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CONTENTS

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COVER: "Victory of Science over Ignorance," erected by Henry Shaw in shelter originally designed for his tomb. A copy of statue by Consani in the National Museum, Naples. Statue cost $1,050, delivered in St. Louis, September, 1886. Photograph by Mr. Carl Brockman.

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Missouri Botanical Garden Bulletin

Vol. XL JANUARY, 1952 No. 1

SIXTY-THIRD 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, 1951.

One can predict with reasonable certainty that in these days the annual report of any privately endowed institution will have something to say about the lack of sufficient funds. The Missouri Botanical Garden is no exception, since it is primarily an educational institution supported almost exclusively by the endowment left by Henry Shaw.

There is no need of going into details concerning the effect of rising prices on a stationary income. The situation is too well known and has in one way or another been experienced by practically every one. The price of the many articles needed by the Garden, as well as the cost of maintaining the library, the herbarium, and the payroll, has doubled in the past ten years, and any balance that had been previously accumulated is now exhausted. The situation is rendered more serious by the need of extensive replacements to the heating plant which has been in operation for forty years; by the pressing need for a new building for the always-expanding library and herbarium, still confined to the space available forty years ago; and many other lesser demands which cannot longer be neglected.

It is not generally understood that the Garden receives no financial assistance from either the City or the State. On the contrary, the Garden pays taxes on everything except the actual garden itself. Unlike the Public Library, the Zoo, and the Art Museum, the Missouri Botanical Garden does not appear in any tax bill, but, on the other hand, helps to pay for these and all the other items covered by city taxes. Since the death of Henry Shaw, the Garden has paid to the City of St. Louis, in special and general taxes, over two and one-half million dollars, all out of income. In 1950 the Garden or its lessees paid to the City of St. Louis $63,830.49 in taxes on revenue-producing property.

It should be remembered that the Garden is not a mere show place. If there were not a single flower or anything worth seeing out of doors and

under glass it would still justify its existence. While Mr. Shaw considered "it an important feature to always keep up the ornamental and floricultural character of the Garden" he likewise founded the library and herbarium and in his will always wrote of "The Missouri Botanical Garden *and Institution.*" Because of its staff of experts, its library and herbarium, and facilities for experimental work, the Garden has become one of the outstanding institutions in the country, recognized internationally for its contributions to the study of botany and horticulture.

The Garden has come to be a center for all sorts of information concerning plants. Not only locally but throughout the country, hundreds of inquiries concerning the names of trees, shrubs, and wild flowers, the care of house plants, what to do for diseases and insect pests and similar questions are answered every year. The Garden also supplies speakers for local garden clubs and various business organizations which desire luncheon talks along gardening lines. An average of once a week throughout the year some member of the Garden staff gives his service gratis.

Still another way in which the Garden contributes to the attractions available in St. Louis is the facilities it offers to visiting organizations. Scarcely a convention of any kind comes to the City without including the Garden in its program, and groups such as the Garden Club of America, the Federated Garden Clubs, the American Horticultural Society, the American Institute of Landscape Architects, The Botanical Society of America, and the American Orchid Society, have built their entire program around the Garden. The herbarium and the library annually attract many students of plants, who obtain here information not elsewhere available.

That additional income is needed to maintain the Garden on at least its present level of service needs no comment. The question is what to do about it. Henry Shaw definitely anticipated that sooner or later the Garden would need more than the income from his estate. He set aside a strip of land 200 feet wide entirely surrounding Tower Grove Park which was to be leased for "villa purposes," the revenue to come to the Garden. But people in St. Louis would not build on leased land, and the City, after the case went through the courts, over a period of ten years paid to the Missouri Botanical Garden five hundred thousand dollars for any rights it had in the land, and the "two-hundred-foot strip" became a much-needed part of the Park.

Mr. Shaw also provided that at any time the Board of Trustees might charge admission to the Garden. While this may have to be considered in the future, it would be unfortunate, and the Board would hesitate to put such a provision into effect until it was absolutely necessary.

A general public drive for additional funds does not seem advisable at this time. The many appeals for money by hospitals and various charitable

institutions having a wider contact than the Garden would appear to make it difficult for us to obtain the financial assistance we would have to have. And yet there must be a group of citizens whose interests are primarily in the Garden—people who do not participate in the other opportunities for giving but would be glad to help the Garden if they realized how much it needed assistance.

The Trustees have been encouraged recently by the fact that the Garden was remembered in three wills. Unfortunately, the one of Miss Ricker was contested by the heirs, and after being carried to the Supreme Court the case was lost by the Garden. Thus, instead of helping, that bequest cost the Garden money in attempting to secure it.

Another will, that of Constant F. Mathey, left about $100,000 to the Garden, and this may prove providential in furnishing the money necessary to make the pressing replacements to the heating plant already referred to.

A third person to remember the Garden was Mrs. Marie Louise Brooker, who, after the expiration of a trust set up for her daughter, left one-half of her estate to the Missouri Botanical Garden. It is to be hoped that with the situation understood, other citizens will remember the Garden in their wills, and eventually the endowment will be restored to a figure that will insure the maintenance of the Garden, with all its activities, in something like the way it deserves.

THE CITY GARDEN

Due to their age, the buildings, greenhouses, and fences are demanding more repair each year. Practically no outside labor has been contracted recently, and it is impossible with our Garden labor to keep up with the deterioration of the property. The large conservatories are in need of reglazing and replacing of decayed mullions. They have not been reglazed since the hailstorm of 1927 (reported in the June 1927 BULLETIN), the work having been done then by outside contract. In the past several years most of the private growing houses and the Linnean House have been reglazed or repaired by Garden labor.

MAINTENANCE.—

Painting and repair work on the Garden buildings during the year included the following:

Cleveland Avenue Residence.—Painting interior woodwork and ceilings of all the rooms (two coats); wall cracks filled with plaster; kitchen ceiling torn down and replastered.

North Wing of Administration Building (Shaw's Downtown Residence).—Walls replastered where needed; halls and four rooms on first floor (including lavatory), and two north rooms and lavatory on the second floor repainted,

using two coats; walls of north room on third floor painted; east balcony outside second floor water-proofed with asphalt to keep rain from penetrating the building.

Lecture Room of Museum Building.—Cloak room painted with two coats of paint.

Main Entrance.—Gates and turnstiles painted.

Engineer's Residence.—Walls and ceilings of first floor replastered where needed; start made in redecorating walls; two extra supports placed in basement to prevent further settling.

Horticultural Research Greenhouses.—South greenhouse completely overhauled during the summer; iron and woodwork repaired and painted, new ventilators installed, and building entirely reglazed. Exterior of head-house also painted.

In addition to the above, 72 garden benches were repaired and painted.

Main Conservatories and Growing Houses.—During the summer, when the greenhouses could be emptied of plant material, 5564 square feet of greenhouse area was reglazed. West section of a floral display growing house reglazed, painted with two coats of paint, and old mullions and broken vents replaced. One growing house in the Exotic Range had to be entirely reglazed, and the woodwork, 200 feet of angle iron purlings, and the curved section of channel iron on the gable ends replaced. Work continued of tearing out the old slate benches and replacing them with concrete ones, 1000 square feet having been completed. Fifty-six lower vent openings permanently closed and sealed with concrete. Replacing of glass broken by windstorms or expansion or contraction during extremes of weather is a continuous operation.

Lily Pools.—The action of frost having caused the five waterlily pools to leak, all the sides have been sealed with a cement and asphalt mixture.

ROUTINE MAINTENANCE.—

Routine maintenance throughout the year consists of repairing broken water lines, clogged sewers, and roads, keeping sewer openings clear, regrading cinder walks, cutting lawns and tall grass areas in the Garden and on the sidewalk areas bordering the Garden. Then there is the repairing of doors, locks, office furniture, clogged toilets, and fences, particularly on Alfred Avenue due to its being a dead-end street. Roof repairs include applying slate, tile, asphalt, and tar-paper. Two Toro mowers and two sickle cutters have been completely overhauled; six stand-by gasoline heaters have been repaired; one heater converted into a blowing-machine to extract heat from the underground steam manholes which permits repair work of the heating system during the winter. Waste paper must be collected over the Garden

and on the walks outside. Over 150 truck- or trailer-loads of leaves were raked and put on the compost pile and an equal amount brought in by the City street department. During September this stock-pile yielded 50 truck-loads of decomposed shredded-leaf soil. In addition, 82 truck-loads of top soil were hauled from Vandeventer Avenue to the stock-pile, and 40 loads of brush were hauled to the brush pile and burned. The two tractors and trailers are in continuous use throughout the Garden—for miscellaneous haulings, plowing, discing, etc. The walls of the public rest-room at the Main Gate call for constant removal of drawings and marks, usually done with lipstick in the ladies' rest-room.

HEATING PLANT.—

Boiler House.—An emergency gasoline-driven sump pump was installed in the coal tunnel to remove storm-water seepage from boiler room. Two tubes in No. 2 boiler and one tube in No. 3 boiler were replaced. The side-wall refractories were renewed in the back of No. 2 and 3 boilers. New insulation was necessary in the fire bowls of No. 1 and No. 2 oil burners. A defective 2½-inch steam main serving the repair shops and garages was renewed for its entire length from the boiler house to the shops. Routine repairs to piping and valves were made as they were needed.

Steam Distribution.—All the heating coils in the three houses north and south of the Orchid Range were removed and reinstalled, using 3040 feet of old 1¼-inch pipe which had been rethreaded and tested in our shop. Two new ¾-inch traps and necessary piping were installed on the steam main serving the Linnean House. During the summer important repairs were made to the 6-inch-high pressure steam main serving the upper Garden buildings. On 400 feet of 6-inch pipe, old flanges connecting the pipe sections were cut off, using torches, and welded together again. All supports were realigned and properly graded. New insulation covering was installed and covered with roofing paper for protection. The small size of the tunnel made working conditions difficult, requiring workers to lie prone at all times when making repairs. At the same time 400 feet of 3½-inch steam return line was replaced with new pipe. A new manhole measuring 4 feet wide, 6 feet long, and 5 feet deep was constructed of concrete blocks to service the same section of steam main. In three other manholes on the underground line 6-inch trap tees were replaced with new ones and the faces of the steam joint flanges resurfaced.

Water Distribution.—Defective sections of piping in 1¼-inch water line in tunnel under Fern House was renewed. The Italian Garden fountain line was connected to 3-inch water main, salvaging 280 feet of good 1-inch pipe from tunnel under Palm House. The ¾-inch water line to hydrant east of Flower House was replaced. Two valves and defective sections of

pipe of the 3-inch water main in the tunnel under the Fern House were renewed.

Miscellaneous Repairs.—A new sump pump was installed in the elevator shaft in the Administration Building, and a new sump pump at the Main Gate was wired. Necessary connections were made to new laboratory equipment in basement of Administration Building.

The maintenance of the City Garden is under the direction of Mr. G. H. Pring, with certain special features, including the two heating plants, under the control of Mr. Gerald Ulrici, Business Manager, and Mr. A. H. Vogel, Consulting Engineer.

MAIN CONSERVATORIES AND EXOTIC RANGES.—

The repairing of cinder walks, pruning of trees and shrubs, spraying with insecticides, and planting are among the operations that have to be carried out every year in the conservatories. Several days were devoted to repairing walks in all the houses. Pruning also required several days, as most plants grow so tall in a year's time that drastic pruning is needed. Spraying to control insect pests is done periodically, and to cover the entire range takes at least three full days. Hundreds of exotic plants were propagated in flats and pots and then set out in beds. Other duties performed as part of a regular routine include identifying plants for the public, giving out cultural information, transacting plant exchanges, etc. During the year the Exotic Range department assisted the Police Laboratory by giving information about seeds used in an abortion case and by growing marijuana from seeds found in a drug peddler's possession to insure that it was the right plant.

In the Palm House the pruning of palm trees was a prelude to a general revamping of the room. Dead leaves were removed from the palms, as well as palm fiber and old woody inflorescences. Jacobinias, which are used for effect under the palms, produced many heads of pink blossoms, but since the spent flowers present an unkempt appearance, these are removed shortly after blooming. It was not unusual to cart away a wheelbarrow of dried flowers after each blooming period. Additional Cattleyas and Oncidiums were fastened to palm trunks, the Cattleyas producing typical lavender blooms in late fall and the Oncidiums sprays of yellow butterflies in early spring. More Philodendrons were planted out at the foot of tall palms. Three flats of African Violets were planted in the north center bed and were the envy of visitors who chanced to see them in full bloom. Sixteen specimens of Agapanthus (Blue Lily of the Nile) were brought in for trial and appear to be enjoying their new surroundings. Gardenias and Fuchsias are also being tested and if adaptable will impart added color and charm to the jungle scene.

Some of the specimens in the Economic House were cut back heavily while others received only superficial pruning, and then a load of leaf-mold

was spread out as a mulch before being spaded under. After an inventory of plants was taken new labels were attached to all the plants. These labels bear both common and botanical name, the plant habitat, and our accession number. The labels were cut from green plastic material, lettered by hand in India ink, and for the first time were sprayed with "Krylon," a plastic substance. The spray was used on over 200 labels, and after a year they are still fresh and neat in appearance.

The last of the tall straggly Norfolk Island Pines in the Fern-Cycad House was cut down and two Araucarias planted in their place. The huge *Monstera deliciosa* produced a large number of cone-like fruits which take about a year to mature. Many branches of this lush tropic vine were cut off for propagating purposes.

In the Coffee-Banana House a load of leaf-mold was added to the soil and manure spread around coffee and banana plants, which are heavy feeders. The coffee trees bore a good crop of berries, but the trees had to be sprayed with a repellant to keep the squirrels from stripping them bare. Ripe bananas were also eaten by the squirrels. The evil-smelling *Agdestis clematidea* was cut down to the ground, as in a year's time the stems managed to reach the top ventilators and then force their way out of the greenhouse. There are several Hibiscus in this house, the outstanding bloomers being "Peach Blow" and "American Beauty." Hibiscus "Coral Beauty" and "Florida Gem" are year-long bloomers in the Palm House.

In the South African House a half load of cinders was required to raise the walk in order to eliminate standing water after sprinkling. Niggerheads bordering the walk were reset and a rock pocket built for Ceropegias. The tall Spurges were staked to insure top-heavy heads from breaking. When three specimens of Euphorbia toppled over, their branches were cut off, trimmed, allowed to callous and then were set out in sand-filled holes for rooting. The Milk Bush *(Synadenium Grantii)* had to be heavily pruned as its branches hung dangerously low over the walk. Clumps of *Sansevieria cylindrica*, S. *trifasciata* and its variety *Laurentii*, S. *metallica* and S. *longiflora* were pulled up from their beds and after being divided and cleaned were set out as a screen in front of the ugly steam pipes.

In the Cactus House three Magueys or Century Plants condescended to bloom. *Agave Ferdinandi-Regis* produced the tallest spike which reached a height of 10¼ feet. An asparagus-like shoot arose from the very center of the leaves on May 16 and reached its maximum length a month later. The plant died after flowering but produced much seed which will be sown later. The second Maguey to blossom was collected in southern Mexico by Ladislaus Cutak in 1947. In its natural habitat it forms dense mats. It was described as a new species in the September-October *Cactus Journal*, being named

Agave nizandensis. The third Maguey to blossom was *Agave filifera.* This species generally produces a ten-foot flower spike, but due to an injury to its tip reached only three feet; however, the flowers were normal. About fifty pounds of Agave leaves from some fifteen different species were sent to Merck & Co., Chemists, at Rahway, N. J., to be used in research on Cortisone, an anti-arthritic hormone. Some of the Pereskias, Yuccas and Beaucarneas that reached the roof had to be cut down and allowed to sprout from the ground again. A crinkly-leaved, scarlet-flowered Pereskia, which came to us in 1940 from the United States Department of Agriculture, bloomed profusely during the past year. It proved to be a new species and was described in the November-December *Cactus Journal* and duly christened *Pereskia corrugata.* It promises to become an excellent pot plant. *Peniocereus Fosterianus* and *P. maculatus*, tuber-producing cacti, were dug up for tuber measurements. All six species of Peniocereus are now being grown in our greenhouse preparatory to a proposed revision of this cactus genus. Two other species are being considered as new but time is not yet ripe for describing them. About 200 potted plants were placed in an outdoor cactus garden established during the summer. Fresh air, direct sunlight, and rain water are like a tonic to plants that are grown in a greenhouse all year round, and the removal of many choice cacti outdoors was a welcome change. The plants were set out on May 21 and transferred back into the glasshouse on October 24, only two weeks prior to the heaviest snowfall in forty years. When autumn arrives the Garden is usually beseeched by telephone calls from people who wish to get rid of plants that have become hard to manage. A large twin *Ferocactus acanthodes* was received from Mr. William Gooch and a very beautiful form of *Cereus peruvianus* from Mrs. Elsie Jockel. Several kinds of bromeliads were shifted to make room for additional plantings of cacti. One of the plants bore a pineapple only two inches long, which delighted visitors for several months.

In the Exotic Ranges *Billbergia thyrsoidea*, with its scarlet torches arising from a nest of bright green leaves, put on a gorgeous display. *Tillandsia Lindeni*, one of the most coveted of all bromeliads, also put on a show when several plants sent up flat pink and green spikes with large lavender-blue flowers. *Aechmea Allenii*, discovered on one of Paul Allen's expeditions in Panama for the Garden, bloomed for the first time in early December, probably the first record of blooming for this species in cultivation. Propagation of Dieffenbachias (Dumb-canes) has been a major project, for the Garden boasts a good collection of these exciting foliage plants.

While Mr. Pring, the Superintendent of the Garden, was in Switzerland during the past summer, he effected an exchange of some very worth-while

exotics, the most outstanding being *Pilea Cardieri* and *Rubus parviflora* from the H. Gubler Nursery. Since the cost of air transportation is high for heavy packages, the plants were sent as rooted cuttings wrapped in sphagnum moss. They arrived at the Garden in fair condition. A new propagation box was built for the south pit house.

The water-lily pools were plowed by tractor on April 17, fertilizer applied to places marked out for the lilies, and planting begun on May 14. A heavy windstorm on May 28 littered the pool with debris which had to be cleaned out. A large round metal tank was prepared for setting out first-generation seedlings of pygmy lilies in which the Garden is now pioneering. Through Mr. Bob Trickett, of London, England, Nymphaea seeds have been obtained from Mr. Bill Harney, who had collected them in Australia. They will be used in our hybridization work on dwarf Nymphaeas, begun a year ago. The Garden distributes *Victoria Cruziana* seeds and Nymphaea tubers to all parts of the world, the latest shipments going to Japan and Malta.

Mr. Ladislaus Cutak is in charge of the Main Conservatories and Exotic Ranges.

OUTSIDE GARDENS.—

To improve the appearance of the Garden, particularly in the winter months, increasing numbers of evergreens have been propagated each year since 1944. Twelve-hundred liners, representing twenty species and varieties of evergreens, were planted in the nursery. The list included various types of tall and dwarf Junipers, Arbor-vitae, American and Japanese Holly, Korean Box and varieties of Yew. The evergreens which were started in the 1940's are now planted in the center and at the north and south entrances of the Italian Garden pergola, on the east side of the Floral Display House, and in the Azalea beds near Henry Shaw's mausoleum. The sixteen circular beds bordering the three large water-lily pools in the main plaza were planted with evergreens in October. Each bed now contains a Burk Juniper *(J. virginiana* var. *Burkii)* for a point plant, surrounded by Pfitzer Junipers *(J. chinensis* var. *Pfitzeriana)*, and these in turn are bordered by a circle of the gray-leaved *Stachys lanata,* or Woolly Lamb's-ear. The winter appearance of this part of the Garden has been much improved by these evergreens, but unfortunately the lawn reverted to crabgrass during the summer. If crabgrass grows in cycles, 1951, with its abundant rains, must have been the peak year. The main plaza lawn was completely renovated and seeded in the fall of 1949, and there was a fine greensward last spring. However, in the autumn hardly a blade of bluegrass was left, and the lawn had to be renovated and seeded again.

Three beds were remade in the rose garden, and 150 roses, in eight vari-

eties, were purchased for them and for replacements in other parts of the garden. All the hybrid tea roses were frozen to the ground during the 1950-51 winter, but they recovered rapidly and grew well during the summer. Mr. George D. Greene gave us two species roses for the garden.

Fifteen varieties of herbaceous peonies and six tree peonies were planted in the Linnean garden. Mrs. Josiah Whitnel, of the Country Club Grounds in Belleville, presented the Garden with the tree peonies from the collection of the late Mr. Whitnel, who for many years maintained the best collection of them in this part of the country. Mrs. Hazel Knapp of Valley Park donated two plants of *Mahonia Bealei.*

The Garden is cooperating in the placement studies of "The Glenn Dale Azaleas" which have been sent to us by Mr. B. Y. Morrison, Principal Horticulturist of the United States Department of Agriculture. The first shipment was received in 1950, and another in June 1951. We now have 167 varieties of Azaleas and a total of 334 plants.

FLORAL DISPLAYS.—

The Christmas display of poinsettias continued until mid-January. This was followed by a small garden of primroses, cyclamen, and buddleias. Orchids were shown from February 11 to March 4. These flower shows occupied the south half of the conservatory, and the north half was used to construct the bulb garden which was later transferred to the Arena for The Greater St. Louis Flower and Garden Show, March 13 to 18. While the bulb display was at the Arena, the Easter show consisting of lilies, hyacinths, tulips, marguerites, nasturtiums, azaleas, etc., was staged in the Floral Display House. The design of this garden was maintained until mid-May, with cinerarias, annual chrysanthemums, schizanthus, ornithogalums and primroses added in April. On May 19 and 20 the St. Louis Horticultural Society held its Annual Spring Flower and Iris Show in the Floral Display House. During June hydrangeas were the major attraction, supplemented by groups of delphiniums, salpiglossis, calceolarias and gloxinias. From July through mid-September the main display consisted of fancy-leaved caladiums. In late September the house was cleared for the annual dahlia show of the Greater St. Louis Dahlia and Chrysanthemum Society, which was staged September 29 and 30. The Veiled Prophet Queen's bouquet of orchids was shown October 3. The Henry Shaw Cactus Society held its show October 6 and 7. The chrysanthemum show was held from November 4 to December 2, being the forty-seventh consecutive chrysanthemum display staged at the Garden. The annual Christmas display of poinsettias started December 8.

Mr. Paul A. Kohl, Floriculturist, is in charge of outside gardens and the floral displays.

ARBORETUM

This is the second year during which irrigation was not required by established plantings at the Arboretum. In fact, the "weather" has so reversed itself that it became a problem to find enough dry days and good footing to perform the usual operations. On the whole, it was a good "growing" year. All trees and shrubs carried much more foliage throughout the summer, and herbaceous growth was equally luxuriant. Winter injury, however, was more extensive than for many past seasons. A severe cold wave last November before plants had terminated growth and additional cold weather in February killed nearly all the plants in the Boxwood Garden. Of all the species and varieties on trial only two Asiatic kinds were adjusted to this weather: *Buxus microphylla sinica* and *Buxus microphylla koreana.*

Road maintenance required 151 hours of grader operation, and the dragline was used to dig and load 1,970 cu. yds. of gravel from the Meramec River. With the assistance of two trucks loaned by the County Engineer, about 1.7 miles of the Old Pacific Road, which is the north boundary of the Arboretum, were graded, and additional gravel was hauled to replace that worn away by the cars driving through the Arboretum (3,354 cars were counted during week-ends).

Mowing during 1951 required 392½ hours, or 60 hours less than last year. This was due partly to a late wet spring and partly to freezing weather which stopped the work in November. Fertilizer experiments with the grassland continues. Some of the open fields which have been lightly disced, limed, and fertilized have responded so well to treatment that they may become a source of bluegrass seed during the coming year. An effort was made to reestablish some of the prairie plants, especially the legumes, which were once a prominent part of the open country. Both direct seeding and mulching with imported hay were tried. The prairie hay was located and shipped from southwest Missouri by the Missouri Quail Hunters. Additional work with plants deemed of special value to bees and quail continued, and partial reports of this work have been published. Fire as a tool to maintain the prairie flora will be tried in a limited way in selected areas.

About 2,000 gallons of arsenate of lead were required for bagworm control in the Pinetum and throughout the Arboretum on conifers. Apparently, any juniper which is allowed to grow as an individual is subject to attack by this insect. Since junipers are scattered over the entire acreage it is possible that five times that quantity of insecticide may be needed during an epidemic year. Just 1,800 gallons of 2-4-D and related compounds were used for weed control. When used with discretion, these materials produce results with less cost than any other way.

Nursery work is at the lowest ebb in twenty-five years. There are but 5,903 plants, representing 212 species and varieties, in the seed-frames and nursery rows. This is because most seedlings or cuttings are moved from propagating frames to permanent positions before they reach a height of seven feet. This practice may not prove so successful when we enter another dry cycle; perhaps at that time larger and older plants will be required.

Mulching material and organic fertilizers are of primary importance and always seem in short supply. An effort to remedy this deficiency and provide even greater quantities of mulching material appears possible through the use of a "Chipper." This machine, obtained in June, is a portable version of the "Hogger," used in large saw mills where all refuse is converted into fuel for the steam boilers. The portable model can be taken through the woods. It is capable of reducing all thinnings, even large branches and small trees, to very small particles resembling coarse planer-shavings. This can be used immediately as a mulch, or placed in a cattle barn as bedding and eventually hauled to the plantings as manure. Over 15 tons will be used as cattle bedding and an equal quantity will be reserved for use as mulch. The cost of this operation and its effect on the woodland is being investigated, and the results will be published as soon as sufficient data accumulate.

Truck operation for the year totalled 16,053 miles, much of it in low gear while gravel was being hauled from the Meramec River. Included also are many short trips, some without load, especially for patrolling on week-ends. Farm tractors were operated 2,038 hours. They are either prime movers or power sources for many operations—digging holes for planting, raking and baling hay, towing and power spraying, mowing grass, etc.

The Arboretum is under the management of Mr. August P. Beilmann.

ORCHID RANGE.—

During the past year, approximately 1,000 lbs. of Osmunda fiber were used in the greenhouses at the Arboretum in the repotting of 30,000 orchid plants. The range produced 40,000 hybrid blossoms and the usual amount of spray orchids and botanicals.

The first indication of the true value of *Laeliocattleya* "St. Louis" is now being realized. This hybrid, developed by the Garden, not only has fine shape and extraordinary growing characteristics, but also produces blooms during all 12 months of the year. This remarkable block of seedlings has produced 2500 flowers during the past 12 months. Another seedling hybrid, very similar to *Laeliocattleya* "St. Louis" in habit and appearance, was registered this year with the American Orchid Society as *Laeliocattleya* "Missouri." It also shows great promise of becoming a producer of outstanding blooms.

This is the first year that all Cattleyas used in the Veiled Prophet Queen's

bouquet were hybrids developed by the Garden. Hitherto all the flowers have been grown at the Garden but were not the Garden's own named hybrids.

The seed-sowing operation is being handled by Mrs. G. R. Lowry. There have been 90 flasks of hybrid Cattleyas and Cypripediums sown. The procedure of transplanting seedlings from one culture flask to another has been successfully undertaken for the first time this year. This method, while necessitating greater care, is very practical in that it produces a greater number of vigorous seedlings from fewer original flasks.

Over 1,000 orchid plants were received this year as a donation from Mr. H. L. Dillon, of Long Island, N. Y., which makes the third block of orchid plants he has presented to the Garden in the past three years. The collection is being kept intact in one 13 × 100 ft. greenhouse.

As an experiment in insect control, 10 per cent Parathion bombs were used in the orchid houses this fall. Two complete sprayings were applied in four hours. The same coverage by old methods of hand spraying would have taken six 8-hour days. The saving of 44 man hours was even more appreciated when results were checked. The Parathion gas was almost completely effective against orchid scale and mealy-bugs, whereas other insecticides, applied in the old manner, were sadly lacking in any great killing properties.

The Cymbidium collection was moved from a "north-south" house to the only "east-west" house in the range to see what effect more winter light and more free air circulation would have on flowering. In preparation for this move, a 110-ft. side ventilator was built into the new house. Old ventilators, salvaged from remodeling in other parts of the range, were used for this project. So far, the number of flower spikes produced this winter is encouraging.

The orchid range is visited almost daily by orchid enthusiasts, amateur growers, and commercial growers, from all over the world. Much interest is now being shown by the recently organized Orchid Society of Greater St. Louis. On September 23 the Society held a meeting at the greenhouses where talks were given by the greenhouse staff.

Maintenance.—The boiler-room crew, under the supervision of Mr. Roy Kissick, chief engineer, carried out their usual maintenance program during the summer months. All the glass from two 26 × 100 ft. greenhouses was removed, the wooden framework thoroughly cleaned, repainted, and the glass re-set with aluminum bar caps. Five houses have now been reworked in this manner during the past three summers, so that gradually the greenhouses will be restored to their original condition, after 25 years of use. During the summer over 2,000 sq. ft. of new cypress decks were built in three greenhouses. By staging the plants on this type of deck the capacity

of each house is increased by well over 500 plants. During the summer the exterior of the engineer's residence was entirely repainted.

Heating Plant.—Other than routine maintenance, the pipe work consisted chiefly of the installation of heating coils and water service in the new greenhouse added to the Orchid Range. The heating coils required 600 feet of new 1½-inch pipe and 100 feet of 1-inch pipe, together with the necessary traps, valves, and pipe fittings. The water-line required 75 feet of 1-inch water pipe, valves and fittings.

The Orchid Range at the Arboretum is in charge of Mr. G. R. Lowry.

RESEARCH AND INSTRUCTION

THE MISSOURI PLANT SURVEY.—

Plant surveys were made by Dr. Julian A. Steyermark, of the Chicago Natural History Museum, Honorary Research Associate to the Garden, in forty-five counties in the state, resulting in numerous new records in geographical distribution, the finding of nine species and one form new to Missouri and of one undescribed form.

Two northern and eastern species—*Filipendula rubra* and *Carex trichocarpa*—were found growing on calcareous meadows in Reynolds County, the first time recorded for Missouri. In a remote sink-hole pond in Shannon County was found *Gratiola viscidula*, previously known from the Piedmont and Coastal Plain. Goldie's Fern *(Dryopteris Goldiana)*, a northern and eastern species, was discovered on St. Peter sandstone bluffs in Warren County. *Lycopodium obscurum* var. *dendroideum*, a ground pine resembling a tiny evergreen tree, was collected on La Motte sandstone bluffs in Ste. Genevieve County, a southwestern limit of dispersal. It is one of the relic plants which have been in the state since remote geological times but not previously collected here. Most relic plants grow in areas difficult to reach, and recent discovery of such plants emphasizes the need for further exploration in Missouri. Three species, not native to the United States but now introduced, were collected: a salsify *(Tragopogon major)*, along roadsides in St. Louis County; the orange-flowered *Cosmos sulphureus*, in Douglas County; *Lespedeza Thunbergii*, often cultivated for its large rose-purple flowers, in Warren County. An Evening Primrose *(Oenothera perennis)* was found in Dent County, its only previous record in Missouri being based upon a cultivated plant at the Garden. Two new forms were *Prunella vulgaris* var. *lanceolata* f. *candida*, collected in Dent County, and a white-flowered *Rosa setigera* (to be described later), in Reynolds County.

The virgin prairie in Phelps County was visited several times each month. It is the largest known natural prairie in the Ozarks and should be preserved for posterity. During the early spring it was covered with thousands of a

rare Bluet *(Houstonia caerulea)*, found growing wild previously only in southeastern Missouri. Indian Paint Brush *(Castilleja coccinea)*, a rare Buttercup *(Ranunculus oblongifolius)*, and a Blue-eyed Grass *(Sisyrinchium atlanticum)* were also found growing at this station. Later, numerous rarities were discovered: the blue-lavender Nemastylis, Ragged Fringed Orchis *(Habenaria lacera)*, three Ladies' Tresses Orchids *(Spiranthes vernalis, S. gracilis*, and *S. cernua)*, Downy Gentian *(Gentiana puberula)*, many compositæ, grasses, sedges, legumes, etc.

Thousands of new county records were added during the year, and some of the plants collected for the second or third time in the state were the following: *Waldsteinia fragarioides* and a rare Shooting Star *(Dodecatheon amethystinum)*, in Dallas County; *Juncus debilis*, and the Yellow-fringed Orchid *(Habenaria ciliaris)*, in Ripley County; Wild Lettuce *(Lactuca hirsuta* var. *sanguinea)*, previously known only from Jasper County, found in several southern Ozark counties; Golden Seal *(Hydrastis canadensis)*, in Shelby County; Widow's Cross *(Sedum pulchellum)*, in Perry County; and a showy Chickweed *(Cerastium arvense* var. *oblongifolius)*, the first record north of the Missouri River in the state.

GENETICS.—

Dr. Edgar Anderson, Geneticist to the Garden and Engelmann Professor in the Henry Shaw School of Botany, began the year by flying to India as the American delegate to a conference on problems connected with the breeding of economic plants in southeastern Asia. The conference was held in Delhi and New Delhi under the joint auspices of the United Nations and the Indian Plant Breeding Society. While in India Dr. Anderson attended the Indian Science Congress at Bangalore and was a guest of the Indian Agricultural Research Station, where he spent most of his time working with the junior staff on the analysis of variation in Indian crop plants. Returning by way of England, he lectured at Kew, Oxford, and Manchester. During the spring he lectured at the universities of Minnesota, Kansas, and Missouri, and gave a series of lectures and seminars at the University of Texas.

For most of the year Dr. Anderson was actively occupied in finishing a book designed to acquaint the general reader with our knowledge (or more precisely our lack of knowledge) of the origin of cultivated plants. It is now in press and is scheduled to be published next summer by Little, Brown & Co.

During Dr. Henry Andrews' absence on a Guggenheim Fellowship, Dr. Anderson, with the assistance of Dr. Paul Pavcek of Washington University, has carried on the executive responsibilities for the Henry Shaw School of Botany of Washington University.

PALEOBOTANY.—

Dr. Henry N. Andrews, Paleobotanist to the Garden and Dean of the Henry Shaw School of Botany of Washington University, was awarded a Guggenheim Fellowship in 1951, effective from July 1951 to February 1952. Most of that time was spent at the Botanical Museum of Harvard University working on his Index of Fossil Plants which is now virtually completed.

MYCOLOGY.—

Dr. Carroll W. Dodge, Mycologist to the Garden and Professor in the Henry Shaw School of Botany, has spent much of the time available for research in identifying miscellaneous collections sent in by correspondents from the western United States, central and northern South America, Chile, India, and tropical Africa, as well as some of our accumulation of unidentified lichens. Routine identification of cultures of fungi, both human and plant pathogens, has been made for correspondents. During the summer a monograph of *Rhizopogon* was nearly completed, and the Farlow Herbarium of Harvard University was visited for the study of specimens of the genus accumulated during the last twenty years.

Following the death of Dr. Greenman, Dr. Dodge moved the sets of exsiccati and the library section on lichens and expanded the fungus herbarium into cases vacated by the return of Dr. Greenman's loans.

Mr. Richard J. Scharlott, herbarium assistant in mycology, finished the insertion of accumulated lichens and fungi and began the indexing of recent accessions of exsiccati by the end of June. Mr. Emanuel Rudolph was appointed Research Fellow in Mycology in September. During the summer a large exchange was received from the Conservatoire Botanique de Genève, rich in collections of lichens from Schleicher's herbarium, which will be very valuable in interpreting Acharian species based on Schleicher's collections, and of fungi, including many duplicates from the herbarium of L. Fuckel. Mr. Rudolph has begun sorting and inserting these, as well as identifying some lichens from our undetermined material.

The usual courses in bacteriology and mycology have been offered during the academic year. Mr. Sidney D. Rodenberg taught bacteriology in the summer session.

HORTICULTURE.—

Dr. Gustav A. L. Mehlquist, Research Horticulturist to the Garden and Professor of Botany in the Henry Shaw School of Botany of Washington University, has given two courses during the year, one in general horticulture and one in advanced genetics and plant breeding. He also participated in graduate seminars and the supervision of six graduate students. Two courses on the propagation and growing of garden plants were given at the Garden.

While the south greenhouse of the two used for horticultural research was completely overhauled during the summer, the rains prevented the work needed on the north one. On that account it will be necessary to defer the annual spring course in gardening until repairs can be effected. Not only does the greenhouse leak very badly in rainy or snowy weather but much of the water goes into the basement, making it very unsafe for materials stored there.

HORTICULTURAL RESEARCH.—

Delphinium.—During the past year nearly 7,000 delphinium seedlings were grown and classified, as part of the breeding program in this genus. That so many could be grown was partly due to the favorably cool spring and early summer, providing good growing conditions in the lath house, and partly to assistance from two commercial growers, Mr. John Lochner, of Warson Woods, and Mr. John Tomasovic, of Des Peres, who generously provided space in their greenhouses for 1500 plants each. More than 5,000 of these seedlings were members of advanced generations from the cross *D. elatum* × *D. cardinale*. There were no reds or pinks with *elatum* characteristics but many fine plants were obtained that were one step nearer to the goal, the best ones being good *elatum* types with deep wine-red flowers. In addition, a great many advanced seedlings from crosses between *D. elatum* and *D. grandiflorum* were grown in order to obtain evidence of the origin of *D. Belladonna*, a long cultivated garden hybrid supposed to have originated through a cross of these species. The *Belladonna* project has been largely in charge of Miss Amy Gage, a graduate student.

Dianthus.—The *Dianthus* project was considerably expanded during the year partly through the assistance of Mr. Robert Gillespie, Jr., a graduate student who is investigating the problem of triploidy in carnations. For this purpose a large number of crosses were made between tetraploid and diploid forms. The resulting seedlings are now being classified cytologically as to whether they are triploid or tetraploid. In addition, many crosses are being made in the diploid section to provide more genotypes suitable for test crosses with diploids and tetraploids.

A study of a peculiar form of variable flower variegation in certain commercial strains is being undertaken by a graduate student, Miss Dorothy Ober. For this study many of the genotypes that have been obtained through several years of genetical studies will be required.

Lilies.—This project, which has been carried at a minimum for the past two years, has been expanded to furnish material for two graduate students, Yoneo Sagawa and Mrs. Ada May Jordan. Mr. Sagawa is studying cytologically a number of seedlings from crosses between tetraploid and diploid

forms of the Easter Lily. It has been reported that such crosses in the past have produced only diploids and tetraploids instead of the expected triploids. Mrs. Jordan is studying the possibility of interspecific crosses in the *centifolium-tigrinum* section.

Orchids.—The cytological results in the genus *Cymbidium* are being brought to the publication stage. The investigations on the *Cattleya* and *Paphiopedilum* groups are being continued. Three years ago 100 plants of *Cattleya Mossiae* and *C. Trianaei* and a trispecific hybrid, "Priscilla," were planted in various mixtures containing vermiculate, tan bark, and leaf-mold. These plants were grown in screen-bottomed wooden boxes 36" × 10" × 10", five plants to the box. It is now evident that none of the mixtures containing ½ or more of vermiculate are suitable for Cattleyas, at least under the conditions that existed during the experiment. Regardless of the supplementary nutrient solutions used the plants gradually deteriorated. The only plants in the present experiment that did as well as controls potted in osmunda fibre in the conventional manner were those planted in ordinary leaf-mold top-dressed twice annually with osmunda screenings.

Saintpaulia.—In order to provide material for a study by Thomas Graven, a graduate student, on the effect of colchicine on *Saintpaulia*, particularly with reference to polyploidy, many new varieties have been obtained during the year, most of which were generously contributed by Mr. Herbert Renner, of Olivette.

SYSTEMATICS AND FLORISTICS.—

Dr. Robert W. Schery, Research Associate to the Garden and Assistant Professor in the Henry Shaw School of Botany of Washington University, had charge of the courses in elementary botany and economic botany from January until June. He was also in charge of assembling material for the BULLETIN. In September he resigned to accept a position with Monsanto Chemical Co., St. Louis.

Dr. Robert E. Woodson, Jr., Curator of the Herbarium and Professor in the Henry Shaw School of Botany of Washington University, in addition to his herbarium activities, continued to direct postgraduate research in the taxonomy of seed plants and to conduct classes in the Henry Shaw School of Botany. His research work centered about the genus *Asclepias*, for which he received a grant from the American Philosophical Society.

Taxonomic research amongst the staff and postgraduate students of the Henry Shaw School of Botany during the year has been centered about the following topics: Dr. R. M. Tryon, Jr., *Selaginella;* Dr. G. B. Van Schaack, Aleutian grasses; Dr. F. G. Meyer, *Valeriana;* Alice F. Tryon, *Pellaea;* Hugh H. Iltis, *Cleome;* John M. Gillett, *Gentianella;* Robert C. Cooper, *Pittosporum;* Ding Hou, *Celastrus;* Jorge León, *Inga;* Bernard C. Mikula, *Baccharis.*

Mr. Gillett is studying at the Garden on leave from his position with the Canadian Department of Agriculture at Ottawa; Mr. Cooper is on leave from his position at the Auckland (N. Z.) Institute and Museum; and Mr. Hou from the Taiwan National University at Taipeh, Formosa. Mr. León, on leave from the Instituto Inter-Americano de Ciencias Agricolas, Turrialba, Costa Rica, is studying at the Garden as a Guggenheim Fellow. Alí are candidates for advanced degrees in the Henry Shaw School of Botany of Washington University.

The Missouri Botanical Garden, and particularly the herbarium staff, was deeply moved by the death of Dr. Jesse More Greenman, Curator of the Herbarium *emeritus*, on January 20, at the age of eighty-three years. An appreciation of Dr. Greenman's career and his significance to the Garden was published in the May number of the ANNALS OF THE MISSOURI BOTANICAL GARDEN.

DEGREES AWARDED IN THE HENRY SHAW SCHOOL OF BOTANY.—

At the June 1951 commencement, the degree of Doctor of Philosophy was conferred upon the following: Reino O. Alava, A.B., Turku University, Finland (Genetics); Donald N. Duvick, B.S., University of Illinois (Genetics); Marion T. Hall, B.S. and M.S., University of Oklahoma (Taxonomy-Genetics); Harrison A. Hoffmann, B.S., McKendree College and M.S., University of Illinois (Microbiology); Daniel O. McClary, B.S., Southeastern State Teachers' College, Oklahoma (Microbiology); and David J. Rogers, B.S., University of Florida and M.A., Washington University (Taxonomy). The degree of Master of Arts was conferred upon Masashi Yamada, A.B., Washington University (Microbiology).

GRADUATES AND FELLOWS.—

The following graduate students and fellows were registered in the Henry Shaw School of Botany in 1951:

Graduate Assistants: Charles J. Felix, A.B., University of Tennessee (Paleobotany); Robert J. Gillespie, Jr., A.B., Washington University (Plant Breeding); Thomas A. Graven, B.S., Washington University (Plant Breeding); William B. James, A.B., University of Delaware (Physiology); Richard N. Kinsley, A.B., Earlham College, Richmond, Indiana (Mycology); Maurice W. Lindauer, A.B., Washington University (Chemistry); Daniel O. McClary, B.S., Southeastern State Teachers College, Oklahoma (Microbiology); George A. McCue, A.B., Washington University (Genetics); Bernard C. Mikula, B.S., College of William and Mary, Williamsburg, Virginia (Taxonomy); Robert B. Nevins, A.B., Washington University (Taxonomy); Norton H. Nickerson, B.S., University of Massachusetts and M.A., University of Texas (Genetics); Sidney D. Rodenberg, A.B. and M.A., Washington

University (Microbiology); Roanne Roeyer, A.B., Washington University (Physiology); Alice F. Tryon, B.S., Milwaukee State Teachers' College and M.S., University of Wisconsin (Taxonomy); Yoneo Sagawa, A.B., Washington University (Plant Breeding); and Masashi Yamada, A.B. and B.S., Washington University (Microbiology).

Guggenheim Fellow (Latin American): Jorge León, of Interamerican Institute of Agriculture and Science, San José, Costa Rica (Taxonomy).

Henrietta Heermans Scholar: Reino O. Alava, A.B., Turku University, Finland (Genetics); Robert A. Dietz, B.S., The Principia, and M.A., Washington University (Genetics).

Special Research Grant from Pioneer Hi-Bred Corn Co.: Reino O. Alava, A.B., Turku University, Finland (Genetics); Donald N. Duvick, B.S., University of Illinois (Genetics).

U. S. Public Health Fellow: Milton Zucker, A.B., Washington University (Physiology).

University Fellow: David J. Rogers, B.S., University of Florida, M.A., Washington University (Taxonomy); Robert C. Cooper, M.A. and B.Com., University of New Zealand (Taxonomy); and Hugh H. Iltis, B.S., University of Tennessee, M.A., Washington University (Taxonomy).

University Tuition Scholarship: Ding Hou, B.S., National Chung-Cheng University, Kiangsi, China.

Missouri Botanical Garden Research Assistant: Marilyn A. Gage, B.S., Pennsylvania College for Women, M.A., Washington University (Genetics); Emanuel Rudolph, A.B., New York University (Mycology).

Independent Students: John H. Ayers, A.B., DesMoines University and M.A., University of Cincinnati (Plant Breeding); George A. Chiligiris, A.B., Washington University (Microbiology); John M. Gillett, A.B., Queen's University, Ontario (Taxonomy); Harrison A. Hoffmann, B.S., McKendree College and M.S., University of Illinois (Microbiology); Ada M. Jordan, B.S. and M.A., University of Missouri (Plant Breeding); Taylor E. Lindhorst, B.S., St. Louis College of Pharmacy (Physiology); Frank W. Martin, B.S., College of Pharmacy (Physiology); Dorothy Ober, B.S., Cornell University (Plant Breeding); and William H. VonMeyer, A.B., Washington University (Microbiology).

PUBLISHED ARTICLES.—

Edgar Anderson, Geneticist: Concordant vs. Discordant Variation in Relation to Introgression. Evolution 5:133–141; Naturalizing Flowers at Gray Summit Arboretum. Mo. Bot. Gard. Bull. 39:47–51 (Reprinted from

Prof. Gard. 3:198–199, 205); Ten Missouri Wild Flowers for St. Louis Gardens. Mo. Bot. Gard. Bull. 39:52–55; The White Rose of the Renaissance. Nat. Gardener 22^{3-4}:15–16.

Henry N. Andrews, Paleobotanist: American Coal-ball Floras. Bot. Rev. 17:431–469.

August P. Beilmann, Manager Missouri Botanical Garden Arboretum: Grandfather and the Necrosed Elm. Arborists' News 16:105–108; Mechanized Gardening. Parks & Recreation 34^{4}:8–10, 34^{5}:12–14; Wildlife as an Indicator of Land Management. Mo. Bot. Gard. Bull. 39:44–45; (with Louis G. Brenner): The Changing Forest Flora of the Ozarks. Ann. Mo. Bot. Gard. 38:283–291; The Recent Intrusion of Forests in the Ozarks. Ann. Mo. Bot. Gard. 38:283–291; The Ditch as Potential Game Cover. Mo. Quail Hunter 7^{3}:8–9, 11.

Louis G. Brenner, Assistant Manager of the Arboretum (with A. P. Beilmann): The Changing Forest Flora of the Ozarks. Ann. Mo. Bot. Gard. 38:283–291; The Recent Intrusion of Forests in the Ozarks. Ann. Mo. Bot. Gard. 38:261–282.

Ladislaus Cutak, in Charge of Conservatories: Agaves—Potential Source of a New Drug? Mo. Bot. Gard. Bull. 39:67–74; *Aloe vera*—Burn Remedy. Desert Plant Life 23:56–58. (Reprinted from Dec. 1937 Garden BULLETIN); Fashions in Succulents. Flor. Rev. 108:29–32. May 3; *Peniocereus* is a Sextette. Jour. Cact. & Succ. Soc. Amer. 23:75–77; A New Dwarf Mexican Agave. Jour. Cact. & Succ. Soc. Amer. 23:143–145; The Status of *Stenocactus* 'Berger'. Chron. Bot. 12:165–166; A New Scarlet *Pereskia*. Jour. Cact. & Succ. Soc. Amer. 23:171–173; Exotic Foliage Plants for Modern Interiors. Mo. Bot. Gard. Bull. 39:195–217; Spine Chats—monthly articles in Jour. Cact. & Succ. Soc. Amer.

George F. Freytag, Graduate Student: A Revision of the Genus *Guazuma*. Ceiba 1:193–225.

Paul A. Kohl, Floriculturist: The Flowering Dogwood. Mo. Bot. Gard. Bull. 39:104–105; Moving Time for Your Shrubs. Horticulture 29:329, 336; The Redbud. Mo. Bot. Gard. Bull. 39:102–104; The Silverbell Tree. Mo. Bot. Gard. Bull. 39:106–109; Two Good Santolinas. Mo. Bot. Gard. Bull. 39:83–84.

Gustav A. L. Mehlquist, Research Horticulturist: Chrysanthemum Breeding. Bull. Nat. Chrysanthemum Soc. 7^{3}:87–88; Mulches. Mo. Bot. Gard. Bull. 39:165–166; Orchids in the Home. Amer. Orchid Soc. Bull. 30:4–7; Some Thoughts about Carnation Growing. Horticulture 5^{9}:83–85; (with Harlan Lewis et al.): Chromosome Numbers of Californian Delphiniums and Their Geographic Occurrence. Ann. Mo. Bot. Gard. 38:101–117; (with Robert W. Schery): Shrubs for Shady Places. Mo. Bot. Gard. Bull. 39:91–111.

Fred G. Meyer: Harbingers of Spring. Mo. Bot. Gard. Bull. 39:63–64; *Valeriana* in North America and the West Indies (Valerianaceae). Ann. Mo. Bot. Gard. 38:377–505.

George T. Moore, Director: The Henry Shaw School of Botany. Mo. Bot. Gard. Bull. 39:181–187.

Robert B. Nevins, Graduate Student: (with Robert W. Schery): The Ozarks. Mo. Bot. Gard. Bull. 39:117–125.

George H. Pring, Superintendent: *Dendrobium Schulleri*, a Rare Orchid. Amer. Orchid Soc. Bull. 20:23; Two New Nymphaeas (excerpt from April 1951 Garden BULLETIN). Gard. Chron. (England) 1951:212–213; Pygmy Water-lilies. Mo. Bot. Gard. Bull. 39:112–114.

David J. Rogers, Graduate Student: A Revision of *Stillingia* in the New World. Ann. Mo. Bot. Gard. 38:207–259.

Robert W. Schery, Research Associate: Evaluation of a Selective Crabgrass Killer. Mo. Bot. Gard. Bull. 39:74–82; Lawn Establishment and Care. Mo. Bot. Gard. Bull. 39:141–164; Leguminosae (second part). In Woodson & Schery's Flora of Panama. Part V, Fasc. 3. Ann. Mo. Bot. Gard. 38:1–94; Mimosas in St. Louis. Mo. Bot. Gard. Bull. 39:109–111; Mulches for the Home Garden. Mo. Bot. Gard. Bull. 39:168–179; St. Louis Springtimes. Mo. Bot. Gard. Bull. 39:85–90; (with Robert B. Nevins): The Ozarks. Mo. Bot. Gard. Bull. 39:117–125.

Julian A. Steyermark, Honorary Research Associate: Botanical Areas in the Missouri Ozarks. Mo. Bot. Gard. Bull. 39:126–135; Plant Survey of Missouri. Mo. Bot. Gard. Bull. 39:31–38.

Rolla M. Tryon, Assistant Curator of Herbarium: Ferns of the Ozark Region. Mo. Bot. Gard. Bull. 39:136–138.

Robert E. Woodson, Jr., Curator of Herbarium: Jesse More Greenman. Ann. Mo. Bot. Gard. 38:95–100; Studies in the Apocynaceae. VIII. An Interim Revision of the Genus *Aspidosperma* Mart. & Zucc. Ann. Mo. Bot. Gard. 38:119–206; (with Robert W. Schery): Flora of Panama. Part V, Fasc. 3. Ann. Mo. Bot. Gard. 38:1–94.

SCIENTIFIC AND POPULAR LECTURES.—

August P. Beilmann, Manager of the Arboretum: Jan. 11, before University City Garden Club, "Beekeeping"; Jan. 11, Garden Club of Fulton, Mo., "Some Better Trees and Shrubs"; "The Conservancy District of the Meramec Basin", Jan. 15, South Side Lions Club, Jan. 21, Lower Meramec Improvement Association, and Jan. 25, Marguerite Kruger Conservation Club; Jan. 19, Fred W. Stockham Post American Legion, "The New Look in American Forests"; Feb. 6, Kirkwood Garden Club, "Newer Trees and Shrubs for

this Vicinity"; Feb. 7, St. Louis Chamber of Commerce, "The Conservancy District as Proposed for the Meramec"; Feb. 12, Men's Garden Club of Webster Groves, "Trees"; Feb. 14, National Shade Tree Conference, Stump-the-Experts panel; Feb. 26, Lions Club of Union, Mo., "Some Aspects of Conservation"; Feb. 27, Carondelet Lions Club, "The Conservancy District of the Meramec"; March 20, at Ware, Mo., and March 24, the High 12 Club, St. Louis, "The Conservancy District Applied to the Meramec Basin"; March 28, Garden Club of Washington, Mo., "City Park Planning"; April 9, Landscape and Nurserymen's Association of St. Louis, "Some Worthwhile and Different Plants for this Area"; April 25, Delmar-Harvard School at University City, "Wild Life Conservation"; Oct. 2, Anglers of Missouri, "The Conservancy District"; Oct. 18, "Forestry of the Future", demonstration of "Chipper" and "Foliar feeding" for the Friends of the Land, at the Arboretum; Oct. 23, Kiwanis Club of Kirkwood, "The Conservancy District"; Nov. 5, Bel-Nor Garden Club, "Conservation."

