MISSOURI BOTANICAL GARDEN BULLETIN

VOLUME XXXII

WITH 27 PLATES AND
34 TEXT-FIGURES

1944

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SOME FACTS ABOUT THE GARDEN

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

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

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

LOOKING SOUTH FROM THE TRAIL HOUSE AT THE ARBORETUM

Missouri Botanical Garden Bulletin

Vol. XXXII JANUARY, 1944 No. 1

FIFTY-FIFTH 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, 1943.

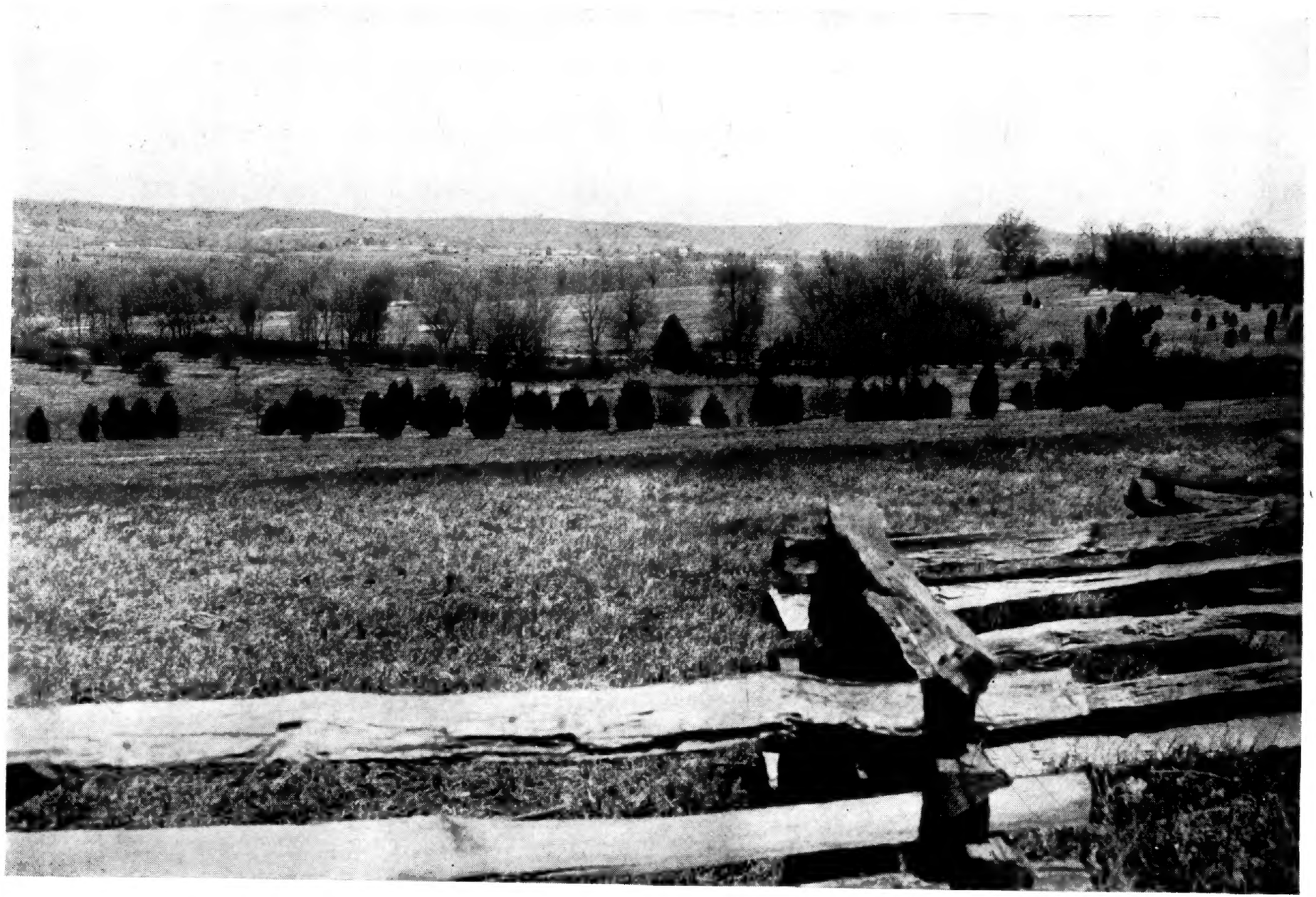
A botanical garden is no exception when it comes to the difficulty encountered during war time. Usually conducted under a reduced income and with cost for labor and supplies increased beyond any possibility of meeting, such institutions are compelled to operate on a maintenance basis with little chance for expansion or development. Few authorities are willing to admit that a botanical garden, with its vast collection of useful as well as beautiful plants—both out of doors and under glass—its important library and herbarium, and its scientific staff engaged in solving fundamental plant problems, is to be rated in any sense as essential or worthy of any special consideration. In spite of the fact that war always imposes additional responsibilities and opportunities for service to the public and the industrial world, gardens such as the Missouri Botanical Garden are fortunate if they can be allowed to survive in any thing like the customary or traditional manner. Without attempting to set up a balance sheet or to enumerate in detail the services of botany in war times, it is only fair to call attention to the fact that, quite apart from the recreational features, plants and their products are supplying more definite and practical contributions to medicine, to food supplies, and to manufacturing industries than ever before. That such important plant products as rubber and quinine formerly came from parts of the world now in the hands of the enemy is pretty well known, but that many other articles essential in both peace and war were obtained from plants no longer available is only beginning to be recognized. Particularly, that a knowledge of the local flora in a tropical country may contribute to the survival of our fighting men is at last recognized by the Army, and both literature and instructions as to edible and poisonous plants to be found in the South Pacific and other regions are now supplied to our troops.

