central American varieties of corn.

At the recent meetings of the American Orchid Society held in St. Louis, Mr. G. H. Pring, Superintendent of the Garden, was elected a Trustee for the coming year.

Prof. R. E. McDermott, of the department of forestry, University of Missouri, Columbia, brought his class in dendrology to the Garden Arboretum to study the collection of trees, November 20.

Recent visitors to the Garden include the following: Dr. Hugh C. Cutler, of the Chicago Natural History Museum; Dr. E. R. Spencer, of Lebanon, Ill.; Dr. Frans Verdoorn, Director of the Santa Anita Botanic Garden, Arcadia, Calif., and Editor of *Chronica Botanica;* Mr. James Marston Fitch, Architectural Editor, *House Beautiful.*

GENERAL INDEX

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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 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. 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 bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.