Ladislaus Cutak, Horticulturist in charge of Conservatories: "Mexico in Kodachrome", March 29, Downtown Kiwanis Club, May 4, Nature Observation Club of Rott School, Kirkwood, Sept. 10, Men's Garden Club of Glendale; Feb. 21, Garden Club of Washington, Mo., "Gardens of Florida"; March 11, Henry Shaw Cactus Society, "Cacti in California"; April 19, Garden Club of St. Charles, Mo., "Exotic House Plants"; convention of the Cactus & Succulent Society of America, Denver, Colo., July 11, "Reminescence Hour with Kodachromes", and July 12, "Other Succulents"; Aug. 24, Alpine, Barrett and Manchester Garden Clubs, at Manchester, Mo., "Four Seasons in the Missouri Botanical Garden"; Sept. 9, Henry Shaw Cactus Society, "Bromels—Jungle Air-Dwellers"; Oct. 15, Belleview Park Garden Club, "House Plants and Their Culture"; Nov. 11, Henry Shaw Cactus Society, "Cactus Forum."

Paul A. Kohl, Floriculturist: Jan. 10, Western Association of Nurserymen, "Four Seasons at the Missouri Botanical Garden"; Jan. 17, Frontenac Garden Club, "Roses"; Jan. 19, Webster Groves Garden Club, Group 1, "Spring Flowers"; Jan. 19, Rose Society of Greater St. Louis, "A Picture Story of Growing Roses"; Feb. 16, Wade School Parent-Teachers' Association, "Four Seasons at the Missouri Botanical Garden"; Sept. 12, Hawbrook Garden Club of Kirkwood, "Preparing the Garden for Winter"; Oct. 4, Hanley Downs Garden Club, "Daylilies and Peonies."

Fred A. Meyer: March 26, Bethel Lutheran Church, "British Gardens"; March 31, Our Garden Club, "British Gardens"; June 28, Stix, Baer & Fuller Pension Group, "Four Seasons at the Missouri Botanical Garden"; Sept. 24,

Four Seasons Garden Club, "Man's Heritage—The Plant World"; Nov. 9, Webster Groves Garden Club, Group 13, "Henry Shaw and His Garden"; Dec. 18, Tree-Lovers Group, "Kew Gardens."

Gustav A. L. Mehlquist, Research Horticulturist: Jan. 17–20, Cornell University Short Course for Florists, "The Role of Genetics and Cytology in the Improvement of Flower Crops"; Feb. 11, Henry Shaw Cactus Society, "Plant Nutrition and Fertilizers"; Feb. 19–20, Colorado State Florists' Association Short Course, "The Production of Better Carnations through Breeding"; April 18, Iowa State Florists' Association Short Course, "The Production of New and Better Garden Plants through Breeding"; April 19, Sherman School Parent-Teachers' Association, "Gardens of Scandinavia"; April 25, The Ittner Corporation, St. Louis, "Gardens and Architectural Features of Scandinavia"; April 25, University of Missouri Horticulture Club, "Horticulture in Scandinavia"; May 11, Orchid Society of Greater St. Louis, "Cymbidiums, Ancestral Species and Modern Hybrids"; May 14, Webster Groves Men's Garden Club, "Genetics Applied to the Improvement of Garden Plants"; May 21, St. Louis Hills Garden Club, "Gardening in St. Louis"; June 2, Webster Groves Garden Club, Group 4, "Fertilizers and Organic Matter in Gardening"; June 17–18, Missouri State Florists' Association Annual Convention, Excelsior Springs, "Water Relations of Plants," and "Better Merchandising of Flowers"; July 31–Aug. 1, Ontario Agricultural College (Ontario, Canada) Short Course for Florists, "Application of Genetics to the Improvement of Florist Crops"; Oct. 2, interview for the radio program, Station WEW, "Garden Guide of the Air"; Nov. 9, Orchid Society of Greater St. Louis, "The Application of Genetics to Orchid Breeding"; Nov. 28, The Frontenac Garden Club, "New Trends in Horticulture"; Dec. 7, The Forward A. C. Club, "Flowers and Flower Types."

George H. Pring, Superintendent: Feb. 21, before American Institute of Electrical Engineers, "Four Seasons at the Missouri Botanical Garden"; Feb. 26, Downtown High Twelve Club, "Mr. Shaw's Garden"; March 2, St. Louis Horticultural Society, "Originating Tropical Water-lilies"; March 5, Carondelet Women's Club, "Visiting English Gardens"; March 26, Glendale Garden Club, at garden forum; April 4, Carondelet Presbyterian Church, "Orchids"; April 11, Alumni Association of Kappa Delta, "Visiting English Gardens"; April 12, St. Louis University School of Medicine, "Originating Tropical Water-lilies"; April 13, at planting of Penny Pines in honor of Mr. and Mrs. L. P. Jensen, Rockwood Reservation, Allenton, "L. P. Jensen and His Work on Conservation"; April 13, St. Louis Orchid Society, "The Boston Flower Show"; April 17, Tuesday Literary Club, "Four Seasons at the Missouri Botanical Garden"; May 23, presidential address at the annual meeting of Kew Guild, London, England; June 28, over British Broadcasting

Corporation, London, "Originating Tropical Water-lilies in the Missouri Botanical Garden"; July 3, over British Broadcasting Corporation, "Orchid Exploration in South America", and "The Missouri Botanical Garden Orchid Collection"; July 5, before students of Royal Botanic Gardens at Kew, "Originating Tropical Water-lilies at the Missouri Botanical Garden"; July 27, over British Broadcasting Corporation, direct to America, "An American Impression of English Gardens"; Aug. 17, St. Louis Rose Society, "European Gardens"; Dec. 6, Engineers Club of St. Louis, "Four Seasons at the Missouri Botanical Garden."

Robert W. Schery, Research Associate: April 5, before Army and Navy Reserve Officers, "The Garden and Its Fields of Research"; April 16, Civic Garden Clubs of Springfield, Ill., "Trees for Street and Home."

Rolla M. Tryon, Assistant Curator of Herbarium: Sept. 11, at meeting of American Society of Biological Sciences, Minneapolis, "Phylogeny of the Filicales."

HERBARIUM

More improvements have been made in the herbarium during 1951 than perhaps within any previous year of the past quarter century. First mention should be made of the establishment of a central herbarium office for the curator and the herbarium records at the south end of the second floor of the administration building. This room is literally in the center of the herbarium and within close access of the students' quarters. The herbarium office also houses the Gray Herbarium card index, and the *Index Kewensis* has been placed upon a table in the hall immediately outside. Former students at the Garden will appreciate these conveniences in contrast to the "old days" when innumerable trips were made by them from their quarters on the second floor at the south end of the administration building to the third floor at the north end to consult the *Index Kewensis*, to the first floor at the north end to consult the Gray Herbarium cards, and to the second floor of the old Museum building, nearly two city blocks away, to consult the curator! The mycologist's office, formerly in what is now the herbarium office in the center of the phanerogamic section of the herbarium, has now been moved to the third floor at the north end and in the center of the cryptogamic section, where it obviously belongs. These changes have resulted in much greater efficiency in the administration of the herbarium, as might be expected.

During the year 1951 a total of 15,736 specimens were mounted and inserted in the herbarium, bringing the estimated total to 1,617,021. Within the same period a total of 66,066 herbarium specimens and photographs was accessioned for future mounting and insertion, of which 1,647 were received

as gifts, 486 by field work sponsored by the Garden, 24,254 through exchange with other botanical institutions, and 39,579 by purchase. Of the last named, 753 are specimens of lichens and fungi, and 38,826 are photographs of type specimens of tropical American plants from the continental European herbaria and are popularly known as the "Macbride Photos."

The purchase of the Macbride Photos is one of the best arrangements which the Garden has been able to make for the herbarium in many years, since the complete set (made under the auspices of the Rockefeller Foundation by Dr. J. Francis Macbride during the 1930's) can be found in very few American herbaria. These photographs are one of the most precious research facilities for American botanists working on tropical American plants because they bring the treasures of the European herbaria to our own, at least vicariously, and particularly since the bombing of several of the continental herbaria themselves and the consequent destruction of their types. The very unusual opportunity to acquire this magnificent collection (and already mounted upon suitable paper), at a fraction of its present cost through usual channels, was made possible by the generosity of Mr. B. A. Krukoff, Merck & Co., and The Friends of the Garden.

The present policy of the herbarium is to secure the most representative collection of the vegetation of the entire world as our accommodations permit. This is necessary because of the extensive use of our collections for postgraduate research in the Henry Shaw School of Botany of Washington University. In this connection it is gratifying to find that of the grand total of specimens accessioned during the past year (exclusive of the Macbride Photos), 2,923 came to us from North America, 1,722 from Mexico and Central America, 708 from the West Indies, 4,297 from South America, 798 from Europe, 3,556 from Asia, 8,027 from Africa, and 2,493 from Oceania (including Australia); 2,716 are cryptogams from miscellaneous sources.

It always is indispensible for the Garden to have close relations with other botanical institutions of the world. In this regard it is gratifying to learn that of the 24,254 specimens received through exchanges, 9 domestic and 18 foreign institutions participated. In the same period the Garden sent out a total of 16,786 specimens in exchange to 11 domestic and 15 foreign herbaria. Our active postgraduate student program necessitates frequent borrowing and lending of specimens to other botanical institutions: during the past year the Garden lent a total of 8,104 specimens to 17 domestic and 2 foreign herbaria, and borrowed 9,190 specimens for current research of our students and staff from 9 domestic and 10 foreign herbaria.

The normal life of a research institution, like that of a plant, is characterized by growth; and the absence of growth generally is indicative of

disease or senescence. It is appropriate to question, therefore, how long the herbarium of the Missouri Botanical Garden may continue to grow and to increase the value of its collections within the limits of its present facilities. Of course, the same conditions obtain with regard to our scientific library which is definitely outstanding in its field in America. Without any doubt, the most precious possessions of the Missouri Botanical Garden, exclusive of its endowment proper and in terms of dollars and cents, are its library and its herbarium. Their value is not secular, in the sense that they owe their value largely to the fact that they have been in existence for so long, and their value increases each year proportional to their yearly care and increment. This is quite otherwise with much of other scientific paraphernalia which often is outmoded or obsolete soon after its acquisition. In this sense, therefore, the herbarium and the library are quite in the same class as the capital endowment of the Missouri Botanical Garden, as far as the necessity of maintneance and prudent investment are concerned.

Perhaps if the citizens of St. Louis were fully aware of the cultural value of the herbarium and the library of the Missouri Botanical Garden, means might be found to care for them more effectively and to provide for their improvement.

As matters stand, our herbarium is faced with two alternatives: either to allow the collections to stand as they are, with consequent deterioration, or to improve their quality through diversification within the cramped quarters presently available. The present herbarium administration, quite naturally, has adopted the latter course.

Every large herbarium contains a greater or lesser number of duplicated specimens, or specimens of certain species and regions which actually are in excess of the requirements of the herbarium as a whole, and lastly of specimens which, largely due to lack of adequate data or to other factors, really are of little or no value whatsoever. Then again every herbarium, no matter how large, will lack specimens of certain important plant groups or from certain geographical regions. Our herbarium administration has decided to improve our collections in supplying our wants of the latter category through the elimination of specimens of the three former categories. This process involves the laboriously double procedure of withdrawing specimens from the herbarium at the same time that more valuable specimens are added to it.

Our herbarium cases and the building which contains them are costly, and it behooves us to see that the cases are not more valuable than their contents. Our duplicated specimens are removed, as are the excess specimens, to be used in exchange for specimens which we lack; that at the same time provides room for the new accessions. The discard of worthless specimens accrues value to us in the additional space which their removal allows.

How long this process may continue before our herbarium is filled to the brim with specimens which we would not discard under any circumstances is problematical; and by that time we may pray that additional quarters may be available. But even without such good fortune we cannot but have increased the value of our collections far beyond that with which we began.

One of the most interesting activities of our herbarium during the past year has been the successful development of our arrangements for cooperation with Cuttington College, an Episcopal mission college in Liberia. This program, which involves the agricultural department of the college, consists in the collection of herbarium specimens by their students and of their naming by our herbarium staff in St. Louis. Names are reported back to Cuttington, where a duplicate set of plants is kept. The results so far have been most satisfactory to all concerned: small but needed funds as well as a working herbarium for the use of agricultural classes for Cuttington College, and a source of duplicate herbarium specimens to be used in exchanges by the Missouri Botanical Garden.

In February Dr. Frederick G. Meyer, of the Garden staff, returned to St. Louis after a stay of about 18 months in London. While in London Dr. Meyer photographed 5,000 type specimens of African plants in the British Museum (Natural History) and the herbarium of the Royal Botanic Gardens at Kew. Dr. Meyer's collection is intended as the nucleus of a collection of African type photos similar to Macbride's for tropical America, and will doubtless bring many benefits to our Garden as its place of deposit. Dr. Woodson has made application for a grant from the American Philosophical Society to enable the Garden to continue this project in London during the coming year.

LIBRARY

The routine work of checking book catalogues, cataloguing, shelving, reference, etc., was carried on in 1951. The agricultural books in the basement were shifted again this last year in order to provide space for at least several years' growth. In other sections of the library conditions are as crowded as ever, and there is no possible way to make additional space except by weeding out non-botanical publications. This poses a problem, for one can never tell when books seemingly unrelated to botany might be of use. For instance, many years ago the government publications on ethnology which were on deposit in this library were returned to Washington as being non-essential. To-day ethnobotany is one of the important studies at the Garden.

The removal this fall of the Gray Herbarium cards from the library to the office of the Curator of the Herbarium gave us space for a reading-room.

Although it can hardly be called a reading-room since it is a passage way and the west half and the walls contain library stacks, there is at least enough space for two long reading tables. The new books, as they come in, will be placed between book-ends on one of these tables so that the staff and students will have the opportunity to examine them before the books reach the shelves. Up to last year the only available reading place for library-users was in the office of the librarian, which was also the editorial office, a current-periodical room, a folio room, and a reference room.

A growing problem which can only be solved by increased funds is the upkeep of the books. The cost of binding has trebled in the last twenty years, and our annual binding appropriation does not even take care of the current periodicals. There is no provision for maintaining the most valuable works in the library—the irreplacable botanical classics which are found in few other libraries in the country. Some of these are in deplorable condition and have to be wrapped up to keep the pages from falling out. Unless something can be done soon, many of them will be beyond repair.

In October Eloise Ensinger Fay, who had been assisting in the library for the past two years, resigned, and Frances Waits was appointed to take her place. Miss Edna Mepham is in charge of most of the routine work in the library.

Accessions.—For some time the policy of the Garden library has been to purchase botanical classics and early reference works rather than current material found in general libraries. A couple of decades ago such rarities were sometimes acquired through foreign book catalogues but since the last war they are seldom advertised. Fortunately, Dr. Fred G. Meyer, of the Garden staff, was in Europe from 1949 to 1951, and he searched the bookshops and museum libraries for our *desiderata* of which he had been given a list. Among the publications obtained from book concerns in England, France and Holland were the following: a complete set of Bonplandia (10 volumes); Blume, Bijdragen tot de flora van Nederlandsch Indie, Vols. 1–3; Sweet, "Geraniaceae", Vol. 5 (which completes our set); Farrer, "Plant Introductions"; Irwin, "Plants of the Gold Coast"; etc. Other rare items which are probably unobtainable in the original, he arranged to have reproduced by photostat through the courtesy of the British Museum (Natural History). These include: duplication of a copy of Joseph Banks' manuscript of "A Journal of a Voyage to Newfoundland and Labrador." 1766; manuscripts of William Bartram's "Journal of Georgia Travels," and "Journal of Florida Travels"; Conrad Moench's "Supplementum ad methodum plantas describendi." 1802; Buc'hoz' "Plantae nouvellement decouvertes . . ." 1776, and "Collection precieuse des fleurs qui se cultivent dans les Jardins de Chine." 1779; John Lindley's "Collectanae Botanicae" (missing parts); Link & Otto's

"Icones plantarum Horti Botanici Berolinensis" (missing parts); Martin Vahl's "Eclogae Americanae." 1796–1798 (missing parts); unpublished manuscript, "Note sur la vie de Mr. Cretien Smith," etc.

Some of the other works acquired during the year were the following: Adamson & Salter, "Flora of the Cape Peninsula"; Aubreville, "Flore forestière Soudono-Guinéene"; Firbas, "Die Waldgeschichte Mittel-Europas"; Guillaumin, "Flore analytique et synoptique de la Nouvelle Calédonie. Phanerogames"; Hoffmann, "Mykologisch Berichte." 1870, 1871 (completing our set); Japanese botanical papers (English translations of 18 papers); Makino, "Illustrated Flora of Japan"; Nessel, "Die Barlappgewächse (Lycopodiaceae)"; Reichenbach, "Agrostographia Germanica" (Vol. II of "Iconographia"); Robyns, "Flora du Congo Belge et du Ruanda (Spermatophytes)", Vols. 1 and 2; Sprengel, "Einleitung in das Studium der Kryptogamischen Gewächse"; Thieneman, "Die Binnengewässer," Vols. 15, 16, 18; Winogradsky, "Microbiologie du Sol"; Ruiz & Pavon, "Flora Peruviana", vol. 4 (photostated).

Many valuable serial publications were also received, several hundred of which were in exchange for the Garden ANNALS.

Garden Publications.—The work connected with issuing the two Garden publications is done by the librarians. The Librarian edits the manuscripts, proofreads them, compiles the indexes, and does the secretarial work relative to publication, while Miss Ida M. Kohl has charge of the subscriptions and exchanges. Volume XXXVIII of the quarterly ANNALS, which was issued during the year, contains 507 pages, 10 plates, and 155 text-figures. One of the numbers constituted Part V, Fasc. 3, of the "Flora of Panama," being the second part of the "Leguminosae of Panama." Three doctors' theses were published in the 1951 volume—Alfred G. Etter's, Fred. G. Meyer's, and David J. Rogers'. A great part of the ANNALS issue is sent to other scientific institutions in exchange for their journals. The foreign exchanges are sent through the agency of the Smithsonian Institution in Washington, but it is not accepting shipments to Russia, the eastern zone of Germany, China, Korea or Manchuria, nor are we receiving any exchange publications from these countries. After November all packages intended for European exchange had to be labelled GTDA (General Technical Data—A).

Volume XXXIX of the BULLETIN, the monthly publication, contains 224 pages and numerous illustrations. Some of the special numbers were: the June number issued for the Ozark Foray of the Botanical Society of America, containing papers on the geology and flora of the Ozarks; the September number on "The Management of Lawns," by Robert W. Schery; and the December number on "Exotic Foliage Plants for Modern Interiors," by Ladislaus Cutak, being a response to a request by some members of the Amer-

ican Society of Landscape Architects after their meeting at the Garden in February. Many of the BULLETINS are sent to Friends of the Garden, a few are sent in exchange for other publications, and some are sold on subscription.

Library and Herbarium Visitors.—In addition to the graduate students and staff of the Shaw School of Botany and of the Garden, classes in pharmacognosy from the St. Louis College of Pharmacy and graduate students from St. Louis University have made extensive use of the library during the year. Among the out-of-town investigators were the following: Dr. Sven Andersen, of Copenhagen, Denmark; Dr. Joji Ashida, of Kyoto University, Japan; Dr. Lyman Benson, Pomona College, Claremont, Calif.; Sister Mary Aloyse Ellingson, of Loretto Academy, Kansas City; Dr. R. A. Evers, of Illinois Natural History Survey, Urbana; Dr. Harry J. Fuller, of University of Illinois, Urbana; Dr. L. J. Gier, of William Jewell College, Liberty, Mo.; Dr. Sven Grèn, Director Experimentalfältet, Stockholm, Sweden; Dr. M. Trufant Hall, of Cranbrook Institute of Science, Bloomfield Hills, Mich.; Dr. Charles B. Heiser, of Indiana University, Bloomington; Dr. David D. Keck, of New York Botanical Garden, Bronx Park; Mr. Robert Kosankie, of Illinois Geological Survey, Urbana; Mr. B. A. Krukoff, of New York Botanical Garden, Bronx Park; Dr. George B. Llano, of ADTIC Research Studies, Maxwell, Ala.; Miss Eleanor McGuilliard, of University of Chattanooga, Tenn.; Dr. Serge Mamay, of United States Geological Survey, Washington, D. C.; Dr. Axel Nygren, of the Agricultural College, Upsala, Sweden; Dr. Gerald B. Ownbey and Mr. Frans G. Pieters, of University of Minnesota, Minneapolis; Dr. Guy Stresser Pean, French ethnologist on tour to Mexico under auspices of Rockefeller Foundation; Dr. Reed Rollins, of Gray Herbarium of Harvard University; Dr. Carl O. Sauer, of University of California, Berkeley; Dr. Jonathan D. Sauer, of University of Wisconsin, Madison; Dr. Russell J. Seibert, Director Los Angeles County Arboretum, Arcadia, Calif.; Dr. Lloyd H. Shinners, of Southern Methodist University, Dallas, Texas; Dr. G. Shiraer, formerly Curator of the Herbarium and Professor of Botany at Masaryk University, Brno, Czechoslovakia; Dr. E. R. Spencer, soil consultant, Lebanon, Ill.; Dr. R. A. Studhalter, of Texas Technological College, Lubbock; Dr. Alois Tavcar, of University of Zagreb, Yugoslavia; Dr. George Ware, of University of Oklahoma, Norman; Mr. Ernest T. Watanabe, rose grower, Honolulu, H. I.; Dr. Paul Weatherwax, of Indiana University, Bloomington; Dr. Joanna Went, of Phytopathologisch Laboratorium, Willie Commelin Scholten, Baarn, Holland.

Among the groups visiting the library during the year were: botany classes from Southern Illinois University, Carbondale; American Association of Landscape Architects, then meeting in St. Louis; the botanists attending

the Ozark Foray of the Botanical Society of America; Dr. Lilian Nagel's botany class at Harris Teachers' College, St. Louis; the special libraries class of Washington University; and a group of graduate students from Indiana University.

Many investigators from other institutions make use of the Garden library by borrowing books on the interlibrary-loan plan, 246 such loans having been made to 38 institutions during the year.

Statistical Information.—There have been donated to the library or received in exchange for our publications during the year 596 books valued at $2,098.22, 1,754 pamphlets valued at $497.85, 1 map valued at $1.50, and 14 manuscripts valued at $49.30. The purchases consisted of 240 books at a cost of $1,426.93 and 14 pamphlets and parts of volumes at a cost of $32.93. The library now contains 60,820 books and 106,018 pamphlets, and 353 manuscripts. The number of index cards now totals 1,133,977, of which 3,578 were added during the year, 780 having been written by Garden employees and 2,898 purchased at a cost of $87.09. There were 183 books bound or repaired during the year.

ANNUAL BEQUESTS

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

ATTENDANCE FOR 1951
(Not including visitors to Arboretum)

	Week-days	*Sundays*
January	3,380	2,306
February	4,084	9,470
March	5,406	9,013
April	7,134	9,858
May	16,086	9,853
June	9,693	6,924
July	10,890	8,665
August	16,304	8,634
September	12,675	9,042
October	9,500	9,665
November	4,968	9,881
December	3,266	1,900
	103,386	95,201
		103,386
Total		198,587

Respectfully submitted,

GEORGE T. MOORE, *Director.*

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 50,000 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 Southampton buses (No. 80), direct from downtown, pass within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN

CONTENTS

Volume XL February, 1952 Number 2

Cover: Looking south toward the Main Conservatories in winter.
Photo by Russell Brill.

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Missouri Botanical Garden Bulletin

Vol. XL FEBRUARY, 1952 No. 2

BASSWOOD—TREE OF DISTINCTION

ROBERT W. SCHERY

The American Linden or Basswood *(Tilia americana)** should not be overlooked as a desirable tree for the St. Louis area. It rates well as a shade and ornamental tree; it is unusual in its flowering habit and in the delightful fragrance of its flowers; it grows with moderate rapidity and little care, and is relatively resistant to disease or insect attack.

In the wild, Basswood is more abundant in the woodlands of the northeastern states than in Missouri and southward. Yet it is found as far south as northeastern Texas, northern Louisiana and northern Florida. From Missouri southward *Tilia americana* usually mixes with its brother species such as *T. heterophylla* (distinguished by a whitish mat of hairs on the lower leaf surface), *T. monticola*, and several varieties. Perhaps, because of its seeming preference for cooler climates, it is sometimes difficult to transplant and have it survive the first summer in this area. It is a remarkably shade-tolerant tree and will grow and reproduce in the shade cast by its companions of the deciduous hardwood forest. The fact that its associates are unable to mature in its heavy shade makes the basswood one of the dominant trees of certain deciduous forests to the north.

If planted in an open situation basswood will assume a symmetrical ovoid shape in contrast to the more spreading form of the familiar elms and soft maples and many of the oaks and hickories. In such a situation it will keep its pendent branches almost to ground level, remaining compact and attractive into old age. As a background for modern ranch houses few trees are superior. The heavy shade cast and its tendency toward surface feeding of the roots may, however, make maintenance of the lawn beneath a basswood difficult or impractical. Seldom does basswood drop dead wood by natural pruning (i. e., shading out) to mar the lawn and provoke under-the-breath epithets of the gardener as the lawn-mower becomes repeatedly halted by unseen twigs.

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*From time to time the BULLETIN has discussed certain unusual trees suitable for the St. Louis region, viz: The Bald Cypress, in May, 1949; The Horsechestnut, June, 1950; and Albizzia ("Mimosa"), May, 1951.

In winter, the basswood has its minor points of attractiveness. In outline it retains its ovoid, neatly pruned appearance, and the large, plump, few-scaled buds are the shiny-red of a ripening apple. These become distinctly mucilaginous if chewed. The terminal twigs, like the buds, may have a reddish cast on the upper side. The longitudinally ridged and furrowed bark of the main trunk neither sheds nor roughens unduly, contributing to the neatness of the tree. The inner bark contains bast fibers that were widely used by the Indians for making harness cordage, nets, mats, and the like. Perhaps its greatest deficiency as a cold-weather ornamental is that the leaves do not have any very attractive autumn coloration but turn a rather dull yellow or yellowish-orange before being shed.

The leaves of basswood are unusual. Generally they are egg-shaped or lance-shaped, but the base of the blade is markedly oblique and the tip is prominently pointed. The margins are decidedly sharp-toothed. The veins stand out, dividing the leaf into a series of small rectangles. The leaves are dark green and smooth above, but below (in Missouri forms) exhibit a silverish sheen due to the presence of a fine mat of star-shaped whitish hairs *(T. neglecta, T. heterophylla, T. monticola)*. They occur alternately on the stem, and typically form two rows up the twig, each alternate leaf occupying a position like and immediately above its predecessor on that side of the twig. They are generally about 8 inches long and have a prominent petiole.

Even more unusual than the leaves are the bracts that are attached to the flower clusters. Few plants in all the plant kingdom have inflorescences arising from such leaf-like accessories. The bracts arise on the upper side of the juncture of leaf and stem and drop down beneath the gracefully pendent leaves. They give the tree a rather "disturbingly different" appearance. One is vaguely conscious that there is "something wrong" with some of the leaves. There seem to be two kinds, and some of them are a lighter green (the bracts). The bracts are short-stalked, about 6 inches long, shaped more or less like the tongue of a shoe. They last through July, generally being shed in early August. The flower cluster comes from the main vein, in the very center.

The flower cluster is about 3 inches long and nearly as wide, consisting of about 25 cream-colored and exceedingly fragrant flowers. They are an excellent source of honey and throughout their blooming period, late June in St. Louis, they are almost constantly visited by bees and other insects. In some sections of the eastern United States basswood honey is especially prized. Individual flowers are "quaint" but not unduly attractive, although the cluster as a whole may be considered rather ornamental. Each flower has

5 slender petals less than ½ inch long, 5 false petals (staminodia), and many yellow-brown stamens densely clustered about the robust pistil. The pistil matures as a round, greenish fruit, about the size of a pea, that contributes little in itself to the ornamental value of the tree.

Wood of basswood is rather soft and light, creamy white, and works well. It is often used commercially for excelsior, woodenware, containers, veneers, and even pulp. In spite of the moderately rapid growth of the tree and the lightness of its wood, factors usually conducive to wind and ice damage in trees, basswood seems to "bend with the breeze" and ordinarily suffers little damage from wind or water. In fact, its ability to withstand adverse physical and poor growing conditions makes basswood widely recommended as a shade tree for city street planting.

The American Linden *(Tilia americana)* in favorable environments becomes a rather large tree. The largest recorded specimen,* growing at Queenstown, Md., is 14 feet 1 inch in circumference. Trees of this species have been known to attain heights up to 140 feet, but a more usual height for a mature tree is only about half this much.

The genus Tilia is widespread in the northern temperate regions, being represented by many species in the eastern United States, Europe, Asia, and Japan. It has also been prominent in past ages, found abundantly in the fossil and peat-bog records. In England, where it is known as lime, it is widely cultivated as an ornamental and shade tree, and at times in past ages has been the dominant tree of deciduous hardwood forests. Both in England and on the continent hybrids and selections have been made, some of which have been introduced into the eastern and western United States. Among the more prominent of these are: the Cutleaf Lime *(T. platyphyllos laciniata)*, with irregularly lobed leaves often cut to the midrib; Japanese Lime *(T. japonica)*; and the small-leaved European Lime *(T. cordata)*. Other very attractive lindens have been introduced into horticulture, such as *T. Henryana* and *T. Oliveri*, from central China, but they have been little planted in the United States. In seeking lindens for the home garden St. Louisans will probably be content to rely chiefly upon the native American Basswood, *T. americana (T. glabra)* and the many southern "species" which hybridize with and grade into it.

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* The American Forestry Association "Report on American Big Trees," 1940, gives the spread of this specimen as 89 feet and height as 75 feet. A specimen of *T. heterophylla*, near Coldwell Corners, Dela., is cited having a circumference (at 4½ feet above ground level) of 17 feet 3 inches.

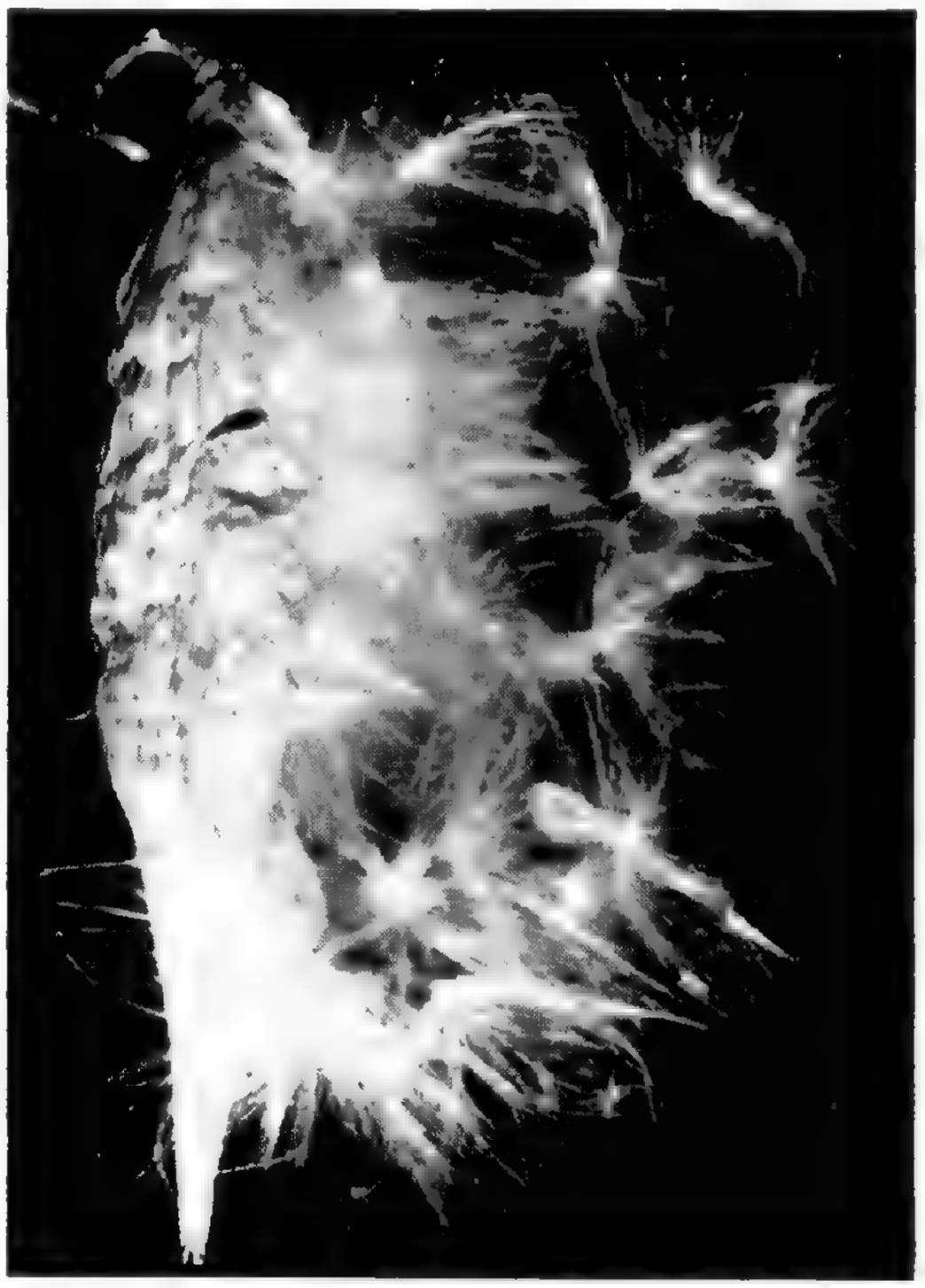
THE ANGLE-POD *(GONOLOBUS LAEVIS)*

PAUL A. KOHL

Many a weed, like the thistle, grows boldly in the open for every one to see. But *Gonolobus laevis* slyly and unnoticed twines and winds its way up through perennials, shrubs and trees. When it is discovered, it is such a tangled mass that it is difficult to remove from its host without breaking or tearing the plant. Often it is not until fall that one notices the seed-pods dangling high up in the leafless shrubs and trees. Many of these pods remain closed until spring when the March winds carry each silken parachute with its seed-passenger to distant places. Then another weed grows to wind its way up through other host plants to complete the yearly cycle of germinating seed, vine, flowers and more seeds.

Gonolobus laevis belongs to the Asclepiadaceae, the Milkweed or Silkweed family, and while its common name is Angle-pod, Climbing Milkweed would seem to be a more appropriate term. *Gray's Manual of Botany* gives its habitat range from Pennsylvania to Illinois, Kansas and southwest. It is a perennial, and pulling out the vine at the ground level will not prevent the reappearance of the plant the following year. Angle-pod is an interesting plant, but it must be classed with the weeds. Persistence in spotting and

Gonolobus laevis growing on Tamarix



Seeds of *Gonolobus laevis* about to be blown from pod.

Gonolobus laevis (Angle-pod)

destroying the vines before seeds have matured and gathering all pods and burning them is the only means of controlling it.

MAHONIA, THE OREGON HOLLY-GRAPE

ROBERT W. SCHERY

Oregon Holly-Grape is a poor name for a fine shrub. It is not a member of either Holly or Grape families, but of the Barberry family, and only superficially resembles true holly and scarcely at all the grape. Doubtless the name "Holly" was decided upon because individual leaflets of the compound leaf have spiny-lobed margins and a rigidity of texture similar to the simple leaves of the American Holly *(Ilex opaca)*, familiar as a Christmas decoration and a first-class ornamental tree in its own right. The "Grape" in the common name is apparently due to the unimaginative, or shall I say over-imaginative, comparison of the bluish-black berry to small grapes. Much more suitable is the scientific name Mahonia, in honor of the American horticulturist M'Mahon, for although a half dozen or so species of the genus have been introduced into horticulture, only *Mahonia aquifolium* is at all common in the trade.*

*More than 100 years ago a supposed cross was effected between *Mahonia aquifolium* and *Berberis vulgaris*, the common European barberry, to yield the plant now named *Mahoberberis neuberti*. Mahoberberis is supposedly sterile (one home-owner in Webster Groves reports his plant to set yellow fruit?), and is not the equal of its Mahonia parent in attractiveness. It was once sold in the St. Louis area, but recently has been on the "black list" of the U. S. Dept. Agr. as alternate host for the wheat-rust fungus. In the Government campaign of barberry eradication it is required that any plant of Mahoberberis discovered be uprooted and destroyed.

Mahonia aquifolium has few peers among ornamental shrubs. Rated for each of the many characteristics desirable in a shrub, it will score near the top in most and not fare too badly in any. It is evergreen, retaining its leaves through the St. Louis winter, but these become flushed with a fine red or purple as the cold weather continues. If in full winter sun or if the winter is severe, the leaves may tend to "burn" and brown late in the season; otherwise only for a brief period in spring, as a new flush of young leaves replaces the old, does the foliage exhibit an objectionably unkempt appearance. The small but abundant, mildly fragrant, bright yellow flowers are borne semi-erect from the young top growth, about April 1 in St. Louis. They are not unattractive, but the shrub is most prized for its dark blue fruits which are striking against a background of new glossy green leaves. The species is tolerant of shade and fair soils, hardy, and little bothered by disease or insects. In habit, the shrub will stay small enough for foundation planting, and a Christmas-time pruning of the upper parts not only supplies the finest in ornamental "holly leaf" for home decoration but prevents the growing shrubs from becoming leggy.

One other species of Mahonia only rarely seen in the St. Louis area, *M. bealii (M. japonica)*, is able to withstand very severe winters without the slightest browning or "burn." The leaves are exceedingly ornamental throughout the winter season. They are larger, thicker and more rigid than those of *M. aquifolium*, with 9–15 oblique leaflets that have 2–5 large spiny teeth on each side. The plant gets somewhat larger than *M. aquifolium*, and may become objectionably "leggy" unless intelligently pruned back. Unfortunately, *M. bealii* is seldom carried in stock by local nurserymen, although the species has much to recommend it.

Where possible, Mahonia is best propagated by division of the old plants. These "root-sucker" to a considerable extent, and can yield one or two large vigorous offspring each year. The suckers must be carefully dug and handled to survive transplanting. Propagation by cuttings is slower and uncertain, but offers the only way of securing good strains of this very variable species. In England these are rooted in a winter coldframe with bottom heat. A more usual means of increase is by seed. Seeds are slow to germinate (said to take 2 years), and the seedlings show great variability. Some out of every lot must be discarded because of dullness of the foliage or other objectionable features. Such variability has led to selection of several named varieties, and is probably a result of hybridizing within the group. Several species of the genus occur in eastern Asia and western North America, including the excellent *M. pinnata*. These are known to be capable of natural hybridization, and in addition some intentional crossing has been carried on by growers.

As a member of the Barberry family, Mahonia can be expected to share some of the characteristics of the barberries. In fact, many authors have included Mahonia as a section of the barberry genus, Berberis. The flowers exhibit anthers opening by pores, and the 6 stamens are borne opposite the petals. Unlike those of the familiar barberries (*Berberis thunbergii*, Japanese Barberry, *B. julianae*, Wintergreen Barberry, etc.), the leaves of Mahonia are compound; in *M. aquifolium* there are usually 5–9 leaflets. Some species of the genus are susceptible to the omnipresent wheat-rust fungus, but fortunately *Mahonia aquifolium* is very resistant to this disease. Coming as Mahonia does from the temperate rain-forests of the Pacific Northwest, it can be expected to prefer moist humified soil. Similarity between the climates of our Northwest and England may explain why Mahonia culture in England has been so successful, for Mahonia is rated there among the finest horticultural importations ever made from the New World. In St. Louis, Mahonia does best in well-watered but porous soils of good organic content, preferably in partial shade and given a heavy organic mulch. But Mahonia is no *prima donna*. It is quite hardy and will "get along" in almost any reasonable situation, although it is a shame not to give so potentially attractive a shrub every opportunity to fulfill its potentialities.

One would suppose that an ornamental shrub so highly recommended would be well known. Paradoxically, however, it is not, even among horticulturally inclined St. Louis home-owners. Many have doubtless seen it, but considered it a holly or some rare shrub unsuited to their needs. The St. Louis area is notably deficient in broad-leaved evergreens and has to rely mostly on a mere handful of barberries, and hollies. As Mahonia becomes better known and selected strains more readily available (and let us hope somewhat less expensive) it will no doubt replace some of the ubiquitous conifers (Pfitzer Junipers, Arborvitae, etc.) now used in foundation planting. Although especially useful for foundation planting Mahonia may find a place in hedging, specimen groups, filling and low screening. It is especially useful for northwest or eastern exposure, being tolerant of or even preferring partial shade.

RARE MISSOURI PLANTS—I

Yellow Fringed Orchis

JULIAN A. STEYERMARK

One of the many beautiful and showy plants growing wild in Missouri is the Yellow Fringed Orchis *(Habenaria ciliaris)*. During all the years of botanical activity in the state, but three stations have ever been recorded for this orchid, two in Ripley County and one in Iron County. These earlier records date back forty to seventy years, and the writer saw the plant in bloom for the first time just last year, in Ripley County.

In Missouri the Yellow Fringed Orchis reaches its known southwestern limit of natural distribution. In some parts of the northern states it grows in acid open peat bogs, where its companions are blueberry, cranberry, and pitcher plant. However, it also grows in other types of situations, such as sandy woods, dryish slopes, and swales. In the section of the Ozark region where I observed it, its roots were embedded in a loose mass of chert rocks mixed with an acid leaf mulch of oak. The shade was rather dense in this upland woods, and the soil at that time was dry. This orchid was growing a few feet away from the margin of a natural upland pond. In the spring this water of the pond is very close to the plant, but the plant itself was never growing with its roots in water, as it sometimes happens when it grows in peat bogs in other sections of the United States. Associated with *Habenaria ciliaris* were species of Farkleberry *(Vaccinium arboreum* var. *glaucescens)*, Deerberry *(Vaccinium stamineum* var. *neglectum)*, Dittany *(Cunila origanoides)*, Sour Gum *(Nyssa sylvatica* var. *caroliniana)*, Scarlet Oak *(Quercus coccinea)*, and other plants of acid soils.

Flower clusters of *Habenaria ciliaris* in bloom August 15, 1951

One of the interesting habits of *Habenaria ciliaris* is the long period of time required to develop the flowers. When I first saw the plant in late June, only the tip of the young flower cluster showed, the rest being enclosed by the upper leaf sheath. A month later, the flower stalk had grown out beyond the leaf several centimeters and showed a cluster of about twenty pale tightly closed flower buds. Finally, on August 19, nearly two months later, when the locality was again visited, the plant was in full bloom, and what a rare spectacle to behold! The pale orange flowers encircled the uppermost part of the plant, the delicate fringed lower half (lip) of the flower standing out in striking contrast to the much smaller and plain margins of the sepals and lateral petals. The three bluish or silvery-green leaves, smooth and elongated, were spaced along the lower half of the stem.

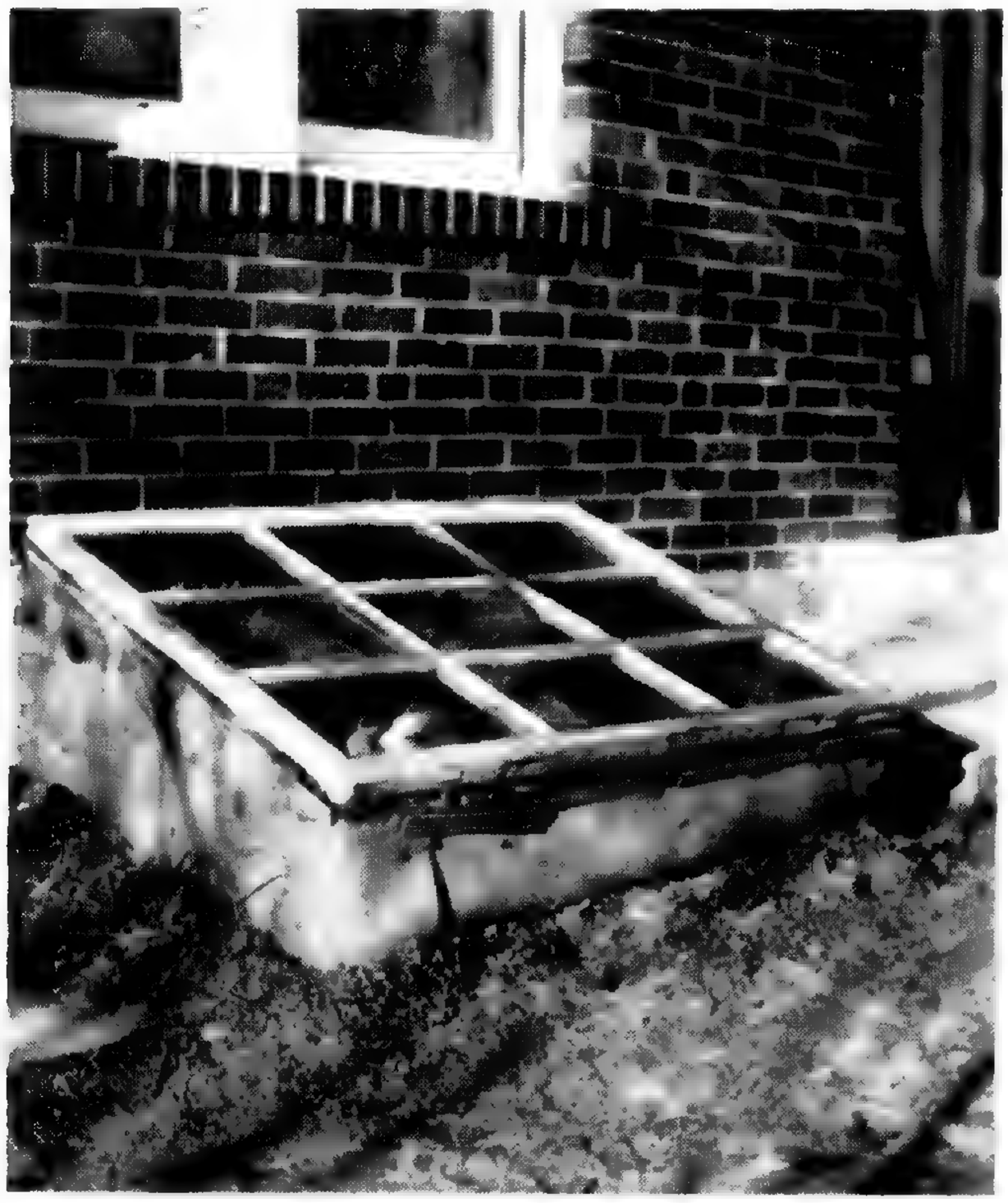
During a previous year, I had visited this locality in the first week of September and found the same orchid with only the orange of the flower stalks showing, the remainder of the flower having dried and turned brown. The period of blooming must therefore not last more than a couple of weeks. This long preparation to reach bloom is in contrast to other native orchids such as Lady Slipper *(Cypripedium)*, which attain their flowering within a much shorter time.

A BASEMENT-WINDOW GREENHOUSE

ROBERT J. GILLESPIE, JR.

If you are a member of that species of gardener whose green thumb remains green all winter, this article may interest you. Many gardeners have the urge to grow a few plants under glass during the winter months, but, for lack of space or for financial reasons, they are unable to have a greenhouse. However, about the only prerequisite for building a greenhouse is a basement window, preferably with a southern exposure. If a southern exposure is not available, an eastern or western one will do.

The author's window greenhouse, pictured below, was built entirely of materials found around the house. It is now in its fourth year of use and has had no repairs other than replacing broken glass and painting the sash. This sash is a common large window sash 3 feet by 3 ½ feet. Similar sash can be obtained cheaply from wrecking concerns. The two ends, 2 ½ feet rear height and 1 ½ feet front height, were cut from a piece of scrap ⅝-inch plywood, but any type of board sheeting will do. The front panel is also made of ⅝-inch plywood; 2 × 4-inch posts were used in the corners, and the sash rests on a 2 × 4-inch frame. The sides were covered with tar paper which was curved around onto the bricks of the house. The crack between



A Basement Window Greenhouse

the greenhouse and the house was stuffed with paper, which must be renewed each year. Every fall leaves are packed up around the sides to serve as insulating material.

By leaving the basement window open, the greenhouse can be heated. Ventilation can be had by propping up the window with a wood block or an empty flower pot. During cold weather the sash must be covered at night with an old comfort or quilt. By doing this, the outside temperature may drop to zero without the plants freezing in the greenhouse.

The advantages of such a greenhouse can be seen readily. In Missouri the necessity of getting vegetable plants started early so as to have them mature before the hot dry summer sets in is very important. By growing tomatoes in pots in his window greenhouse, the writer obtained ripe tomatoes as early as the middle of June. Cabbage, peppers, and many other vegetables can be started, thus extending the growing season by several months. The flower gardener can also use such a structure in which to start annual flowering plants in the spring. Later, after these plants are set out, hardy mum cuttings may be rooted for fall blooming. During the summer, house plants can be renovated in the greenhouse provided that some type of shading is added.

In the fall various kinds of perennial seed may be sown in this little greenhouse. If the grower wishes to go to the expense of installing an

electric heating cable to keep the temperature in the desired range at all times, such plants as African Violets and begonias can be grown the year round.

The versatility of such a greenhouse, along with its low construction cost, cannot be over-emphasized. Only two major disadvantages have been noted. The most important is one of area. Any ambitious gardener will soon find his window greenhouse completely packed with plants and many others coming on with little or no room for them. The second disadvantage is one of height. The structure being only 2½ feet in height, it is impossible to grow taller plants in it. With these two limitations in mind, the average gardener should be able to improve his gardening program with this window greenhouse and also enjoy the luxury of growing a few selected plants during the winter months.

MAGNOLIA ACUMINATA AS A LAWN SHADE TREE

MARTIN BAGBY

Magnolia acuminata, or Cucumber Tree, is an interesting shade tree which has proved itself in this mid-western region near St. Louis. The *Morton Arboretum Bulletin of Popular Information* reports it has grown satisfactorily in the Chicago lake region as well.

Specimen of *Magnolia acuminata*, over 100 years old, growing near Gray Summit

Thirteen-year-old offspring from tree at left, now growing at the Arboretum.

It is symmetrically pyramidal in shape and from 60 to 100 feet tall when growing wild. This tree attains great age without losing its youthful beauty. Its seed pods are oddly shaped and twisted, resembling a cucumber, hence its common name. In the fall they form large masses of brilliant pink and rose while the foliage is still green. When they burst the brilliant red seeds pop out, still held to the pod by elastic strings. The leaves of the Cucumber Tree are silky, usually 6–10 inches long, though sometimes 17 inches, and 3–6 inches wide. The blossoms are insignificant.

The accompanying illustration (fig. 1) shows a specimen of *Magnolia acuminata* in the yard of Ernst Wedemeier on Highway 50 near Gray Summit. It is estimated by old residents in the neighborhood to be over 100 years old, is 4 feet 3 inches in circumference, and around 40 feet tall. It was planted by Frederick Steines, a teacher from Germany, who built his home and an academy there in 1842. The light masses in the picture are the pink "cucumbers."

Magnolia acuminata is easily reproduced and is an average grower. The seeds from the Steines tree and a good number of similar trees were scattered in a seed-bed at the Arboretum on October 1, 1938. They were covered first, with 1½ inches of soil, then 1½ inches of sand. An offspring propagated by seed from the Steines tree is growing in the Missouri Botanical Garden Arboretum (fig. 2). Now, at 13 years of age, it is 20 feet tall, 2 feet in circumference, and in health and beauty promises to equal, if not surpass, the parent tree.

GRAVEL BAR ROOTS

ROBERT W. SCHERY

In traveling Ozark rivers one is constantly amazed that any vegetation at all can exist on the gravel bars that line the slow inner side of the river bends. The gravel, consisting mostly of well-rounded and worn Pennsylvanian chert deposits, is generally very coarse on the upstream end of the bar and grades downstream into many patterns of gravel and sand. Practically no soil is to be found for many feet down, and temperatures in the intense sun commonly rise in summer well above 100° F. In flood time, fast water carrying gravel, floating logs, and other debris scours these bars mercilessly, and leaves them pitted and channeled to bleach white in the coming summer.

In spite of this harsh environment, some plants are able to survive, albeit often stunted or mutilated. Among the trees the most notable are willows (Salix) and sycamore (Platanus), usually found in rows where seeds in a favorable year had washed to the then-present shore-line. Usually they form

Gravel-bar roots

impenetrable tangles of sprouts that are renewed as some fall victim to the hazards of gravel-bar life. Now and then a few reach respectable tree size in spite of the impoverished "soil." Occasionally the elms (Ulmus) or soft maples (Acer) will join willow and sycamore as moderately large gravel-bar trees, while buttonbush (Cephalanthus) and witchhazel (Hamamelis) seem best able to "take it" among the smaller shrub-like growth.

One wonders what the root system of these gravel-bar pioneers must be like, in order to hold fast against flood and channel shifts. Occasionally, parts of root systems are washed free, and the very intimate relationship between gravel and root may be seen. The accompanying photograph shows sycamore roots that not only have grown between gravel particles, but in some instances nearly around them. No root in soil was ever so gnarled, an endless pitting of pebble shapes. Notice how firmly most pebbles are held by the root, which has conformed to their shape and grown about them. Root and rock are much a unit, and the tree is as firmly anchored as is the gravel-bar itself. The misshapen wood forms gyrations and turns scarcely believable until the natural habitat is considered.

A NEWLY DISCOVERED CACHE OF ENGELMANNIANA

ROLLA M. TRYON, JR.

While sorting over material of pine cones and fruits long in storage, a single box of notes and letters of Dr. George Engelmann was unearthed. The contents have not been critically examined but evidently consist of several important items. There are various exchange lists and catalogues pertaining to Engelmann's herbarium, bibliographies and indices to the literature, and also copies of systems of classification from contemporary books.

One folder contained what was apparently Engelmann's class notes of 1832 from lectures by Alexander Braun in Paris. Engelmann's broad botanical activity is indicated by a list of his correspondents including no less than 99 in foreign countries and 70 in the United States. One exchange list shows that he sent, from 1835–1847, 7,900 specimens to Berlin, 2,900 to St. Petersburg and 900 to Asa Gray at Harvard. This list indicated that two of his shipments during this period were lost in transit. The other item of major interest was a collection of about 100 letters, half of them from Ferdinand Lindheimer.

There are no Lindheimer letters in the bound volumes of Engelmann's correspondence in the Garden library, so these fill an important place in that collection. They were written from various parts of Texas during the period 1835–1846. Apparently, there were times when Lindheimer was short of paper, for some of his letters have the pages written on twice: once in the conventional manner in black ink and then crosswise to this in red ink. Sometimes, too, the letter was written over the drawings of plants, which does not facilitate the reading of the German script.

TWO INTERESTING BOOKS ABOUT TREES

Within the last month there have come into the Garden library two books which will be of interest to most readers of the BULLETIN. Both of them are about trees; both are interestingly written and tastefully put together; in other respects they are strikingly different, in format, in subject matter, and in price. "What Tree Shall I Plant," by August P. Beilmann, Manager of the Garden's Arboretum, has been published as volume 31, No. 6, of the *Transactions of the Academy of Science of St. Louis*. It is a convenient bulletin of some 70 pages with an attractively designed heavy paper cover and around 50 illustrations. Under 60 headings it discusses native and exotic trees suitable (or for that matter, unsuitable) for street and lawn planting in the central Mississippi Valley, and includes general

directions for tree planting and maintenance.

For once, here is a book about trees written by a man who knows what he is talking about. Since the time he was a young man, the author, in one professional capacity after another, has had the actual job of planting, pruning, and caring for trees. The book shows this on every page. Too many of the standard works in this field have been written by horticultural writers who had only book knowledge of their subject. Even the one or two which were honestly put together are not particularly helpful in the St. Louis region because they were written from the standpoint of experience along the eastern seabord. Mr. Beilmann's bulletin is being widely distributed by the Academy of Science and should do much to improve tree planting and tree care in this area. Extra copies can be obtained from the Academy of Science, 4642 Lindell, price $1.50.

The other book is a handsomely bound volume with beautiful colored illustrations, many of them covering a full page: "Flowering Trees of the Caribbean," published by Rinehart & Co., New York, price $10.00. To say that it also fills a long-felt want is an under-statement. Traveling through the tropics is a frustrating experience to the plantsman who has grown up in the temperate zone where all common trees have generally-accepted common names and if one runs across a new one all he has to do is ask a few questions and possibly consult one or two reference books. Not so in the tropics. Common names vary from country to country and from town to town. Specialists on the native flora may know the commoner wild trees, but as for those planted along streets and avenues, it is only the commonest half dozen which seem to be accurately known even to most experts.

Under the sponsorship of the Alcoa Steamship Company, William C. White has put together a book which will answer most questions for the thirty flowering trees commonly encountered by the visitor to the Caribbean area. Handsome, but photographically accurate, illustrations by Bernard and Harriet Pertchik leave no doubt in the mind of the rankest amateur as to whether or not this is the tree he has just been looking at in the park. With the assistance of various experts, notes as to the history and relationship of each tree have been effectively brought together and the common names of each are listed for the various Caribbean countries where they are grown. The book is so beautiful to leaf through that many people will want to own it just to look at the pictures, but for those who travel and study in these countries it is something to read and reread.—EDGAR ANDERSON

NOTES

The Camellia Show in the Linnean House at the Garden will be at its peak during the next few weeks.

The Orchid Show attracted 9,375 visitors during the first two weeks, the largest attendance yet recorded for the Orchid Show for that period.

Mr. August P. Beilmann, Superintendent of the Garden Arboretum, was elected president of the St. Louis chapter of the "Friends of the Land" at their January meeting.

On February 6 the snowdrops *(Galanthus nivalis)* were in bloom in the Mausoleum grounds. This is the second earliest blooming date of these flowers during recent years, the earliest being January 23, in 1950.

Recent visitors to the Garden herbarium and library were Dr. Paul A. Daniel, of Cuttington College, Suacoco, Liberia, Africa, and Dr. Delbert Swartz, of the University of Arkansas, Fayetteville.

The St. Louis Orchid Society held its monthly meeting at the Garden on February 8. Enthusiasm about orchid growing in St. Louis seems to be increasing, the Society having more than tripled its membership since its organization a year ago.

Souvenir hunters removed a section of colored glass, about 12 × 6 inches, from Henry Shaw's Mausoleum recently. During the last year several small panels have been torn out at various times but this is the first time that a large section has been taken.

A group attending the national convention of American Heating and Ventilating Engineers visited the Garden, January 30. Mr. G. H. Pring, Superintendent of the Garden, conducted them through the Orchid Show, after which he gave them a talk on "Henry Shaw and the Garden."

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 50,000 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 Southampton buses (No. 80), direct from downtown, pass within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN

CONTENTS

Volume XL March, 1952 Number 3

COVER: *Saintpaulia* BLUEBIRD, medium-violet.

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Missouri Botanical Garden Bulletin

Vol XL MARCH, 1952 No. 3

SAINTPAULIAS

(African-Violets)

GUSTAV A. L. MEHLQUIST

Probably no flowering plant has ever been grown in such large numbers by so many people as the Saintpaulia is today. There are at least three reasons for this. First, the cultural requirements of this plant more nearly coincide with the conditions of the average home than do those of most other house plants; second, it is easy to propagate; and third, it is now avail-

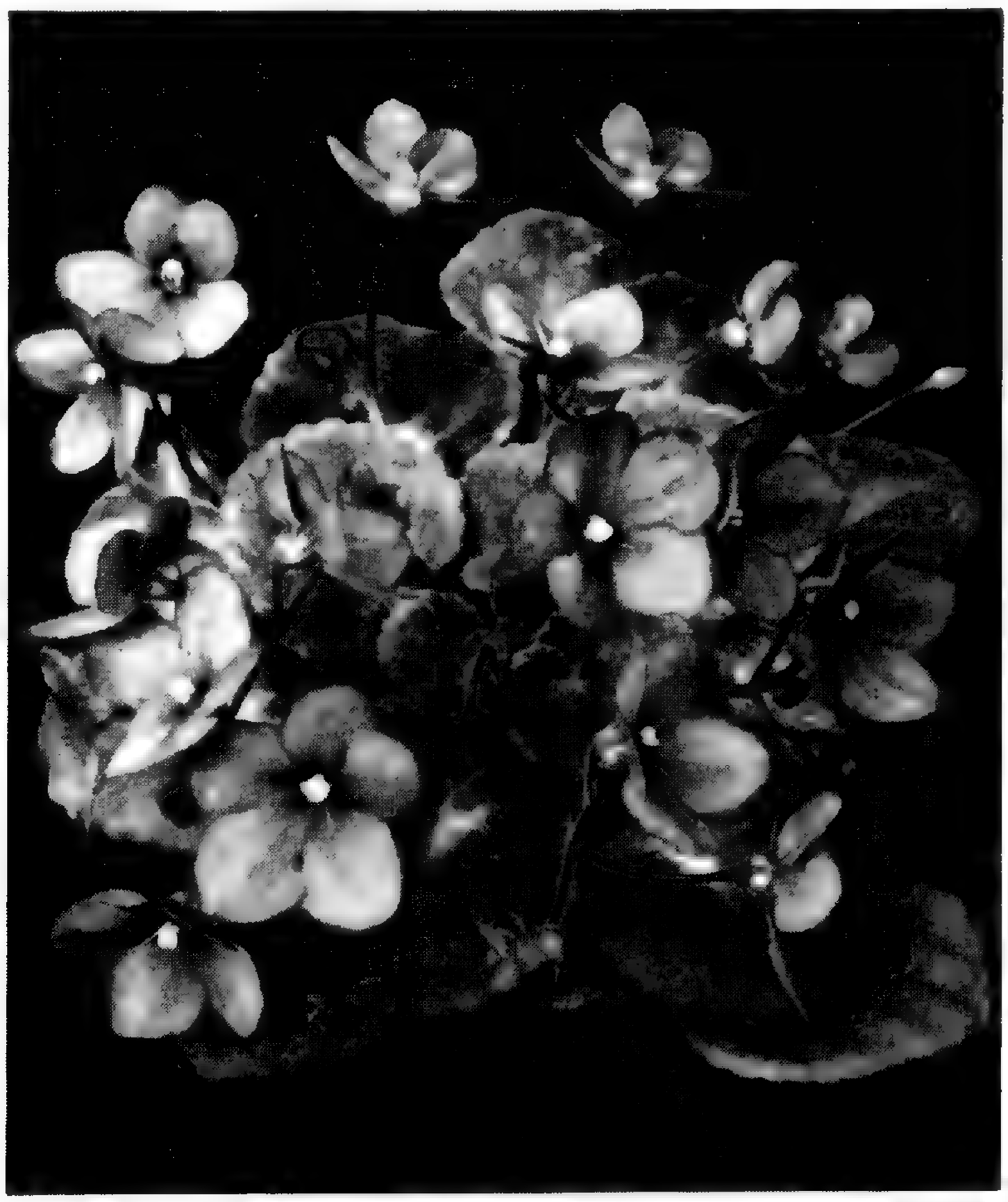


Fig. 1. Blue Girl.

Fig. 2. Saintpaulia seedlings in the Experimental Greenhouses at the Garden.

Fig. 3. Multiple-crown plant on the left; single-crown plant on the right.

able in so many forms that almost every one can find a form to suit his taste and even the collector can satisfy his desire for many colors and types.

It should be pointed out at once that African-Violet is a very misleading name for this plant. To be sure, it does come from Africa, but it is not a violet nor even closely related to the violet family. It is a member of the family Gesneriaceae, to which belong such well-known house plants as Gloxinia, Streptocarpus and Achimenes. Since Saintpaulia (the genus name) is not a difficult name either to pronounce or to remember, there is no reason why it should not be generally used to designate this plant.

Saintpaulia was named in honor of Baron Walter von St. Paul-Illaire whose son discovered it around 1890 in Usambara, a province of Tanganyika in the territory of East Africa. Apparently, what is now considered two distinct species *(S. ionantha* and S. *diplotricha)* were included in the original shipment of seeds. It has been assumed that both of these species have entered into the formation of the group of varieties that we now refer to as *Saintpaulia ionantha,* but this assumption has not to my knowledge been proved. Certainly most of our present-day varieties are more like S. *ionantha* in appearance and behavior than S. *diplotricha.*

Propagation.—Propagation of Saintpaulias can be effected by seeds, leaf cuttings, and division. Since probably no variety of this plant comes true from seed, this method is used only when new varieties are wanted (see under *Hybridization*). If multiple-crowned plants (fig. 3) are available, division affords the best method of obtaining flowering-size plants in relatively short time. To divide a plant, simply knock it out of the pot, separate the crowns, and pot them individually. It does not matter whether each division has roots or not, as they root quite readily under suitable conditions. The main precaution to be taken is not to keep these divisions too wet until they have established themselves in the new pots. If the divisions are large, flowering-size plants can be had almost at once or in a few weeks.

Propagation by leaf cuttings is the method whereby the greatest number of plants can be obtained but usually six to nine months are required to obtain flowering-size plants. Only mature leaves in good condition should be used. It is possible to get plants from even the smallest and poorest leaves but it just takes longer to get flowering-size plants, and such leaves are much more prone to diseases of various sorts. The leaves should be broken off clear at the base of the mother plant and the petioles shortened to about 1–1 ½ inches in length. These trimmed leaves can be rooted in sand, cinders, vermiculite, leafmold, peat moss, potting soil, soil-sand, leafmold-sand, or peat-sand mixtures. In short, the kind of rooting medium is not important provided it is slightly acid to neutral in reaction, well aerated, and not too

Fig. 4. Saintpaulia leaves rooting in water.

rich in nutrients. Saintpaulia leaves can also be readily rooted in plain water (fig. 4), but the cuttings usually take much longer to become established in soil when potted up later on, so nothing is gained by this method except that one learns how roots gradually emerge from the base of the leaves and later how shoots grow into typical little plants.

The leaf petioles should be inserted so deep that they barely clear the surface of the rooting medium (fig. 5). If the leaf blades rest on the surface or are inserted into the medium there is danger of rotting. Regardless of what rooting material is used, it is advisable not to remove the leaves until the shoots formed at the base of the leaves are well above the surface. In fact, if the leaves are spaced far enough apart, the young plants can be left in the rooting medium for a considerable time. Figure 6 shows leaves with numerous shoots that have been in vermiculite for three months without any nutrients added.

Saintpaulias root particularly well in vermiculite and produce numerous plantlets in a short time. This material is light in weight, highly aerated, retains moisture well, and is sterile. If, for some reason, it is not convenient to remove the plants when they are ready to be transferred to individual

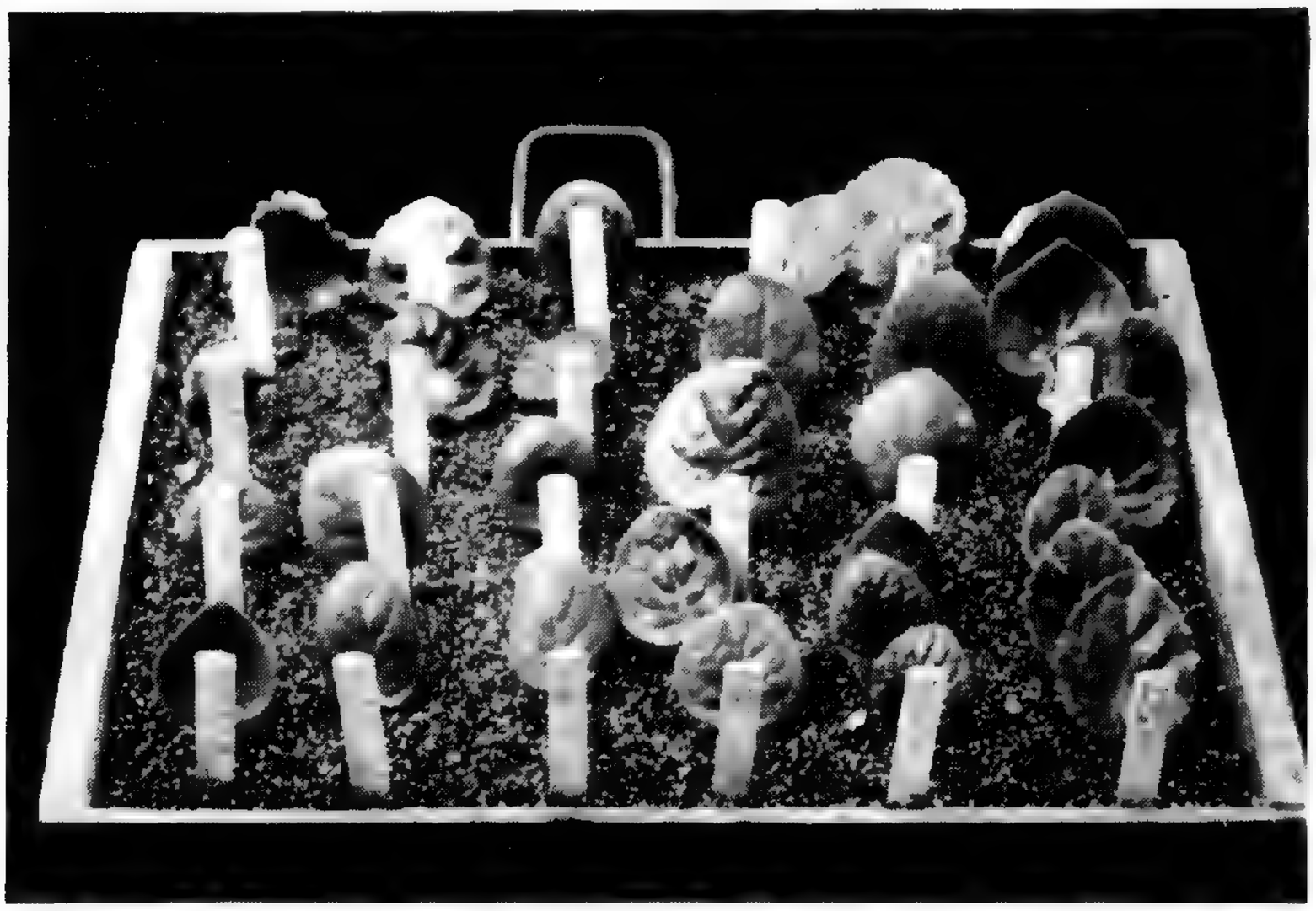


Fig. 5. Saintpaulia leaves being rooted in vermiculite.

pots, usually at the end of 10–12 weeks, they can be left in the vermiculite for several months provided supplementary nutrients are applied. The vermiculite available in the St. Louis area is sold for horticultural purposes under the name of "Terralite." It contains appreciable amounts of calcium, magnesium, and potassium. Although the distributors do not claim that these elements are available, they must be so in sufficient quantity for Saintpaulias, for we have obtained as good results by adding only nitrogen and phosphorus as from the addition of complete nutrients. However, since complete fertilizers are often more readily obtained than special formulas, it is usually convenient to use complete ones. Care should be taken not to apply too strong fertilizers. We have had the best results when only ½ the strength recommended for other pot plants was applied every two to four weeks.

Most people who have tried vermiculite for propagation have been enthusiastic about it, but some have been disappointed, probably because they have not understood how to use it. Our practice is to fill the flats or pots with vermiculite to the desired depth and then stand them in a tray of water until the vermiculite is saturated with water. To insure this we leave them in the tray about two hours, after which they are allowed to drain before being removed to a permanent position. The Saintpaulia leaves, and other cuttings for that matter, can be inserted into the vermiculite as soon as the water comes to the surface but the flats or pots should not be removed from the tray for at least two hours. Students like to work with vermiculite because with this material cuttings can be taken out and examined from time to time with no harmful effect until they are found ready to pot up.

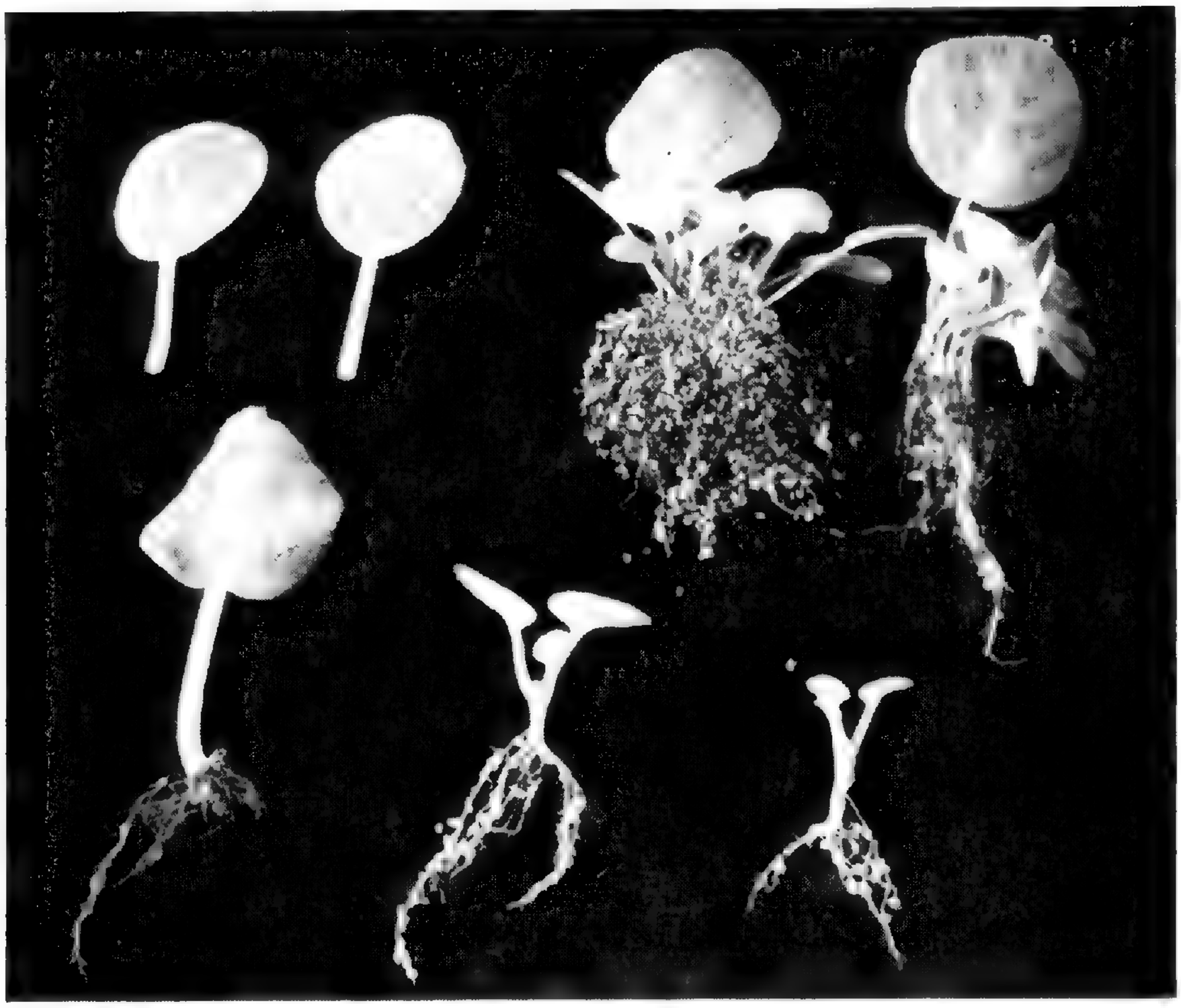
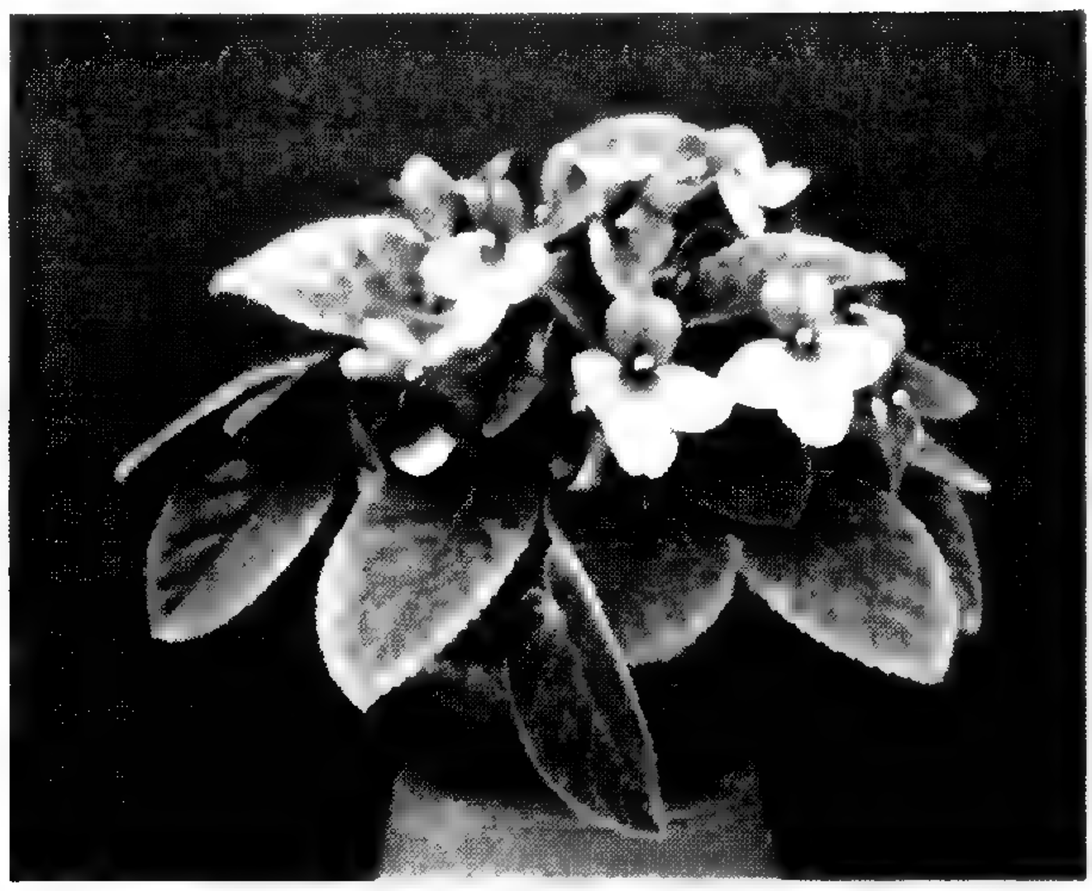


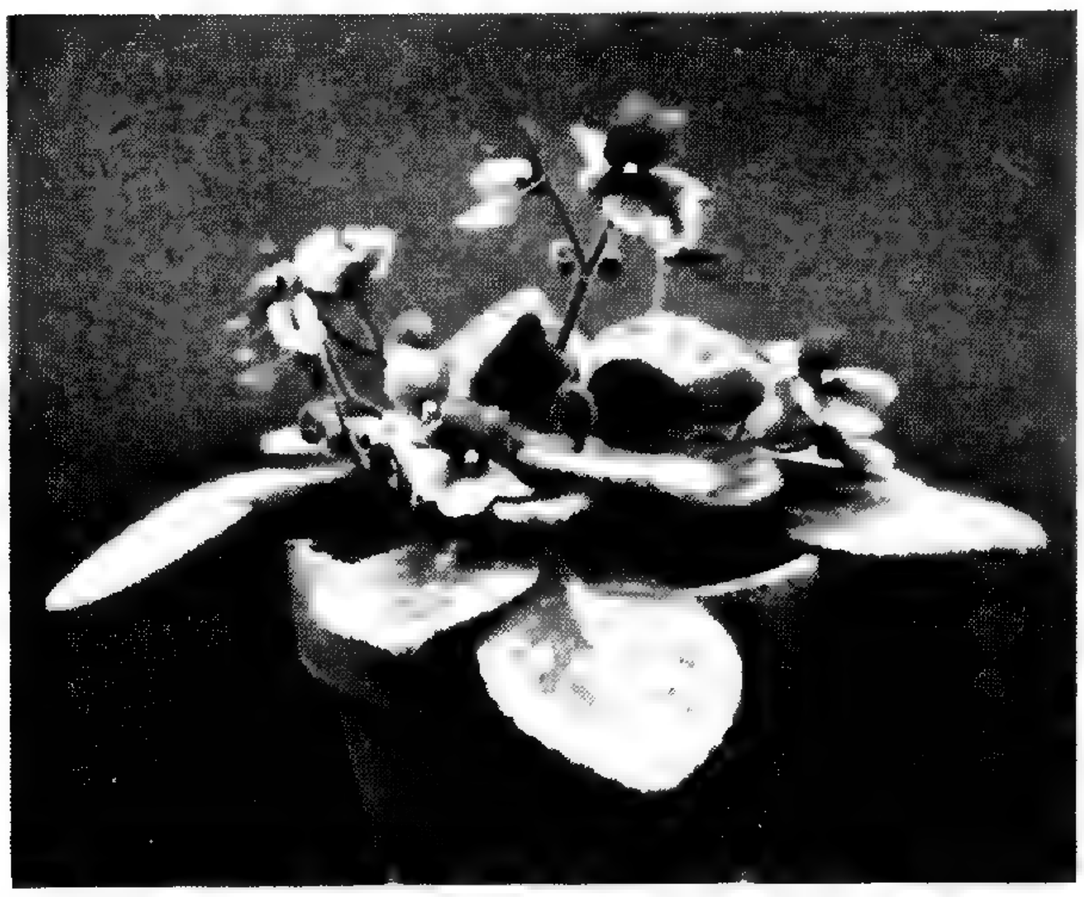
Fig. 6. Upper left, two leaves prepared for rooting; upper right, two leaves after three months in vermiculite; lower left, leaf from which the two plantlets at the right have been removed.

Soil.—Saintpaulias are not nearly as particular in soil requirements as some people would have you believe. If this were so, these plants would not be the universal favorites they are. However, there are three soil requirements that should be met, if possible, in order to produce good plants with a minimum of effort. They are: high organic content, good aeration, and relatively low fertility. We have met them by using the following mixture: 2 parts of garden loam (the best we can find), 1 part Canadian peat moss (really moss peat), 1 part leaf mold, and 1 part clean sand. We pasteurize the loam, the leafmold, and sometimes the sand (2 hours at 160° F.), but not the peat moss as it is generally free from harmful organisms unless it has been lying around with contaminated materials. Because of the difficulty in pasteurizing soil in the home, it is probably advisable to use what is at hand without pasteurization or to buy the required amount of soil from a reliable nursery. However, if you have a pressure cooker and do not mind using it for soil, pasteurization is not too difficult. Fortunately, so far no harmful organism has been found that in its active state is not killed when exposed to 160° F. for one or two hours. Heating the soil beyond this point only serves to eliminate the beneficial organisms along with the harmful ones. In fact, it is for this reason that soil which is completely sterilized, as when it is baked in an oven, often gives poorer results than does unpasteurized

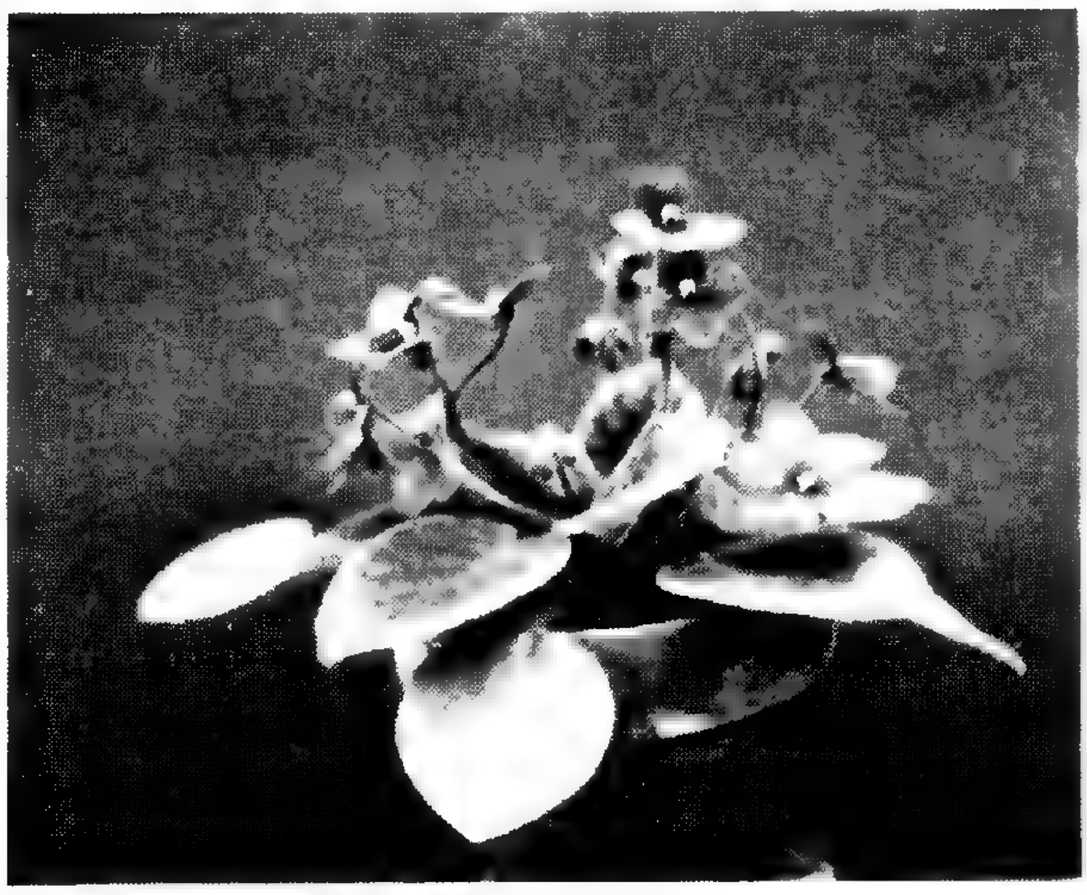
WHITE ATTRACTION



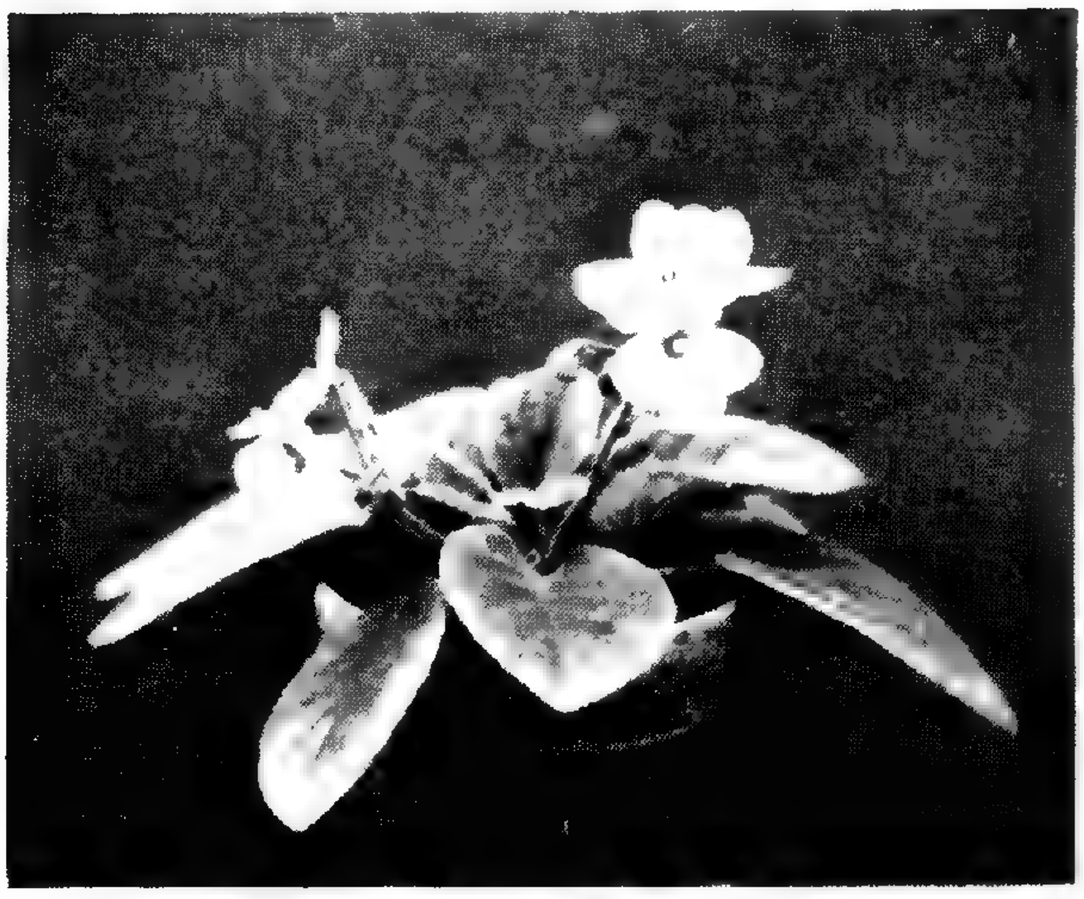
PURPLE KNIGHT—deep violet



MENTOR BOY—violet-blue



PURPLE PRINCE—deep purple



LAVENDER BEAUTY—large-flowered

WHITE HYBRID

SOME SAINTPAULIA VARIETIES

Fig. 7. Saintpaulia plant showing the effect of cold water on the leaves.

soil. Therefore, if pasteurization is attempted, it should be done by steam. How this is done by means of a pressure cooker, the average housewife knows more about than I do.

Watering.—There has been a lot written about the relative merits of subirrigation versus watering from the top. Perhaps it is worth pointing out that because of the difficulties involved in providing subirrigation on a large scale nearly all commercial growers water their plants from the top and often so that the foliage is thoroughly wetted at the same time. To be sure, not all Saintpaulias grown commercially are as nice as those raised in the home, but some of them are better. There are but three simple rules in watering Saintpaulias. First, if the water is allowed to strike the leaves it should be of a higher temperature than the leaves at the time of watering, or whitish spots on the leaves are likely to result (fig. 7). This may mean a few degrees higher than room temperature, for leaves exposed to sunlight (even partial sunlight) may be several degrees warmer than the surrounding air. Second, the plants should be watered so early in the day that any water

spilled in the center of the crown dries up before night-fall, or crown-rotting organisms may get a start and eventually cause the whole plant to die. Third, if more water is applied at the time of watering than the pot can hold, the excess should not be allowed to stand in the saucer for more than an hour or so, as then the soil might remain so wet that the aeration of the roots is reduced to the danger point. Unfortunately, it is impossible to state just how often the plants should be watered, since this depends on so many factors such as the nature of the soil, the temperature, the relative humidity, etc. Probably the correct answer, even though the least helpful, is that the Saintpaulias, in common with most other plants, should be watered when they need it.

Light.—Good specimens of Saintpaulias are grown under various light conditions due to the fact that temperature, relative humidity, and day-length interact with the light, and that success depends on a suitable combination of these factors rather than on any single one. However, it is generally agreed that in terms of foot-candles the light intensity should be not less than 300 nor more than 1200. As the light-intensity requirement is inversely proportional to the day length it follows that the shorter the day the greater the intensity that can be tolerated. Consequently, the plants can stand and actually do better with a higher light intensity during the short winter days than during the longer summer days. Generally, though, it is safer to grow Saintpaulias in the indirect or suffused light that comes through a curtain rather than in direct sunlight, especially in the summer. In too strong light the leaves tend to become light-colored but flowers are produced at a normal rate or nearly so. In too weak light the leaves become long-stemmed and dark-colored, and the flower production is slowed down considerably. There is no harm in moving the plants around the house with the season or until a suitable spot is found.

Temperature.—Saintpaulia being a tropical plant, it is not surprising that it is rather sensitive to temperature changes, particularly sudden ones. Although different varieties vary somewhat in their requirements all those that I am familiar with do best in a night temperature somewhere between 60 and 70° F. The day temperature on bright days should be about 10 degrees higher, and up to 30 degrees higher will do no harm. In cloudy dark weather a day temperature only slightly higher than the night one will be all right.

Humidity.—When one speaks of humidity in relation to plant growing, what is really meant is the relative humidity of the air surrounding the plant. As this term refers to the amount of water in the air compared to the amount the air could hold, and this capacity varies with differences in temperature,

Fig. 8. Double Sea Girl—light blue.

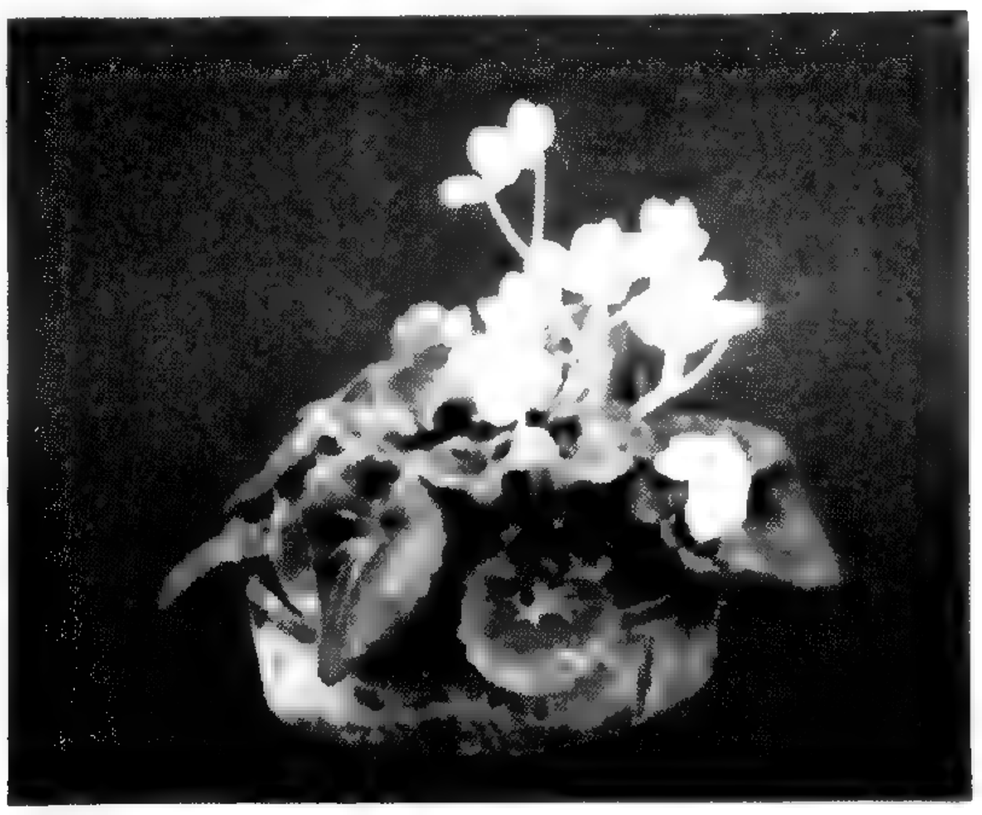


Fig. 9. White Girl.

it follows that the relative humidity is seldom constant but varies during the day and often from day to day. It is not known at just what relative humidity Saintpaulias grow best but in greenhouses, where they do very well, the relative humidity often goes up to 85–90 per cent during the night and then gradually drops to around 50 per cent as the temperature increases during the day. From this it has often been assumed that the relative humidity should be at least around 50 per cent; that is, the air should contain at least one half of the water it could hold at the temperature maintained. If it is necessary to grow the plants near the radiators, where the relative humidity will be the lowest due to the higher temperature, some provision should be made for evaporating water around the plants. This is readily accomplished by placing a tray filled with water on the radiators. If the plants are to be grown in or immediately above the tray it is advisable to fill it with coarse sand or fine gravel which should be kept moist as evaporation is much faster from such material than from a free water surface.

Nutrition.—Saintpaulias do not require a great amount of fertilizer. With the soil mixture mentioned earlier in this article we have had excellent results by applying complete fertilizers only once a month at one half the recommended strength, and we usually skip November, December, and January. Of course, if fertilizers are added to the soil mixture before potting, less will be needed later. It should be remembered that if the plants are regularly watered from underneath various salts from the fertilizers will gradually accumulate in the upper surface of the soil. To prevent this accumulation from reaching injurious concentrations, the plants should be thoroughly watered from above at least once every two weeks.

Pests and Diseases.—Only five pests are likely to be bothersome on Saintpaulias. If these are controlled, any other that might come along occasionally

is likely to be eliminated in the process. Mites which may be either the Cyclamen mite or the broad-mite variety are very bad at times, causing a great reduction in growth and producing smallish, thickened, and twisted leaves in the center of the plant. Various sprays have been suggested, but the only treatment we have found effective is the use of sodium selenate. This is a systemic insecticide readily absorbed from the soil, hence it is applied the same way as a liquid fertilizer. One gram (1/30 oz.) should be dissolved in one gallon of water and the affected plants thoroughly watered with this solution twice, two weeks apart. Care should be taken not to spill any of the solution on the leaves as this may cause burns. This material may check the growth of the plants somewhat but they will soon recover and usually minus the mites. These mites must be gotten rid of, otherwise they will completely destroy the plants in time. Many people fear this material because it is a strong poison, but actually it is no worse if taken internally than many of the newer cleaning fluids often kept around home. However, every care should be taken that no children, big or small, get at it. It is at times difficult to buy sodium selenate in small quantities, but any druggist can obtain it on order and will usually sell it in gram lots so that there will be no need for accurate weighing at home.

The next bad actor is the mealybug, a woolly-white insect a little more than ⅛ of an inch in length. It is very resistant to all sprays that can be safely used in the home. Plants that will stand high water pressures can be readily cleaned by a strong stream of water, but this method cannot be used on Saintpaulias. The cheapest and most convenient way is to select some healthy leaves for propagation and throw away the rest of the old plant.

The third insect that may be troublesome is the thrips, a minute pale-colored insect that attacks the young leaves, causing silvery-white disfigurations and greatly reducing the growth. Any spray containing DDT will readily control it and pyrethrum-rotenone sprays will do a pretty fair job too.

The fourth pest is the springtail, a little white insect often seen in large numbers on the soil in the pots in the evening or in the saucers beneath the pots in the daytime. This insect is said to live on the soil only, causing no damage to the plants. However, it is unsightly and I believe at times injures the tender roots of the plants. It is readily controlled by dusting the soil and saucer under the pot with 5 per cent chlordane dust which is readily obtained in seed stores and nurseries.

The fifth pest is really not an insect but a minute eelworm causing lumps or knots on the roots of many plants, including the Saintpaulia, hence its name root-knot nematode. It causes a general stunting of the plants by

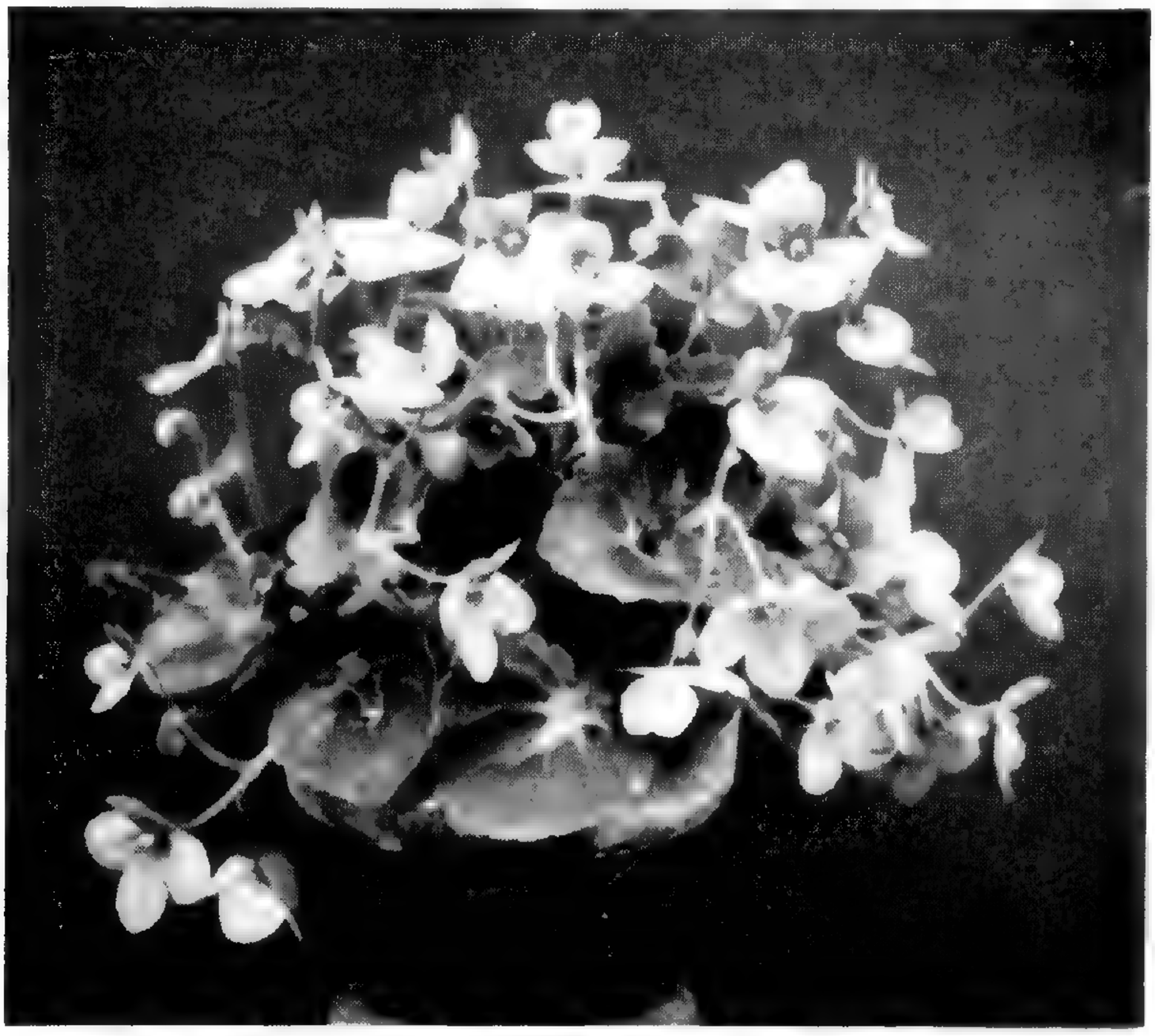


Fig. 10. BLUE BRONZE—pale blue flowers, bronzy foliage.

interfering with the movement of water and minerals through the roots, so the plants may look starved even though they are being watered and fed regularly. These root knots can be readily recognized if the suspected plant is carefully knocked out of the pot and the roots examined. There is unfortunately no remedy known that will eliminate this pest except complete sterilization with steam or chemicals. Because it is a soil inhabitant and occurs from time to time in garden and potting soil, any soil suspected of containing it should not be used unless sterilized. This nematode does not go up into the leaves, and it is therefore possible to remove leaves for propagation without danger of nematodes. However, care must be taken not to handle the soil at the same time, or nematodes might be introduced into the propagation medium and reinfect the plants as soon as roots begin to form, thus repeating the cycle.

Not many diseases bother the Saintpaulia but two or three fungus diseases do occur occasionally. The most prevalent one causes sort of a crown rot, in which the center of the plant rots out or the whole plant suddenly comes loose from the pot due to the "neck" having rotted off (fig. 11). None of these diseases is likely to become serious unless the plants are watered too frequently or so late in the day that the foliage in the center remains wet over night. If the trouble is detected in time a light dusting with fermate and careful watering will usually save the plants. Frequently, a plant whose roots have completely rotted off can be re-rooted in fresh soil and re-established in relatively short time, provided it is not again subjected to overwatering.

Fig. 11. Crown rot on Saintpaulia plants. Plant on the left is completely rotted off; that on the right is badly affected but probably could be saved.

Hybridization.—Space does not permit a complete discussion of this fascinating subject but a few pointers may be of value. Seed is readily obtained from most varieties if artificial cross pollination is made, and sometimes, but not so readily, from self-pollination. Self-pollination involves pollination of the stigma or pistil by pollen from the same plant or other plants of the same variety. Cross-pollination involves the transfer of pollen from one variety to the pistil of another. Some varieties set seed more readily than others, but it makes no difference whether a given variety is used as the seed (pistil) plant or pollen plant. For some reason, there is a common belief, expressed in most books and articles dealing with Saintpaulia hybridization, that the seed parent will have a greater influence on the constitution of the progeny, and the pollen parent the greater influence on the flower color. There is no theoretical reason for this assumption, and the results obtained with Saintpaulia, and many other plants where a great deal of breeding has been done, do not support it either. However, if one parent has a greater number of chromosomes than the other, it will contribute a correspondingly greater number of genes or hereditary factors to the progeny and consequently exert greater influence as regards every heritable character. Preliminary studies made by some of my students indicate that the so-called "Amazon" or "Supreme" types, as well as DuPont's hybrids, have higher chromosome numbers than the ordinary types. This greater number of chromosomes usually causes larger flowers and larger pollen grains (figs. 12

Fig. 12. Left, flower stem from giant mutant of BLUE BOY; right, flower stem from normal BLUE BOY.

and 13). To my knowledge, no one has definitely established just what the chromosomal constitution is in any of these giant types, but presumably they are tetraploids, which means that they possess twice the number of chromosomes of the ordinary varieties which are diploids. Through treatments with colchicine it is fairly easy to produce giant types that are similar to those already mentioned. In describing these giant varieties they should be called "gigas" types, as this term has been used in genetics and plant breeding to denote just such types for some fifty years.

The most intriguing problem in Saintpaulia breeding probably is that of producing a yellow-flowered plant. Unfortunately, no yellow-flowered species has yet been reported, hence there is no good starting point. In the three genera that are most closely related, namely Episcia, Petrocosmea, and Ramondia, there appears to be only one, *Petrocosmea Kerri* from Siam, which is said to have yellowish flowers. It is not known whether any intergeneric hybrids can be produced in this family, and even if it proves possible, it is by no means certain that a good yellow-flowered Saintpaulia-like plant could be obtained. Several years ago I made the statement that no intergeneric hybrid had ever been produced in the family Gesneriaceae. I was promptly challenged by a member of the garden club where I was talking and was even offered seed of a Streptoxinia allegedly a cross between Streptocarpus and Gloxinia. I gratefully accepted the seed and grew a large number of seedlings (over 300), all of which proved to be a small-flowered form of Gloxinia. The fact that apparently no intergeneric hybrids have been pro-

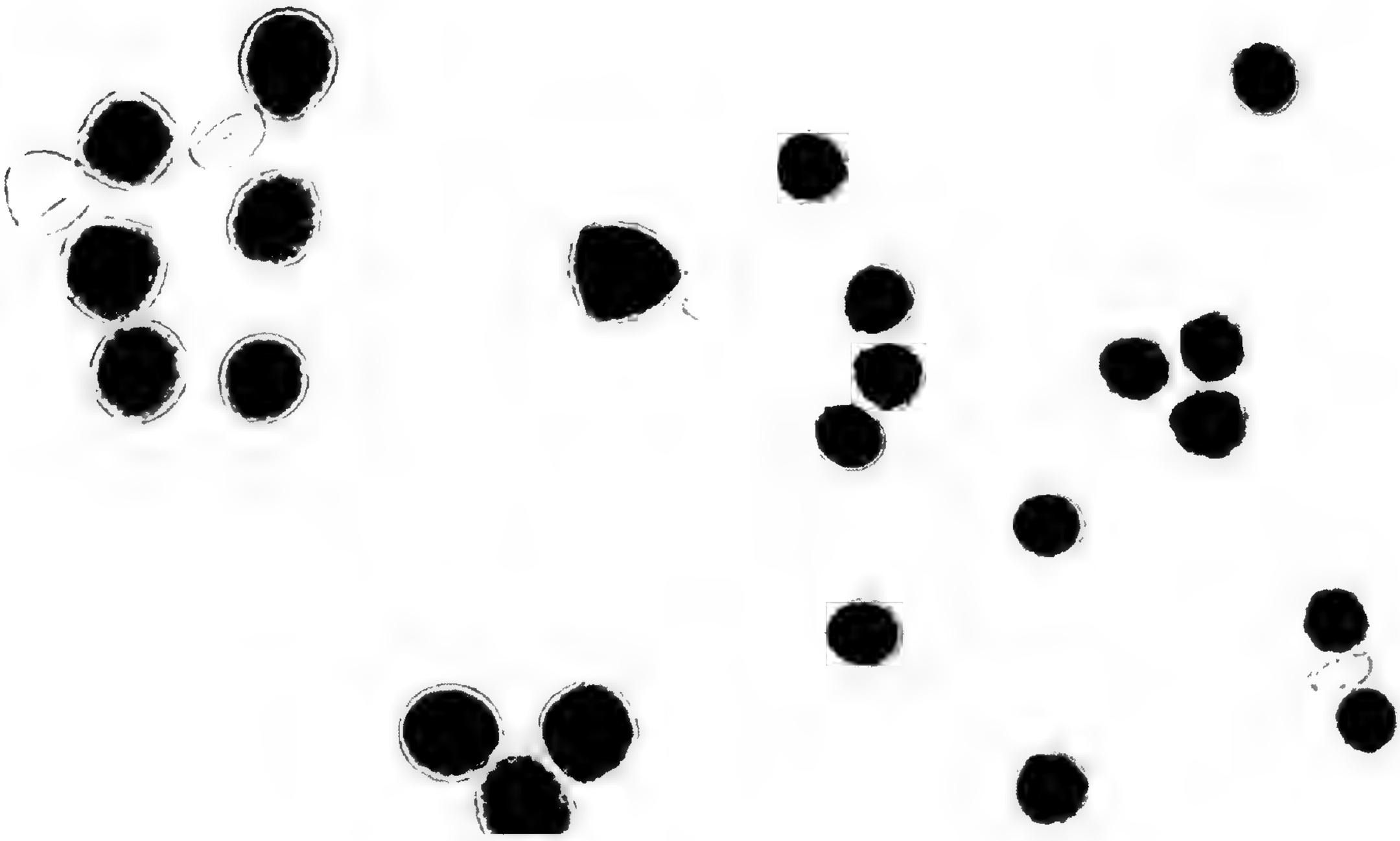


Fig. 13. Left, pollen grains from giant mutant of BLUE BOY; right, pollen grains from normal BLUE BOY.

duced in this family does not necessarily prove that they cannot be obtained, but it probably will not be easy.

X-ray treatments provide another line of attack which might be worth trying. Again, it is not known just what sort of treatment would be most effective, but those who have access to such equipment might try by exposing the plants to various dosages at the time germ cells are formed, in the hope that mutations heretofore not seen might occur. From data obtained from other plants it is very likely that yellow flower color would be determined by a recessive gene, and recessive gene mutations are probably the ones most likely to occur from x-ray treatments. Crosses involving the pink and white form of Saintpaulia probably are the most likely to produce yellow forms if it is at all possible with or without any external treatment.

The seed pods require a rather long time to mature, occasionally more than nine months. The seed germinates readily when fresh and sometimes year-old seed germinates as well. Any one of the mixtures or materials recommended earlier in this article for rooting of leaves is also good for seed germination. As the seed is very small it should be covered but lightly, if at all. The main precaution to be taken is to keep the seed bed, especially the surface, evenly moist until the little plants are well established. If the seed is planted in the late winter or spring the first seedlings may show their blooms in six months, but usually more than a year is required to flower

them all. Since the most interesting varieties often will come from the slowest seedlings, none should be discarded until it has bloomed. It may require large numbers of seedlings and good judgment in the selection of parent plants to produce world-beaters, but nearly every batch will produce some interesting ones.

For references or further reading the readers are referred to the *African Violet Magazine* and to two recent excellent books: "All about African Violets," by Montague Free, Doubleday & Co., Garden City, N. Y.; and "African Violets," by Helen Van Pelt Wilson, Barrows & Co., New York.

Most of the photographs in this Bulletin were taken by my colleague, Ladislaus Cutak. The cover illustration and the illustrations on pages 55, 58, and 60 are from plants in H. C. Renner's Greenhouse, Olivette, Mo.

NOTES

Miss Nalini Nirodi, of Central College, Mysore University, Bangalore, India, arrived in March to begin her graduate studies at the Henry Shaw School of Botany as a Pioneer Hi-Bred Corn Company Fellow.

Mr. George H. Pring, Superintendent of the Garden, acted as chairman of the judging committee at the Nashville Orchid Show, March 8, and on March 19 he attended the meeting of the American Orchid Society, in New York.

The first number of Volume XXXIX of the ANNALS OF THE MISSOURI BOTANICAL GARDEN was issued in March, with contents as follows: "Variation and Hybridization in *Juniperus*," by Marion Trufant Hall; and "Spikelet Variation in *Zea Mays* L.," by Reino O. Alava.

Dr. G. A. L. Mehlquist, Research Horticulturist at the Garden, has given short courses in horticulture recently at Massachusetts Agricultural Experiment Station, Waltham; and at Denver and Fort Collins, Colo., under the auspices of the State Florists and Colorado A. & M. College.

Recent visitors to the Garden include: Dr. Balaji Mundkur, who received his doctor's degree in the Shaw School of Botany and is now returning to the University of Bombay, India, after being two years at Southern Illinois University, Carbondale; Mrs. Gretchen Harshbarger, of North Liberty, Iowa, Garden Editor of *Household;* Dr. Norman C. Fassett, of University of Wisconsin, Madison; Dr. E. R. Spencer, Soil Consultant, Lebanon, Ill.; Rev. Enrique H. Schoenig, S.V.D., of University of San Carlos, Cebu City, Cebu, P. I.; Dr. John M. Voight and Dr. Ernest L. Stover, of Southern Illinois University, Carbondale, with two groups of students in botany from that institution.

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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 50,000 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.

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MISSOURI BOTANICAL GARDEN BULLETIN

CONTENTS

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COVER: Wood Duck Lake at the Garden Arboretum, Gray Summit.

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Missouri Botanical Garden Bulletin

Vol. XL APRIL, 1952 No. 4

WHY AN ARBORETUM?

AUGUST P. BEILMANN

Webster's definition of an Arboretum as "a place where trees are grown for scientific purposes" allows much latitude in activity. A resume of the functions deemed suitable for an Arboretum in the past, as well as those at present, indicates that as needs and customs change the Arboretum administration has generally attempted to meet the requirements. During the heyday of the explorer-collector plantsman most Arboretum effort was directed toward systematic classification and the planting and testing of new species. Systematic classification and identification will always be a major activity. A published description of the plant, along with a suitable name, is the very beginning of any botanical effort. After a plant has been described and named according to a set of rather formal rules, that name will be used by all botanists regardless of the part of the world in which they work or the tongue in which they write.

The planting and testing of new species very often had some potential economic aspect. Perhaps seeds of great commercial or even medicinal value were collected and forwarded to the Arboretum for trial. This was certainly well within the limits of Webster's definition, and such activities will always retain their important position. The days of Douglas, the Scotch botanist who explored in California and Oregon before 1830, and E. H. Wilson, who brought many things from China, Japan, and Korea are probably over. However, there will always be some activity in plant collecting, and in the future it may involve other explorers and other Arboreta. Perhaps the scene will drop further down the bulge of the world and involve plant explorations in the tropics, near-tropics, and the test stations of the same latitude. Should such a station grow more than one tree it can certainly be called an Arboretum, although its primary purpose may have commercial applications not ordinarily associated with a scientific institution. In the northern latitude the need for more information about forest trees, land use, as well as the ornamental aspects of plants, can only be obtained

The Trail House at the Arboretum

from an Arboretum. It is only here that a long-range program, once begun, is not likely to be side-tracked by some problem of the moment.

The identification, the labeling, and the assembling of like species into groups for ready reference and study have always been considered a function of the Arboretum. As has been indicated, identification is, and always will be, important although it is also becoming increasingly complex as more of the world's plants are becoming known. The complexities will further increase as the geneticists, delving into the parentage of whole plant families, publish the results of their findings. The continued efforts of paleobotanists, uncovering the long-preserved forms of ancient plants, may help clarify certain relationships. The labeling of plants is a mechanical operation, but no Arboretum whose facilities are open to public inspection considers this an unimportant function. In this field at least the modern Arboretum excels. New material, new methods, and new equipment make it possible to use labels which are much more durable, more easily read, and less costly than the more elaborate cast labels of a generation ago. The use of plastic sheets, sometimes in contrasting colors, and the lettering by automatic routing machine make it possible to produce superior labels of good legibility. Plant labels have a curious fascination for collectors of *trivia*, and the total annual loss for necessary replacements is sometimes stupendous, always a great nuisance, and never a trivial matter.

The old practice of growing plant species in related groups is becoming somewhat less used in an Arboretum. Perhaps the loss of soil fertility has been partly responsible. In the modern Arboretum, it has been found impracticable to group all the related species for ready comparison. Often it is much more satisfactory to plant a species on a suitable site regardless of its relation to its neighbors. However, systematic plantings do have many advantages. When all of the closely related plants are placed together, many of the variations due to soil, site, and exposure are reduced and the opportunity for critical comparisons is improved. The careful keeping of records is akin to labeling. In this field a routine operation can be turned into a scientific one. To keep accurate records requires equally accurate maps, so that the original location and identity of any plant, regardless of size, can be determined long after a succession of souvenir hunters have removed label after label. The system used must be flexible enough and so dependable that the history and behavior of any plant can be found in the records. Keeping records of 1,000 to 10,000 new plants annually becomes quite a chore, but these records are the very foundation on which an Arboretum is built.

A typical system may work as follows: When a plant is received, its name, origin, and any other pertinent information about it is entered in a book, and the plant automatically is given a number which it carries throughout its existence. If another specimen of the same species arrives on the same day or years later, it is entered under a different number, and these records are also entered on cards filed alphabetically. Should the plant succeed and grow, it will be included in one of the nursery inventories, and will appear and reappear in the inventories until it attains a size permitting its permanent planting. When planted out, its location is marked on the map of that section. Throughout this time, and even after permanent planting, notes are kept up to date on the behavior of the plant. Should the plant die, this is entered in the planting record. Over a period of years a mass of information has accumulated concerning the many species and varieties which could not have been obtained except through the careful keeping of records.

Perhaps in the field of development and maintenance the present-day Arboretum enjoys the greatest advantage. It seems that almost every bit of land needs some corrective topographic changes to make the area completely suitable for the many species grown in an Arboretum. Ordinarily, the better that a road or some such major feature fits into the landscape the more certain it is that careful attention was given to the grading. The earth-moving machinery available today so far out-strips the multiple-mule equipment of early days that there is no comparison. The most elaborate

Beginning to dig Wood Duck Lake at the Arboretum

lake, for instance, can be dug at a fraction of its cost a generation ago. Much of this machinery can be obtained in highly portable and flexible models, and it becomes more and more necessary as additional plants are acquired and as plant families are added. Whether an Arboretum purchases the necessary heavy equipment or has this work done under contract depends entirely upon local conditions. The same increased efficiency of machinery applies to the smaller farm tools. High-speed plows, more flexible tractors, and a vast assortment of accessories are available which make it possible to increase the output per man hour and reduce the drudgery.

Some of the supplementary tools for use with farm tractors range from digging machines for tree planting to snow plows and front-end loading devices handling all the bulk material which ordinarily would require a considerable portion of the available labor. The day of the wheelbarrow, rake, and shovel as a standard tool for each workman is now only a memory. Perhaps the quality of the gardening has somewhat deteriorated, but the opportunity to plant on a vast scale and create the necessary conditions has much improved. It seems that the continued loss of soil fertility has hastened the day of heavy machinery. With the higher fertility of earlier days a wheelbarrow of manure from the stable was all that was required to grow plants. Today the need for such material has increased a hundredfold, and much more is required to duplicate the accomplishments of those gardens of an earlier generation.

Since there seems little chance, in the foreseeable future, of obtaining the funds or the man-power to carry on many of the time-honored functions of a botanical garden, it seems that our attention should be directed toward conservation problems and demonstrations of wise land use. In place of the one, or ten or more men per acre, required for the highly developed garden we have less than $\frac{1}{300}$th man per acre. Most of the work is carried on by machinery, much of it "heavy" machinery, and those activities needing too much man-power are simply set aside for the moment. This means that much of the area will remain "rough," and only a very little will show the polish possible through hand finishing.

The picture having changed little by little and decade by decade, the greatest opportunity to-day for public service for an Arboretum such as ours lies in the field of "land-use." This is a term which quite recently has come to have an all-embracing meaning. Once it described the kind of crop which might be grown, or the use which might be made of urban real estate. But now it has come to mean the relation of man to the soil; the interdependence of game and crops, and the relation of rain to forests and grass. It means the wise use of all our resources. It means that we must solve some of the problems caused by an expanding population without reducing our capital—the top-soil, the trees, and the grass. We must provide the food, the timber, and the game, and do it without loss of time. This is both conservation and wise harvesting.

Haying field at Arboretum ready for pick-up baler.

Loading and hauling gravel from the Meramec River at the Arboretum.

Here then is the opportunity within the boundaries of the 1,674 acres of the Garden Arboretum. There is room for controlled experiments in forestry; since we have always been interested in seeds, seedlings, planting, site relationships, growth rates, and finally the harvesting. Our experience with the saw-mill has resulted in some local acceptance of lumber cut from species not ordinarily in commercial use. Over the years, thinning of trees in a wood-lot has resulted in an increased game capacity. The use of a "chipper," to reduce thinnings, and foliar feeding of woodland trees both appear to hold promise as growth stimulants of the remaining trees.

The 800 acres of grassland, the herd of Aberdeen-Angus cattle, and a wild herd of 30 to 60 deer provide an opportunity to study forage and the plants of the prairies. Much more must be known about grazing pressure and seasons and what combinations of grasses, herbs, and legumes will support cattle and game. The role of the honey bee as a pollinator of wild flowers has been clearly demonstrated in the rapid increase and distribution of some plants. Less information is available on the pollinators in the maintenance of pasture and prairie plants, which is one of the most important facets of bee-keeping. The Arboretum contains four lakes, and the area is bisected by Brush Creek and the Meramec River. Here we have different habitats, with the various floras, birds, and animals partial to such areas. Here too is the opportunity to study rainfall and floods. Brush Creek, in fact, has become a yardstick and a demonstration of what can be done toward flood reduction through wise land use. The return of the

nearly extinct minnows to the "creek that never floods" is of interest to both fishermen and serious students of conservation.

Who are the people and organizations who benefit from the careful labeling, the plantings, the observations on deer browsing, the demonstrations of flood reduction, and the pollination work of the honey bee? Who would be interested in the birds of a marshy shore, the food preferences of quail, or the life span of a Scots Pine? Of first importance are children and their teachers. Men are the products of the soil on which they live—to-day as well as yesterday. Therefore an Arboretum should have wide use by school children, and the land-use displays should be so organized that children can derive some benefit from their visit. Second are the botanists and horticulturists. The systematic plantings, the labeling, and the record keeping are the tools used by them at all times. Third, the various state and federal agencies should be able to draw upon the knowledge, gained from long experience, as a guide in the use of plant material. Then there is another large group—the conservationists. They may be interested in habitat restoration, the reduction of flood crests, or the carrying capacity of a given range for either birds or animals. Lastly, there are those who have only a mild interest in growing plants. Special groups have not been mentioned, since it has been assumed that Scout organizations, florists, nurserymen, and even sportsmen are either represented or have a representative in these major classes of visitors. A modern Arboretum can appeal to a large segment of the population. It grows something of interest to almost every one.

It does little good to gather information unless it is made available to the ultimate user. Therefore publication of the observations is of primary importance. But a gardener may not be interested in the complexities of crow shooting, nor would all beekeepers be equally concerned in flood control. The forester may consider some thinning practices too costly, while the game manager would immediately recognize the opportunity for increased game range. An Arboretum should be able to supply some information to many people and still carry on its work so that those not trained in biological fields feel fully repaid after a visit.

The spring flower show now being held in the Floral Display House is designed to represent a Dutch formal garden, with grass and flower squares alternating in a checker-board fashion. Looking down from the south balcony one is impressed with the gorgeousness of colors—orange and red climbing nasturtiums, masses of golden calendulas mixed with deep blue cinerarias, pink azaleas and roses, stocks, kalanchoes, primroses, schizanthus, etc., in all the rainbow hues. But one of the most delightful features is the fragrance which permeates the whole house.

The little elm is doomed. Its companions have already died and left no trace except the convolutions of the grape vine.

THE RIVER BANK GRAPE

AUGUST P. BEILMANN

Have you ever wondered why a grape vine doesn't grow straight up the tree it has selected as a support—why so much of it is draped about in fantastic curlicues when the shortest way to the top would be in a straight line? Well, in reaching for sunshine grape vines do grow as straight as possible, but long before they become fixed in the crown of a forest giant, the individual vine has won several battles in the race for survival. With the grape vine it is a race to reach the sunlight.

A germinating grape seed, if fortunately placed, sends its first shoots upward and in the region of adequate light. If the swaying tip encounters a woody twig within the sunny area, it immediately grasps the support and continues the upward growth. Generally a grape vine has little difficulty in finding adequate support. An abandoned field, or even a small opening in the woods, is quickly taken over by the maximum number of tree seedlings. The vine will grow faster than most of the forest trees, and shortly it appears above the tip of the little tree which furnished its first support. When it reaches the topmost shoot it grows upward for a while, but soon it is unable to bear its own weight and it is forced to grow horizontally. At this time many auxiliary buds open and grow, completely engulfing the little tree while probing for additional support. Often the little trees are but inches apart, and then the grape can grow from tree to tree, shading out and destroying all the smaller ones in the process. If there are no adjoining trees the grape develops into a mound of vines, the oldest and lowermost acting as a trellis for the new annual growth. This vegetative growth may continue for many years and the single vine may eventually cover considerable territory. However, such mounds are usually formed when a mature tree, smothered by the grape, finally dies and then collapses.

While a grape vine never grows as straight or taut as Virginia Creeper, Poison Ivy, or Trumpet Creeper, the loss of the little tree support leaves the grape with even more slack and the first festoons appear. The continued loss, through shading, of even larger trees allows more and more slack in the main branches of the grape vine. At the end of twenty-five years such a vine may be well established in the crown of a thirty-foot tree but the vine may be three times that long.

A careful examination of a mature grape vine will often reveal a number of very sharp bends and twists. These mark the places where it topped a supporting tree and was forced to grow horizontally for a while. Meanwhile, additional axillary buds open, and the vine probes for another trellis.

When a taller tree stem is encountered in adequate light the upward growth continues. But eventually all the smaller trees are shaded out; they were but stepping-stones as the grape attempted to keep pace with the annual growth of the forest trees. Sometimes the whole story can be reconstructed —the sharp bends, the approximate location of the missing trees, and the vine emerging from the soil fifty or more feet from the forest giant now acting as a trellis. A grape vine can rarely kill a full-grown tree; usually the tree crown is too dense to admit sufficient light for the suspended vine. However, if the mature tree falters in its growth rate and enough light is admitted, the grape will quickly take over and the tree is doomed.

There are at least nine species of wild grapes in Missouri and they are all important food plants for game. Some species can be found from the river bank to the dry oak ridges—a very versatile plant. Many of the early travelers commented upon the immense size of the vines but now we seldom find a grape vine larger than four to six inches in diameter.

A NEW HENRY SHAW LETTER

By a series of strange coincidences a piece of Henry Shaw correspondence has returned to St. Louis after more than one hundred years. Mr. Louis F. Yeckel, a resident of St. Louis and an enthusiastic philatelist, recently ordered from an eastern stamp dealer a letter folder sent before the days of stamps. (At that time the postage cost was simply paid to the post-master, who marked the amount on the envelope.) When the folder arrived Mr. Yeckel was much surprised to find it addressed to Mr. Henry Shaw in England and enclosing a letter written by "Caroline Shaw." Mrs. Yeckel, thinking is more than likely that the addressee was our Henry Shaw but never having heard of any of Shaw's relatives living in St. Louis, brought the letter to the Garden for verification. It was true. The letter was written by Shaw's younger sister (later Mrs. Julius Morisse). On a previous visit to England, in 1840, Caroline had accompanied her brother.

From where the dealer had received this letter we do not know. Did Mr. Shaw, by any chance, leave it with relatives or friends in England who preserved it all these years and only recently sold it for the intrinsic value of the post-mark? If the envelope had been purchased by any one else than a St. Louisan, it might not have been recognized and might never have found its way home. The letter, which Mrs. Yeckel was good enough to have copied for us, is here reproduced:

St. Louis Dec. 16, 1846

My dear Brother

Two weeks since I had the pleasure of receiving your much esteemed favor from Amsterdam in which you mention having received all my letters up to Sept. 16th, and hope we shall have no further interruptions in our correspondence. Your imagination

pictured truly when you supposed me sitting by my "cheerful coal fire" when I read your letter—the evening was severely cold and as the twilight deepened I had drawn the rocking-chair nearer a bright and cheerful fire whose comforts I was quietly enjoying when your welcome letter was brought to me. I read it by the fire light and smiled to think how exactly your imagination had corresponded with the fact. I have also received from Sarah [another sister] your interesting journal from Amsterdam, &c. You have found by mine of Oct. that the bills of Sales tho' delayed came duly to hand. Since my last I have not much in the way of business—The settlement of the late Mrs. Soulard's estate has not progressed as rapidly as was expected. Something will be paid in January, and also H. G. Soulard's note for upwards of $2000 will be paid—Do you wish me to continue to loan as here tofore or do you think it more advisable to deposit the monies I receive in Bank to remain until your return? I notice what you say respecting the pressure for money in Europe and observe that it has in some measure extended to N. York. I think Mr. Tiffany is disposed to overrate the value of property, or rather he falls in too much with the extravagant estimates now placed upon property in and about the City. This makes me cautious respecting loaning lest the security he thinks ample should not be so in your view. The President's message is peremtory respecting the Oregon question,—should England be equally so, I suppose war will probably be the result. What effect that might have on the value of property here I suppose can hardly be foreseen. I shall wait your answer to this before I make any further loans.—You will see by Cash account annexed that the tenants at B. Desnoyers are pretty punctual in their payments. I find it advisable to make some change with Strautmann & Reiger. I have permitted them to give up their lease and have concluded the rent to another man and Strautmann, for four years from this time at $5.00 per acre. The house is very much out of repair—O'Halloran promised when he leased to rapair & find lumber for a shed or stable—all that has been done towards it is the allowance of $2.00 as per acc't. following for joists, and Mr. Lindell agreed with me that it would be doing well to bind them to make the necessary repairs and make the rent the same as the other tenants on that part of the land.—I have done better with Wetzel & Cluke than I expected, having secured the whole of the year's rent for the land. I am about to rent the land now occupied by Donnelly to a Frenchman (from France) named Chironze & his brother at 3 dols per acre—I think it probable he may purchase of you hereafter. I have not infrequently, a levee of farmers in my little parlour.

[Account follows].

. . . . . .

The tax for resurvey of Manchester road was divided equally between the petitioners viz. yourself, Jopling & Conney. Jopling paid his share, but as Conney had signed the petition merely to accommodate us and the alteration of the road would not have affected him, I thought it right to pay his part of the tax. Bridget returned to St. Louis about 10 days ago—I had felt uneasy about her as the weather was very severe. She came 60 miles by land in an open wagon and was a good deal exposed. She had a bad cold when she reached here but is now recovered & ready to begin work. I have bought her a warm shawl and other clothing and from this time she is to pay $4 per month as before. The Capt. told her he shall wish to hire her again when the river opens.

. . . . . .

Corn has advanced to 30c per bu. at which price it will probably remain for sometime. Mr. Lindell thinks it will be higher next Spring & Summer, but as we shall at that time have full employment for the teams we must sell our crop chiefly this winter. About the 25th of last mo. (Nov.) winter commenced in good earnest. Last week the river was frozen over so hard that it made a firm bridge across the Mississippi and for a few days light teams & foot passengers were constantly crossing. For a novelty Miss Welsh & myself walked over to Illinois Town on Saturday. Since that it has thawed so much it is no longer safe—today is uncomfortable enough with rain & snow. Kemper College has been purchased by the County Court and is to be converted into a poor house—it was sold for debts the Co. Court having given the amount of the liens against it, viz. $13,000. I fancy the location of a poor house will not enhance the value of property in that direction. On Thursday last Miss Sanford (Mrs. Capt. Clark's sister) was married to Mr. Ransom of Albany. After the ceremony, which was at her father's, she came to St. Louis & received her friends at the Planters' House—having an invitation I went with the crowd to pay my respects to the bride. Cold as it was they started in the Stage next morning for Louisville. You have no doubt received letters from sister before this time—hers of August & Sept. must be lost.

I hope none of mine will have a similar fate. I had the pleasure of a letter from Sarah yesterday by which I learn that she & dear mother are both well. Allow me to wish my dear brother a "Merry Christmas & happy New Year" tho' this will not come to hand until both are over. I remain as

ever your very affectionate
/s/ Caroline Shaw

P. S. I see by the papers that Mr. Charles Chouteau was married in Washington on the 27th of Nov. His father & mother are gone to spend the winter in N. York.

/s/ Sister Caroline
16 dec. 1846

NOTES

The three orchid alcoves in the Floral Display House are now filled with orchids, mostly *Cattleya Mossiae* from Venezuela.

The annual flower sermon, provided for in the will of Henry Shaw, will be preached at Christ Church Cathedral, April 27, by the Rt. Rev. Arthur C. Lechtenberger, Bishop Coadjutor of the Diocese of Missouri.

Dr. Henry Schmitz, Dean of the School of Agriculture and Home Economics of the University of Minnesota, who received his doctor's degree in the Shaw School of Botany, has accepted the presidency of the University of Washington, Seattle.

Miss Amy Gage, Scientific Assistant at the Garden, has been awarded a predoctoral fellowship of the National Science Foundation for the years 1952-54. She will continue her research on chromosome morphology of Delphinium, particularly of *D. Belladonna.*

Dr. Edgar Anderson, Assistant Director of the Garden, is giving the course in genetics and natural history for the spring quarter at Stanford University, Palo Alto, Calif. Dr. M. Trufant Hall, of Cranbrook Institute of Science, Bloomfield Hills, Mich., will take over Dr. Anderson's classes at Washington University during his absence.

Recent visitors to the Garden include Dr. D. Isley, of Iowa State College, Ames; Dr. Sergio Tonzig, of the Botanical Department, University of Milan, Italy; Prof. P. Chouard, of the French Ministry of Education, Paris, France; Dr. Julian A. Steyermark, of Chicago Museum of Natural History; Dr. Alfred A. Etter, of New Mexico Military Institute, Roswell, N. Mex.; Mr. A. J. Proebstle, orchid-grower, Brazoria, Texas.

THE MISSOURI BOTANICAL GARDEN

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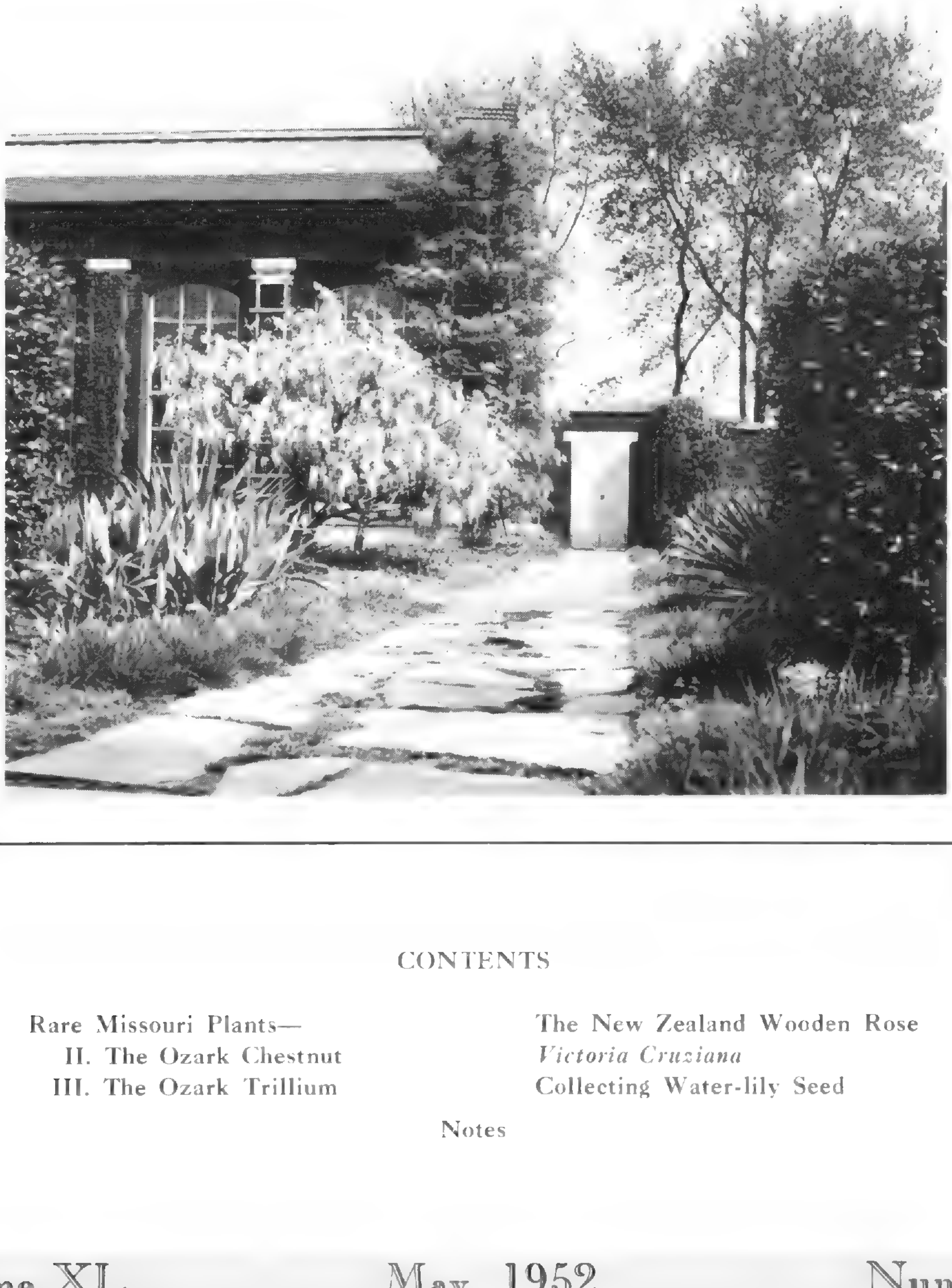

CONTENTS

Volume XL May, 1952 Number 5

COVER: East end of Linnean House garden in May, showing Tree Wisteria at left and old gate leading to Fruticetum.

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RARE MISSOURI PLANTS—II

The Ozark Chestnut

JULIAN A. STEYERMARK

Among the many unusual trees in the Ozarks none is more interesting than the Ozark Chestnut *(Castanea ozarkensis)*, often referred to as Chinquapin. Although its leaves are somewhat similar to those of the Chestnut Oak or Chinquapin Oak *(Quercus Muehlenbergii)*, the spiny fruit immediately reveals its real affinities with other members of the Chestnut clan. This native chestnut is a western counterpart of the common eastern species *(C. dentata)*, one of the dominant forest trees that at one time was distributed from the eastern and northern United States north into southern Ontario. The chestnut blight disease has taken such a heavy toll of this once-abundant and noble tree that it is completely obliterated from many of its former localities, and it is doubtful whether it can ever regain its place as a conspicuous feature in the eastern forest landscape. So far as known, *C. ozarkensis* has not yet been attacked by the fungus parasite, *Endothia parasitica*, but the blight has been recorded[1] as occurring in Missouri on the eastern species *(C. dentata)*, which is found cultivated in various portions of the state.[2] One of the Fungi Imperfecti, but not a disease carrier, *Coryneum pustulatum* (?), has also been reported on *Castanea dentata* in Missouri.

The Ozark Chestnut is known to occur wild in the state only in the southwestern corner, in Howell, Stone, Barry, and McDonald counties. Here it is one of the common trees, usually not exceeding sixty-five feet in height, generally much shorter. It occupies the upper reaches of ravines and narrow crests of stony chert or flint ridges where the soil is acid or non-calcareous

[1] Maneval, W. E. A list of Missouri fungi. Univ. Mo. Stud. 12, No. 3, pp. 3, 100. 1937.

[2] Planted specimens of the eastern *C. dentata* have been seen in Clark and Clay counties, while large and established trees growing naturalized away from cultivation have been recorded from Crawford and Howell counties. The Crawford county specimen is a magnificent large tree with a spread of branches covering a diameter of sixty feet and bearing prolifically.

Ozark Chestnut *(Castanea ozarkensis)*

and with a good accumulation of leaf mold. In such places it is associated with Sour Gum *(Nyssa sylvatica* var. *caroliniana)*, Flowering Dogwood, White Oak, Blackjack Oak, Post Oak, Black Oak, Buckley's Hickory *(Carya texana)*, Mockernut, and Shagbark Hickory. The forest floor in the Ozark Chestnut forest is usually covered with Blueberry *(Vaccinium vacillans* var. *crinitum)*, Deerberry *(V. stamineum* and var. *neglectum)*, and Farkleberry *(V. arboreum* var. *glaucescens)*, along with many other kinds of acid-soil plants. The eastern species of chestnut *(C. dentata)* is also restricted to acid soils, as has been pointed out by Dr. E. Lucy Braun in her book "Deciduous Forests of Eastern North America."

In common with other kinds of chestnuts, the Ozark species flowers comparatively late, from the last of May through June, the long slender aments of buff-colored male flowers extending out conspicuously near the ends of the branches when the tree is in full foliage. The leaves are similar in shape to those of the Chestnut Oak *(Quercus Muehlenbergii)*, but are of

Branch of Ozark Chestnut

rich grass- or yellow-green on the upper side instead of the blue-green or dull-green of the oak, and the margins are more sharply toothed. The Chestnut Oak, furthermore, is an indicator of alkaline soils, occurring on limestone strata.

The mature nuts of the Ozark Chestnut, like those of the eastern *C. dentata*, are very sweet and much valued as a food. Although much smaller than the European species *(C. sativa)*, their flavor is very good. During September they begin to ripen, but after October chestnut collecting will probably be disappointing, as the busy squirrels have already opened up most of the mature fruits. The nuts of the Ozark species are not flattened on one side, as are those of the eastern chestnut. These fruits are not easily handled, their outer surfaces being covered by numerous brown spines. In the eastern species these spines are hairless, but in the Ozark chestnut they are covered with tiny hairs.

In addition to a limited section of southwestern Missouri, the Ozark species of Castanea is found wild in adjacent Arkansas, eastern Oklahoma, northern Louisiana, and Mississippi. The clan to which this species belongs has had a long geological history, records of fossil chestnuts having been found as far back as the late Cretaceous period, estimated at nearly 60,000,000 years ago. The similarity between the Ozark *Castanea ozarkensis* and the eastern *C. dentata* suggests an ancient Appalachian relationship, as Dr. Braun pointed out in the work previously noted. The split in the an-

cestral stock must have occurred millions of years ago, before the last Ozark uplift, which took place at the end of the Tertiary period. The discovery of a species of Castanea in the southwestern part of the Ozarks probably indicates a long period of continuous occurrence of the species.

RARE MISSOURI PLANTS—III

Ozark Trillium

JULIAN A. STEYERMARK

In Missouri *Trillium ozarkanum* (Ozark Trillium or Wakerobin) is known from only two widely separated localities (Shannon and Barry counties) in the southern part of the state. It is of more frequent occurrence in northwestern Arkansas, but is one of the rarest wild flowers in Missouri. It is also one of the most gaily and diversely colored of the native species of Trillium. The plant grows from six inches to a foot tall and has smooth stems which are usually dull purple at the base. The three spreading leaves are dull green above and shiny below. The single flower, which is carried above the leaves at the summit of an erect stalk, consists of the usual three green sepals, conspicuously 5-veined, and three narrow or broad petals. The petals spread out in a more or less horizontal position or bend backwards.

The first time that one sees a colony of the Ozark Trillium he is amazed at the great display of color in the flowers, varying from pure white to shades of pink, rose-red, or even magenta. The outside of the petals is also tinged with pale pink to magenta. However, this apparent diversity of color is due to aging of the blossom, which (as in *T. grandiforum*, with which it has been confused) changes from white to various stages of pink and rose-red. After the petals wither, the originally erect flower-stalk begins to droop.

The Ozark Trillium was first collected in Arkansas in 1921 by the late Dr. J. T. Buchholz, but was not found in Missouri until 1930 when Miss Cora Shoop (now Mrs. Julian Steyermark) discovered it in upland woods south of Cassville, in Barry County. A search for the exact locality of her discovery eventually led the author on a trip to that area in 1935, with Miss Shoop serving as guide, and eventually to a more permanent association. The material gathered on this trip formed the basis, together with the earlier collections made in Arkansas, of what was believed to represent a new species, related to a coastal-plain Trillium, *T. pusillum*, and to a Texas species, *T. texanum*. The Barry County locality was the only one known in Missouri for the Ozark Trillium until 1946, when Mr. Bill Bauer of St. Louis traced down a report from a wild-flower enthusiast of a new station in Shannon

The Ozark Trillium *(Trillium ozarkanum)*

County. The writer visited Shannon County the following spring and found the Ozark Trillium as frequent there as at the Cassville locality.

Both areas have the same type of habitat—shallow, comparatively level draws in rather dry upland woods where the soil is acid and full of chert and flint particles. At the Shannon County locality the dominant trees were Southern Yellow Pine *(Pinus echinata)*, Sour Gum *(Nyssa sylvatica* var. *caroliniana)*, and various oaks and hickories. An endemic species of Spiderwort *(Tradescantia longipes)*, that inhabits acid soils, was associated here with the Trillium. At the Barry County locality the dominant trees were native chestnut *(Castanea ozarkensis)*, restricted to acid soils, and various oaks and hickories. Some of the associated herbaceous plants were Rue Anemone *(Anemonella thalictroides)*, Wood Betony *(Pedicularis canadensis)*, and other acid-soil plants. At each of these stations the topography is a more or less undissected portion of the Ozark Plateau where the upland profile is relatively broad and comparatively level and the peneplain aspect rather evident. In such places, the shallow draws are filled by sudden freshets but remain dry at other times. This type of habitat, found in rather level parts of the Ozark Plateau, is not conducive to the diversified vegeta-

tion found in the more dissected portions of associated narrow ridges, steep slopes, rapid run-offs, and generally more youthful topography.

It would appear, judging from its restricted habitat, that new stations for this Trillium will probably be similar upland shallow draws in comparatively level undissected portions of the plateau. The acid-soil requirement of this species is a feature, too, as the other kinds of Trillium in Missouri are found in calcareous to circumneutral soils. The Painted Trillium *(T. undulatum)* and Nodding Trillium *(T. cernuum)*, neither of which occur in Missouri, are similarly restricted to acid soils in their distribution.

The Ozark Trillium may be transplanted rather readily. It naturally prefers the conditions of its native habitat—rather dry, acid soils in semi-shaded locations. The writer has grown plants in various situations in his wild flower garden in northeastern Illinois for the past five years. Although they come up each year and produce flowers, the petals are usually white on the inside, pale pink on the outside, seldom turning to the deep rose or magenta shades found in the wild state. Whether this tendency to pale colors is associated with a different light intensity and day length or soil conditions is not known.

The true botanical status of the Ozark Trillium is yet to be agreed upon. Dr. Stanley J. Smith, who recently has made a study of the genus, considers the Ozark Trillium not a distinct species, as it was originally described, but a good subspecies of *T. pusillum*. As opposed to this view, the late Dr. M. L. Fernald, in the eighth edition of *Gray's Manual*, considers it to be the same as the plant called *T. pusillum* from the South Carolina coastal-plain area. A variety of *T. pusillum* occurs in Maryland and adjacent Virginia. As there have been no stations as yet discovered between the South Carolina-Maryland and Ozark localities, to which either of these species could be referred, some botanists believe that the South Carolina plants represent different species from the Ozark ones, especially as the Ozark plants possess larger petals and usually 5-nerved instead of 3-nerved sepals, longer flower-stalks (peduncles), and broader leaves.

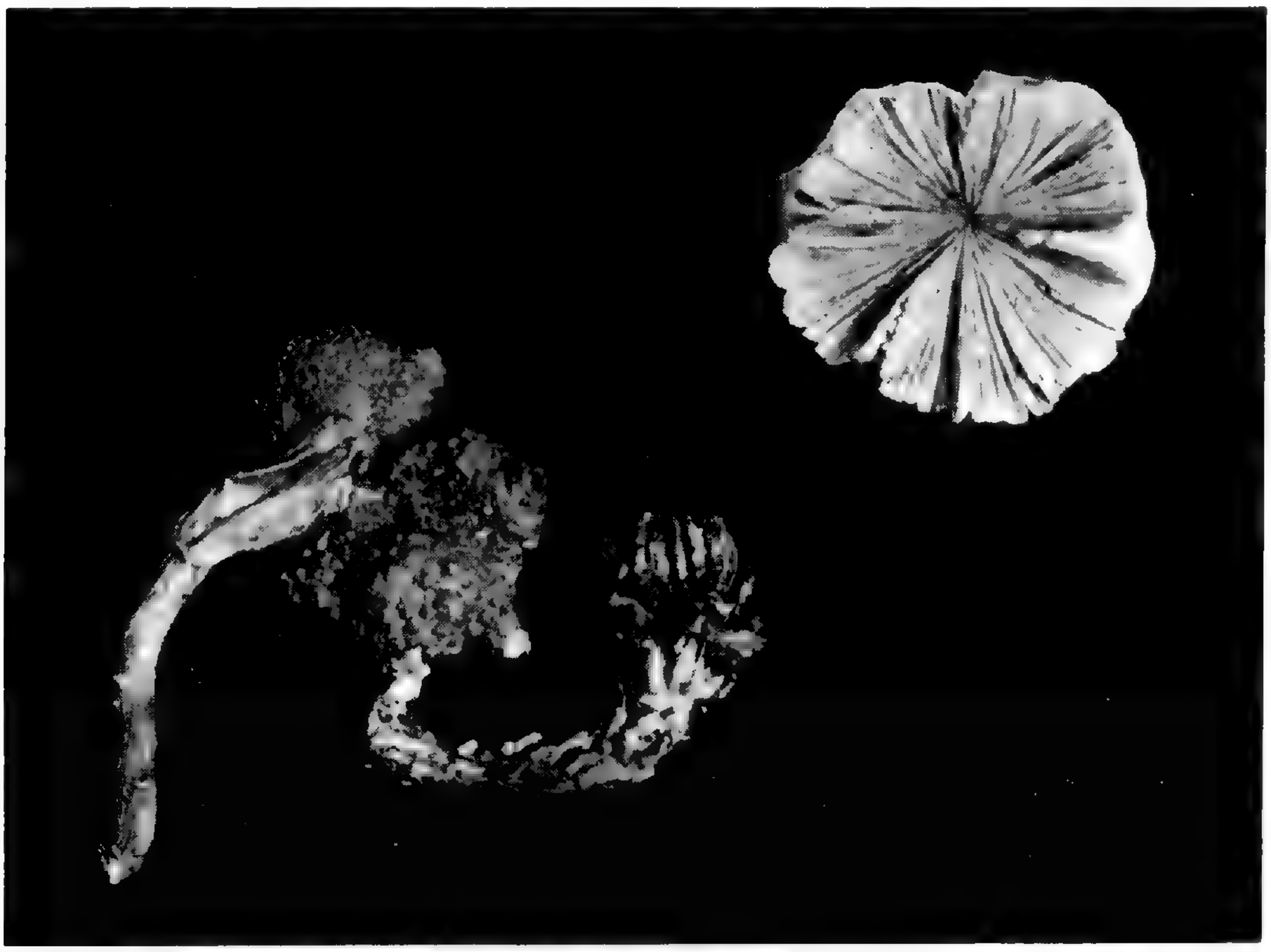
"PLANT A ROSE WEEK" IN ST. LOUIS

According to the *American Rose Magazine,* St. Louis is the only city whose mayor ever proclaimed a "Plant a Rose Week." It was the week of March 31–April 6, and the Garden and the members of the Rose Society of Greater St. Louis collaborated by giving a demonstration of how to plant a rose. The demonstration was planned to take place in the rose plot (west of the Old Residence) which is being maintained by the Society, but the weather was so wet that it was given on a table south of the Palm House. About sixty rosarians met for the occasion, and, besides learning how to plant a rose, they obtained help on the preparation of soil, pruning, and the best methods for controlling insects and diseases.

THE NEW ZEALAND "WOODEN ROSE"

ROBERT COOPER

Last year Mr. Henry J. Dentzman, of St. Louis, brought to the Garden specimens of a curious plant which looked like a wooden flower. He had received them from Mr. George Miller, of New Zealand, a fellow member of the Wood Collectors Society which has members in all parts of the world. The plant had been collected in the North Island, at TeAwamutu, a Maori name meaning "The Crossing." As it turned out, "Wooden Rose" is the common name for the plant botanically known as *Dactylanthus Taylori.*



The New Zealand Wooden Rose *(Dactylanthus Taylori)*

This remarkable plant is a root parasite. It was discovered by the Rev. Richard Taylor, in March, 1845, in rough, forest-clad country near the Wangaehu River in the North Island of New Zealand. Taylor, a missionary, was stationed at Wanganui where there was a large settlement of Maoris (a war-like Polynesian race). From his manuscript journal it is clear that he found the plant when he was travelling on foot over the difficult Maori trail from Taupo, an inland native village, to Wanganui. In 1856 he took a specimen to England, and three years later Sir Joseph Hooker described it in the *Transactions of the Linnaean Society.*

Subsequently, New Zealand botanists found the parasite in a number of widely separated localities over the greater part of the North Island in both inland and coastal districts and from practically sea-level to 3,600 feet. The plant is most abundant on the Volcanic Plateau about National Park and Lake Taupo. It is commonly found where trees or shrubs form a dense leafy canopy and the ground is well covered with humus.

The plant is mainly subterranean and is not easily found except in the flowering season when short stems covered with overlapping scale-leaves project an inch or so above the leaf mould. It is simply a hard, rough, brown, leafless ball entirely covered with hard angular papillae (pimple-like projections). In large specimens the papillae are so hard that they can scarcely be cut with a knife. Plants nearly 18 inches in diameter have been reported, but the average size is not more than that of the fist. Each is firmly attached to the enlarged disc-shaped end of a root of a near-by tree. The common practice of bushmen, when they find these balls, is to cut them free and boil them until the tissues disintegrate and the terminal disc of wood formed by the host root is freed. This disc is usually hollowed and fluted like a finely chiseled flower and is known as a "wooden rose." It is occasionally seen in curio shops in New Zealand, and at least one local artist has used it in design. It has no other uses.

Similar wooden roses occur in members of the Balanophoraceae (the family to which Dactylanthus belongs) in other countries on roots, and in some Loranthaceae (Mistletoe family) on stems. No other members of the genus Dactylanthus have been found, and the Balanophoraceae family is best developed in tropical lands.

The flowering shoots arise from small buds which closely resemble the papillae. A plant can produce twenty or more flowering shoots simultaneously, and these appear above ground in the autumn (February to May in New Zealand). Along the flowering shoot, even on the subterranean portion, there are simple undivided brown scale-leaves.

The flower cluster is usually unisexuel and consists of a head of 15 to 20 spadices (spikes). Each spadix is a grooved fleshy stalk with flowers crowded along the ridges. Irregularities in flower structure are common. The typical stemless male flower consists of 2 thread-like "petals" and a single stamen. The whole inflorescence, with a "skirt" of reddish-purple scale-leaves and numerous spikes coated with pollen, is attractive. The female flower consists of a short, blunt, dark red style and a yellowish ovary to which two tepals are fused. The mass of small styles and tepals make the spadix quite hairy. Pollination is probably effected by small flies, attracted by a sweet, heavy perfume.

The fruit, which is simply an enlarged dry hardened flower, is released on the decay of the flower stalk and is carried for short distances by rain water. There is nothing in the dispersal method to explain the remarkable distribution of the plant. On germination of the seed a radicle develops and penetrates a rootlet of a host plant. No cotyledons are formed. Frequently the limit of growth is reached without a host being encountered. The chances of reaching a rootlet before the reserves of food in the seed are exhausted are perhaps increased by the presence, on the surface of the fruit, of a fungus which appears to bind the fruit to a rootlet. After establishment of communication with the host, the parasite gradually surrounds the host root. Growth is slow and Dactylanthus is long-lived. Apart from the "Wood rose" effect on the root, Dactylanthus seems to have little effect on its host.

The list of host plants includes: Southern Beech (Nothofagus), Lemonwood (Pittosporum), Lancewood *(Pseudopanax crassifolium)*, Five-finger *(Nothopanax arboreum)*, and Matipo *(Suttonia australis)*. The Rev. Taylor recorded the Maori name of Dactylanthus as *Pua-o-te-reinga*, or the "Flower of Hades," and another early resident stated that some Maoris called it *Wae-wae-atua*, meaning the fingers, foot or toes, of an *atua* or spirit.

As the flowers decay (and when the plants are boiled to obtain the "wooden rose") they give off a heavy and disagreeable odor almost rivalling that of the celebrated skunk, which may well have suggested the name "Flower of Hades."

GROWING *VICTORIA CRUZIANA* FROM SEEDS

GEORGE H. PRING

The Giant Water-Platter was discovered in Brazil in 1801, and later was found in Argentina and British Guiana. The name *Victoria regia*, in honor of Queen Victoria, was given to the plant found in British Guiana, and the Argentina plant was named *V. Cruziana*, honoring General Santa Cruz. The two species are nearly identical but *V. Cruziana* is the one usually seen growing in St. Louis. (See March 1949 Garden BULLETIN for the history of this water-lily.)

Henry Shaw is responsible for introducing this nocturnal water-lily to St. Louis, and the St. Louis climate has proven itself well adapted to growing the plant outside. For many years the Garden had been a source of seed supply for *Victoria Cruziana*. Recently, seeds have been sent to such distant places as Hong Kong, China, Japan, Australia, and Malta, being packed in damp sphagnum moss and sent by air mail.

The March 1949 BULLETIN gives full directions for growing water-lilies, and the following paragraphs are concerned only with the collection and germination of the seed of *Victoria Cruziana*, the Giant Water-Platter or "Lily-Boat."

Fig. 1. Showing the better germination of old seeds. Both compartments in the tank were sown in January 1951, the one on the left with seeds collected in October, 1949, and the one on the right with seeds collected a year later.

Fig. 2. Plants of *Victoria Cruziana* which had been grown from seeds collected in the outside pool in January. Extremely cold temperature does not harm the seeds but improves the ripening by stratification. They were immediately planted in a seed pan and germinated in two weeks.

After fertilization the flower will dive down one foot below the surface of the water. In warmer climates the seed-pods rise to the surface when the seeds are ripe, then split open, scattering the seeds. The seeds are covered by a soft jelly-like substance which permits them to float away from the pod to shallow muddy areas where they germinate. However, the short growing season in St. Louis does not permit the seeds to ripen in the pool, and during the latter part of September or October the pods are cut off and placed in a tank or tub in the greenhouse to ripen. Leather gloves or forceps should be used to handle the pods, for they are more spiny than cacti. After the pods start to disintegrate (in a few days) the decomposing mass should be stirred with a broom-handle to separate the seeds, and the water changed every day. Within three weeks the seeds will be free from the pods. They are then screened, cleaned, placed in jars of water, and stored in the refrigerator for further ripening. Fully ripened seeds are black and sink to the bottom of the jar, while unripened seeds are pale greenish-brown and float.

Fig. 3. Plants grown from seeds transplanted February 17, 1951, photographed May 10, ready to be planted in outside pool.

Seeds have been successfully germinated at the Garden by planting them in a small iron tank which is half filled with sandy soil. To maintain a 90° temperature, the tank is built six inches above the steam pipe (fig. 1).

Seeds two to three years old give the best germination. During January they are sown one inch deep in an iron tank. Germination is evidenced in about two to three weeks by the appearance of needle-like shoots. When three to four floating leaves have developed the plants may be transplanted into 4-inch pots. By May these are filled with roots, and the plants are then transplanted into 8-inch pans which are large enough to carry them through until planted outside (fig. 3).

Fig. 4. Plants grown in 8-inch pans ready to be planted in outside pools. Normally, this is about May 10–15, but during 1952 the weather was so hot that the lilies were transplanted on May 6. Not often are the leaves in greenhouse plants robust enough to turn up at the edges as in these specimens, which are 12–14 inches in diameter. At this stage the plants are in flower but since this lily is a night-bloomer and the photograph was taken in the daytime, only the buds are seen.

The strength of the Victoria leaf has always been a matter of wonder. The October 1927 Garden BULLETIN contained an article, "Amazon Water-lilies as Engineers," in which the construction details of the leaf were described. The entire under-surface is spanned by a framework of narrow ribs attached at the stem and gradually tapering toward the edge. A network of side-veins nearly as deep as the main ribs join them together. That the veins do form an efficient support has been often demonstrated. Figure 5 shows two children with a combined weight of about 100 pounds standing on a *Victoria Cruziana* leaf in the water-lily pool at the Garden. In order

to distribute the weight evenly over the surface of the leaf and to keep it from tearing, a piece of wall-board was cut the size and shape of the leaf and placed inside the rim.

Fig. 5. Two children (Joanne Pring and Ronnie Cutak) using a *Victoria Cruziana* leaf as a "Lily Boat."

COLLECTING SEED OF TROPICAL WATER-LILIES

The Missouri Botanical Garden is constantly on the search for seed of new tropical water-lilies. In the past, seed obtained from Africa and Australia have produced plants which served as parents of the new hybrids which are on display at the Garden during the summer. This collection of hybrids created at the Garden is recognized throughout the world as superior to any other display of the kind.

The following letter written to Mr. Robert Trickett, of London, by Mr. Bill Harney of the Herbarium Staff of the Royal Botanical Gardens at Kew, England, gives some idea of how collecting water-lily seed may be as exciting as big-game hunting. Mr. Trickett has been active in helping to secure for the Garden rare tropical water-lily seed.

Darwin. N. T. Box 241.
5-3-1952.

Dear Bob:

This story relates to the Lily seed collecting in Australia for you by Cobber Bob Trickett.

My trip through Queensland was with the Bureau of Commerce and Agriculture. Our job was to have a check on all the cattle-stations to see if they could increase their beef supply for the export trade for Britain. The trip was, all told, about nine thousand miles and I thought this would be an excellent time to collect the water-lily seeds for you.

We travelled north for over five hundred miles; then just as we were appreaching the town of Proserpine I saw some very pretty blue lilies growing in a lagoon on the side of the highway. We pulled up our "Land-Rover" utility, and soon I was intently watching the surface of the lagoon for suitable water-lilies. My eyes were on the lilies and I did not notice that a big bull had spotted me and was trotting up to see what I was up to. I went into the water and found the seeds and had just reached the bank when I saw the animal pawing up the ground about five feet away. My nonchalance, owing to the fact that I had not seen him, was the thing that kept him off me for I am certain that if I had seen him coming I would have raced for the utility and he would certainly have overtaken me. As it was, I was on the bank of the water hole and he was between me and the utility. I picked up a stick and gave a very feeble shout, and mistaking this for a challenge he made a rush but I was off and into the water before he could get going. My mate in the meantime was revving up the utility and blowing the horn; he came over. The bull again pawed up the earth, but while he was looking at the utility I was swimming down the water to come out lower down and as my mate drove over near me I was out and into the bus and we were away. I am not too sure if the bull would have attacked me, but nevertheless I got a good ducking—clothes and all—but I did have the seeds and I hope they turn out all right. The seeds were the large blue from the Proserpine Area.

Once in the Gulf of Carpentaria we were in the crocodile country, and although I had had some experience with these creatures in the Northern Territory it is never theless a bad thing to lurk around a deep lagoon for one never knows what is about. These crocodiles have been caught in the Darwin area up to twenty-four feet in length and a full-grown one can easily pull a big bull into the water with ease.

The smaller crocodiles live in secluded spots to be away from the big fellows, for they are distinctly cannibalistic, and will fight, kill and devour each other. Owing to this, the little crocodiles are generally away in some quiet lagoon, and in one of these quiet spots on the Mitchell River I had just been in to collect some of the white variety of water-lily and also a specimen of a small parasitic lily. My search in that spot was futile and whilst out on the bank pulling off the seed bulbs my mate shot some ducks. He swam out to get them and just as he was reaching out his hand to take hold of one it disappeared under the water. We enquired of an Aboriginal who happened to come up at that time what was the cause of this disappearance and he quietly informed us that it was "Little fellow crocodile after tucker" (food). We learned afterwards that not only do little ones frequent these lagoons but the real big fellows live there to drag down the cattle as they come in to drink.

So much for the coastal streams. Water-lily collecting is a fascinating thing and it is very difficult to resist the urge to go into the water after a plant you have never seen before.

Even the quiet waters behind my beach hut is full of leeches and a strange fungus called "Inggerung." It is attached to the leaves of water-lilies and trees, and when it comes into contact with the body cause a nasty irritation with red swellings. In fact, the name of this swamp place is called "Inggerung-doulk"—a Wargite Aboriginal word that means "The birth place of the itch fungus." Apart from this fungus, the swamp is also the spot where the female crocodile lays her eggs and then waits for the eggs to hatch. During this period she is very savage, for as I stated before the crocodile is cannibalistic and the old bull crocodiles will try and dig out the young to devour them, hence the savage mother crocodile. I wouldn't like to see a rare lily growing near her eggs. If I knew the eggs were there I would keep away. If not I would most certainly be chased away by the ever-watchful mother. The paper ends and so does the yarns but they show that water-lily collecting is just as exciting as big-game hunting that one reads so much about.

Well good luck cobber from yours truly,

Bill Harney.

MORE SHAWIANA

The following accounts were enclosed in a letter written in 1846 to Henry Shaw by his sister Caroline (see April BULLETIN).

Dr.				Cr.	
Nov.	16	Amount on hand	3000.69	Nov. 22	By I. M. Feazel's dft. favr Jno. Simonds 3000.00
"	19	To Beny Machurra on acct.	25.00	" "	By ⅔ of tax for resurvey of Manchester road 10.15
"	25	To balance of rent for Wetzel & Cluke's land	57.15	Dec. 1	By M. Hannons bill for B. Desnoyers 4.00
"	"	To Anderson & Thornton's rent	112.50	" "	By C. Phelan & wife one mo's. wages 25.00
Dec.	1	To P. Ruckle pd. on acct. 2d. instalt.	50.00	" 2	By Hotel bill one mo's. wages 75.50
"	"	To C. Phelan—proceeds of produce sold, &c....	40.00	" 2	By Caroline 25.00
"	3	To Berthold & Ewing's rent	112.50	" 2	By Livery Stable's bill 5 months 26.75
"	6	To B. Urke p'd. balance of this yr's. rent.....	30.00	" 10	Clothing for Bridget.... 3.50
"	8	To Bridget's 6½ mos. C. $12 per mo.	78.00		$3169.90
"	8	To H. M'Shane's rent, 1 quarter	87.50		
"	10	To Jabez Warner paid his note	100.00		
"	11	To P. Donnelly p'd. 2d. instalment rent	90.50		
"	13	To balance of Strautmann & Reiger's rent .....75.50 deduct for joists as per agreement 2.00	73.50	Dec. 16	Depot in Bank..... 1016.29 Cash on hand..... 382.00
Colld by Bk		T. H. West's note....	111.10		Total $1398.29
"	"	" Finney Lea & Co's. note	300.00		
"	"	" Isaac Watkin's note..	300.00		
			4568.44		
			3169.90		
		Balance $1398.54			

The following is Phelan's account for November:

B. Desnoyers Dr.	To Cash	Cash Dr. to B. Desnoyers	
pd. for weighing 2 loads straw.....	.50	rec'd for two loads rye straw.....	13.52
pd. for setting two horse shoes.....	.25	" " oats straw	3.62
pd. for barrel flour 4.50 100 lbs. beef 2.00	6.50	" " pasture of 8 steers 3 weeks	8.00
pd. for two hogs for stock.....	6.00	Cluke p'd. one mo's. house rent.....	4.00
one Mo's. wages to E. Dineen.....	11.00	Sold 180 bush. corn @ 20c per bu.	36.00
" " " P. Leedy do W. Jenkins	20.00	rec'd. for use of Kitchen 7 days.....	1.00
Pd. for hops, matches & kettle mending	.45		$66.14
Corn Meal 70c 115¾ lbs. beef @ 2¼c	3.30		
	$48.00		

NOTES

The Rose Society of Greater St. Louis will hold its rose show in the Floral Display House at the Garden, May 24–May 25.

Word has been received at the Garden that U. Tin, Economic Botanist Government of Burma, and a graduate student at the Garden during 1950-51, died at Rangoon, Burma, on April 4, following an appendectomy.

Mr. Hugh J. Iltis, graduate student at the Garden, who will receive his doctor's degree at the Washington University commencement in June, has accepted an instructorship in botany at the University of Arkansas, Fayetteville, for the coming year.

The members attending the annual convention of the American Iris Society which was held in St. Louis, May 18–20, started their tour of local iris gardens at the Missouri Botanical Garden. The visitors were especially interested in the plantings of iris in the test plot and in the Linnean House Garden. The flower show of the St. Louis Horticultural Society (mostly iris) also was staged in the Floral Display House at that time.

This has been a most unusual spring. On account of the continuously cold weather in March and April, early flowering things such as forsythia, narcissus, and flowering trees bloomed at the normal time and stayed in bloom for weeks. On the other hand, later-flowering plants—Azaleas, tulips, wistaria, iris, etc.—developed in a hurry during the hot spell in late April and early May and were gone in a matter of days.

Recent visitors to the Garden library and herbarium include: Mr. Floyd Hall, writer, of Petrolia, Kansas; Dr. Leon Croizat, of the Universidad de los Andes, Merida, Venezuela; Dr. Charles B. Heiser, with a group of students from Indiana University, Bloomington; Dr. Elzada Clover, Dr. Pierre Dansereau, and Dr. Rogers McVaugh, of the University of Michigan; Dr. and Mrs. Wells, orchid enthusiasts, of Los Angeles; Dr. J. Thomas Johnson, accompanied by a group of his students from the University of Arkansas, Fayetteville; Mr. William Dress and Mr. Mott, of the Bailey Hortorium of Cornell University, Ithaca; Dr. Dan O. McClary and Dr. and Mrs. Balaji Mundkur, of Southern Illinois University, Carbondale; Dr. Harry J. Fuller, of the University of Illinois, Urbana; Mr. Paul H. Allen, of Esquinas Experiment Station, Palmar Sur, Costa Rica.

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 50,000 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 Southampton buses (No. 80), direct from downtown, pass within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN

CONTENTS

Volume XL June, 1952 Number 6

COVER: *Laeliocattleya* "St. Louis" raised at the Garden and registered with the American Orchid Society.

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Missouri Botanical Garden Bulletin

Vol. XL JUNE, 1952 No. 6

HYDROPONIC CULTURE OF ORCHIDS

The culture of plants in gravel or sand saturated with nutrient solutions has been used by botanists for years to study the effect of various chemicals on growth. In the 1930's soilless cultures, or "hydroponics," seemed to have possibilities beyond the limits of research laboratories, and commercial growers and amateur gardeners began experimenting with it on a large scale. It was the shortage of peat during the war that led the Garden to try out this method for growing orchids. Dr. David C. Fairburn, Horticulturist to the Garden at that time, began a series of experiments in 1938, and in October 1944 the results were written up in the Garden BULLETIN (vol. 32, no. 8). This article was reprinted later in that year as a supplement to volume 12 of the *American Orchid Society Bulletin*. Both these publications have been out of print for some time, but since the interest in the hydroponic culture of orchids is still so alive we are reprinting here a slightly condensed account of Dr. Fairburn's experiments.

"GRAVEL" CULTURE OF ORCHIDS

DAVID C. FAIRBURN

Preliminary experiments at the Garden were designed to learn the best type of "gravel" to use, what the composition and concentration of the nutrient solution should be, how to apply the solution, etc. Three types of medium were used: (1) washed and screened cinders, (2) Meramec River gravel, and (3) Haydite gravel (a crushed clay or shale heated to high temperatures to form an inert porous material that is ground down to the various sizes of gravel used in concrete). Cattleya seedlings were taken from the culture flasks and planted in three paraffin-coated baskets each of which had been filled with a different one of the above gravel materials. The baskets were then suspended in porcelain jars just deep enough to touch the nutrient solution. At the end of the year it was observed that: (1) Haydite proved to be the best rooting medium; (2) seedlings "damped off" or rotted if the plants were kept too wet; (3) the hybrid Cattleyas grew well in most of the nutrient cultures, but the following solution produced the best root and top growth:

Cattleya plants, 4¼ years old (on right), raised in Haydite gravel. These plants started to flower when they were only 3½ years old.

Calcium nitrate	1.0 gm.	Monobasic potassium phosphate	.25 gm.
Ammonium sulphate	.5 gm.	Ferric phosphate	.25 gm.
Magnesium sulphate	.25 gm.	Distilled water	1 liter

This was the formula commonly used in flask cultures except that the iron content had been increased. The solution was held at pH 5.0 by the use of phosphoric acid.

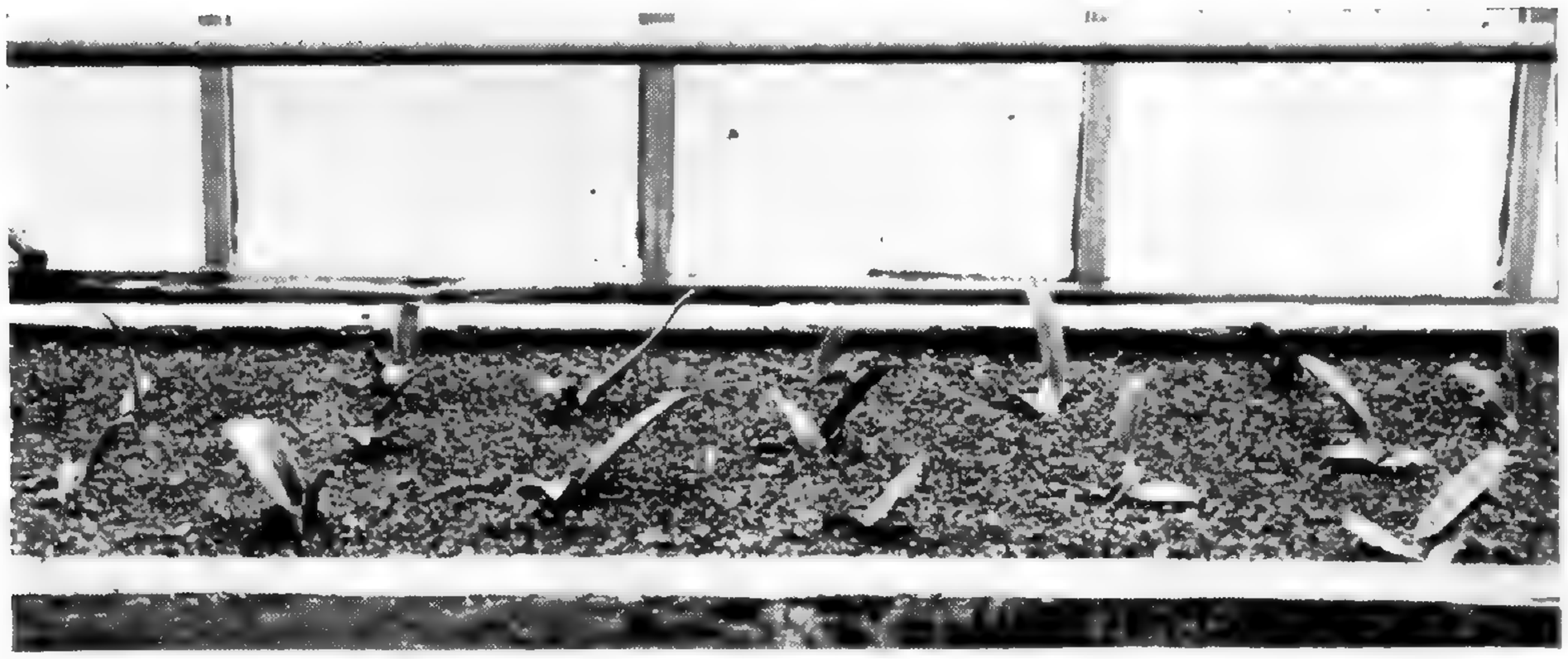
In the next experiment metal tanks and pails were used instead of baskets and jars. The tanks were 3 ft. × 2 ft. × 4 in., with a combined intake and drain pipe in the center. After being filled with Haydite (½–1/16 in. grade), they were planted with seedlings of Dendrobiums and Cattleyas and mature Cattleyas and Paphiopedilums (Cypripediums). Two 5-gallon pails, each with an outlet spout attached by rubber tubing to the drain pipe in the tank, acted as a reservoir for the nutrient solution which was forced into the tank by gravity when the pails were lifted high enough. The tank was flooded with the solution every other day except on cloudy days when the Haydite remained moist enough. The solution was renewed every six weeks.

After two years the following results were tabulated: (1) Cattleya seedlings did fine—good leaf development and splendid roots. One plant produced a flower at the age of 3¼ years, and several bloomed when they were four years old. (2) Dendrobium seedlings did not do so well; roots were all right but leaf growth was inferior. (3) Mature Cattleyas made good growth but the tops were mediocre. (4) Mature Cypripediums had roots and tops about average.

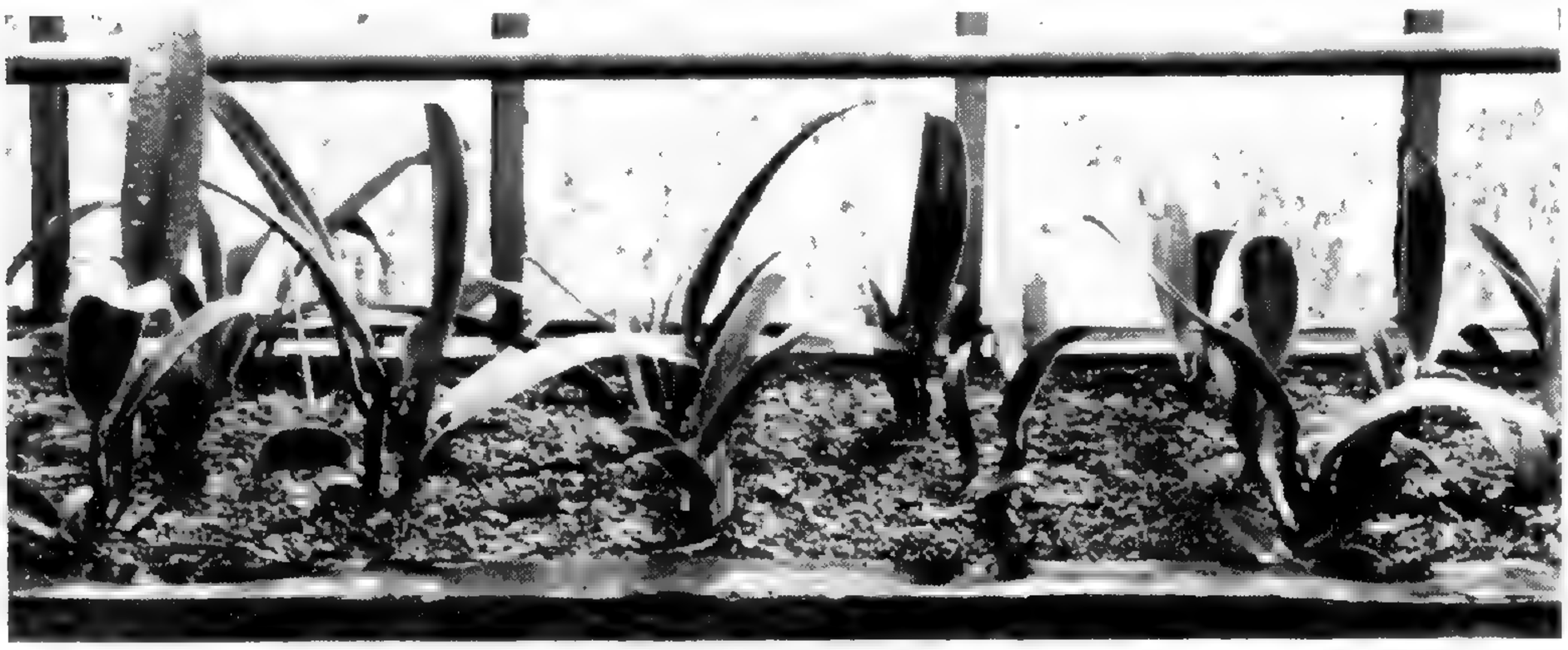
In the meantime a larger tank (7 ft. × 3 ft. × 6 in.) of galvanized sheet iron reinforced with a wooden frame was prepared. A 50-gallon oil drum served as the reservoir, and the nutrient solution was forced through a ½-inch pipe into the tank by a centrifugal pump every other day and completely renewed every 2 months. The tank was filled with Haydite, and 450 hybrid Cattleya seedlings, 20 months old, were planted in it. The solution was the same as the one mentioned above except for the addition of the following minor elements which had been dissolved in 1 liter of water:

Boric acid	2.86 gms.	Zinc sulphate	0.22 gms.
Manganese chloride	1.81 gms.	Copper sulphate	0.08 gms.

One cc. of this stock solution was used for each liter of nutrient solution. Water was added to compensate for evaporation, and the pH was kept at 5.0 with phosphoric acid. In one year the tank had become so crowded that the seedlings had to be transplanted, and the results were so encouraging that it was decided to proceed on a larger scale.



Cattleya seedlings, 2½ years old, in Haydite bench at start of experiment.



The same plants one year later. Rough spots on leaves are drops of water.

Two years later. Many of the plants (now 4½ years old) had produced flowers. Note the wire bracing the plants.

A concrete bench (50 ft. × 2½ ft. × 7 in.) was made water-tight by filling all drainage holes with concrete; then through a hole drilled in the bottom the intake and drainage pipe was attached to a 150-gallon reservoir containing the nutrient solution in the basement. A piece of ⅛-inch wire screen was placed over the drainage pipe to keep out stray pieces of gravel. The top of the pipe was flush with the bottom of the bench to insure complete drainage. A wooden box with a removable glass lid and wire screening at the bottom was built in over the intake pipe to prevent severe washing of the Haydite when the nutrient solution was pumped into the bench rapidly. To facilitate uniform distribution of the solution, two 1½-inch pipes, perforated with ¼-inch holes 1 foot apart, were fitted into openings near the top of the box and gradually sloped to the ends of the bench. Small pieces of window screening were wired over the holes in the pipe to keep out particles of gravel. All this equipment, including the galvanized storage tank in the basement, received two coats of asphaltum paint.

Two inches of coarse Haydite gravel (⅜–$^{5}/_{16}$-in.) were placed in the bottom of the bench, and fine gravel (¼–$^{1}/_{16}$-in.) was used for the top 5 inches. The following orchids were planted, 8 inches apart, in the gravel:

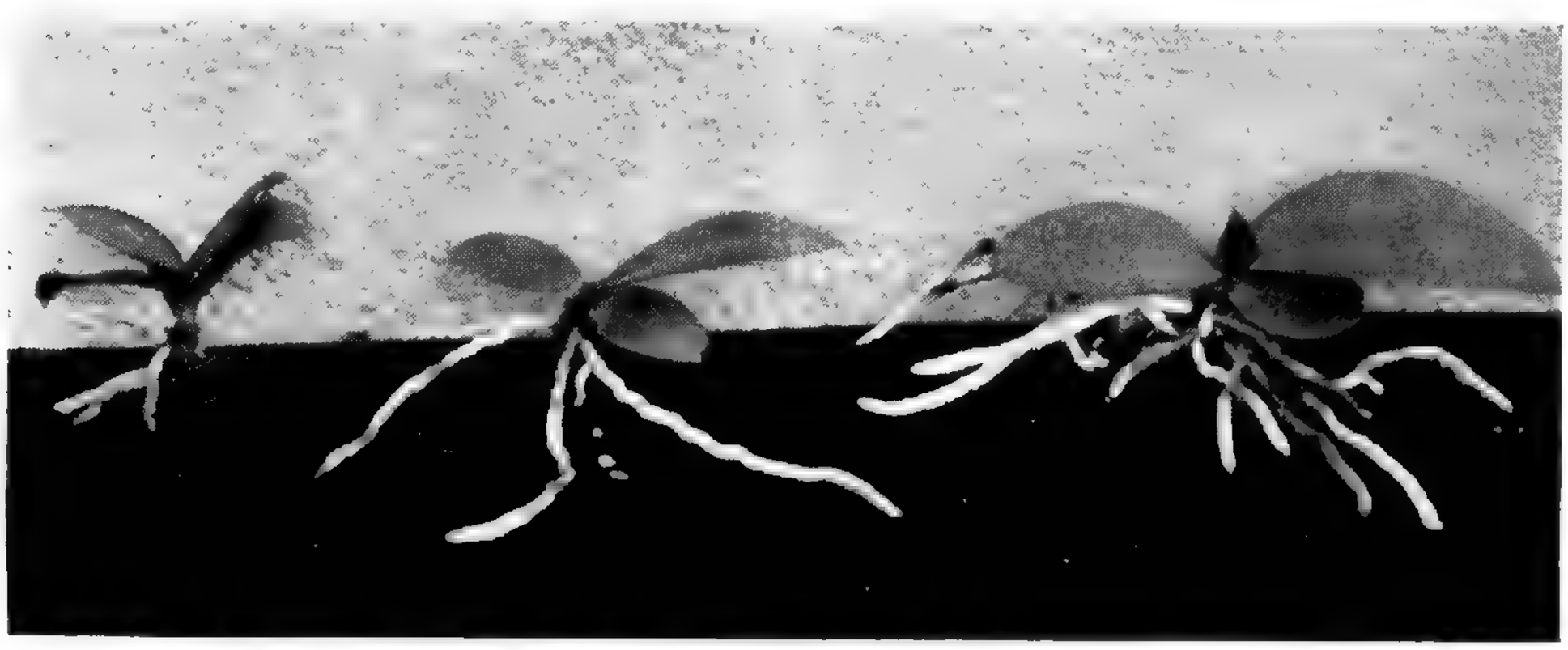
Cattleya seedlings grown in Haydite (left) and orchid peat (right). Both plants were from the same culture flask, consequently identical in parentage and age (3½ years old).

Hydroponics bench painted and ready for gravel. Note intake box with perforated pipes extending to ends of bench for rapid distribution of the nutrient solution.

Bench No. 2 completed. The community pots plunged in gravel stayed too wet and had to be removed.

(1) 100 seedling Cattleyas 2–3 years old, transferred from the large tan[illegible] of the previous experiment; (2) 30 *Dendrobium Phalaenopsis* seedlings [illegible] years old; (3) 30 *Dendrobium nobile* seedlings 2½ years old; (4) 10 matu[illegible] hybrid Phalaenopsis; (5) 3 mature Cymbidiums; (6) several mature (b[illegible] weak) Cypripediums and Calanthes, to see if the gravel treatment wou[illegible] revive them.

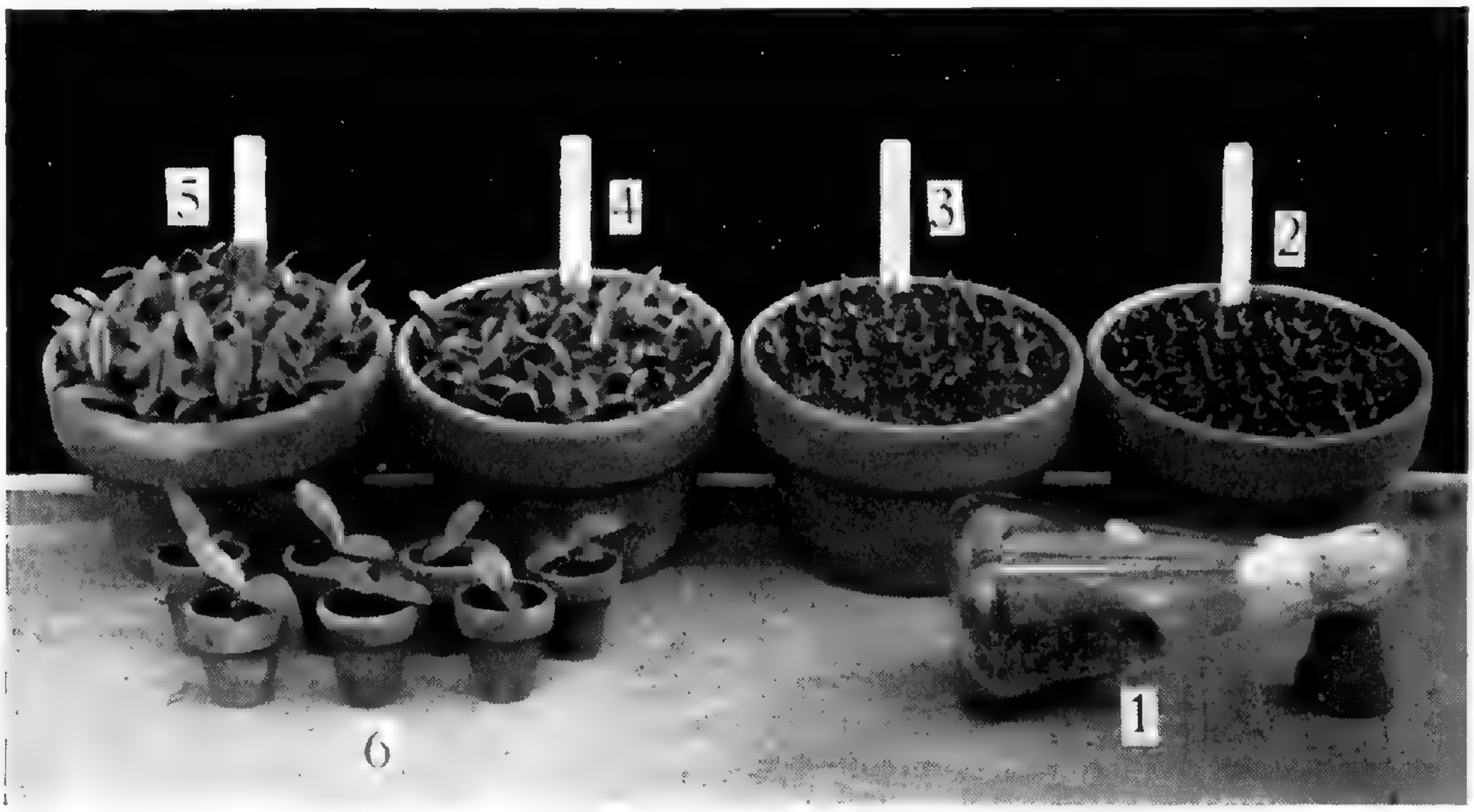
Three methods of planting the seedlings were used: (1) with all pe[illegible] removed from the roots; (2) pots removed, and ball of peat with roots und[illegible] turbed plunged in the gravel slightly deeper than previously planted; (3[illegible] pots and all plunged to the rim in the gravel. As a check, an equal numb[illegible] of plants identical in parentage, size, age, and quality to the above plan[illegible] were potted in orchid peat and grown according to standard procedure.



Phalaenopsis seedlings after 6 months: grown in cinders (left); Haydite (center); and granite (right).

Almost 100 gallons of solution were required to flood this bench. T[illegible] centrifugal pump mounted over the storage tank in the basement was co[illegible] tacted by a pull-cord attached to an ordinary light socket near the bench [illegible] that the operator would have rapid control over the amount of solutio[illegible] pumped in. A control valve on the intake drain pipe under the bench mad[illegible] it an easy matter to switch off the pump, close the valve, and hold the solu[illegible] tion in the bench as long as desired. The nutrient solution used in th[illegible] experiment had the following composition:

Calcium nitrate	378 gms.
Monobasic potassium phosphate	378 gms.
Magnesium sulphate	378 gms.
Ammonium sulphate	378 gms.
Ferric phosphate	95 gms.
Minor elements—	
boric acid, 2.86 gms., manganese chloride, 1.81 gms., zinc sulphate, 0.22 gms., copper sulphate, 0.08 gms., water, 1 liter	378 cc.
Hydrant water	100 gals. (378 liters)



Development of young orchid seedlings in community pots of gravel: (1) flask ready for transplanting, (2) seedlings 1 year old planted in pot containing gravel sifted through 1/8-inch screen, (3) seedlings at 15 months, (4) seedlings at 18 months, (5) seedlings at 2 years, ready for transplanting to a gravel bench or (6) to single pots containing orchid peat.

After 2 1/2 years in the concrete bench the following results were recorded:

1. Hybrid seedlings of Cattleya, Brassocattleya, Laeliocattleya, Phalaenopsis, and Dendrobium made faster and better growth in the Haydite than the check plants did in orchid peat.

2. Seedlings of the Cattleya group in peat usually made only one lead growth per plant at a time while those in gravel seldom made less than two or three.

3. The plants in gravel remained in active growth with no rest period such as occurs when grown in peat.

4. The plants in gravel made extensive root growth.

5. The seedling Cattleyas started to flower one or two years earlier than the check plants in peat, and the flowers were larger and more abundant.

6. The color, size, shape and texture of the flowers of the plants grown in gravel were superior to flowers from the check plants in peat. In gravel the flowers seemed to be a bit more susceptible to smoke injury, however.

7. It may have been a coincidence, but the plants in gravel suffered practically no damage from scale, slugs, or other pests that thrive under ordinary conditions. With peat, bugs of all sorts can hide among the fibers or underneath the pots, but in gravel the bugs have to come out when the bench is flooded "or else."

Other results and observations on the operation of this gravel bench may be summarized as follows:

1. About 10 o'clock in the morning seems to be the best time to pump the solution into the bench; never pump on cloudy wet days.

2. The bench should be flooded to within one inch of the surface of the gravel. Complete coverage leads to extensive growth of algae on top.

3. The bench may remain flooded for several hours to permit the roots to take full advantage of the nutrient solution.

4. At no time has it been necessary to flush the gravel or the pumping system with plain water to remove any toxic chemical accumulations.

5. Although only a limited number of plants were involved, mature plants of Cattleya, Cypripedium, and Oncidium did not respond satisfactorily when transferred from peat to gravel.

6. Transplanting young seedlings from peat to gravel and *vice versa* was done easily and quickly. Roots came out of the gravel very readily, making it possible to move crowded plants without any injury.

7. A wire and string support to hold the leaves upright was used when the plants required bracing. However, within two years they were strong enough to hold each other erect, and no supports were needed.

In November 1943 another "hydroponics" bench was put in operation, this time being divided into three sections, one containing Haydite, one red granite, and one cinders (weathered, washed, and sifted through a ¼-inch screen). The plants used were: (1) over 1400 hybrid Cattleya, Laeliocattleya, and Brassocattleya seedlings 1½–2 years old, planted in the three types of "gravel" using the three types of planting: bare roots, ball of peat left on roots, left in pot which was plunged to rim in the gravel; (2) about 50 mature but weak Phalaenopsis plants; (3) seedling Cattleyas 1 year old, fifty 6-inch community pans (about 100 plants to the pan) being plunged to the rims in Haydite. The nutrient solution was the same as used in the previous experiment. After one year the results were as follows:

1. Community pots plunged in the gravel remained too wet and the seedlings damped off.

2. The cinders were a failure. In spite of precautions they apparently retained enough sulphur to be definitely toxic. Roots were dwarfed or killed, and there was little new leaf growth. The plants looked very sick, so after 6 months the cinders were replaced with a mixture of half Haydite and half granite, and in it 250 Phalaenopsis "Helvetia" seedlings were planted. They have made excellent growth.

3. The "bare root" method of planting in gravel has proven best.

4. The weak but mature Phalaenopsis plants have taken a new lease on life. The growth of all Phalaenopsis plants in gravel was extraordinary.

5. Results in granite have been slightly better than in Haydite, especially with Phalaenopsis. The fine grade of granite (about 1/8-inch) retained moisture longer than did the Haydite, and less irrigation was required.

6. For best results an entire bench should be devoted to one type of orchid, different types requiring different conditions.

7. It is questionable whether the minor elements added (copper, zinc, manganese, and boron) are necessary; in fact, very slight over-doses are fatal.

Cattleya seedlings 1½ years old raised in community pots of gravel.

The same plants after growing 1 year in the gravel bench.

A Cattleya seedling raised in Haydite, blooming when four years old.

While the bench tests were in progress the idea was conceived of transplanting the seedlings from the culture flasks directly into the community pots of gravel instead of peat. The standard 5-inch bulb pan was used (after being thoroughly washed). The hole in the bottom was covered with a piece of broken pot and the pan was half filled with coarse washed Haydite. Then Haydite or granite put through a $\frac{1}{8}$-inch mesh screen was added almost to the rim. Mixing the top layer with about $\frac{1}{3}$ chopped peat gave good results too. The gravel was tamped down thoroughly, and the pans sterilized in an autoclave (pressure cooker) at 15 pounds for half an hour in order to eradicate any "damping-off" organisms that might be present. When the roots started to develop the seedlings were taken from the culture flask and planted about $\frac{1}{2}$ inch apart in the gravel, each pan containing anywhere from 50 to 75 seedlings. The community pans were then placed in a Wardian case that could be ventilated and sprayed with water whenever the gravel became dry. If no peat were used with the gravel the water was acidified to pH 5 by the addition of phosphoric acid. Once a week the pans were watered thoroughly with the same nutrient solution as used in the gravel benches. After the seedlings had been in the pans 6–12 months they were transplanted into a gravel bench or potted in peat. Transplanting them directly from the culture flask to the gravel bench was not feasible unless the plants were unusually large with well-developed roots.

The roots of seedlings grown in community pots are sometimes so interwoven and cling so tightly to the peat fibers that it is almost impossible to separate them without considerable breakage. In gravel this difficulty is eliminated.

A great deal of time and patience is needed in potting young plants. Transplanting 200 seedlings into 1½-inch pots would be a good day's work. In a gravel bench an agile person could set out 200 seedlings an hour, provided that the roots systems were not large and unwieldy.

These gravel culture experiments have aroused substantial interest among orchid growers, professional and amateur, in various sections of the country. Further tests are needed to determine the ideal composition and concentration of the nutrient solution, what type of "gravel" is most desirable, and how many different kinds of orchids can be grown successfully this way.

FURTHER EXPERIMENTS ON ORCHID CULTURE

GEORGE H. PRING AND G. R. LOWRY

Since 1944, there have been several stages in the experiments with "gravel" culture of orchids at the Garden. First, it was realized that for the method to be a complete success it should be practical for the commercial orchid growers and experiment stations as well as for the amateurs. In an effort to set up an easily prepared and controlled feeding program, experiments were carried on with both organic and inorganic fertilizers. Horse, cow, poultry and sheep manures were tried, also commercial chemical fertilizers of varying concentrations.

By 1949 we had concluded that a stock solution made from dry sheep manure and commercial fertilizer (containing 13 per cent nitrogen, 26 per cent phosphorus, and 13 per cent potash) was showing best results. Since that time, we have made this stock solution in the following manner. Twenty-five pounds of commercial sheep manure and 25 pounds of commercial fertilizer were submerged in separate barrels each containing 25 gallons of water. After one week, the resulting solutions were drawn off and combined in one 50-gallon barrel which is connected to our proportioning pump.

The proportioning pump was installed in 1946. It has one moving element and operates from the normal pressure of our water supply. The driving piston is cushioned alternately at the forward end of its stroke and then against an adjustable stop which determines the volume of fluid drawn from the stock barrel. By means of this pump, fresh nutrient solution could be blended into our regular watering system at the rate of 100 cc. (little less than ½ pt.) per gallon of water. Controlling the food supply

Nutrient solution proportioning pump in use at the Arboretum.

in this manner enabled us to feed the plants at the same time that they were receiving their regular overhead watering. The sub-irrigating schedule of feeding every second or third day was used with the overhead system. Two distinct disadvantages in sub-irrigation were eliminated by this method of feeding. The first was the elimination of the old 900-gallon underground storage tank in which the nutrient concentration and pH balance were rather difficult to control. The second was the possibility of a mistake being made in the nutrient solution, or of a prolonged flooding of the benches which could ruin the entire collection.

Throughout all the gravel experiments the hydrogen ion concentration was closely checked in an effort to keep the feeding solution between pH 5 and pH 5.5. During the last few years of the hydroponic experiments approximately 20,000 orchid plants were grown, 10,000 in open gravel benches, and 10,000 in individual pots of gravel.

Hydroponic culture of orchids was discontinued at the Garden in 1950, when Osmunda fiber was no longer difficult to obtain and we felt we had learned some of the essential points, advantages, and disadvantages of gravel culture. A great difficulty with hydroponics, as far as the Garden was concerned, was that plants grown in the gravel benches in the orchid range at Gray Summit could not be transported to the City Garden where orchids are exhibited. Through the years of hydroponic feeding we learned to our own satisfaction that orchid plants do respond favorably to a feeding program. Consequently, while our entire orchid collection is again potted in osmunda fiber, we are still using the same feeding solution, applied through

Cattleya hybrids grown in hydroponics bench *(Cattleya Trianae alba)* × *(Cattleya* "Ida Kingsbury"). Pollinated Dec. 21, 1942; sown in flasks, Jan. 22, 1944; transplanted into community pans Sept. 1, 1945; planted in hydroponics bench and photographed by Lad Cutak, Dec. 20, 1946.

Same bench of Cattleya hybrids two years later. Photographed by Lad Cutak in 1948.

Same bench of Cattleya crosses in full production. Photographed in 1950 by Lad Cutak.

the proportioning pump, at the same concentration. Our feeding season starts in March and all the plants are fed once a week until the latter part of October. No check is made to control the pH conditions as the osmunda fiber, in itself, is a satisfactory buffering agent.

CONCLUSIONS

1. Granite was found to be superior to other kinds of gravel.

2. The nutrient solution found most satisfactory was the one made from half sheep manure and half commercial fertilizer, the latter having an analysis of 13 per cent nitrogen, 26 per cent phosphorus, 13 per cent potash.

3. Cattleya seedlings make as fast or faster growth with gravel culture. However, the plants were not as stocky nor was the foliage of mature plants as deep a green, and the flowers did not have as good keeping qualities as those grown in peat.

4. Phalaenopsis grew faster with gravel culture than with peat, particularly up to flowering size.

5. Dendrobiums have not been successfully grown in gravel. The root systems of these plants are easily destroyed by too much moisture. In an effort to feed them properly during their growing season, it is very easy to keep the gravel too wet.

Phalaenopsis Rimstadiana "Helvetia" grown by hydroponics. From flask of seedlings (100 in flask) sent by Bruno Alberts in 1943. Photographed by Lad Cutak in 1949.

6. Orchids can be successfully moved from gravel to osmunda fiber if the plants are shifted when the lead growth is just starting to make its new root system. However, old roots removed from the gravel will seldom continue to grow.

7. Seedlings grown in gravel do not require as much light as those grown in osmunda fiber, and mature plants require about 10 per cent less light. If the benches are more than seven inches deep, about the same amount of light should be given. Gravel dries much more slowly in deep beds and a heavy shading would encourage growth of algae.

8. Vandas and Aerides did very well in gravel. They apparently like a great amount of moisture, light shading, and sheep manure as a fertilizer. Although their flowers were not quite as large as those grown in osmunda fiber, their keeping quality was just as good.

9. In the event that osmunda fiber again became unobtainable the Garden's orchid collection could be maintained with gravel culture.

AN APPRECIATION

1912–1952

At a meeting of the Board of Trustees of the Missouri Botanical Garden held on May 21, 1952, the following appreciation was read and ordered spread upon the minutes:

On May 1, 1912, George T. Moore was appointed Director of the Missouri Botanical Garden, and today, forty years later, we, his fellow-trustees, wish not only to record our appreciation of his long and invaluable service but also to honor him for the four decades of the continuous growth and development which the Garden has enjoyed under his wise direction and inspiring leadership.

Prior to his appointment in 1909 to the staff of the Garden as Plant Physiologist, George Moore was known, nationally and internationally, as a scholar, a researcher, and an administrator; and since 1912, when he became the Director of the Garden, his record of accomplishments has continued to be a most enviable one, and one, too, in which he himself may take justifiable pride.

The Herbarium today contains in excess of 1,000,000 specimens; future generations, due to his vision and foresight, are going to enjoy the 1600-acre Arboretum at Gray Summit and all that it has to offer; and, as a result of the many other important betterments and improvements which he initiated, the Garden, as it exists today, is not only a vastly different Garden from what it was in 1912 but also, under his wise and able direction, has become one of the outstanding botanical gardens of the world.

And to keep pace with the physical development of the Garden, research and instruction have progressed rapidly during his administration. The year 1913 marked the beginning of publication of the MISSOURI BOTANICAL GARDEN BULLETIN, and in 1914 the new quarterly journal ANNALS OF THE MISSOURI BOTANICAL GARDEN was inaugurated and promptly recognized everywhere for the quality of the papers published.

Year by year the scientific staff was enlarged, and botanical students from all over the world were attracted to the Garden to do graduate research for their degrees under staff members with established reputations and to make use of the ever-growing botanical library of priceless books and foreign botanical publications. And today graduates of the Henry Shaw School of Botany are distributed throughout the United States, Europe, Asia, South and Central America, where, because of the high standards maintained by the School, they are qualified for top positions in colleges, universities, and government work.

Few men, indeed, are blessed with the healthful longevity necessary to compile such a record of accomplishment, but fewer still possess not only the knowledge of a scholar, the talent for administration, the wisdom of the planner, but also the respect and affection of his staff and associates, as does George T. Moore.

His fellow-trustees are proud and honored to offer this tribute, together with their congratulations on this anniversary of his fortieth year as Director, and to extend to him their best wishes for many more years of health and happiness.

NOTES

Dr. Gustav A. L. Mehlquist, Research Horticulturist to the Garden, will leave July 1 to become Professor of Horticulture at the University of Connecticut, Storrs.

Dr. John M. Gillett, having completed his revision of the genus Gentianella begun at the Garden in 1949, will return to Canada where he will be Botanist with the Department of Agriculture, at Ottawa.

Recent visitors to the Garden include: Dr. Charles B. Heiser, of Indiana University, Bloomington; Dr. W. H. Emig, of the University of Pittsburgh; Dr. W. R. McAtee, of Chapel Hill, N. C.; Dr. William T. Winne, of Union College, Schenectady, N. Y.; Mrs. Richard Froeschner, of Ames, Iowa; Mrs. Gretchen Harshbarger, of Liberty, Iowa, Garden Editor, *Household Magazine*.

The May number of the ANNALS OF THE MISSOURI BOTANICAL GARDEN (Vol. 39, No. 2) was recently issued, with contents as follows: The Induction of Parthenocarpy in *Petunia*, Henry A. McQuade; The Geography of Pokeweed, Jonathan D. Sauer; The Gametophyte of *Cardiocarpus spinatus* Graham, Henry N. Andrews and Charles J. Felix; Factors Affecting the Morphology of *Candida albicans*, Dan Otho McClary; Forest Quadrat Studies at the Arboretum and Observations on Forest Succession, Louis G. Brenner.

At the commencement of Washington University, June 11, the degree of Doctor of Philosophy was conferred on the following students in the Shaw School of Botany: Robert Austin Dietz, B.S. Principia College, A.M. Washington University; John Montague Gillett, B.A. Queens University, Canada; Hugh Hellmut Iltis, B.S. University of Tennessee, A.M. Washington University; Alice Faber Tryon, B.S. Milwaukee State Teachers College, M.S. University of Wisconsin; Milton Lawrence Zucker, A.B. Washington University. The degree of Master of Science was conferred on Ding Hou, B.S. National Ching-cheng University, China; William Boyd James, A.B. University of Delaware; Yoneo Sagawa, A.B. Washington University; Charles Jeffrey Felix, B.A. University of Tennessee.

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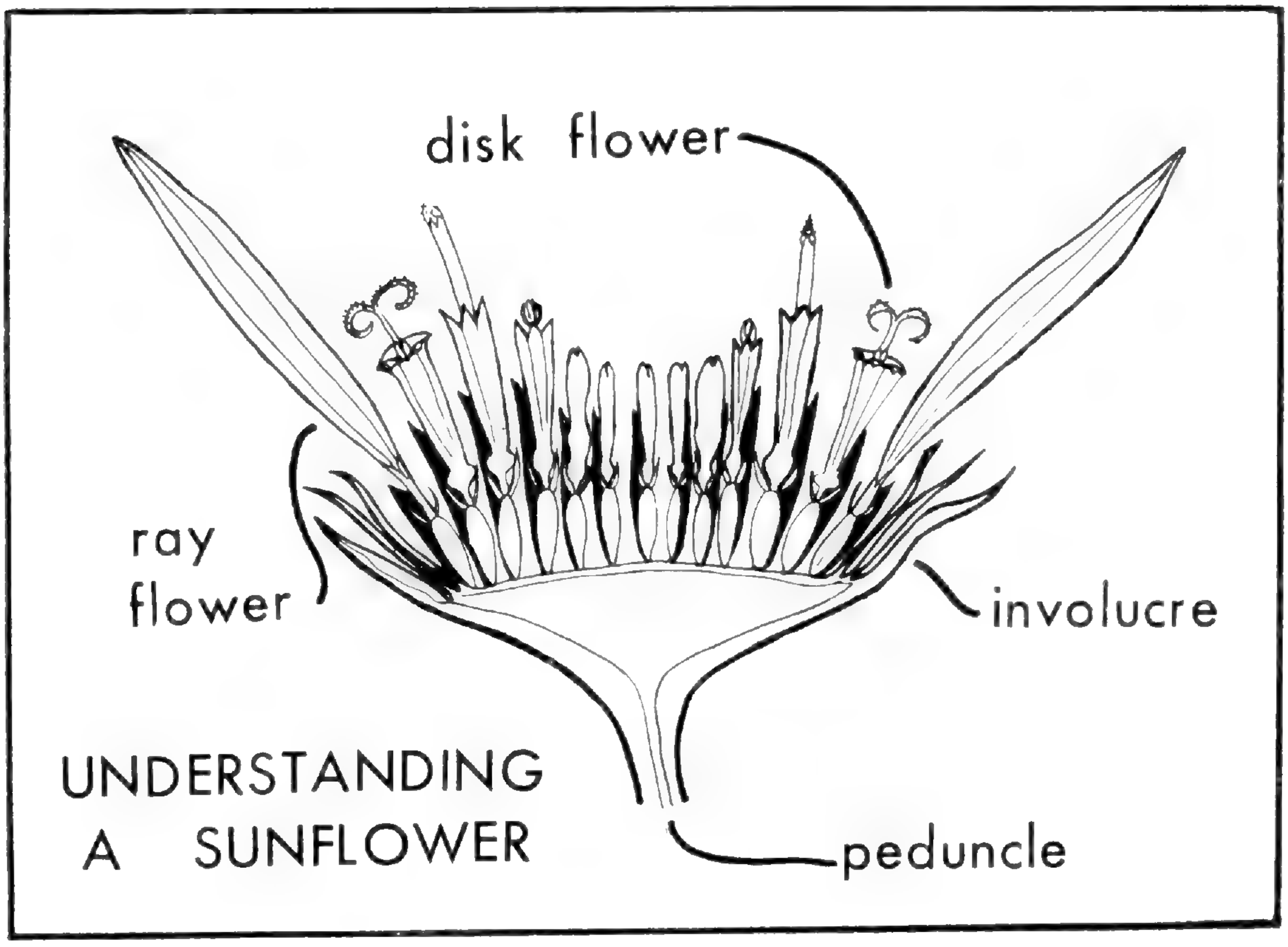
SOME FACTS ABOUT THE GARDEN

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 50,000 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 Southampton buses (No. 80), direct from downtown, pass within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN

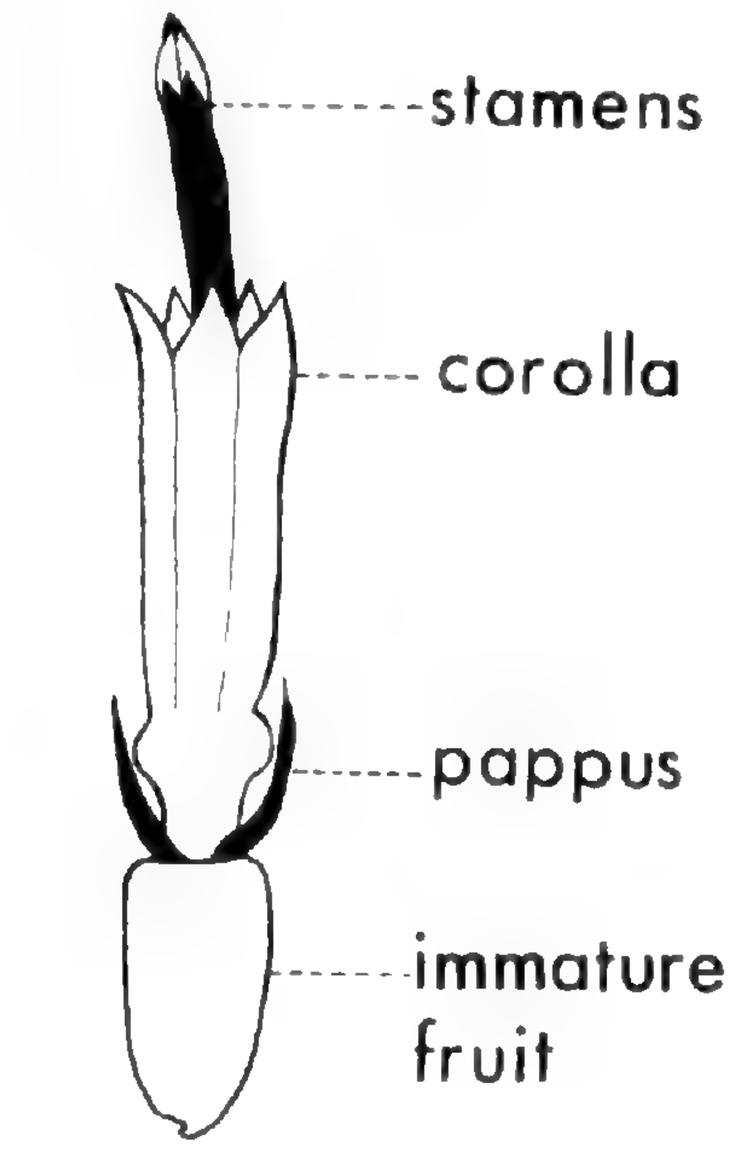


UNDERSTANDING A SUNFLOWER

CONTENTS

Volume XL September, 1952 Number 7

DETAILS OF THE FLOWERS OF A SUNFLOWER



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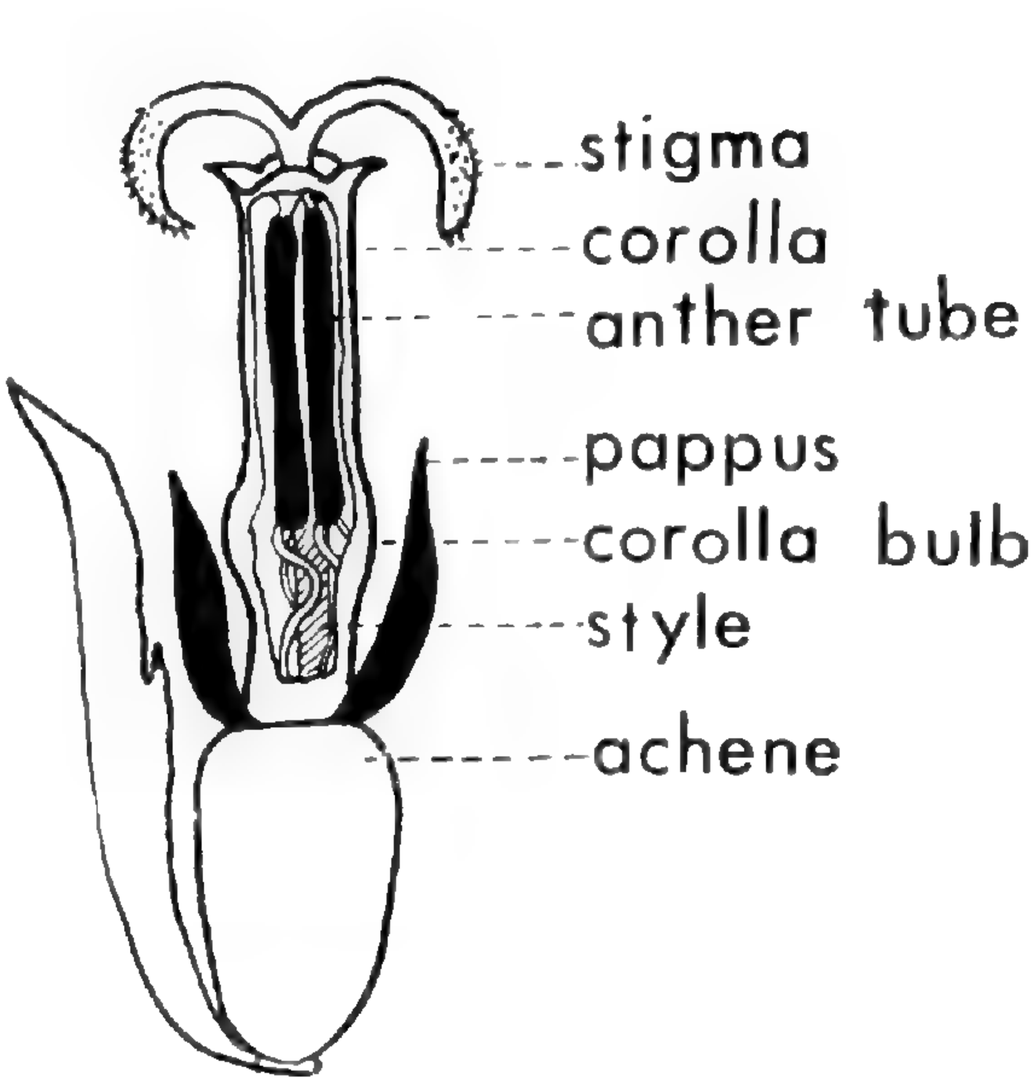

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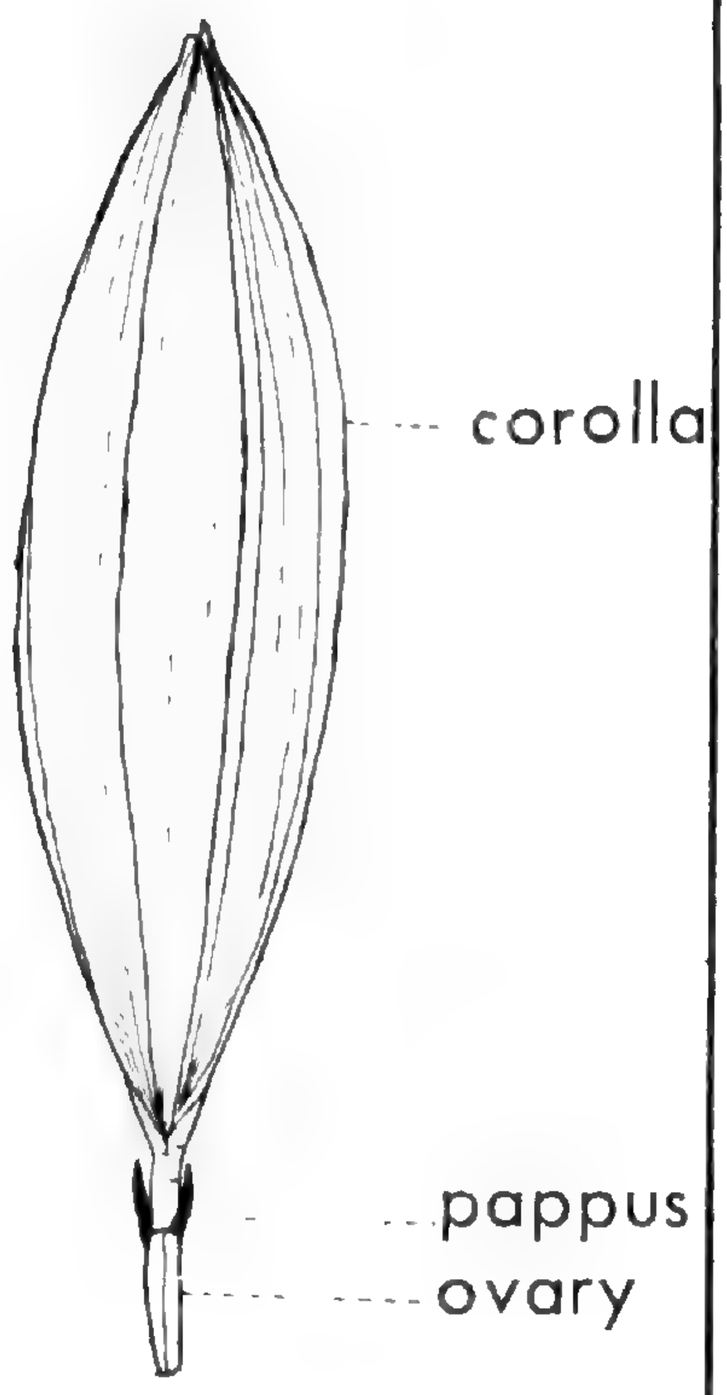


DISK FLOWERS

RAY FLOWER

Missouri Botanical Garden Bulletin

Vol. XL SEPTEMBER, 1952 No. 7

OUR COMMON AUTUMN WILD FLOWERS

EDGAR ANDERSON

Autumnal bloom poses a very special problem for the botanist who attempts to talk about it to his friends or to write about it for the general reader, a problem which he can ignore altogether with spring wild flowers and keep within appropriate bounds in talking about the flowers of our summer meadows. Fully three-quarters of the common fall wild flowers belong to the Daisy-Sunflower-Thistle family, the so-called Compositae, whose blossoms are just different enough from ordinary everyday ones, like lilies or violets, so that there are no words in common English speech for referring to their main features. Spring wild flowers present no such problem to the professional botanist with a good vocabulary. He can replace such technical Choctaw as "nodes" and "inflorescences" with "joints" and "blossoms," their rough equivalents in common speech, and his words will carry enough meaning so that they can be understood without technical botanical training. But what is one to do in the autumn? For three-quarters of the plants we should most like to discuss, there is nothing in the ordinary man's vocabulary with which to describe the main features of the blossoms. There are about a dozen such terms as ray floret, pappus, bract, achene, which we could use profitably again and again in speaking about the sunflowers and bonesets and beggar-ticks. Describing these in plain English is like trying to discuss the faces of several pretty girls in a language which has no terms for eyes, lips, or dimples.

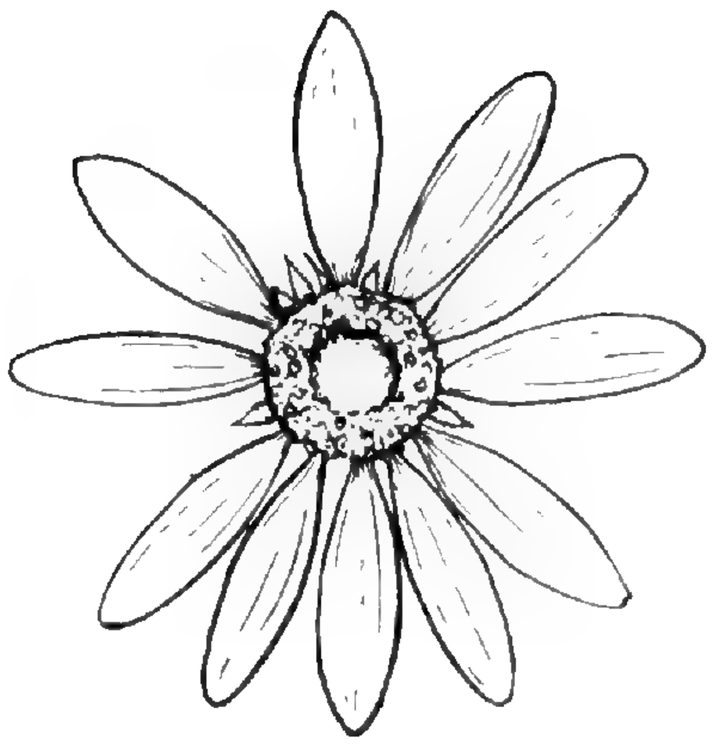
In preparing the following account, we have tried to solve the problem in several ways. We have reduced these technicalities to the absolute minimum, and have preceded the discussion with a short illustrated description of the simplest and commonest of our native Composites. This expository section attempts to equip the general reader with the half-dozen technicalities which will best prepare him for looking a daisy or an aster or a sunflower intelligently in the face. If this bare minimum is too much to ask, why then no matter! If you don't want to be bothered with even a

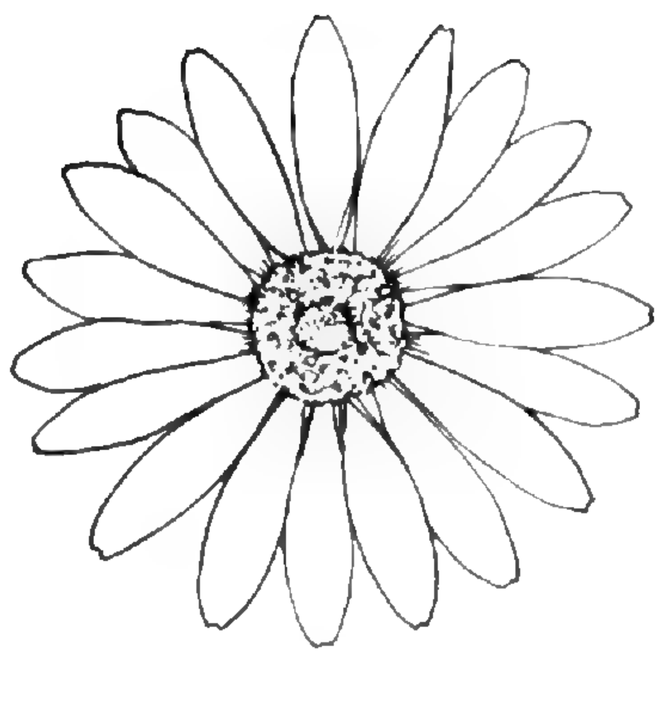
minimum of technicalities, if your life will be simpler without the effort of putting "achene" and "disk flower" into your vocabulary, you can easily just skip this whole section and pass on to the one which deals directly with the flowers themselves. In so far as it is humanly possible, we have tried to phrase their descriptions and discussions in words which would not be out of place at a family reunion, a bridge luncheon, or a cocktail party.

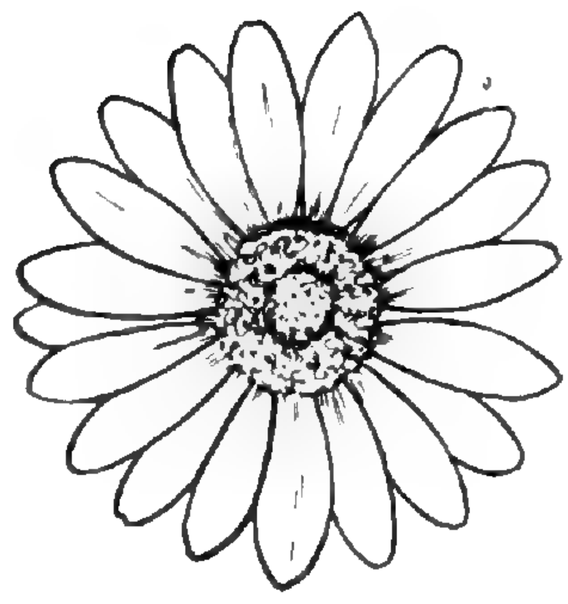
THE PARADE OF COMPOSITES

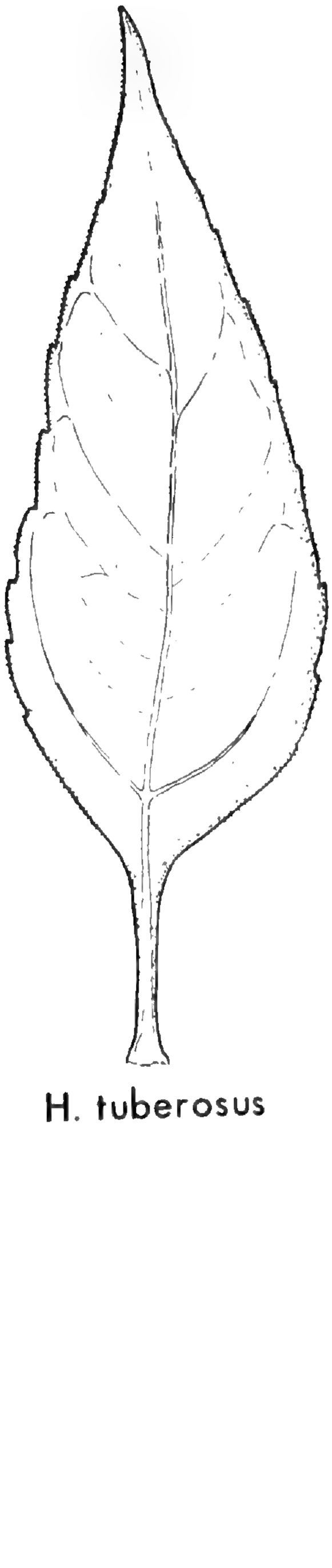
The Sunflowers.—If you want to know a little something about these common autumn wildflowers, the best place to start is along the dump-heaps and railroad yards and vacant lots in the city of St. Louis. Not that you will find many wild flowers there—far from it, but you will find one of our native weeds that is interesting and beautiful in its own right, the common sunflower, *Helianthus annuus*. One starts with it, not because it is a wild flower (strictly speaking, it is not one in the St. Louis area) but since it is the very simplest and easiest introduction one may hope to find to that amazing family of plants, the Compositae. These flowers are difficult for the ordinary person to understand, not so much because the flowers are really complicated, but because the single flowers are mostly so tiny that it is difficult to see their details and understand how they are put together. The little florets, by the dozens or hundreds as the case may be, are jammed together into a tight head of bloom which takes on the general appearance of a single flower. Only after a careful second look do we realize that the blossoms of daisies and asters and sunflowers are made up of many little separate flowers packed tightly together.

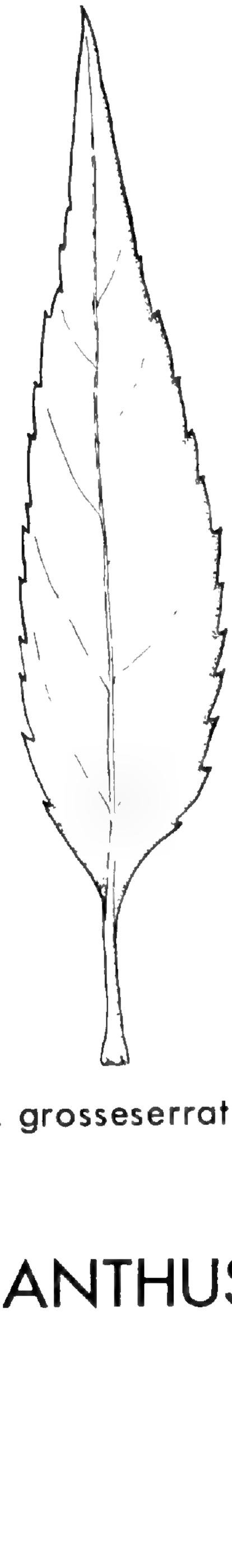
The sunflower provides a simple introduction to these complexities because, unlike the daisies and the asters, it has flowers so large that all the essential details can be seen with the naked eye. Collect one of these golden disks and examine it carefully. Any kind of sunflower will serve, either the big-headed sorts which are grown in gardens, or the many-flowered ones which are so common in waste lands. Pull the head apart with your hands or cut it with a knife. The whole center of the bloom, the so-called disk, is made up of tens or hundreds of little separate flowers, set neatly together in mathematical perfection. Each one of these florets has a corolla like any ordinary flower. It is yellow tinged with reddish brown, and aside from its size does not look so different from a rather stiffish tiger lily. Round about the disk flowers is a circle of much more highly specialized ones, the ray flowers, whose great lop-sided corollas stick away from the flower head, and look for all the world like single petals. Under the whole flower head is a series of small leaf-like organs thatched closely one on top of the other, and covering practically all of the flower head when it is in the bud. This whole affair is called the involucre, and the separate flaps are known as involucral











H. tuberosus H. grosseserratus H. maximiliani

HELIANTHUS

bracts, bract being a usefully vague term which botanists use to indicate a leaf-like organ either too small or too chaffy in texture to merit the designation of "leaf." Each flower gives rise to one seed, and at the junction of corolla and seed there are two little scales called the pappus. In the sunflower the pappus is nothing much, and might easily escape notice; in many other Composites it is developed to fantastic proportions. It may be large or small, with few scales or many, or instead of scales it may have hairs, bristles, or plumes of various sorts, as, for instance, the gay little parachutes on which dandelion seeds float away when they are ripe, or the intricate rosette one finds when an Oyster Plant or wild Goat's Beard goes to seed.

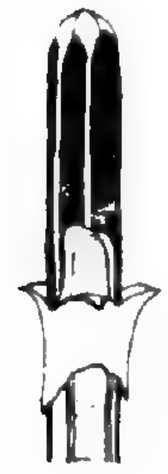
A sunflower head is much more fascinating to watch than any one might suppose who had not studied the same head day after day throughout its blooming season. One autumn I was confined to the hospital for a fortnight during the time that sunflowers are in bloom, and one of the men from the laboratory who came to visit me during the noon hour had picked a bouquet of weed sunflowers as a joke. The nurse put them in water on my bedside table. I learned that they were more diverting than one might have supposed. Each head of bloom goes through a complicated cycle of development, and there is a fascinating daily rhythm to the opening of the florets, the pushing out of the bright golden pollen, and the protrusion of the two-parted stigma, that organ which in nature acts as a receptor for pollen brought from other plants by visiting insects.

In the young flower-head the tiny florets are hidden by the dark purple bracts or chaff, narrow and stiff, a single bract sheltering each floret around the outer half of its circumference, then bending inwards across the floret so that in the bud the whole disk is little more than a resinous circle of glistening pointed scales, shingled concentrically on top of each other and all pointing towards the center. As each flower opens, it is thrust upwards by the elongating style and stigma which push up like a ramrod through the central circle of stamens, shoving the pollen ahead so that as the corolla lobes fold back the golden dust fills the flaring cornucopia made by the corolla, and for the time being hides everything else in the flower. Blooming begins at the outer edge of the disk, and proceeds regularly and rhythmically towards the center. First the outer row blossoms, then the next and so on, so that every morning there is a tiny circle of gold with the new crop of pollen for the day. Outwards from this circle are the florets which blossomed yesterday and the days before that, the pollen all dispersed, the brush-like stigmas curled back. Inwards from the golden line are the florets which will bloom tomorrow. The tension of the upward stigmas already pushes them up into the air, not only beyond the unopened buds which lie centerwards, but even past the opened flowers of this morning, which, hav-

HOW THE SUNFLOWER SHEDS ITS POLLE

A DRAMA IN FIVE ACTS

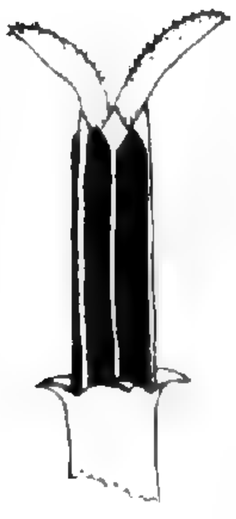
ACT I: The ramrodding stigmas push the anthers up and out of the flower.



ACT II: The pollen is forced out.

ACT III: The stigmas, still held together, begin to emerge.

ACT IV: The stigmas unfold.



ACT V: The pollen is all shed and the anthers have collapsed. The stigmas await pollen from other flowers.

ing released their load of pollen, are no longer pulled taut and have settled back comfortably.

Among our American wild flowers there are two general sorts of sunflowers, the annuals and the perennials. The annual sunflowers from which our garden sunflowers were eventually derived are truly native to the West and South, though in St. Louis they are weeds of the railroad yards and waste places throughout the city. Several of the perennial species are native in this area, chiefly *Helianthus grosseserratus*, with man-high wands of pointed green leaves topped off with a small spray of rather ordinary yellow daisy-like blooms. It is common along fence-rows around the outskirts of East St. Louis. On higher and poorer soils its place is taken by *Helianthus tuberosus*, the species which the Indians domesticated to produce the so-called Jerusalem artichoke. In its general appearance it is one of the least interesting and least distinctive of all the sunflowers. The rough leaves are set far apart on a slender stem, and the flowers are in no way outstanding —just good, average, small-sized sunflowers. This species grows in scattered clumps here and there over the uplands and can be quite variable from one clump to another.

A much more outstanding perennial sunflower is native just west of St. Louis, Prince Maximilian's Sunflower *(Helianthus Maximiliani)*, and a particularly fine form of it is fairly common in St. Louis gardens. It grows in thick clumps and sends up wands six feet high or more, with graceful willow-like leaves and handsome masses of rich golden bloom closely set all along the top of the stem. It does well in the informal garden and may even be grown as a sort of hedge, for it is much less coarse and rampant than most of our other species. It does not like shade and will blossom more freely if it is planted in full sun.

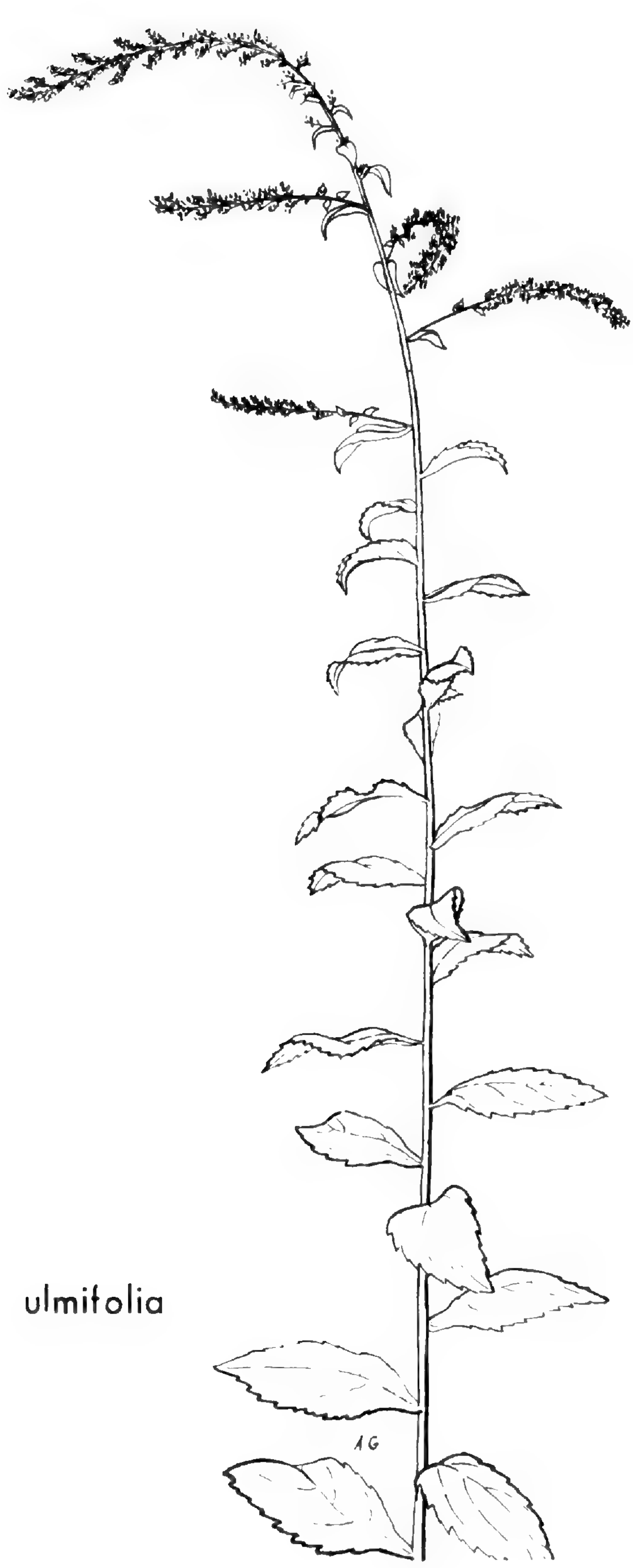
Spanish Needles or Beggar-ticks.—Many of the fall Composites are golden, but none more so than the Spanish Needles or Beggar-ticks. There are a good many species in the St. Louis area, but most of the mass display is provided by *Bidens coronarius*. It is a brilliant yellow flower, like an "Orange Flare" Cosmos, which grows profusely around the edges of swales and generally in low places. It gives a burst of gold for a week or ten days; then the flowers ripen off rapidly into the sharp two-pronged stick-tight from which the common names are derived. One does not realize how much of our landscape is touched with this color until he takes a plane ride on a bright day in early autumn. The yellow is even more visible high in the air than it is down below, and one sees lines of yellow bordering fields, sheets of it in all the low places, and sometimes an abandoned field which is solid yellow for acre after acre.

Goldenrods.—There are a good many goldenrods in Missouri, but only one or two merit special mention. The common goldenrod of this region is *Solidago altissimum*, literally the highest of the goldenrods. This is a good name, for it is often taller than a man and its chief difference from the common goldenrod of the East and North, which it closely resembles, is in its somewhat larger size. Around St. Louis it is the common autumn wild flower of upland pastures, fading from a greenish-yellow to a dull yellow-brown as the flower-heads go to seed. Though something of a weed it has a certain blowsy charm; though larger in size and rougher in texture it has the same graceful lines as its eastern cousins.

Of the other goldenrods which are common in our area, only one is really distinctive, the Elm-leaved Goldenrod, *Solidago ulmifolia.* It comes into flower in open upland woods in late summer and stays in bloom into September. Not only is its leaf like an elm, the whole shape of the plant is elm-like. This shape is particularly characteristic of the plants one sees in the Ozarks, which are definitely less rampant than *Solidago ulmifolia* as one customarily sees it in the East and North. With us the slender branches arch away from the main stem in much the same way as do the branches of an American elm.

The Wild Asters.—Asters are perhaps the most typically American of all our wild flowers. From the Great Plains to the Atlantic Coast, from Hudson Bay to the mountains of the Gulf States, autumn is the time of the wild asters, and wherever one goes in the fall he finds them in profusion. There are so many species and some of them are so common that the roadsides, the wood edges, the cliffs, the brook-sides, and the swales of eastern North America are bright with asters as the nights begin to be frosty. Missouri has thirty species, and one can count on finding half a dozen of them in bloom during an afternoon's stroll at the height of the aster season.

The New England Aster *(Aster novae-angliae)* is one of the first to bloom as well as one of the most conspicuous. Its flower-heads are as large as a five-cent piece, and are borne freely over the branching top of a plant which is frequently shoulder-high. The blooms have many brilliant narrow ray flowers, and the bracts of the involucre curl backwards, giving the blossom a kind of shaggy appearance. Wild forms of this species are usually a bright dark blue and can be found in low sunny meadows or in rich soil along railroad tracks. It is not a common wild flower in this area but pink forms of it are frequently cultivated and make good garden plants. One of the best ways to get interesting and effective plants for one's garden is to buy one plant of these superior sorts, most of which are lower and more widely branched. If one then brings a native Missouri plant of New England Aster into the garden, the two sorts will be crossed by the bees, and



Solidago ulmifolia

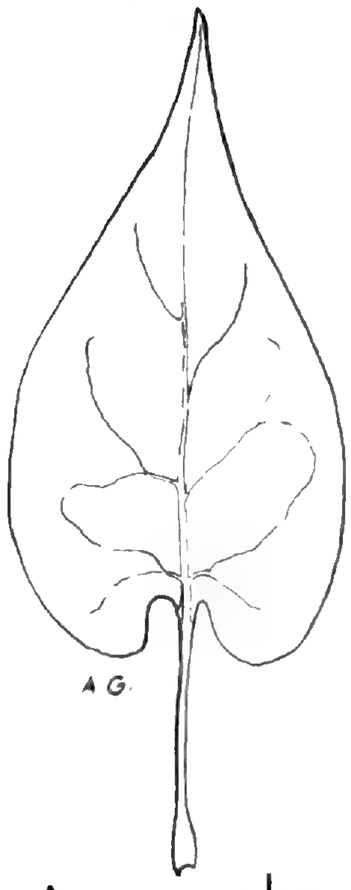
hybrids will start seeding themselves. Some of these will be more robust than the garden sorts, and usually every plant is different in color, some of them wine-purple, some of them rose-purple. Not all of them will be refined enough for the perennial border, but the best will be worth keeping and will give a pleasant effect with little attention.

Of our common native species, *Aster turbinellus*, the Ozark Aster, is by far the best for the perennial border or the wild garden. It grows in sun or semi-shade on dry ridges throughout the Ozark area, and has blossoms nearly the size of a penny, of a bright clear blue and a texture so smooth that the whole top of the plant looks as if it had been enamelled. Technically, it is distinguished by the tiny tightly overlapping bracts of the involucre which make a kind of urn-shaped or turban-like base for the flower-head. Seen in the wild, *Aster turbinellus* gives little indication of how glorious it may be in the garden. Given half a chance it branches and rebranches and the flower heads are so close together as to turn the whole plant into a mound of blue. Unfortunately, though it is well worth cultivating in even the most formal sort of perennial border, it is confined pretty exclusively to the Ozarks, and since it has not become generally known, it is difficult or impossible to buy plants from a dealer.

Another Ozark species is a little more difficult to manage in the garden, though in some ways even more rewarding as a garden plant. It is the Mauve Aster, *Aster anomalus*. It owes its intriguing scientific name to the possession, in one and the same plant, of large flower-heads with shaggy bracts like the New England Asters, and heart-shaped leaves like quite other sorts. The texture of the leaves, however, is really distinctive. They are harsh, leathery, and gray-green; the whole plant seems designed for the dry limestone ridges on which it is found. The flowers are a true mauve, a clear pinky-blue, and in garden-grown plants they are frequently borne in great profusion. For best results in the garden it needs to be reset every few years. It is apparently a strong feeder and will bloom more satisfactorily if it is moved about occasionally. There is in the Ozarks another beautiful species with recurved bracts, *Aster oblongifolius*. It is a low-growing species, seldom knee-high, and it frequently forms great mats of bloom. The flowers are a uniform dark blue, and stay in bloom after many other autumn wild flowers have gone by. This is one species which definitely is nicer looking as a wild plant than when moved into one's garden. The leaves are rough and hairy and look out of place with garden plants. Unless given complete sunshine it does not flower as well in the garden as on the dry rocky ledges where it is native, and it frequently grows rank and coarse when brought in from the wild.

In the St. Louis area the commonest of the blue asters is a small-flowered

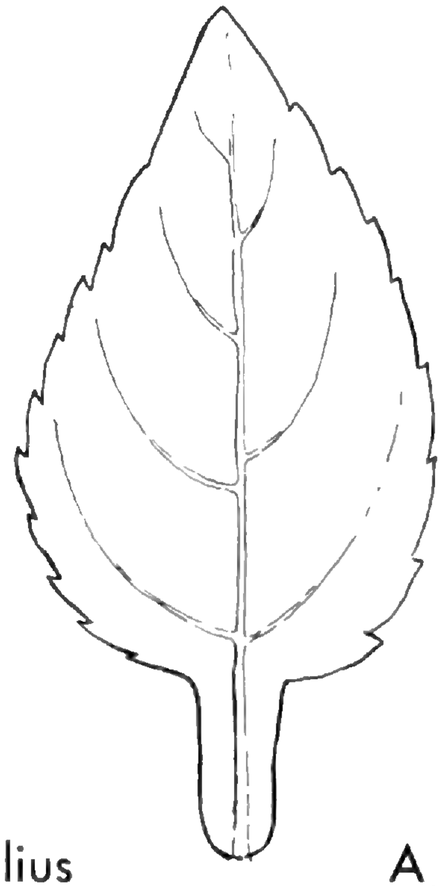
ASTER



A. anomalus

A. turbinellus

A. oblongifolius



A. Drummondii

A. novae-angliae

species called *Aster Drummondii.* It was originally native to rich wood edges and is a fairly rank-growing plant which bears large irregular panicles of blossoms which are roughly the size and the gray-blue color of lilacs. The leaves are thinnish and more or less heart-shaped with conspicuous indentations along their margins. This is one of the more variable species around St. Louis; some of its members are too coarse and weedy when brought into the perennial border, but others produce effects similar to the eastern species of aster which have been domesticated in England under the name of Michaelmas Daisies and which, by and large, are more reliable in the north and east than here in St. Louis.

Unless you want to wade in technicalities, it is better to call all the native white asters just "White Asters." In parts of the South there is a charming and appropriate common name, "Farewell to Summer," which is generally applied to all these small-flowered white asters which appear as if by magic when the nights begin to get cool. There are several species in Missouri, but the differences between them are technical, and on the whole they look very much alike. They are lowish plants, closely set with yellow-centered white flowers which, given a second look, appear like tiny white daisies. They are one of the glories of our autumn, but they are so common that most of us take them pretty much for granted. They make a white tracery around field edges and along roadways; sometimes in the bottomlands they fill an entire meadow with lacy white bloom.

Wild Ageratum or Mistflower.—One of our commonest Missouri flowers, the Wild Ageratum *(Eupatorium coelestinum)* can be identified by its color alone. It is a pure, soft blue, unmarked with any other color except as an occasional plant may show an undertone of purplish as the flower ages. In the late summer and autumn the only other all-blue wild flower is the blue lobelia, and it has shadings of purple and is marked with white, though, of course, many of the asters have shades of blue—blue-gray or blue purple—but they are all starry blooms with yellow centers. The Ageratum is just pure clear coerulean-blue. In this beautiful soft color, it is in lovely contrast to the bright golden yellows of so many wild flowers which bloom at the same time of year. To anyone except the specialist it seems almost identical to its tropical relative, the true Ageratum, so commonly used as a bedding plant throughout the world. The Wild Ageratum has flowers of the same soft blue, tightly set in little heads about the size of the eraser on a lead pencil, many of these heads being clustered at the top of the plant. In height it varies from a few inches to a foot or more and may have many branches, or almost none. It is native to dampish places in semi-shade and is most frequently found along old cart tracks at the edge of lowland woods or in poorly kept drainage ditches along the highways. It has a long bloom-

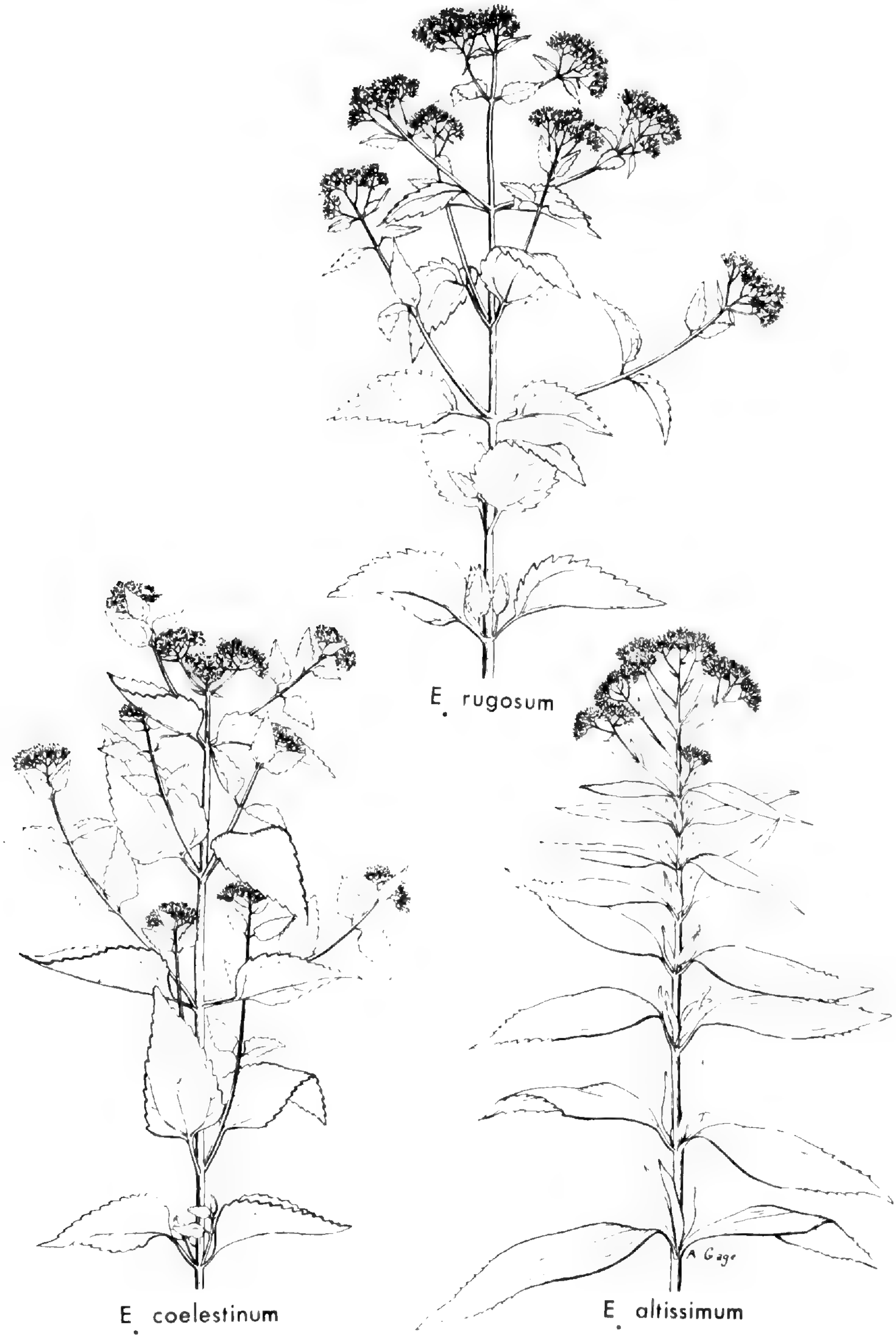
ing period, coming into flower about the first week of August and usually continuing in good bloom throughout September and early October. When one knows how to manage it, there are few better flowers for an average St. Louis garden. It grows rampantly and has a way of turning up not only in the same bed in which it was planted but even in other parts of the garden. However, it is easy to control. The rootstalks run right along the top of the ground and if it is going places where you do not want it, just yank it up by the handful when it is in full bloom. The seeds are greatly relished by such birds as Juncos, and if one has masses of Wild Ageratum in his garden it will serve them for shelter as well as food on cold winter days.

Very rarely a pure white form of the same species is found in Missouri, and one which turned up at the Arboretum of the Missouri Botanical Garden has been introduced into cultivation. Interplanted with the blue it gives a beautiful effect in the informal perennial border.

White Snakeroot.—Not only is there a rare albino form of the Wild Ageratum precisely like the blue except for its color; there is very commonly found a white-flowered sister species *(Eupatorium rugosum,* frequently listed as *Eupatorium urticaefolium)* which resembles it so closely that one must give it a sharp look to see that there are various other differences besides flower color. It has the same plush-soft little flower-heads, the same more or less heart-shaped leaves set opposite to each other on the stalk, but it is a larger and rangier plant, frequently waist-high, and though the two species may sometimes grow together, the White Snakeroot is usually found in places too dry for the Wild Ageratum—shady pastures, the edges of woods, or along old fence-rows. It is more open in its habits of growth and the flower-heads are not so tightly clustered into a few compact groups.

At times the White Snakeroot has been one of the most dangerous plants in our native flora. It is poisonous, possessing a principle which induces a condition not unlike diabetes. Not only does it poison cattle; the drug is passed on into the milk and is concentrated in butter made from it. Fortunately, the plant is so bitter that cattle do not ordinarily eat much until they are driven to it, but in pioneer days before adequate pastures were available, it was a common thing for a whole family to come down with "milk sick," as the poisoning was then called, and death sometimes resulted. Nowadays, with better pastures, this is much less common but when we have a drought in August and September, there is still some danger that cattle may be driven to browse on the White Snakeroot; even then, it is only when the milk (and more especially the butter) is used by just a few families and the poison is concentrated that anyone is made ill.

There are about eight other kinds of Eupatorium to be found in Missouri. The Common Boneset with its conspicuous stiff dark green leaves occurs in



EUPATORIUM

old pastures here as in the East, though much less frequently. Missouri has its own Joe Pye Weed, but unlike the brilliant mulberry-flowered Eupatorium of eastern swamps and meadows, ours is taller and more slender. Its flowers are such a pale pink that it is almost white, and is largely confined to woodlands. It is definitely, in Missouri, the sort of plant for the amateur botanist to take an interest in, but not common or beautiful enough for those who want their wild flowers to make splashes of color in the landscape.

Eupatorium altissimum.—One of our commonest autumn wild flowers is another Eupatorium, *E. altissimum* to be exact, and unfortunately that is all we can call it, for Missourians have not yet got around to giving any kind of an English name to this interesting and ubiquitous flower. Common names belong to the common people and when they do a good job, there is nothing better. Heart's Ease, Beggar's Lice, Love-in-a-mist, Bleeding Heart, Dutchman's Breeches: these names describe the plants they belong to; they linger in the mind, they come to us not as lessons to be learned but as a sort of folk poetry which is part of us. But until the common people get around to honoring a common plant with a real common name there is little that a professional botanist can do except fold his hands and wait. Made-up book names (a kind of Englished Latin) have been tried out but they just don't work. On that pattern we might refer to *Eupatorium altissimum* as "Tallest Boneset," which strikes me as about on a par with "Double-breasted Seersucker" as a good common name.

Eupatorium altissimum, then, is the tallish gray-green plant with the off-white flowers which is common in hilly pastures and abandoned fields. It is the plant which you have ignored for year after year every time you drove out into the country in the early autumn. If you are the kind of person who makes yourself do certain things just because it is good for you (like reading all of Tolstoy's "War and Peace," for instance) then this year as your goal why not teach yourself about *Eupatorium altissimum?* It is not just the simple weed it seems to be. It has a honey-sweet perfume. Perhaps "Honey weed" would make a good common name for it. It is effective in the perennial border; it is beautiful in flower arrangements. If enough of us take a little interest in it we might get some improved varieties of general garden merit and make another forward step towards a distinctly regional kind of gardening.

Eupatorium altissimum might be hard for an amateur to identify if it were growing in a garden as part of a collection of American Eupatoriums. Around St. Louis one does not have to resort to technicalities in describing it effectively. In this region it can be distinguished easily because it is so very common. It is one of those late summer bushy perennials which crowd into undergrazed pastures; it grows in old deserted fields with goldenrod and Broom Sedge; one cannot drive through the countryside in the late

summer and early fall without seeing thousands of plants in field after field. It grows mainly on the uplands, though a related species with wider leaves is found in the valley bottoms. The leaves and stems are densely clothed with fine white hairs, giving the whole plant a grayish aspect and making the blossoms appear less white than they really are. The narrowish leaves vary a good deal, not only on each plant but also from one plant to another. They come to long tapering points, and are generally smooth-edged, though they frequently have a few notches just back of the tip. The whole top of the plant is covered with the clustered flower-heads. When they first come into bloom the flowers have a delicious honey odor. Because they are such a soft gray-green in their general effect they are most attractive both in the perennial border and in flower arrangements. In size, perfume, hairiness, and general habit of growth there is much variation from plant to plant in almost any pasture full of these Eupatoriums. With all this variation to work with, one should have little trouble in selecting a particularly graceful variety worthy of a real place in the American perennial border.

(To be continued in the October BULLETIN)

PLEASE!!!

Korea has a climate much like our own with hot summers and cold winters. Some of the finest shrubs in our gardens came originally from Korea, and the Korean chrysanthemum has given rise to a whole race of Korean hybrids which are transforming late autumn gardens in the St. Louis area. Accordingly, a year ago, the Garden made an appeal to those readers of the BULLETIN who had friends and relatives on the Korean front to have them collect seeds of Korean plants. A number of seed packets have been received, including seeds of the Korean Larch and a Lily (or at least something from the Lily family which could not be positively identified by the seeds alone). These have all been planted, and now that it is again harvest time we would like to remind our friends that we are still interested in seeds from Korea.

NOTES

The Eastern Missouri Beekeepers held a field day at the Arboretum, July 13.

Dr. Robert A. Dietz, who received his doctor's degree at the Washington University commencement in June, has accepted an appointment as Instructor in Botany at the University of Tennessee, Knoxville.

Mr. George F. Freytag, who has been in charge of the experimental plot at the Esceuela Agricola Pan-Americana, Honduras, in connection with Dr.

Edgar Anderson's Guggenheim Foundation fellowship work, will return to the Garden this fall to resume his work toward a doctorate.

Miss Nalini Nirodi, Pioneer Hi-Bred Corn Co. fellow in the Henry Shaw School of Botany, spent the summer working in the cytological laboratory of the Pioneer Hi-Bred Corn Co., at Johnston, Iowa.

The garden of Dr. and Mrs. Julian A. Steyermark, at Barrington, Ill., has been named the most outstanding in Illinois by the president of the National Federation of State Garden Clubs. More than 1000 kinds of Missouri plants are grown in their four-acre lot which is divided into four sections—prairie, upland pond, meadow, and rocky slopes. Dr. Steyermark is Curator of the Herbarium, Chicago Natural History Museum, and Honorary Research Associate to the Missouri Botanical Garden. In the latter capacity he has been conducting a survey of the Missouri flora for several years which has resulted in finding numerous species and varieties new to Missouri and to special areas in the state. He is also the author of a book, "The Spring Flora of Missouri."

Visitors to the Garden library and herbarium during the summer months include the following: Miss Eula Whitehouse and Dr. Lloyd H. Shinners, of Southern Methodist University, Dallas, Texas; Dr. R. E. McDermott, of the University of Missouri, Columbia; Dr. José Cuatrecasas, of the Chicago Museum of Natural History; Dr. H. de Laszlo, of the Royal Institution, London, England; Miss Eleanor McGuilliard, of the University of Chattanooga, Tenn.; Dr. Alexander Grobmann, of the Escuela Agricola Nacional "La Molina," Lima, Peru; Dr. Alfred Etter, of the Washington University Farm, Clarksville, Mo.; Mr. E. E. Stanford, of College of the Pacific, Stockton, Calif.; Mr. H. A. Steavenson, of the U. S. Soil Conservation Service, Elsberry, Mo.; Dr. John J. Finan, of the Institute of American Affairs, State Department, Washington, D. C.

It has been a hot summer but the rains have been well distributed, and never, it seems, has the Garden been so full of leafage as this September. The native Magnolias, with leaves half again as big as in some autumns, lend a tropical air to several of the beds. The Ivy collection around Mr. Shaw's tomb was never an evener, darker green than it is now. The variegated tapioca plants (that's what they really are, just plain ordinary tapioca plants from the Tropics with green-and-ivory leaves instead of the usual green) were never more effective as a background for the tropical water-lilies. Prices are going up, the Garden is short-handed, there are many problems to face, but as one walks around the paths on an autumn morning all these troubles fade into the background.

THE MISSOURI BOTANICAL GARDEN

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MISSOURI BOTANICAL GARDEN BULLETIN

CONTENTS

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COVER: A flowering umbel of *Allium stellatum*. (After Hooker).

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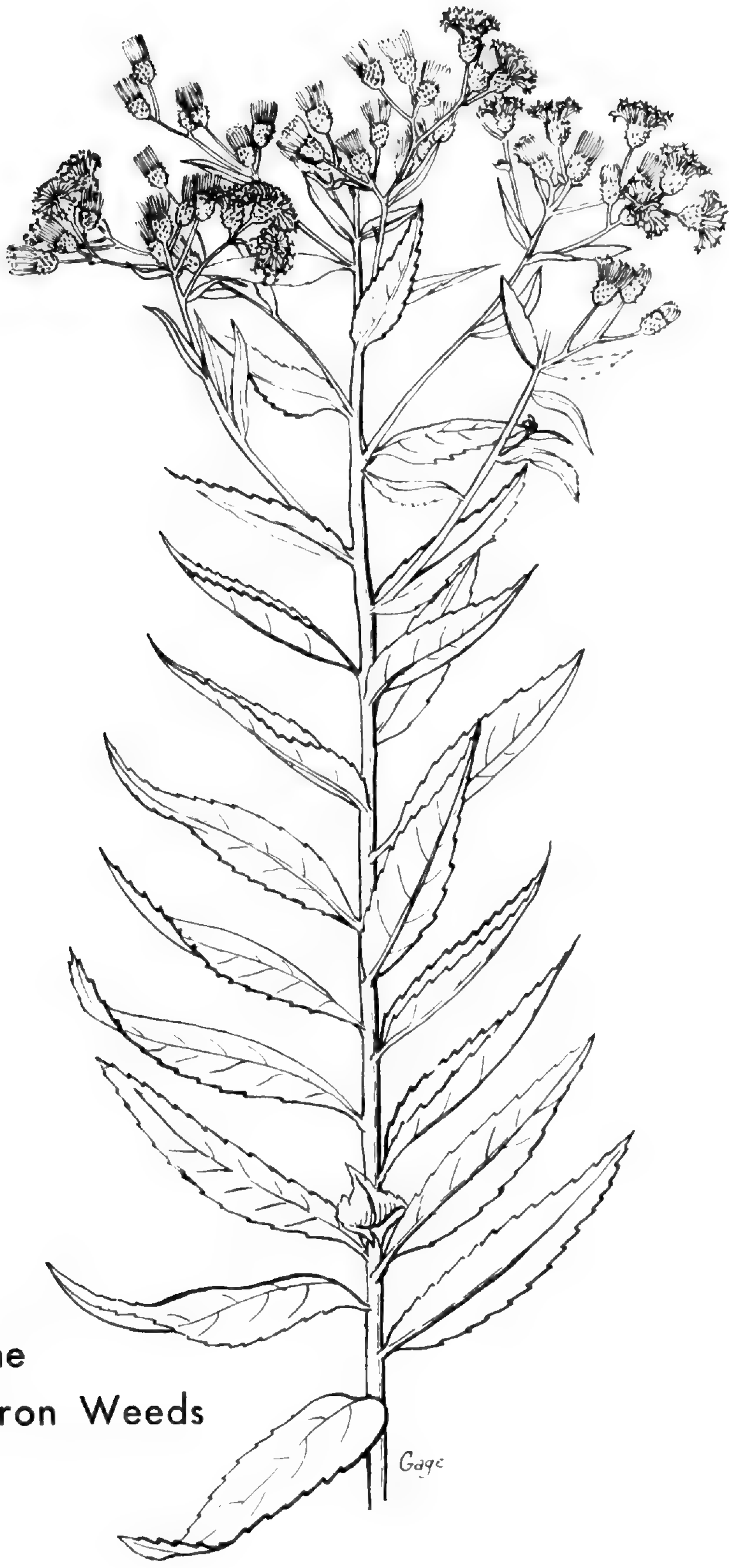
SOME FACTS ABOUT THE GARDEN

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 50,000 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 Southampton buses (No. 80), direct from downtown, pass within three blocks of the main entrance.



One of the
Missouri Iron Weeds

Missouri Botanical Garden Bulletin

Vol. XL OCTOBER, 1952 No. 8

OUR COMMON AUTUMN WILD FLOWERS

(Continued from September BULLETIN)

EDGAR ANDERSON

Ironweed (various species of Vernonia).—The ironweeds come naturally to mind after discussing *Eupatorium altissimum* because, like it, they are most commonly found in old fields and under-grazed pastures. There are many species in Missouri, and one frequently finds several on one farm with many puzzling mongrels which are difficult to classify. They are quite closely related to Eupatorium but are easily distinguished by the rich wine-purple of the flowers, which in most of the species are borne in flower-heads much larger than those characteristic of Eupatorium. When the flowers go to seed, the conspicuous pappus is made up of silky bristles of a bright chestnut-brown. A plant of Ironweed with its heads partly gone to seed and partly still in flower is a curious sight, an arrangement of little tassels sticking straight up into the air, part of them a luscious wine-purple and part a silky chestnut-brown. Most of our Ironweeds do not make good garden plants. Taken into a formal perennial border they become even ranker and coarser than they were in the wild. Though they are rather handsome when seen along fence-rows or in a pasture they do not even make a good subject for a casual bouquet. They wither easily, they go out of flower quickly, and they somehow lose the bold purple look which they had in the field.

Blazing-stars and Gay-feathers (various species of Liatris).—Like Eupatorium and Ironweed, the Blazing-stars are among those composites which have no disk flowers, as in a daisy or a sunflower, but all of whose florets in any one flower head are almost exactly similar. Like them, too, they are quite as much flowers of the summer time as the autumn, and one of our commonest species, *Liatris pycnostachya*, is usually out of bloom by the end of August.

Once seen, a Blazing-star is never forgotten, except possibly by a person who is very color-blind. The clear rosy-pink of the blooms is so brilliant

and the flowers are so gracefully set along a slender wand-like stem that one of the loveliest sights in Missouri is a stretch of unplowed ancient prairie land along a railroad track with hundreds of these rosy wands waving in the breeze.

There are six species of Liatris in Missouri, but they are so much alike in flower color and in habit of growth that anyone would recognize them as being the same general kind of plant. Their most conspicuous difference from one another is the extent to which the actual flower heads are separated. The florets in Liatris are a good deal larger than those in Eupatoriums and Ironweeds, and they are borne in chubby little heads like globes or goblets. In the common Blazing-star of early summer, *Liatris pycnostachya*, the heads are small; they are set close against the main stalk, and are so tightly packed together that one sees the blossom as just one long wand of rosy-pink bloom. In the other species one notices the separate little goblets; they show as balls or spots of color gracefully held out away from the stalk itself. Some of the species are scarcely knee high, while others may reach shoulder height, but they all look very much alike in their color and general effect. The commonest one in Missouri is *Liatris scariosa*. Both it and *Liatris cylindrica* blossom well into the fall.

Blazing-stars are attractive in the perennial border, and do not become coarser and weedier looking when they are brought into the garden, as do many of the Compositae. All our Missouri species make good garden plants, but they differ a great deal in the type of soil they prefer. If you want to try them in your garden, therefore, it is a good idea to move in one or two different kinds. They will probably differ somewhat in flowering period and extend your season of bloom, and one of them will undoubtedly make itself more at home with you than do the others and give you much more bloom for the same amount of care.

One of the loveliest and most interesting of our autumn wild flowers has everything a wild flower needs except a good common name. It is an

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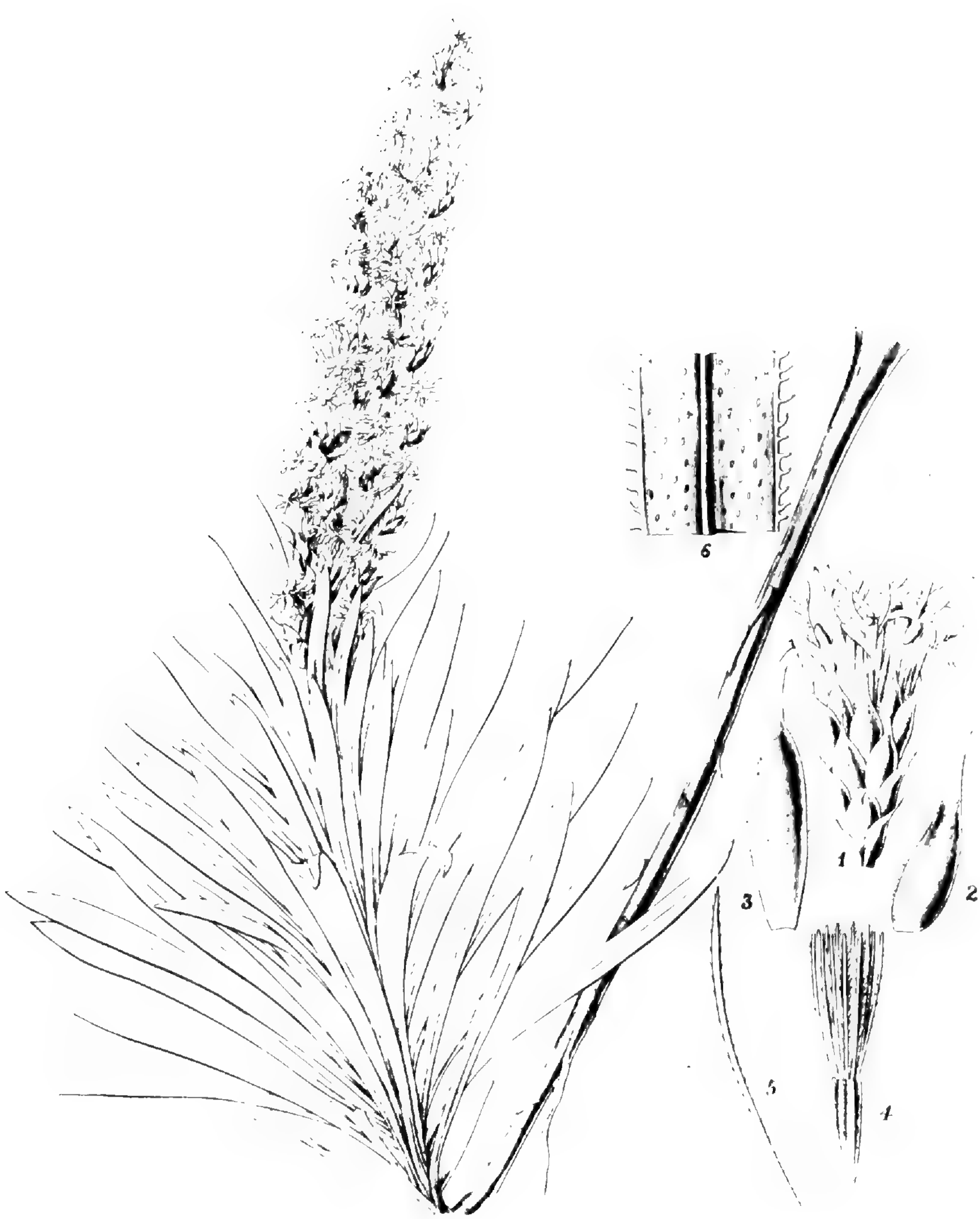
Explanation of the opposite plate.—

A botanical analysis of a common species of Liatris (in this case *L. punctata*) from Hooker's "Flora Boreali-Americana," volume I, 1840. The distressed looking specimen at the left-hand side of the plate is correct for its technical botanical details (such as the shape of the slender leaves) but it fails altogether to indicate either the grace or the brilliant color of the living plant. At the right, very greatly enlarged, are details of a separate flower-head. At the top (number 1) is one of the heads which make up the flowering wand. It consists of about a dozen separate flowers closely set into a cup formed by the involucral bracts. At the bottom (number 4) is a single seed, the seed being at the base, topped with a plumy pappus.



Liatris punctata

Allium (*Allium stellatum* is its precise scientific name), and since it has rosy pink flowers perhaps "Rosy Allium" will do for some kind of a name. Certainly Allium is not half as hard to say or to spell as Azalea or Chrysanthemum, two scientific names which the public has taken on without a shudder. The Rosy Allium is related to onions as are all the species of Allium, but surely that is no reason for tagging some such name as "Fall Onion" onto a beautiful flower.

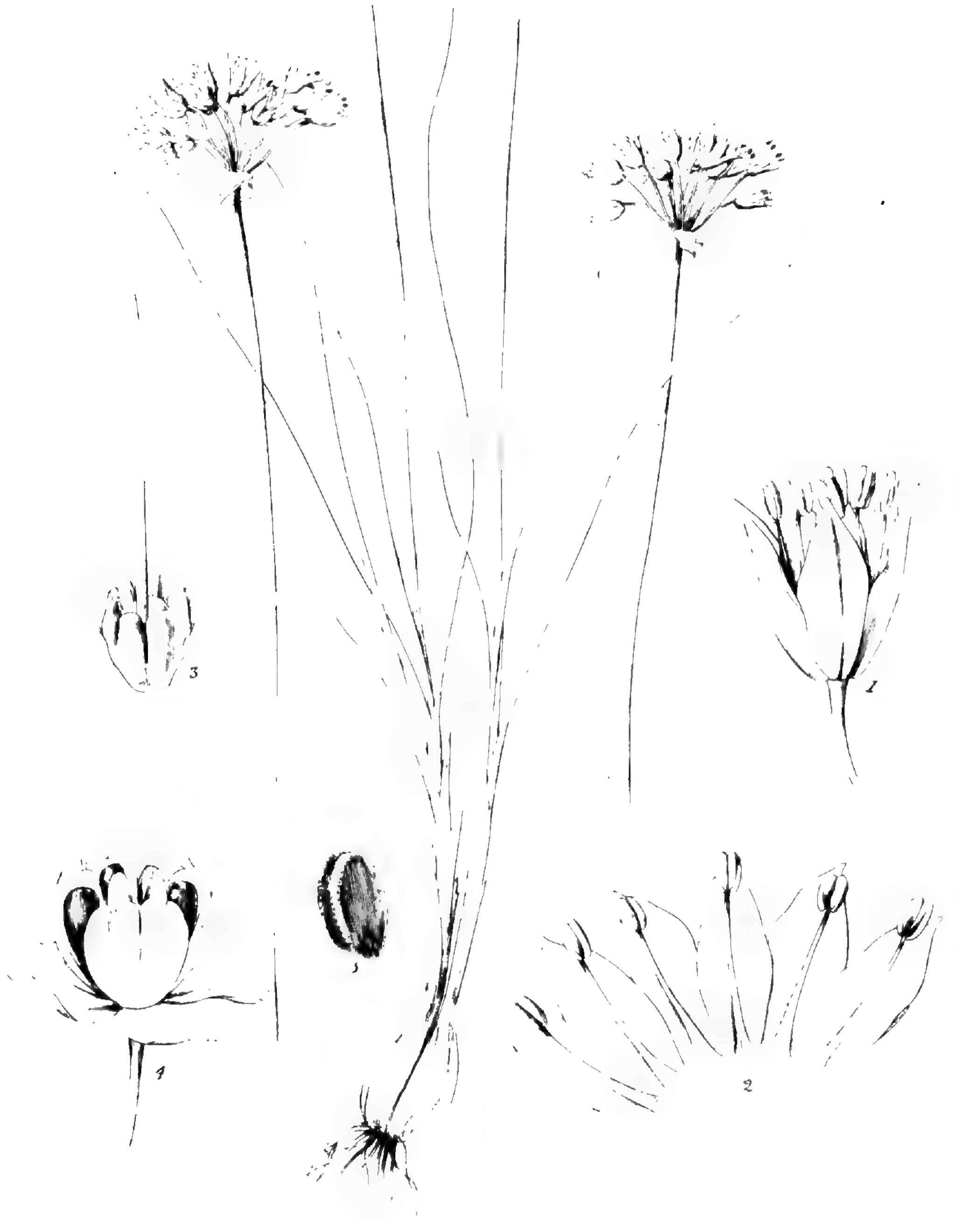
The Rosy Allium grows in rocky or gravelly places and begins to come into bloom sometime in August though it is frequently still flowering by the first of October. The delicate crown of bright pink flowers on slender stems rises above the rather ugly grassy leaves, the whole affair having almost exactly the lines of a bursting skyrocket. Each single flower is a plain little thing with six parts to the corolla and six stamens, but the whole head makes quite a splash of color.

The Rosy Allium is easy to transplant. The roots seem to do their main growing in the spring so that they are semi-dormant when the plant is in bloom. So far as I know, it is not yet carried by bulb dealers, though it certainly ought to be. The ones in my own garden came from places where the highway was being widened, and I saved dozens of bulbs from the advancing steam shovel and brought them home in a picnic basket. They are not at all choosy and bloom year after year even in a small city garden. The flowers are particularly attractive when combined with purple asters and blue ageratum, and if they are put near daffodils, the blooming daffodils will conceal the rather ugly Allium leaves when they do their main growing in the springtime.

Two of our autumn wild flowers are orchids, and while they do not look at all like the general public's notion of what an orchid ought to be, they are charming little plants. They have a good common name, Ladies' Tresses, which is most appropriate because the flowers and buds are set so tightly

Explanation of the opposite plate.—

Allium stellatum as illustrated in Hooker's "Flora Boreali-Americana," volume II, 1840. The illustration represents a comparatively small plant. Very commonly in the Ozarks the Rosy Allium is much lustier and has many more flowers in a head. The figure at the lower left shows an opening seed pod with the black seeds just beginning to peek out. A single seed is illustrated farther to the right on the plate. The top of the seed pod shows the odd little crown from which the species derives its scientific name. These strange little flaps can also be seen in the bloom itself as is indicated by the figure immediately above (number 3) which shows the appearance of the pistil of the flower at the time it opens. Various other details of the blossom are diagrammed at the lower right.



Allium stellatum

together that they resemble a braid of hair. Both of them are delicate little things, the whole plant seldom much more than a foot high, and they can be quite common before many people will take much notice of them. Both rise on slender stems from a cluster of small leaves, and both have whitish flowers, about the size of a grain of rice, set closely one after the other, smack up against the stem, making a tight little spike usually several inches in length. The perfume is sometimes there and sometimes not, but when it is strong enough to be perceptible it is rich and heady and like that of many tropical orchids.

The slender species, *Spiranthes gracilis*, is the first of the two to blossom. It comes into flower in August, or very early September, and is characteristically found in dampish spots on grassy hill sides. In this species the individual flowers are set so regularly around the spike that the whole blossom makes a sort of floral corkscrew.

The other species is called *Spiranthes cernua*, though that is probably not the right name for our Missouri plants. It is stouter throughout, with a heavy stem, thicker petals, and stubbier flowers. *Spiranthes gracilis* is so white as to seem almost greenish-white in some lights; its stouter cousin is ivory-white at best and may appear almost yellow at times. It flowers very late, the exact time depending somewhat upon the rainfall. Our plants are frequently in flower the second week in November, and I have found them still with a bloom or two as late as Thanksgiving. Their characteristic habitat with us is in seepy places on rocky hills in full sun or in light partial shade. In the Arboretum there is a large colony on one of the cedar glades, in a spot which is bone-dry most of the summer but usually has a little seepage water by the time the flowers are in bloom.

As we have said, the books maintain that this little orchid is perfectly good *Spiranthes cernua*. This is certainly one of those instances where the authorities are wrong. It may well be that it is some as-yet-unnamed variety of that species but it is certainly quite distinct from *cernua* as one sees it in the East, summer blooming, in wet pastures by cold spring-fed brooks, flowers pure white or at most an ivory-white. Our Missouri orchid is apparently allied to some of the Texas species of Spiranthes which are still imperfectly understood.

Explanation of the opposite plate.—

Two spikes of Spiranthes, a copy of one of Mrs. Oakes Ames' well known illustrations of orchids studied by Professor Ames. This one is from an article in *Rhodora* for 1903, in which he discussed a hybrid of *Spiranthes gracilis*. Though a little coarser than that species it is not greatly different in its general appearance. *Spiranthes gracilis* has the same tuberous roots, the same narrow leaves, and an even more slender spiral of delicate flowers.

Blanche Ames del

Ladies' Tresses

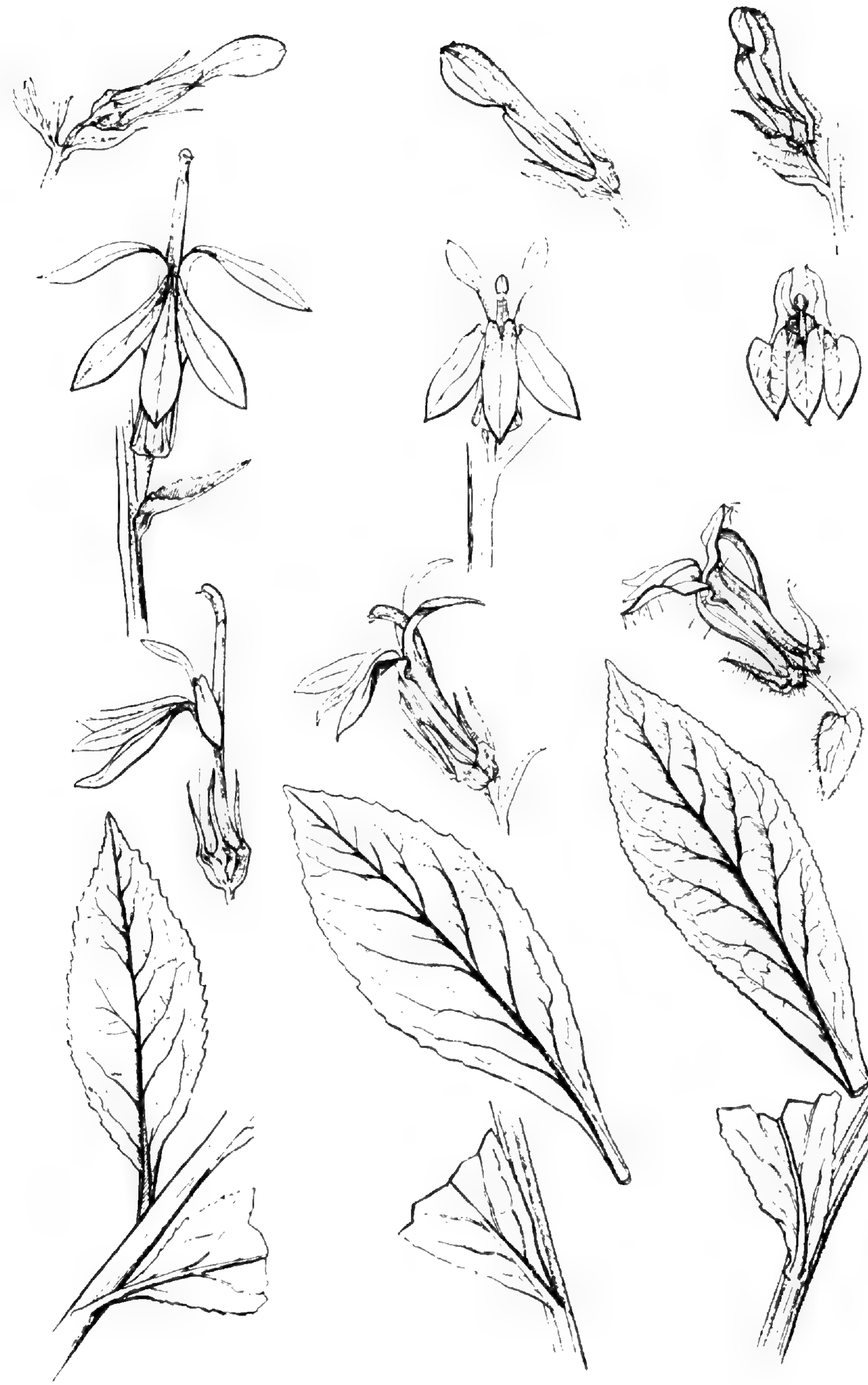
Lobelias.—There are two Lobelias in our autumnal flora, and both of them are showy, the Cardinal Flower and the Blue Lobelia. The Cardinal Flower has graceful snapdragon-like flowers, in a slender wand of bloom—flowers of such an intense cardinal-red that it dazzles the eye to look at them in bright sunshine. They do not take kindly to civilization, and a distinctive part of their beauty is the places they choose to grow: ferny bogs, black-watered swamps, and unspoiled niches along the margins of quiet rivers.

The Blue Lobelia is much more tolerant of man. It persists in semi-wooded pastures and may take to roadside ditches. It comes into flower in late summer and has a long period of bloom. The flowers are less slender than those of the Cardinal Flower, and they are set more closely together. Each flower is about the size of one's little finger, and the blooms make a wand up to a foot in length. The blossom is intricately folded in a two-lipped fashion, and though the prevailing tone is a clear blue, it is variously marked with white, blue-purple, and black.

Very rarely indeed one may find a natural hybrid between these two beautiful species. In the accompanying plate, which is copied from an article about these hybrids, Mrs. Oakes Ames has skillfully shown the way in which the form of the hybrid flower is midway between that of the two parents. In England, where the climate is damper and it is easier to grow such plants in gardens, these two species have been hybridized to produce a whole race of large-flowered garden perennials with such distinctively British names as "Queen Victoria" and "King Edward."

Explanation of the opposite plate.—

Our two common Lobelias and their hybrid. This plate has been copied from Professor Oakes Ames' article on the two species and their hybrid which appeared in *Rhodora* in 1903. The original drawings were by Mrs. Oakes Ames, one of the finest botanical illustrators of modern times. The figures at the left show the Cardinal Flower, those at the right the Blue Lobelia; their hybrid is illustrated in the center. From top to bottom are shown successively the buds, the flowers as seen from the front, the flowers as seen from the side, and the leaves. As the figures show, the flower of Lobelia is a pretty complicated affair. The corolla is cut into five unequal lobes which arrange themselves in an upper and lower lip. The style, with the stamens closely set around it, protrudes through the upper lip and arches over the end of the blossom. The illustration will serve not only to identify these two Lobelias but to demonstrate the way in which hybrids are often intermediate between their parents, detail by detail. Note particularly the front view of the corolla and see how the hybrid is intermediate in size, in the shape of the lobes, and even in the position at which they are held.



Blanche Ames del.

Lobelias

A CORRECTION

In last month's BULLETIN mention was made of the commonest and brightest of the species of Bidens in the St. Louis area. The species name should have been given as *Bidens polylepis*. The name *Bidens involucrata* was used in the seventh edition of *Gray's Manual* for this species and may be more familiar to some readers.

SUMMER FLOWERS WHICH LINGER INTO FALL

EDGAR ANDERSON

It is a curious fact that when one sits down with a record of blooming dates it is quite easy to separate our Missouri wild flowers into three distinct groups, those of the spring, those of the summer, and those of the autumn. The summer wild flowers differ in other ways than just their time of bloom. Unlike the spring and the fall bloomers they tend to stay in blossom for very long periods, six weeks or more. Most of them are plants of strong tropical affinities; quite a number belong to characteristic tropical or sub-tropical genera and are frequently the only species of those groups whose native distribution is well outside the tropics.

All of these summer bloomers we plan to discuss at length in some future year when we hope to publish one or two BULLETINS concerning the common summer wild flowers of the St. Louis region. As a sort of stop-gap we have added here, as a kind of appendix, a remark or two about the summer wild flowers one is most apt to encounter in St. Louis during the month of September.

Of the conspicuous flowers in which the public is particularly interested all are clearly summer or fall bloomers, except one, the False Dragonhead, *Physostegia virginiana*. Calling this either a summer-bloomer or an autumn bloomer with us is just a quibble. If we set the first Monday in September, the time when the primary schools open and the general vacation period is definitely over, then the False Dragonhead in some years blooms more in autumn than in summer. If we were to take what is biologically a more significant threshhold, the opening of college, then the False Dragonhead definitely belongs with the summer wild flowers. It is a beautiful thing, so showy with its clear rosy-lavender flowers that even when it is native it looks like something run wild from the perennial border. The individual flowers, very much like a snapdragon in general form (but smaller and more delicate), are set closely together in branching wands of bloom. On each flowering stem they are arranged rather stiffly in four strongly delimited rows, giving an almost artificial air to the inflorescence.

For the rest of the lingerers-on, their frequency in the autumn is pretty much according to the weather. Most conspicuously dependent upon the pattern of summer rainfall are the various relatives of the common Black-eyed Susan. These three species of Rudbeckia are much too attuned to our chancy summer rainfall to come into blossom when it is bone-dry in early summer. In seasons such as this one of 1952, they sit around waiting for a really good rain before they start into growth. In the drought year of 1936, *Rudbeckia missouriensis* did not come into full bloom until late in September. This year it waited for the good soaking rains of July and was not in good flower until August, which meant that it has lasted well into fall. It is much like the common yellow Black-eyed Susan of our early summer meadows, except that it grows in dry rocky places and tends to hold all its flower heads at about the same level from the ground, producing yellow sheets of bloom. *Rudbeckia triloba* is also a good deal like a Black-eyed Susan but its flowers are much smaller and it branches and rebranches making great masses of bloom on a rather weedy plant. It is almost a weed, though not a troublesome one. It grows in semi-shaded places along roadsides; it sometimes comes into the edge of a farmyard if there are woodlands close at hand. In its general effect it is quite similar to the better known *Rudbeckia bicolor* which is frequently grown as a garden flower in Europe and along our eastern seaboard. The third species of Rudbeckia, *R. laciniata*, is represented in the Ozarks by a race typified by a great rank-growing sloppy-flowered plant (quite different from the eastern Rudbeckias classified under the same name) and to an ordinary person not at all reminiscent of a Black-eyed Susan. It is with us pretty much confined to low ground, along the edges of river woods, near bridge abutments, and such like places.

The Marsh-Mallow, *Hibuscus militaris*, nearly always lingers on into September. It is one of the most beautiful and most spectacular of our wild flowers. It grows in wet places and has rather the appearance of a large pale-flowered hollyhock. Our common purple Gerardia, *Gerardia tenuifolia*, also characteristically stays on well into September. We have a number of Gerardias in the state, some of them yellow and some of them purple or rose-colored. *Gerardia tenuifolia* is a little low plant of dry woodlands, a foot or so high at the most with delicate, wiry stems, and delicate narrow light green leaves. The flowers are delicate too, about an inch long, like little trumpets of rosy purple. Were it easy to transplant, many of us would want to move it into the perennial border. Though frequently attempted this is seldom successful, presumably because although the plant does not look so, it is a partial parasite on neighboring plants and one would have to move the entire entourage as well as the Gerardia.

NOTES

The annual Chrysanthemum Show at the Garden will be open to the public on November 2.

Mr. August P. Beilmann, Manager of the Garden Arboretum, was elected to the Board of Trustees of "Friends of the Land" at its annual meeting, held at Indianapolis, September 28.

Mr. George H. Pring, Superintendent of the Garden, spent three weeks during the summer on the West Coast, where he visited the large nurseries and botanical gardens from Vancouver, B. C. to Los Angeles, Calif.

The Atomic Energy Commission has awarded a grant of $4,000.00 to the Garden for technical investigations in the field of evolution. Much of the actual work will be carried on by Dr. Henry A. McQuade of Harris Teachers' College (a former student in the Henry Shaw School of Botany of Washington University), under the general direction of Dr. Anderson.

Among the new graduate students in the Henry Shaw School of Botany this year, Mr. Antonio Molina, a Latin-American Fellow of the Guggenheim Foundation, now on leave from the Escuela Agricola Pan-Americana, Tegucigalpa, Honduras, and Mr. Byron Wise, of the University of Florida, Gainesville, will do most of their research work at the Missouri Botanical Garden.

The September number (Vol. 39, No. 3) of the ANNALS OF THE MISSOURI BOTANICAL GARDEN has been issued, with the following contents: Arthroxylon, a Redefined Genus of Calamite, by Fredda D. Reed; Some American Petrified Calamitean Stems, Henry N. Andrews; Variation in the Perfoliate Uvularias, Robert A. Dietz; The Evolution of a Gravel Bar, Robert A. Dietz.

Recent visitors to the Garden library and herbarium include the following: Mr. Selwyn Everist, of Queensland Museum, Australia; Dr. Yoshiharu Matsumura, of Tokyo, Japan; Dr. Hugh C. Cutler, of the Chicago Museum of Natural History; Mrs. Jean Manda Swearinger, of West Orange, N. J.; Dr. Jonathan D. Sauer, of University of Wisconsin, Madison; Dr. Dwight M. Moore, of the University of Arkansas, Fayetteville.

Dr. Edgar Anderson, Assistant Director of the Garden, is the author of a book, "Plants, Man and Life," published in June by Little, Brown and Company, of Boston. It has been enthusiastically reviewed in the *New York Times*, *Chicago Tribune*, *St. Louis Post-Dispatch*, *The Saturday Review*,

House and Garden, etc. Although written primarily for non-technical readers, several universities are now using it as a text-book or for collateral reading. A detailed review of the book will be given in a forthcoming number of the BULLETIN.

The Garden and the Henry Shaw School of Botany of Washington University were well represented at the annual meeting of the Botanical Society of America and associated biological societies (sponsored by the American Institute of Biological Sciences), at Cornell University, Ithaca, N. Y., September 8–10. Of the staff, Dr. Andrews, Dr. Anderson, Dr. Commoner, Dr. Dodge, Dr. Steyermark, Dr. Alice Tryon, Dr. Rolla Tryon, and Dr. Woodson were present, as well as the following students: Burton Anderson, Norton H. Nickerson, Amy Gage, Dorothy Ober, Robert Cooper, and Emanuel Rudolph. A number presented technical papers. Dr. Commoner was on one of the important symposia, and Dr. Anderson presided as President of the Botanical Society.

As the years pass, the area about the Garden becomes more completely urban. This month bull-dozers carved away one of the few remnants of more-or-less native vegetation from our neighborhood, directly across Shaw Boulevard from the Banner Iron Works. Here on a stretch of dry bank a few species of prairie plants had held their own and one of them (a grass so unknown to the general public that we can only refer to it as *Sporobolus asper*) managed to form a coarse turf of considerable extent. It became of more than passing interest to the few botanists at the Garden who are familiar with the lesser-known grasses of the native flora. It is gone now, all but a remnant on the edge of the Missouri Pacific tracks. There is something peculiarly sad and comic about the passing of a plant of such slight concern to most of mankind that it has no folk name by which we can record its end, a grass of such little interest even to the average plantsman that when the bull-dozers went to work there were only two of us on the staff to mourn the event.

Our horsechestnuts have fruited heavily this year, and during the last fortnight many little boys have left the Garden with bulging pockets. To us the horsechestnut harvest brings the same old problem we have been struggling with for nearly fifty autumns. What can you do with them?

One of our rarest autumn wild flowers, the pale gentian *(Gentiana flavida)*

THE MISSOURI BOTANICAL GARDEN

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MISSOURI BOTANICAL GARDEN BULLETIN

ORCHID GROWING BY AMATEURS

(Special Number Prepared by the Greater St. Louis Orchid Society)

Volume XL November, 1952 Number 9

COVER: The Reh's "Maxlite" greenhouse illustrating optimum light compared to conventional glass house adjoining.

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Missouri Botanical Garden Bulletin

Vol. XL NOVEMBER, 1952 No. 9

GROWING ORCHIDS IN A SMALL GREENHOUSE

THEKLA NEUNER

In a small greenhouse, such as I have, 17 × 16 feet, it is a rather difficult matter, when growing several kinds of orchids, to give them the conditions they require. This problem must be solved, more or less, by keeping the plants in different areas in the greenhouse in order that they may receive at least a certain degree of their specific requirements. Even in a small greenhouse one will find that the light, humidity, temperature and air circulation differ in various areas.

Cattleya gigas, C. Luddemanniana (or *C. speciosissima*), and their hybrids require a great amount of light and air, and therefore are hung near the glass. Laelia hybrids prefer the same conditions and are treated likewise. *Cattleya Trianae* and *C. Mossiae* and their hybrids are satisfied with less light and are placed on benches. *Dendrobium nobile* requires much light and a cool atmosphere and is placed at the far end of the greenhouse, which is the brighter end as well as the coolest in the winter months. While *Dendrobium Phalaenopsis* requires the same amount of light as the aforementioned, it prefers a slightly warmer temperature. However, due to the restricted space in a small greenhouse it is necessary to place it near the *Dendrobium nobile*. Phalaenopsis is hung in the warmest area.

The largest portion of my plants consists of Cattleyas (the balance being made up of Dendrobiums, Phalaenopsis, Cypripediums, Cymbidiums, and some novelty types), and under this arrangement, I am more or less compelled to maintain Cattleya conditions in the greenhouse and fit the other kinds as best as I can into this atmosphere. A night temperature of 60° F. is maintained in winter and about 75° during the day. This daytime temperature may vary. On a bright sunny day, the temperature in the greenhouse rises rapidly and is controlled by the amount of ventilation. On cloudy cold days, when no heat is furnished by the sun, the thermostat is moved up to 65° and the temperature may not rise above this for the day. It is better to have the plants accept the lower daytime temperature on dark days, as running the heat too high will dry the air rapidly and hence lower the

humidity. Ventilation is very important to the health of orchids, and some ventilation is given every day, even on very cold days.

During the summer months the inside greenhouse temperature is controlled to a certain degree by the amount of shading. While shading should be sufficiently heavy to prevent the plants from burning, as much light as possible should be allowed for the plants to produce strong growth. It is a matter of experimenting on your own greenhouse and one will have to be his own judge as to the amount of shading necessary. On my greenhouse a thin coat of shading is applied in late February or early March, and it is gradually increased so that it is heaviest during June, July and August. By September it is gradually removed so that the glass is practically clear by the latter part of November, remaining in this condition during December and January.

In addition to shading in the summer months, water lightly with a fine spray several times a day to keep the humidity high, the plants cooled off, and the atmosphere damp. On very hot dry days, I found that when the ventilators were kept partially closed, the inside temperature was affected very little but a higher humidity was maintained. In short, by keeping the ventilators partially closed one is able to keep more moisture in the greenhouse, and this is all important.

The first orchids in my collection were mature plants, and as I became better acquainted with their habits, I decided to experiment with seedlings. I purchased a seed-sown flask of *Dendrobium Phalaenopsis* in the early spring of 1949, transferring seedlings to community pots in the summer, and to individual pots the following year. A number of these plants flowered in the autumn of 1951, the seedlings being approximately three years old. At the present time, about 70 per cent of the aforementioned seedlings are in flower. In February, 1950, a flask of Cattleya seedlings was purchased, and these went through the same procedure as the Dendrobiums. Some of these plants are now in 3-inch pots, but since Cattleyas do not flower as young as Dendrobiums, they are not expected to flower for another two years.

I have been fairly successful in flowering orchids in my greenhouse, with one exception—the Cymbidiums. Whether because a 60° night temperature is too warm or because five-year-old plants are possibly not old enough to flower, I do not know, but I am trying to convince myself it is their age and that sooner or later I will be rewarded with a flowering spike.

In trying to increase the number of plants as quickly as possible I divided them when repotting. However, I soon learned that this was unwise as the plants quite often are so weakened that at first they make only small pseudobulbs but no sheaths and consequently no flowers. While each succeeding growth increased in size it took several years before the plant was ready to

Mrs. Neuner in her greenhouse at Chesterfield, Missouri

The Reh's greenhouse, Belleville, Illinois

flower. The number of plants was increased in this manner but the number of flowers actually decreased. Now, no dividing is done until the plant reaches the 6-inch or 7-inch pot size. By so doing the plant is not stunted and generally will flower on the next growth.

Feeding the orchids regularly once a month with a commercial fertilizer resulted in the plants making rapid growth but many of the sheaths came through blind. I find that by feeding once during April, May and June, I have eliminated this condition to a great extent.

This year I have had considerable trouble with grasshoppers getting into the greenhouse. This has been overcome to a great extent by screening the side ventilators. Their choice dish is the orchid buds just when the buds are emerging from the sheath. So, each time a grasshopper is noticed, there is a wild hunt until the culprit is found and destroyed. I have found Parathion to be one of the best insecticides for the control of greenhouse pests. One spraying absolutely rids the house of all mealy-bugs, red spider, thrips, sow bugs, scale, ants, aphids, and no doubt many other pests. It is, however, very dangerous to use, and the prescribed precautions should be followed very carefully, including wearing a gas mask and covering one's body completely with a non-porous material such as plastic or rubber.

All in all, the growing of orchids has been a most rewarding hobby and one affording me a great deal of pleasure.

THE EVOLUTION OF THE GREENHOUSE

FREDERICK O. AND WINIFRED REH

When discussing greenhouse construction it is assumed that a glass house is indicated, since light is one of the fundamental requirements for plant growth. Progress in greenhouse design has been limited because the construction is conditioned on the use of glass panes laid on bars in shingle style. To demonstrate, we have a pane of glass 8″ × 12″, dull with age, which was on a greenhouse eighty years ago. The surface and thickness are uneven—a characteristic of blown glass. In glazing, the convex surface was faced up or out, to resist shock and strain better. The present-day double-strength rolled glass pane, averaging 16″ × 24″, is uniform in thickness and has fewer defects, but the method of its application has not been changed.

We are making these observations and comparisons by the softly diffused light in our new greenhouse "glazed" with sheets of "Maxlite", sizes up to 44″ × 144″. (CORRULUX is the trade name of this material, made in various color tints, but "Maxlite" is the term applied to the daylight tone of CORRULUX used in our house.) This house was sufficiently completed by July 10, 1952, to start its "test run" with a collection of Cymbidiums, for

which it was designed. Varieties of both sun- and shade-loving botanicals were gradually introduced for test purposes. We were not favorably impressed with the light effect of blue-toned glass used by some growers. Colored glass solved the shading problem to some degree at the obvious expense of natural light, but it does not solve the hail-damage problem.

In March, 1952, while attending the Cymbidium show in California, we talked with Professor C. H. Muller, Research Associate, Santa Barbara Botanic Garden, who has had an experimental house glazed with fiber glass since August, 1948. He unhesitatingly recommended the fiber glass as a substitute for glass because of the danger from hail in the mid-west area, and said that so far he has observed no deterioration of the material. Furthermore, he found that fiber glass was equal to regular glass for plant culture. He suggested that we use a more color-free product than he had, although he had to shade for several months, because "shade-requiring plants were distinctly *in distress*, although this resulted in no burn even after exposure of two weeks, and the plants fully recovered after subsequent shading."

It was obvious that although this new material can be applied to the regular greenhouse frame, better results could be achieved by adapting the design to the fiber glass. This, to our knowledge, had not been done before. After consulting with manufacturers of fiber glass about color, durability, cost, etc., we contacted the greenhouse manufacturers. At first they were skeptical, since we had several structural revolutionary innovations in mind. A young draftsman associated with National Greenhouse Company, at Pana, Illinois, who devoted some effort to research on the material, made a preliminary sketch. After further consultations with him and with heating and ventilating engineers, a plan was evolved that necessitated a special set of blue prints.

The house extends from the front of a lean-to glass house—the door of the latter connecting the two—along the east wall of the utility room in a northeast-to-southwest direction. The floor dimensions are $16' \times 22'$, with an adjoining areaway over the outside basement steps and entrance, of $6' \times 10'$. Thus we can enter the greenhouses from the basement of our home without having to go outdoors. The ridge is 12′ high and the eaves 6′ high, affording ample air-space and head-room. The galvanized steel frame is faced with $2'' \times 2''$ cypress bars and purlins, secured with screws and carriage bolts. The roof bars and purlins are spaced at 4′ intervals, creating open "lights" of $4' \times 4'$. The "Maxlite" sheets of the roof are corrugated and rest on corrugated asphalt strips on the purlins. They are fastened to the purlins, ridge pole and eaves with galvanized screws, set with lead washers, overlapping one corrugation which is sealed with a clear mastic. This makes a solid, continuous, leak-proof and air-tight panel of the entire surface of the roof, enclosing all wood and metal.

A 4-light ventilator over the basement areaway is covered with one piece of flat "Maxlite." There are no vents in the roof of the house proper. The potted Cymbidiums stand on inverted pots on the gravel floor, and four screened ventilators, at ground level, provide air circulation at plant height. Along the walls there will be one row of welded steel shelves, made of light-weight angle-iron floored with 1″ × 2″ mesh wire, welded, to hold orchids of other genera. (Trays of the same type have been used in our Cattleya house for two years, giving excellent results by providing free air circulation and quick drainage around the pots.)

The top ventilation is provided by a thermostatically controlled two-speed fan, with the r.p.m. timed to make a calculated air change in the house without creating drafts. This fan draws the fresh air in through the ground level vents, but on stormy days, when the vents are closed, humid air is drawn through a window of a fruit cellar in the rear of our house basement. The distance of over 60 feet for this air course cools the air in hot weather and takes the chill off in winter. This fan innovation was not an eidolon, but an adaptation of an experiment successfully used in the glass house since 1948, when on dark cold winter days the watering of Phalaenopsis created a special problem. To let them run on the dry side was not the solution. The air movement under glass on very cold days was vertical at a fast rate of interchange. The cold air also settled around the pots on the benches and rested on the Phalaenopsis foliage. After changing the material and design of our staging for better air circulation we then sought to find a way to interrupt this fast vertical exchange of temperature. Two warm-air ducts were extended from the residence furnace into the greenhouse 4 feet over floor level and between the blower and the outlets a water tray 6′ long and 2″ deep was built into the air duct. This water pan carries a sufficient number of spun glass baffles set up parallel to the air course to cut down the force of the air, reduce the temperature, and vaporize the water siphoned by the baffles. With a few minor adjustments an atmospheric condition was created which extended the flowering season of the Phalaenopsis considerably. Strands of "Spanish moss" *(Tillandsia usneoides)*, hung three to four feet away but in line with the air outlets, promptly revealed low humidity by its appearance and texture before orchids were affected. The fact that a strand of this moss which is suspended from a basket of *Oncidium Cebolleta* six feet from the fan is thriving in that location is an indication that the humidity and temperature of the "Maxlite" house are in good balance.

A deep cistern is under the new greenhouse (it was there before the new house was built), and a horizontal fan in the housing of the manhole draws moist air up from the cool water. Although this has been a very hot summer, this extra humidity boost from the cistern was seldom needed, because

the prevailing humidity plus the regular dampening down from a hose kept the humidity in the house over 50 per cent. Of course, any number of fans will not bring the temperature down much over 15 per cent if the outside temperature is 100° for weeks on end, and it may be necessary to introduce special mechanical temperature controls for Cymbidiums during the months of July, August, and September.

The side walls are flat "Maxlite" sheets up to 36″ × 72″, edges butted; seams sealed with putty-tape, and covered with cypress molding which is drawn tight with wood screws. The "Maxlite" extends to the ground level, affording full-length light surface for the plants. When the ventilators at the floor level and the automatic fan shutters are closed, the house is practically air tight, and the heating engineer anticipates controlling the temperature in winter within a very close margin. The "Maxlite" manufacturers claim up to 30 per cent less heat loss than through glass. Be that as it may, there must be an appreciable difference, because there are no loose panes or other cracks often found in a glass house. As fall is approaching, and the nights are becoming cooler, moisture is collecting on the inside of the glass, but has not as yet been observed on the "Maxlite." In the early morning the glass house warms up quicker under the sun and cools off faster in the evening than the "Maxlite" house.

Let us assume that a cold wind (20° F.) strikes the building on a cloudy day. The thermostat on the heating plant calls for a certain set degree. Suddenly the sun comes out and adds its radiation through the "Maxlite" with a larger radiation surface than glass would have. Here the heat circulator shuts off, and the ventilation fan cuts in, avoiding any extreme rise or fall in temperature at any level selected by the automatic controls system. An electric generator as a stand-by in case of power interruption is a necessary part of the equipment.

To get more and longer sunlight exposure during the short winter days, the ridge was shifted to the northwest of center, providing 12′ × 22′ light exposure from the northeast, east, and southeast. The opposite side of the roof is 6′ × 22′, which correspondingly reduces the glare and heat of the afternoon summer sunlight and modifies the photoperiod notwithstanding the longer daylight. Both the glass and "Maxlite" houses are shielded from the north and northwest by our home, but get the first morning sunlight. On August 1 the sun was off the glasshouse at 5:30 P. M. and off the "Maxlite" an hour later. The daylight time between sun-up and sun-down had already shortened by 45 minutes, but was still in excess of 13 hours per day. Orchids and other tropicals do not have long and short days in their natural habitat. Too much and too long sun exposure in summer necessitates very dense shading in many greenhouses, which cuts off the short light rays and

distorts the color bands of normal light. The plants then suffer from light deficiency.

The material on the roof (corrugated for strength and distribution of weight) scales 1 ¼ inches more surface to the running foot than flat glass, and since the wood bars and purlins are less than half the bar surface of a conventional house, we have over 8 square feet additional light surface in the "Maxlite" roof. The color bands of light transmitted are directly proportional to normal sunlight, so that the light is apparently like that of sunlight in quality but in quantity below the burning point. No defined shadows are cast by bars, posts, or plants because the fibers of glass in the "Maxlite" diffuse the transmitted light, making every foot of the house available for plant culture. More light comes through the corrugated roof because, regardless of the angle at which the sun's rays strike the corrugation, some of them are always at right angles to the surface, and come straight in to be diffused by the glass fiber in the plastic. The light is similar in tone, quality, and quantity to that of a lightly overcast sky.

We agree with Professor Muller that leaf burn is highly improbable, and we discovered what he meant by "plants being in distress" under unshaded fiber glass in July, when the outside official temperature was 104° F., and the reading in the sun was 120°. Certain plants sensitive to high light intensity took on a devitalized appearance, because they were not conditioned to the sudden change to stronger light.

We moved the Cymbidiums into the new house on July 11, just before a severe rain storm which would have leached the compost in the pots if they had remained in the lath-house. This rain storm also washed most of the shading from the glass house. While applying a fresh coat of shading to that house, we applied it in the same density to the "Maxlite." A reading of foot-candle light under the shaded "Maxlite" roof was 4500, while under the shaded glass it was 3400. At floor level under "Maxlite" we read 1500, and in the glass house 800. Rains in July and August have gradually reduced the density of the shading so that the reading on August 15 was proportionally higher. The plants have gradually become accustomed to higher temperature and brighter light, and have required correspondingly more moisture. Although, in comparison to glass, fiber glass is not hot to the touch under sun, we find that "Maxlite" needs some shading, especially in a summer as hot as that of 1952, since the material transmits and radiates heat in relation to the light. On July 25, 26 and 27 the temperature outside under full sun against the "Maxlite" was 124–126° from noon to 4 P. M. The reading inside against the "Maxlite" was 94–98°. Several Dendrobiums, with 3–6 inches of their new tender growths resting against the plastic walls at these

same check levels, experienced no distress then or any subsequent injury thereafter. The foot-candle reading at plant level was 4800, but the humidity was not allowed to go under 60 per cent. That the quality of light, and not merely the quantity, is different than glass was further shown with Cattleya seedlings in 1½" pots. They were under "Maxlite" three weeks for test purposes before being shifted to 2" and 2½" pots (having made new breaks and better root action in comparison to the controls kept in the glass house). The foliage of the transplants developed light areas, which slowly disappeared when moved to the more heavily shaded glass until they were established. The photoperiod was adjusted without changing the temperature range; the "Maxlite" apparently, in many ways, is more suitable than glass for established plants, but is too strong for plants under shock. We then put a glass case with "Maxlite" top in the "Maxlite" house for repotted seedlings and back bulbs, which is proving very satisfactory.

The "Maxlite" can be cut with a handsaw (guard against glass fibers getting into your clothes and skin from the "sawdust"). It will safely support a 200-pound man on the roof, is hail-proof, and practically fireproof. It can be nailed, but a more craftsman-like result is achieved if holes are drilled for nails and screws. It weighs less than ½ pound per square foot.

The loss of glass after a hailstorm, with the accompanying mess and labor of replacement, is a catastrophe, but an even greater one is the falling glass destroying, in a few seconds, the fruits of a lifetime of collecting, selecting, and hybridizing. Prevention of such damage alone more than justifies the present difference in cost of the "Maxlite." When architects and builders discover the many uses to which this material can be adapted and when it is more readily available it will no doubt be cheaper. Obviously, we did not have the patience to wait for this. We have found that the cultural advantages also offset the difference in cost between our "Maxlite" and glass houses. We could duplicate our house now at a considerable saving, because several structural difficulties have been solved. Standardization of material would be a result of demand. The saving in heating cost and the apparent elimination of repairs for many years ahead are also indicated.

Although it will take at least a year to make a comprehensive study and comparison of the results in the "Maxlite" and in the glass house, we have made the following observations:

Vandas and their hybrids, Oncidiums, and several species of Odontoglossum show excellent color of foliage and very active root growth. In fact, Vandas having just finished blooming, are developing new flower spikes. Dendrobiums are growing like weeds, and this is no over-statement. There

is no evidence of fungus disease or spotting of foliage, though water has been copiously applied. (Their native state has as much as 250 inches of rainfall per month in the rainy reason.—See R. T. Northen, Home Orchid Growing, p. 170.) Cattleyas have been hung from the purlins to test how much radiated light and heat they could endure, and they are growing vigorously. A *Coelogyne pandurata* and a *Laelia Gouldiana*, which stand side by side on a high shelf along the east wall under full light all day, are making excellent growth. The same intensity of light under ordinary glass would have finished the Coelogyne. Several species and hybrids of Miltonia and warm-house Cypripediums were set on the gravel-covered floor on inverted pots under a long bench along the west wall. They are exposed to top light from the east and south until early afternoon, and thereafter the diffused light under the bench is brighter than their former location in the glass house. All have shown increased vigor.

A *Columnea gloriosa*, which sun-spotted under glass when the shading washed off, is now making new growth of good color under "Maxlite." A *Fittonia argyroneura* and a *Fittonia Verschaffeltti*, very sensitive to bright light, are exposed to floor level to full "Maxlite" and are growing vigorously.

The new growths made under the "Maxlite," on all kinds of plants, are stronger, larger and more lush, without any evidence of the softness commonly associated with quick growth. With the natural and radiant sunlight effect and the gently moving air in all parts of the house eliminating dark and musty corners often found in glass houses, we can water generously with cistern water without fear of overwatering. This we dare not do in the glass house, although the atmosphere in the latter has improved, due to the fan in the connecting house.

SUMMARY

1. In late spring and early summer we found that Cymbidiums, various Oncidiums, and Dendrobiums made better growth in a lath house than under glass, but—

A. In weather with low humidity, the respiration could not be properly controlled under lath, especially in late summer.

B. On very hot, wind-still days, burning occurred through the laths. This had to be checked by supplementary shading, which on dark, rainy days created a stagnant condition, with possibly harmful consequences.

C. Heavy rains leached the compost in the pots, and hail damaged the foliage.

D. Covering the lath-house with transparent material proved impractical. Wind tore off fabrics, and vibrations cracked the glass.

E. Under certain climatic conditions, it would be practical to put plastic glass on a lath-house, but direction and velocity of prevailing winds and storms must be taken into consideration in locating the building, and wind escape must be provided under the roof. Plants resent being moved around, even "sulk" for a while after being brought in from under the lath and placed under glass in the fall. If climate permits leaving plants in a lath house the year round, the plastic roof would be ideal. The material, self-supporting over a reasonable area, can be extended over the eaves 6–12 inches, thus reducing rain splash on the footing and eliminating the cost of guttering.

2. Our "Maxlite" house presents a more satisfactory ecology in the St. Louis climate, notorious for its extremes in weather.

The Reh's greenhouse, Belleville, Illinois

Mrs. Read's greenhouse, Pine Lawn, Missouri

A. The plants can be exposed to brighter light because it is better balanced and more evenly distributed than the light under glass, shaded or otherwise.

B. Controlled circulation of fresh air can always be provided in the "Maxlite" house. Consequently a simulated tropical atmosphere prevails with a correspondingly greater water acceptability by the plants with decidedly improved cultural results.

C. We plan to maintain this environment in winter also, by providing warm air circulation from overhead steam radiators, equipped with a circulating fan slowed down to avoid strong drafts. Directional fins will distribute the warm air where needed.

If, after a year's side-by-side comparison, the "Maxlite" continues to outpoint glass, we intend to replace at least the roof of the glass house with it. Although the "Maxlite" house was built to grow Cymbidiums and other cool-house orchids, more and more of other horticultural specimens have been introduced, prompted by interest in research, and the advice and council from Mr. George H. Pring, Superintendent, Missouri Botanical Garden, for a preliminary report in the BULLETIN. The "vacation" of these summer visitors will soon be over, and they will have to go back into the glass house, because the "Maxlite" house is to be used to carry on a specific program of Cymbidium culture. The Cymbidiums are in excellent condition and the new growths are maturing satisfactorily. According to the records of our local wholesale dealers, the demand for cut Cymbidium flowers is increasing at a greater rate than that for Cattleya flowers. To date, the flowering of Cymbidiums under glass in our mid-west climate has not been successful horticulturally. We hope to overcome this difficulty by study and research, and we believe that the difference in cost of the "Maxlite" house could well be equalized over a reasonable period of time.

Anyway—we're having fun! "Dulce est desipere in loco!"

WHAT ORCHIDS DID TO ME

LELAND B. READ

It must have been during the summer of 1948 that my wife smuggled an orchid plant into the car in Florida and did not let any one know about it until we arrived home. Her excuse for having it seemed to be very lame but sincere. During our conversation about the plant, I believe it was mentioned that I was not above indulging my fancy for tools and that I would not need to have anything to do with any orchids.

I was being broken-in gently. That fall a Wardian case appeared around the house without any possible place to set it except in the basement. The case was absolutely necessary because other orchid plants mysteriously appeared around the house but none of them ever seemed to leave, and we needed some room to wash dishes in the kitchen sink. It was finally decided to suspend the Wardian case outside the living-room window. By removing

the door from the case that side of the case could fit rather snugly against the window-sill, and by leaving the window open the plants could be kept warm by the heat in the house. I was trapped because the kitchen sink was too crowded. So, the case was suspended—outside the window, that is.

During the winter it was necessary to add auxiliary heat in the Wardian case. To accomplish this, a large orange-juice can was mounted on an electric coffee-pot heater, suitable openings having been cut at the bottom of the can to admit air, to convert it as much as possible to a convection heater and to direct the radiant heat directly upward. The heat was controlled by an aquarium thermostat. A show-case type reflector and light were mounted along the far upper corner in the case, being controlled by the same thermostat. It was hoped that the light would benefit the plants as they didn't receive too much sunlight. Anyway, it was convenient to turn the light on at night to display the orchids. I was learning that there were some "little" things that my wife wanted me to do about the orchids.

Things were rather tranquil until the early part of 1950. The Wardian case had begun to fill, bulge, and then overflow. I heard rumors that WE needed a greenhouse. I said flatly—anyway, it fell flat—that *I* didn't need a greenhouse and that I wouldn't have anything to do with one. In September, 1950, I was away from home for 36 hours. When I returned Saturday morning the back yard was cluttered with all the necessary parts to build a greenhouse. I took a look at it and decided to go to work—at my office. A carpenter and my wife put "IT" up. I refused to have anything to do with "IT." So far, so good, "IT" was up.

BUT what good is a greenhouse if it cannot be used in the winter? "IT" needed "little" things, like heat, electricity and water. With plumbers and electricians not being a dime a dozen, I have to help the little woman out with HER greenhouse. Just the "little" things, of course. First, we get a 3-foot-deep ditch dug for the 60 feet from the house to "IT." Then, we knock a 6-inch diameter hole through the 13-inch solid concrete basement wall. I don't recommend that "little" chore for anyone not accustomed to it. Several nights and week-ends were spent on that "little" chore. By that time it was cold weather and "IT" still couldn't be used. However, things lightened up. I got some lead-covered 3-strand wire in flexible conduit and some two-way switches, boxes, receptacles, etc., and "IT" had electricity. (I will not mention that a light mysteriously appeared in the garage about that time.) This "little" thing only occupied 2–2½ weekends.

With the assurance that there would be light to work by, we tried to get some pipe. Guess they quit making it at that time! Finally, the little woman found some pipe—120 feet of it. Incidentals, like valves, couplings, unions, elbows, nipples both long and close, and just how the pipe was going

to connect itself together, lay itself down in the ditch, and connect itself to the water pipe and gas pipe in the basement, were among the "little" things required for "IT." With a few moments of my time, about three weekends, the pipe got itself settled in place and connected.

By December 18, 1950, the orchid plants were in "IT" and were being kept warm with outside temperatures down to about zero. "IT" is an Orlyt house approximately 8′ × 15′, and a 20,000 BTU gas heater with temperature controls keeps it nice and warm. Last season we disconnected the smoke stack and let the fumes into "IT." The fumes did not seem to affect the plants. Natural gas was used.

One of the essential things is to have an alarm bell inside our house. This bell should ring if the heat should go off for any reason. This "little" thing and its wiring rated about one weekend. The little woman has gotten up in the middle of the night and turned up the heat. An automatic ventilator opener, thermostatically controlled, was a "must" for the warm weather. That only rated about one-half a weekend as it is very easy to install when the wiring is in.

This last June was exceptionally hot in St. Louis. The shading which had been put on the glass earlier this year had lost much of its value when the hot weather arrived early and suddenly. Some plants were burnt. Some one suggested that one of the bamboo screens that roll up would be good to shade the plants. I must have inadvertently agreed. Such a screen appeared. I heard from somewhere that the screen should be put up. I don't remember whether anything was said about letting the plants burn at that time or not. After studying the project several times with proper supervision, no direct instructions were received as to how it could be done. When the boss doesn't know what to do, the worker's field of action is not limited. So two rails made out of ¼″ galvanized pipe and fittings were run from the inside peak of the gable to the bench. The rails are approximately 3 to 4 feet apart. The assembly of the rail was as follows: Floor flange screwed to the wood in the peak of the gable, a 5-inch nipple to flange, 90-degree elbow, 4′ length, 45-degree elbow, 4′ length, 45-degree elbow, 5-inch nipple to floor flange on bench. This left approximately five inches between the sloping roof and the sloping side so the shade can be rolled up or down conveniently. The top bamboo stick on the shade was wired to the upper 5-inch nipples with clothes-hanger wire. This was really a little "little" requiring only two hours or less. It was found that when a wire was strung between the two rails at the 45-degree elbows in the middle of each rail, the weight of the plants hung on the wire tended to pull the rails together. This was corrected by notching a stick in each end and placing it between the rails at that position.

Mrs. Read in her greenhouse

An unusually fine plant of *Epidendrum tampense*, one of the easiest orchids for the amateur.

I don't remember when the extension telephone first appeared in "IT," but it has been there over a year.

Just recently I have heard rumors that the benches in "IT" could be improved. They shouldn't be just flat benches. They should be elevated and offset like stair steps. More plants should be hung but the gable has required bracing already. Something is cooking, and I am beginning to feel like a dog on a Fourth of July. Maybe it is worth it to see the light in the little woman's eyes when she tells me that nine of the new seedlings she recently potted have sprouted already. However, I will continue to live dangerously and fight to the bitter end.

I am still wondering how I was cajoled into writing this.

DESIGN CONSIDERATIONS FOR A SMALL ORCHID HOUSE

R. F. NAGEL

I am certain that the construction of a 7′ × 11′ "lean-to" would present no major problem to the average "week-end carpenter." However, certain details of construction and operation should be of interest to prospective greenhouse builders. The lean-to greenhouse shown in fig. 1 was constructed in April, 1951, at a total cost for materials of 150 dollars including the labor charge for an 8′ × 12′ × 3′ excavation, three poured concrete steps, and a poured foundation footing. Three-inch concrete blocks were used to build the foundation and to construct a 24″ wide walk in the center of the house. The walk was constructed by placing the blocks on edge and then back-filling the excavation to the top of the blocks with sand followed by gravel. Double-strength glass was used for glazing all vertical panes. The roof, however, was covered with a plastic-covered window screen such as "Vim-Lite" or "Screen-Glass." This material has proven quite satisfactory; its condition after 18 months of service indicates a life in excess of three years.

The open-flame natural-gas heating system, which was later vented, is housed in a 3′ × 5′ annex constructed on the east side of the house (not visible in fig. 1). This annex was extended three feet above ground level so that a basement window could be opened into the greenhouse—a seemingly minor consideration which, however, proved of great value during the first summer when a small floor fan was placed in this window to blow cool basement air into the house. Two 36″ high redwood slat benches were constructed in the house. The front bench, which is 32″ wide by 10′6″ long, is being used for growing mature plants. Seedlings are grown on the 27″ × 5′ rear bench. A humidifier, installed above the rear bench, proved to be an absolute necessity during the summer months and highly desirable during the winter.

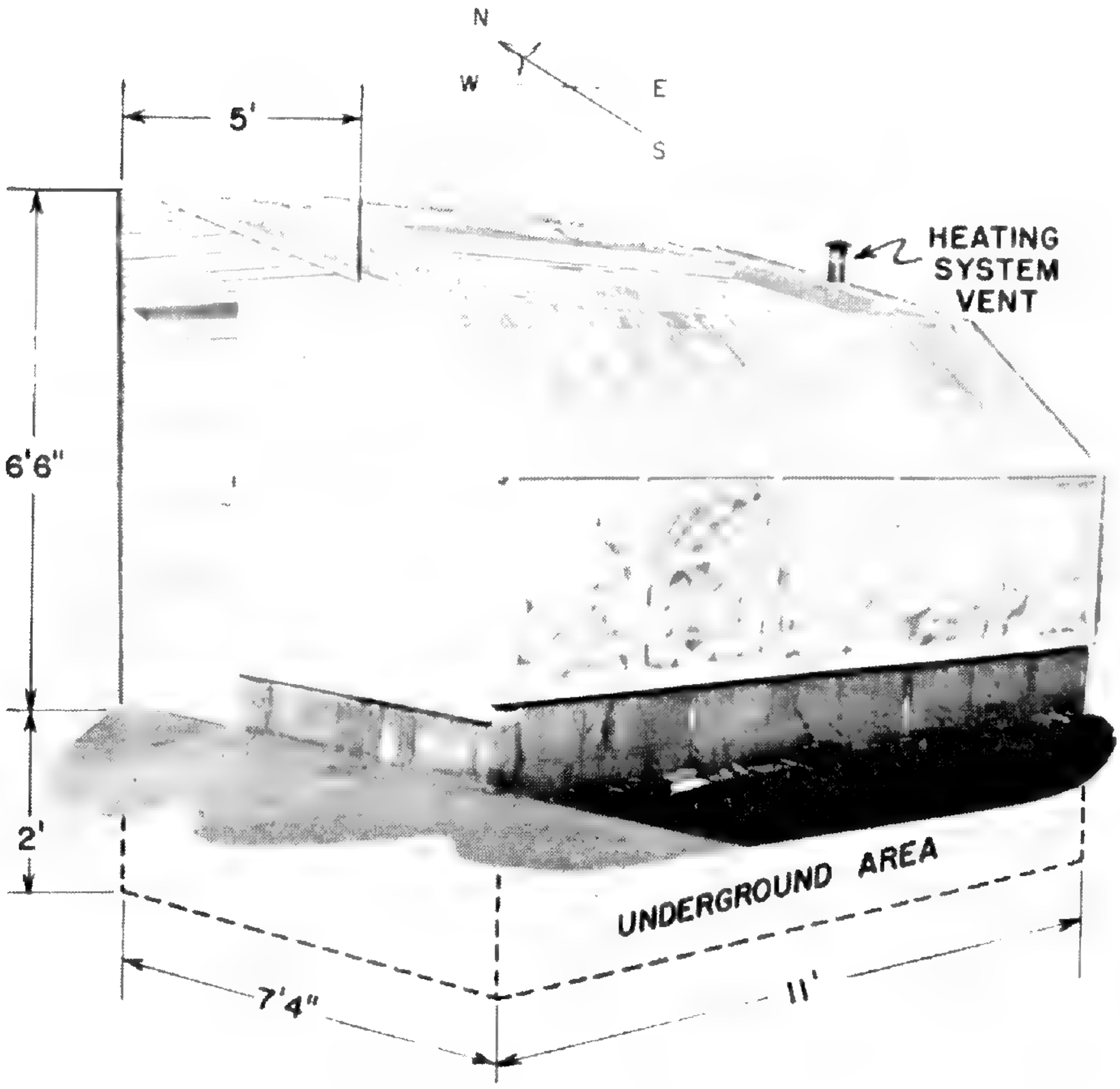


Fig. 1. Mr. Nagel's greenhouse.

The operation of this house is shown by the data presented in figs. 2 and 3, giving the light intensity, temperature, and relative humidity. The data were taken simultaneously on September 13, 1952. While these curves do not necessarily represent optimum growing conditions, they do represent conditions under which orchids may be grown successfully. During the winter months much more ideal conditions may be attained.

Light intensity readings were taken with a G.E. exposure meter equipped with a 100:1 incident light multiplying mask. The important feature of these curves is their relationship. Note that the light intensity at the rear bench, on which the seedlings are grown, is about one-half of that at the front bench. This condition is due largely to the fact that the front section of the roof is shaded more lightly than the rear section. An even lighter coat of shading is applied to the vertical panes in the front of the house. Shading in this manner helps to maintain a more constant light intensity throughout the year, for as the sun dips lower in the southern sky, light enters the greenhouse through the areas having the least shading.

Temperature control is perhaps the greatest problem for the owner of a small greenhouse. Although the winter months present no special problem,

summer conditions are an entirely different matter. Due to lack of sufficient overhead space for trapping and venting the heated air, it was found necessary to blow cool basement air into the house by means of a fan. Humidification also helped reduce the inside temperature. The temperature curves shown in fig. 3 are apt to be misleading in that the position of the inside curve does not change in proportion to the position of the outside curve. This is largely due to the fact that the temperature of the basement air brought into the house remains relatively constant with changes in outside temperature. An inside temperature of 102° F. was recorded this summer when the outside temperature had reached 105° F.

Humidity control was achieved by the use of a Daffin humidifier equipped with a standard humidistat. Incidentally, removal of the "derby top" on this unit seemed to improve its performance a great deal. Notice, from the relative humidity curves shown in fig. 3, that the inside humidity runs higher than the outside humidity. Without the humidifier, however, the converse of this would be true due to the higher inside temperature. During the winter months the relative humidity is held at 50 per cent while during the summer it is raised as high as 70 or 80 per cent to offset the effects of the higher temperature on the plants.

The majority of the orchid population in this house are Cattleyas; although a few Dendrobiums, Cypripediums, and Phalaenopsis are also grown. The Phalaenopsis were found to do quite well on the back wall close to the humidifier and the Cypripediums and Dendrobiums on the east end of the

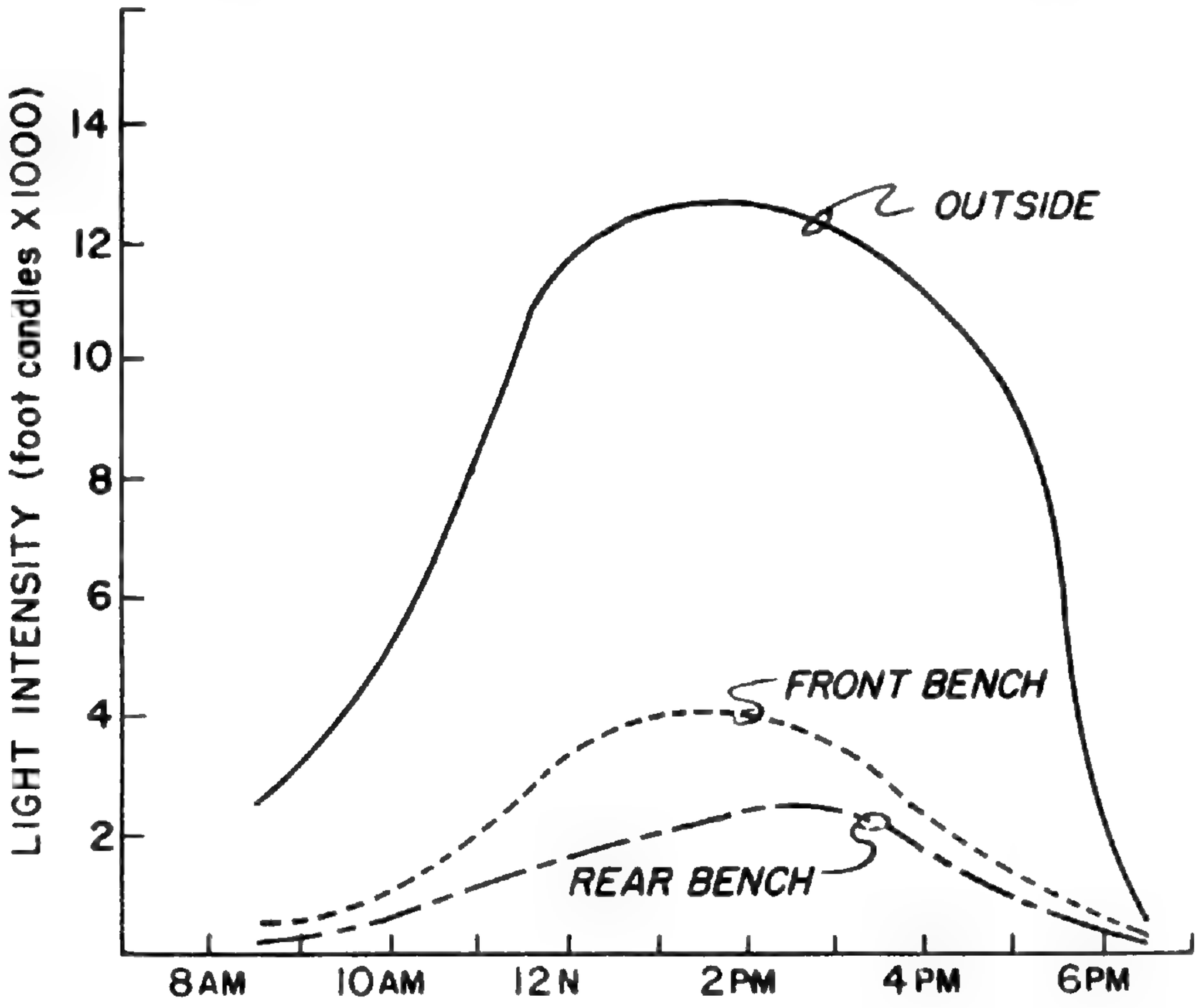
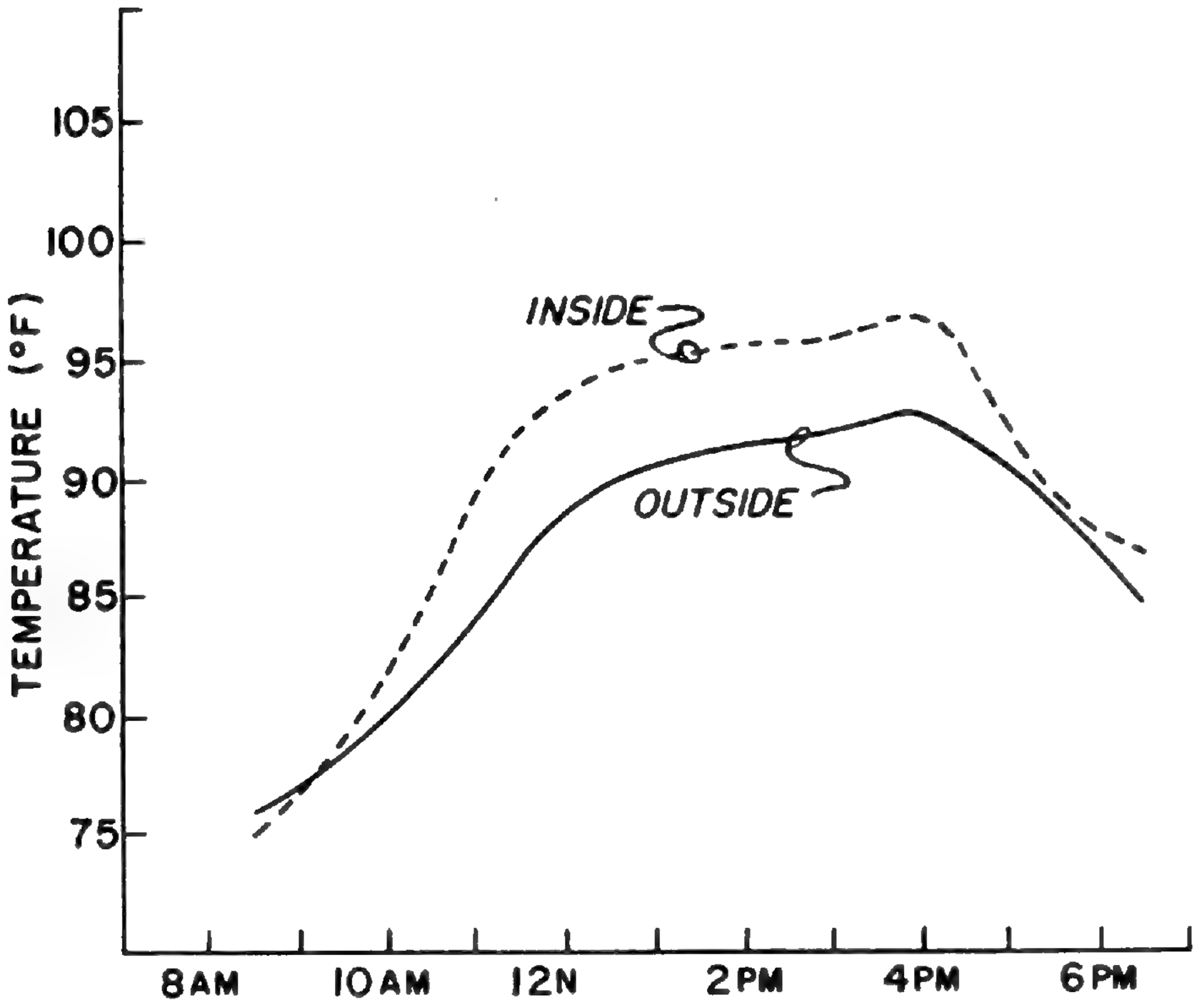


Fig. 2


TEMPERATURE (°F)
105
100
95
90
85
80
75
INSIDE
OUTSIDE
8AM
10AM
12N
2PM
4PM
6PM

RELATIVE HUMIDITY (%)
75
70
65
60
55
50
45
house wet
down at
11:45 AM
INSIDE
OUTSIDE
8AM
10AM
12N
2PM
4PM
6PM

Fig. 3

front bench. As one might surmise from the light intensity curves presented in fig. 2, I have taken to growing my Cattleyas rather "hard." I have found that under the conditions presented herein both the seedlings and the adult plants make vigorous growth with light green foliage and plump pseudobulbs and that many of the hybrid Cattleyas can be induced to flower twice each year.

A BEGINNER'S EXPERIENCE

JOHN E. NIES

Some of the most pleasant recollections of my youth are associated with growing up in the close proximity of the Missouri Botanical Garden. With others of my age, I roamed the greenhouses and the grounds, especially the natural area to the rear of the present garden which we affectionately referred to as Shaw's Woods. In later years, as my business brought me in contact with members of the Garden staff, my interest in floriculture grew, and I looked forward to the time when I would have a garden and greenhouse of my own.

After several years of growing plants and starting seedlings in glassed-over window wells I finally acquired my "Orlyt," a seven section, three bench wide. Soon thereafter I was bit by the orchid bug, and after three years the thrill of a new plant or an exceptional bloom is still great. We grow Cattleyas, Cymbidiums, Cypripediums, Dendrobiums, Odontoglossums, Oncidiums, all in the same house, by placing them in cooler or warmer locations as required. We are able to do this by having our heat valved off into four separate areas and placing the plants on shelves or hanging them.

We heat by means of a gas hot-water boiler with a circulator pump, all thermostat controlled. Our benches are inverted concrete slabs filled with torpedo gravel, set above waist level to avoid working in stooped position. This height also allows for shelves below the benches for shaded plants and starting boxes. The plate-glass shelves are suspended by galvanized chains and do not cast shadows. Automatic vents open on rise of temperature. We have plastic-covered painted frames for each section for shading and also as protection from hail, and these are readily put in place as needed. A mixing valve allows us to get hot, cold, or warm water from the same spigot. We have found that warm water is a decided help to our orchids, particularly in cold weather.

At the present time we have approximately 125 plants and have almost constant blooms. We have learned to do our own dividing and repotting, and it is a great satisfaction to have success in this line. While orchids are our prime consideration we have found African Violets make a very good companion plant.

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 50,000 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 Southampton buses (No. 80), direct from downtown, pass within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN

CONTENTS

Volume XL December, 1952 Number 10

COVER: "*Rosmarinvm coronarium*"—From an herbal by Petrus Andrea Matthiolus of 1560.

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Missouri Botanical Garden Bulletin

Vol. XL DECEMBER, 1952 No. 10

ROSMAREIN AND ROSEMARY

ALICE F. TRYON

Rosmarein, the festival of Rosemary, held in Saint Louis each autumn is an event which savors of age-old traditions. It was brought here by people of German-Hungarian descent from south-central Europe where it originally was a festival of the church. Mr. Mike Schmitz, President of the Saint Louis Chapter of the American Aid Society, on a recent visit to the Garden, told us of the festival which he attended as a young man in Gros-Jécsa, about 20 miles from Temesvar, Roumania, and of that in St. Louis at which he has officiated for more than forty years.

The festival in St. Louis is held in the evening at one of the large halls. An auction of the Rosemary plant is the main event but the festivities begin as the guests assemble, receive sprigs of Rosemary and are drawn to the dance floor by sprightly rhythms of the folk music. Beer, sausage and pastries are served at tables around the dance floor. This is a festival of gaiety, of dancing, good food and fellowship. Midway during the evening the music heralds the entry of the Rosmarein procession which is led by a military guard followed by two children carrying Rosemary and wine. The president of the Aid Society bears the large Rosemary plant, gaily festooned with colored ribbons and he is followed by a group of young dancers. Rosemary is much in evidence in the costumes of the dancers as they enter and form a circle around a maypole in the center of the dance floor. Mr. Schmitz addresses the assemblage of more than 300 guests in words of welcome and thanksgiving, proclaims the virtues of the Rosemary, and the auction begins. This is an exciting, competitive event, for each young man is trying to secure the Rosemary plant for his fair lady. Several bids are made, the music starts and the dancers whirl around the maypole. The music stops and the bidding is resumed. Following several rounds of bidding and dancing, the Rosemary plant is finally taken by the highest bidder and given to his attractive lady as the Queen of the Rosmarein. She carries the plant as they dance around the pole. Then they each take a new partner and dance around again. Each new partner dances around the maypole, proposes

a toast with a glass of wine, and makes a contribution to the Aid Society Fund. This fund, the proceeds from the sale of Rosemary sprigs, and all other profits of the evening are turned into a collection which is used for the aid of displaced persons coming to St. Louis. Many of the guests have only recently come to this country and gladly contribute to this worthy cause.

In Europe the Rosmarein begins with the morning church service in which the Rosemary plant is brought into the ceremony. The festival lasts for two or three days, during which whole sheep are roasted and barrels of wine consumed. However, the celebration is much like that in St. Louis, an assemblage of people in expression of thanks and for the pleasures of good company.

The symbolic use of Rosemary reflects a bond common to many peoples and persists through many centuries. Most readily recalled is that of Shakespeare's Ophelia—"There's Rosemary that's for remembrance; pray you love, remember . . ." In the English Tudor period until as late as the eighteenth century it was given to mourners, for remembrance, to be carried to the churchyard and thrown into the grave. At weddings it was the bride's herb to be strewn before her down the church aisle, and the bridesmaids presented gilded and beribboned sprigs to the bridegroom on the wedding morn; perhaps to remind him of the old adage that where Rosemary flourishes the woman rules. Branches of Rue and Rosemary, which on official occasions are carried by judges in the high courts of England, are reminiscent of medieval times when the herbs were used to ward off "gaol-fever." Garlands of Rosemary bedeck the halls and churches of England at Christmas and the traditional boar's head is embellished by a sprig of the herb. It has so long been a part of English traditions and gardens that it is difficult to accurately place the time of its introduction. This is thought to have been during the Roman invasion and it still grows in the vicinity of the old Roman encampments.

The French name of the plant, Incensier, indicates its use as a substitute for the more costly incense. The wood was often combined with the berries of Juniper and burned for an effect of purity in hospitals. In the old French language of flowers, Rosemary was possessed with the power to rekindle lost energy. For that reason it was used to awaken the princess in Perrault's Sleeping Beauty—but without effect.

It is known by the Spanish as Romero and because of its powers to ward off the "evil eye" the country folk wore sprigs of the herb tucked into their hats.

As a medicinal plant the history of Rosemary can be traced back to the Greek physicians. Pliny recommended it to treat failing eyesight and the

Susan Schmitz and Kenneth Wilhelm holding a plant of Rosemary

For the past two years these children have participated in the Rosmarein procession. The plant they hold is a small replica of the Queen's plant and the beribboned sprigs they wear are similar to those made for all the guests. Kenneth's hat is festooned with ribbons and Rosemary sprigs much like those of the dancers. This custom of decorating Rosemary branches is an old one and is recorded in an account of an English wedding in 1593. Sprigs of the herb were given to all the guests and—"There was a fair bride cup of silver gilt carried before her, wherein was a goodly branch of rosmary, gilded very fair, and hung about with silken ribbands of all colours." The wine bottle which Kenneth holds is reminiscent of the Rosmarein of south-central Europe where it is a harvest festival and barrels of wine are prepared for the event.

root for the healing of wounds. The first British book devoted to herbs, printed in 1525 and generally attributed to Richard Banckes, lists the virtues of herbs. Rosemary, among these, is recommended for the preservation of youth—"boyle the leaves in whyte wyne and wasshe thy face therwith . . . thou shall have a fayre face." The famous Hungary-Water (L' eau de la reine d' Hongrie), a toilet water favored throughout western Europe for more than two centuries, contains Rosemary. The receipt is credited to Queen Elizabeth of Hungary who was reported to be a woman of such enduring beauty that at the age of 72 she received a proposal of marriage from the King of Poland. A receipt for Hungary-Water given by E. S. Rohde in her "Garden of Herbs," calls for one handful of Rosemary (leaves and stalks) and one handful of Lavender added to one gallon of brandy or clean spirits. After this has stood for three days it is distilled and the resulting product is recommended as the finest Hungary-Water. The most famous English herbal, by John Gerard, first published in 1597, which maintained its popularity largely due to the prosy, philosophical writing rather than accuracy of data on herbs, notes of Rosemary: "If a garland thereof be put about the head, it comforteth the brain, the memorie, the inward senses and comforteth the heart and maketh it merry." The first published list of English plants that would thrive in America was written by John Josselyn, just fifty years after the landing of the Pilgrims. His list records the introduction of such weeds as dandelion, shepherd's purse, plantain, and many herbs including Rosemary. Some of our older pharmacopoeias list the oil of Rosemary as effective in stimulating the hair bulbs to renewed activity and to prevent premature baldness but in recent editions it is listed only as an aromatic and condiment.

Botanically, Rosemary is of the Mint family and is named *Rosmarinus officinalis*. The name is generally considered to have been compounded from the latin *ros* (dew) and *marinus* (marine) and broadly interpreted as Dew of the Sea—an association probably applied because of its existence around the Mediterranean. However, Hegi, in his authoritative work—"Illustrierte Flora von Mittel Europa"—disputes this origin and suggests that it is more likely from a Latin name of the shrub or a translation of the Greek folk name *(rhops myrinos)*, meaning fragrant shrub. The German name Kranzenkraut was applied because of its use in making kranzen or wreaths. Rosmarinus when anglicized became Rosemary as if it meant the Rose of Mary but this evidently is a corruption of the Latin.

The unique appearance of the plant clearly distinguishes it from all others however confusing the name might be. It is generally 2–3 feet in height but on some favorable Mediterranean islands it assumes a very robust habit, reaching nearly 4 feet, while at high altitudes it is quite dwarfed. The leaves

are slender, almost needle-like, with the margins strongly curled under. The upper surface is dark green and the lower grayish or whitened by numerous branched hairs. Cut branches remain fresh long after gathering because of the pebbled, leathery texture of the leaves. Clusters of small, pale blue flowers of irregular form are produced around the stem and scarcely protrude beyond the leaves. Both the flowers and leaves emit a pungent fragrance seeming to be a blend of pine, menthol, nutmeg, and heliotrope. As with most plants native to the Mediterranean lands that are brought to St. Louis a special mulch and cover must be provided for the winter. To escape any risk it is best to lift the plants to a warmer situation. In regard to this treatment, a longer verse on the virtues of Rosemary which Mr. Schmitz recited contained these lines:

Im Sommer gewachsen unter Son und Mondeschein
Im Winter in Keller bei kühlen Wein.

The distinctive aspect and penetrating fragrance are perhaps reason for the passing of the plant by cuttings and seed from Athens to London and from Temesvar to St. Louis but so much a part of ordinary things that few facts actually are known as to how or why it traveled these ways.

SALADS FOR QUAIL

LOUIS G. BRENNER

Now that the growing season for most herbaceous plants has ended, the several species capable of enduring the rigors of winter should be of particular interest to the bio-ecologists and especially to those interested in wildlife management. In the case of the quail, Missouri's own number-one game bird, it has been shown that green plant material is an important source of those vitamins necessary for production of large clutches of eggs, high fertility, and general good health of the birds. If insufficient quantities of these vitamins are not available the birds soon suffer from visceral gout, more commonly known as nutritional roup, which in extreme cases is attended by swollen watery eyes, blindness, and eventually death. Experience with caged birds has shown the great importance of green plant material if they are to be kept healthy; the birds consume almost unbelievable quantities of green foods. Extended periods of drought leaving all vegetation parched, and sleet and snow blanketing the earth, can be serious factors in creating such vitamin deficiencies among quail.

During the winter months quail are almost entirely dependent upon the rosettes of the more hardy winter annual and perennial plants for this important "salad." Such plants are usually found on warm sunny banks, and

considerable numbers are usually available in row crop fields left to fallow for the winter (more often the preference of the birds for such sites in their feeding habit is due to the presence of salad plants more than for the grains left in harvesting). Such salad plants are dependent upon a more or less open and bare soil surface, and their worst competitor is heavy sod. Modern high-speed agriculture is developing serious deficiencies in salad sources for quail. Permanent pastures are based only upon a well-developed sod cover; summer row crops are tilled to a winter cover crop of rye or wheat which are poor sources of greens for the birds and exclude the valuable rosette-forming winter "weeds." The serious game manager will find added success if he plans an open sod-free cover to permit an abundance of salad for his quail in winter and especially early spring to insure healthy fertile birds for the approaching nesting season.

Quail show little interest in grasses as a source of salad but do eat the leaves, buds, flowers, and green seed-pods of many other herbaceous plants. Following is a list of some important salad plants with remarks on their habitats:

Wood-Sorrel (*Oxalis* sp.)—Important salad plants, common in fallowing fields and on warm sunny banks.

Sheep-Sorrel *(Rumex Acetosella)*—Another plant associated with fallowing fields and also with the more sparse cover found on poorer soil types.

Clover (*Trifolium* sp.)—Excellent salad plants usually occurring as agricultural escapes and not available to the birds except along brushy field edges or in old fields where higher and coarser plants supply cover.

Chickweed (*Stellaria* sp.)—Abundant in fallowing fields and common around many abandoned dwelling sites.

Mouse-ear Chickweed (*Cerastium* sp.)—Common in fallowing fields.

Carolina Cranesbill *(Geranium carolinianum)*—Common in fallowing fields and in old fields not heavily pastured.

Buttercups (*Ranunculus* sp.)—Old fields and open woods.

Strawberry (*Fragaria* sp.)—Old fields and sunny open woods.

Dandelion (*Taraxacum* sp.)—Road and ditch edges, old fields, and sunny open woods.

Winter-Cress (*Barbarea* sp.)—Old fields and road edges.

Cinquefoil (*Potentilla* sp.)—Old fields.

Bluets *(Houstonia minima* and *H. patens)*—Old fields, usually where sod cover is thin and there is not too much competition from other plants; excellent source of very early spring salad.

Paper-white narcissi started now should be in flower shortly after the holidays.

MUSHROOMS IN AND OUT OF THE HERBARIUM

EMANUEL D. RUDOLPH

What should one with mycological leanings do after identifying a recently discovered clump of mushrooms—collect them for the herbarium (a collection of preserved plant specimens), take them home as additions to the next meal, or just leave them to develop their full beauty and thus be appreciated for their magnificence? Such a problem presented itself when a striking clump of mushrooms appeared in the lawn a short distance behind the administration building here at the Garden. In this case, we were indeed fortunate because one might say we ate our cake and still had it. The mushrooms were found to be *Pleurotus sapidus* Kalchb., a very close relative to the common oyster mushroom and a gastronomical delight. They had apparently sprung from the buried stump of an old felled elm, but gave the appearance of springing suddenly from the midst of the lawn. Their striking color aroused considerable comment. Since they were so close at hand, they could be left to develop to their fullest for a photograph which would preserve their beauty, and then some could be taken for the herbarium and the cooking pot. Upon further observation, it was noticed that some other small buttons were pushing their way through the soil near the large Pleurotus clump. In a day, a number of patches of short-lived inky-cap mushrooms, *Coprinus micaceus* Fr., appeared, fruited, and melted to a black mush.

Mushrooms, besides being of interest to the mycologist or student of fungi, are interesting to many who consider themselves gourmets. One need only mention the famous truffle to point out how luxurious a food item mushrooms can be. We can easily go to the neighborhood store and purchase commercially grown field mushrooms, *Agaricus campestris* Fr., which are now big business. Still, nothing can compare to the delight of discovering a field of fresh morels. Certainly mushroom collecting is an old and esteemed art. Charles McIlvaine, an ardent student of mushrooms from a gastronomical point of view, held that almost any mushroom except one of the deadly Amanitas could be eaten. He spent considerable time eating and studying our native larger fungi and published his observations in a substantial tome entitled, "One Thousand American Fungi." Before becoming a mushroom collector, one should become familiar with the common eatable mushrooms as well as with the poisonous Amanitas. The latter can be told when mature by the stalk which has a cup or volva at the base and a ring or annulus on its upper part, and any mushroom with these characters should be avoided. Most of the tests reported for poisonous mushrooms, such as their turning a silver spoon black, are of no value. The only real test is

Pleurotus sapidus Kalchb., growing in the lawn of the Missouri Botanical Garden. Photograph by George B. Van Schaack.

knowing your mushrooms. There are many books that can help the beginner to identify mushrooms, and a few are listed at the end of this note.

Once the fungi are collected, one is faced with the problem of how to prepare them for the table. They are versatile food items which can be boiled, broiled, baked, fried, sautéed, or eaten raw. Many recipes for mushroom dishes are listed in the literature and a complete meal could be planned using mushroom dishes for most of the courses. First there might be *hors-d'ouvres* of mushrooms followed by mushroom soup. Then for the entrée we might have mushroom croquettes, baked mushrooms on toast, fried puffballs, mushroom omelette, mushroom rarebit, or stuffed morels, with side dishes of mushroom pickles, mushroom catsup, and a mushroom salad. Finally, for dessert in our imaginary meal we might have a mushroom soufflé or mushrooms in jelly. Most of us are content with a steak smothered with mushrooms or some creamed mushrooms.

When complaining about the high cost of living and reminiscing about the "good old days," we can be sure that mushrooms, as all else, have been affected by inflation. Whatever the cost of mushrooms at your local vegetable store, it is certainly more than the cost of the 1911 morels, one of which is resting in our herbarium. On the label the following information is supplied: "*Morchella esculenta*", Peters Station on Clover Leaf Railroad, Ill., Sold at Franklin St. Market for 25¢ per quart, Determined by M. Craig,

April 18, 1911." We can take heart with the thought that now as always, out in the woods, many quarts of mushrooms are waiting to be collected.

Mushroom Books.—

Krieger, Louis C. C. The Mushroom Handbook. New York: The Macmillan Co., 1936.
McIlvaine, Charles. One Thousand American Fungi. Indianapolis: Bowen Merrill Co., 1900.
Pomerleau, René. Mushrooms of Eastern Canada and the United States. Montreal: Les Éditions Chantecler, 1951.
Thomas, William Sturgis. Field Book of Common Gilled Mushrooms. New York: G. P. Putnam's Sons, 1928.

AUTUMN COLORS IN 1952

JULIAN A. STEYERMARK

It is always difficult to predict autumn coloration. Some years coloring seems much more intense than in others. Sometimes there are early frosts, sometimes there is abundant rainfall preceding coloration, and sometimes there is an unusually dry season. This year, with the unusually severe drouth over the Ozark area, one might have expected a rather drab spectacle with leaves becoming brown prematurely. On the contrary, this autumn in the Ozarks has proved to be one of the most vivid in many years. Acres of forested land during middle and late October flashed a variety of spectacular colors that would be difficult to match anywhere for sheer beauty. The oaks are largely responsible for the autumn color. The Black Oak *(Quercus velutina)*, so common on the drier rocky slopes, provides the main yellow and gold tones, while the White Oak *(Q. alba)* is responsible for the duller reds varying from rose-red to purplish, and the Scarlet Oak *(Q. coccinea)* bestows the scarlet or crimson splash upon the hillside. The Post Oak *(Q. stellata)* gives us the rosy-purple to dull reddish hues. The Blackjack Oak *(Q. marilandica)* is one of the most brilliant as well as the most variable in color, one tree having mostly reddish coloration and another a mixture of red, orange, yellow, and green in different combinations or proportions. The Shingle Oak *(Q. imbricaria)* may have different combinations of russet-brown or yellow-green mixed with pale rose or purple.

Combining with these oaks to enhance the scene is usually the rich yellow of the Ozark Hickory *(Carya texana)*. Here and there on slopes where the soils are acid from sandstone, chert and flint, or granitic rocks, the Red Maple *(Acer rubrum)* stages a brilliant display of crimson-red, orange, or red and yellow. In areas of limestone, the Sugar Maple *(A. saccharum)* is prominent with gorgeous shades of gold or rich yellow, often edged with a touch of crimson or rose-red hues.

While the mass of color over the greater part of the forested area in the Ozarks during the latter half of October was furnished by the oaks and maples and some hickories, the other woodland species of trees and shrubs,

which still had their leaves, were not to be discounted. Thus, along the streams, the Ozark Witch Hazel *(Hamamelis vernalis)* and the River Birch *(Betula nigra)* fill in with pale yellow colors, while the Alder *(Alnus serrulata)* retains a dark green. The Black Haws *(Viburnum rufidum* and *V. prunifolium)* are brilliant with rose-purple and dull reds, while the Flowering Dogwood *(Cornus florida)* provides some of the rose-red color it displayed earlier in the season. The fiery red of the Tupelo *(Nyssa sylvatica* var. *caroliniana)*, one of the most brilliantly colored forest species of late summer and early autumn, had shed most of its leaves by the middle of October, turning over its part of the autumn display to the oaks, the last to color. The display of orange, yellow, and green, put on by Sassafras during August and September, is now past, and the trees are quite bare, as is the Persimmon when the latter part of October comes around.

The dry summer of 1952 in the Ozarks had its many ugly aspects which are not pleasant to state, but it culminated with a burst of beautiful color over all the landscape, making the autumn one of the pleasant memories we can carry through during the winter and leading to the thoughts of glorious spring to come.

Dr. Steyermark's discussion of fall color in the Ozarks could be paralleled by one on fall color in the Missouri Botanical Garden for 1952. The Ginkgoes were particularly outstanding. Our century-old specimen trees are now big enough to make great domes of yellow in the landscape when they turn color in the fall. This year the turning began so gradually and continued for so long a period that they were effective as displays for over a month. Finally, at the first touch of really cold weather the bulk of the leaves fell within a few hours and made handsome carpets of imperial yellow-gold under the old trees until they gradually withered and faded.

This fall's almost continuous sunny weather brought the Chrysanthemums into bloom early. As a result the "Mum" Show was packed with bloom from the time it opened, and though this posed special problems later in the month they have been met successfully.

During most of the month of November many of the walks in the Garden were strewn with a curious brown substance something like a gritty dark corn-meal. In some places it lay so thickly on the pavement that one would have thought that uncooked breakfast cereal, or some such substance, had been spilled accidentally by one of our visitors. Investigation showed that the meal was made up of seeds from the Sweet Gum trees *(Liquidambar styraciflua)* which this year are unusually heavily fruited.

BOOK REVIEWS.—

From time to time the BULLETIN publishes reviews of books and articles which look as if they would be of general interest to our readers. Since the book mentioned in the following review was written by one of the members of the Garden staff we have asked some one from another institution to prepare the account, Dr. J. D. Sauer, Assistant Professor of Botany at the University of Wisconsin.

Plants, Man and Life, by Edgar Anderson. Little, Brown & Co., Boston. $4.00.

The severe-looking red-brick administration building near the southeast corner of the Missouri Botanical Garden has little meaning to casual Garden visitors. The few who wander inside find only ordinary-looking offices, library stacks, and batteries of filing cabinets. Usually they retreat quickly to the more inviting public grounds and greenhouses, perhaps wondering why so much paraphernalia is needed to run a botanical garden. As most readers of the BULLETIN are well aware, the administration building is considerably more than housekeeping headquarters for the public display gardens. This old building houses one of the world's great centers of botanical research. Here is the Garden's academic heart, the base of operation for scientific investigations which have made the Garden known around the world to people who have never heard of its orchid shows or walked around its lily ponds.

For many years, Edgar Anderson has led one of the lines of research in which the Garden has achieved international distinction. In his exciting new book, Professor Anderson throws open to the public the story of this research—why it was begun, how it is being done, and what it is yielding. It is rare for a distinguished scientist to attempt a popular book of this kind. Perhaps none has ever succeeded so completely in communicating to the general reader his great enthusiasm and the fascination of his research.

The subjects of Professor Anderson's investigations are common plants, the ordinary weeds and crops with which mankind lives in daily intimacy, but which academic botanists have generally passed by in their concentration on the wild, the rare, and the exotic. The hundred or so kinds of plants which are the cast of characters of this book will be familiar, at least by name, to almost everyone. Some are such romantic things as taro, opium poppies, and tea, but many are as commonplace as wheat, sweet corn, and sunflowers. What Professor Anderson has to tell about these plants is far from commonplace. He is mainly concerned with tracing the stories of these plants back to the beginnings, discovering where they originated, how they came to be weeds and crops, and how they have changed during their long association with the human race.

The reader follows the unravelling of these stories step by step. The author gives the critical evidence accurately but in plain English, without ever hiding behind unintelligible technicalities. Concrete facts from archaeology and cytology are fitted together in a reconstruction of the evolution of modern wheat from accidental crosses between weedy grasses in primitive Stone Age fields of the Near East. Ethnology and genetics supply the clues by which the corn we grow for roasting ears can be traced back to ancient varieties grown for brewing in the Andes. There is a whole chapter on the still partly mysterious history of sunflowers, "the one native American crop," which should leave most readers as "intoxicated with sunflowers" as the author.

All these and many others are stories which have not been told before or have been published only as fragments in highly technical papers. Perhaps the greatest charm of this book is in its complete newness and freshness. It has nothing in common with the usual run of popular books on economic plants, which rehash the same tired old facts and dusty, armchair theories. From start to finish, this book is an original creation, for the most part taken directly from a rich background of personal experience. Although the old building at the Garden has been Professor Anderson's base of operations, he has worked largely out of doors with living plants, and his work has taken him to many parts of the world. The book contains vivid first-hand observations from such varied places as the vacant lots and railroad yards of St. Louis, abandoned Ozark fields, the coastal grasslands of California, the English countryside, the fields of India, Mexican villages, native gardens in Guatemala, and palm groves in Honduras.

Much of the colorful factual detail and broad interpretation in this book will be new and exciting even to specialists in this particular field, yet the language of the book is so informal and sprightly that much of it reads as effortlessly as a novel. Anyone with a normal endowment of curiosity concerning the plants around us should find this book a pure delight.

Witch Hazels—Another Test of Smoke Control in St. Louis.—For over a month the old bushes of the common Witch hazel *(Hamamelis virginiana)* in the Garden have been so full of their pale lemony blossoms, which appear just as the leaves are falling, that they have been attractive in the landscape. Fifteen years ago the bushes were there but only an occasional botanist noticed the flowers. Those were in the days when St. Louis was smoky. The bushes ordinarily did not bloom well and if they did the blossoms were so sensitive to smoke that they curled up and browned off after a few days. Their continued beauty during the last month is proof that there has been virtually no smoke in this part of the city during the entire blooming period.

Where is the biggest Rock Elm?

The biggest Rock Elm *(Ulmus Thomasi)*, according to an article in the *American Midland Naturalist* for 1947, is in Big Oak Tree State Park, in southeast Missouri. Now along comes Mr. Albert Chandler, of Kirkwood, with information which may bring this honor to the St. Louis metropolitan area. He writes:

> "For the biggest tree of its sort, I nominate the *Ulmus thomasi*, 60 feet NE of the NE corner of St. Vincent's Asylum, in Normandy—north of St. Charles Rock Road and west of the Normandy High school. It is 15 feet 9 inches in circumference, breast high, with the characteristic horizontal lowest limbs about 20 feet above ground. It stands beside a group of four European Plane trees of good size. Mine were handkerchief measurements, measuring the handkerchief after coming home; so there is no doubt some inaccuracy.
>
> "In its list of 'biggest trees' Am. Mid. Nat. (Vol. 37, p. 794. 1947) gives the honor to a *U. thomasi* 3′ 6″ in diameter in Big Oak Tree State Park, Mo. Multiplying that by Pi would give a circumference of just under 12 feet. Anyway, a picture and measurement with a steel tape is indicated."

NOTES

Mr. A. P. Beilmann, Manager of the Arboretum, joined the field trip of the dendrology class of the School of Forestry, University of Missouri, Columbia, which was studying Conifers under Dr. R. E. McDermott, Instructor.

Recent visitors to the Garden include: Mr. Gordon Dillon, Editor *American Orchid Society Bulletin;* Dr. Sergius H. Mamay, Paleozoic Paleobotanist, U. S. Geological Survey, Washington, D. C.; Dr. Alfred Etter, of the Malvern B. Clopton Experimental Farm, Clarksville, Mo.; Dr. M. Trufant Hall, of the Cranbrook Institute of Sciences, Bloomfield Hills, Mich.; Mr. Leopold Charette, of Burlington, Vt.

The fourth number of Vol. 39 of the ANNALS OF THE MISSOURI BOTANICAL GARDEN was recently issued, with contents as follows: A Sketch of the History of Fern Classification, by Rolla M. Tryon, Jr.; A Study of the Arborescent Lycopods of Southeastern Kansas, Charles J. Felix; The History of the Use of the Tomato: An Annotated Bibliography, by George A. McCue.

Mr. George H. Pring, Superintendent of the Garden, attended the meetings of the American Orchid Society held at Houston, Texas, November 22-23. He took with him an exhibit of two orchid hybrids originated at the Garden, Laeliocattleya "Dr. George T. Moore" and "St. Louis." Although he had not expected to enter them for competition, he was urged to to so by some of the orchid specialists, and a clone of "St. Louis" named "MO BOT GARD" received an Award of Merit. While in Houston Mr. Pring acted as one of the judges for the Houston Orchid Show.

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 50,000 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 Southampton buses (No. 80), direct from downtown, pass within three blocks of the main entrance.

GENERAL INDEX

Figures in *italics* refer to page numbers of illustrations.

X

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