In addition to furnishing plants or information of all sorts to the Quartermaster Corps, Bureau of Plant Industry, The Rubber Development Corporation, American Quinine Company, as well as to drug houses and various industries, the Garden has supplied for rubber or quinine investigations nine former students or members of the staff, who are located in Central or South America.

It is a gratification to include among the notable events of 1943 the publication of the first two fascicles of the "Flora of Panama," a project which the Garden has had in preparation for the past fifteen years. The portion published represents perhaps five per cent of the finished work, and includes treatments of the lower seed plants from Cycadaceae through Cyclanthaceae. In addition to the treatments of miscellaneous families by the editors of the "Flora," Dr. Woodson and Dr. Schery, it is significant to note the admirable contributions by eminent specialists of other botanical institutions, particularly those on the Gramineae by Jason R. Swallen, U. S. Bureau of Plant Industry, Cyperaceae by Henry K. Svenson, Brooklyn Botanic Garden, and Palmaceae by L. H. Bailey, Cornell University. Manuscript is now being edited for the remainder of the monocotyledonous families to be published during the coming year. Among the rather few modern floras of tropical America, the "Flora of Panama" is conspicuous because of its broad and authoritative scope and excellent illustrations.

The publication of a new flora can hardly be expected to appeal to the general public, but this type of research is possibly the most enduring in botanical science. Floras are ponderous works composed, in the best instances, after years of labor shared in common by the outstanding authorities of each plant group. They last for generations. They are the last word on the plant resources of a region, and the inclusive information stored in them always has been of vital concern to nations and their rulers. We have evidence of such concern since the days of Alexander the Great. Martius' "Flora Brasiliensis," in fifteen folio volumes, compiled under the joint auspices of the King of Bavaria and the Emperors of Brazil and Austria, was a half century in the making and remains to this day the most inclusive authority for the vegetation of half of South America.

In our own country, we must not forget Thomas Jefferson sending to England for John Bradbury to botanize the Louisiana Purchase from St. Louis as a base, nor the botanical collections of Captain Kearney and of General Fremont on the first expeditions westward to the Pacific. But one can see most clearly the uses of floras and of men trained in that phase of botany in the vast and imperative programs of the United States government to find in America sources of wild rubber, quinine, fibers, and other vital commodities to take the place of those recently lost to us. The research and



LOOKING NORTHEAST FROM PARKING LOT AT THE ARBORETUM

training programs that the Missouri Botanical Garden and similar institutions had supported during the years of peace are now of utmost importance and use in our national emergency.

ARBORETUM

As did the report of last year, this one deals largely with maintenance, although a few somewhat spectacular construction projects were completed. In the Pinetum six head-walls and catch basins were built along the east road. This required 789 man hours, ½ ton of steel and 125 sacks of cement. Later, about 66 yards of soil were hauled to complete the grade and 10 loads of sod were laid in the vicinity of the head-walls.

A small tool shed (10 x 12 feet) was built at the seed-frames, all the material used being either sawed on our sawmill or salvaged from other buildings removed during the last three years. About 326 man hours were required to complete this building, exclusive of the second coat of paint.

During the months of January, February and March 24,769 board feet of walnut, maple, cherry, elm, hackberry, locust, oak and cottonwood were sawed at the sawmill. A new 5,000-bushel granary and a 28 x 40-foot general-purpose barn on the farm were constructed entirely of lumber sawed from trees harvested on the property in 1942 and 1943.

For the first time in many years the demonstration apple orchard maintained for floral effect was sprayed. A total of 1,600 gallons of lime-sulphur lead-arsenate spray was used in the "cluster bud" and "first cover" sprays. This was done as a war measure, the fruit being distributed among the employees at picking time, and an additional 50 bushels placed in storage for distribution later in the year. Other projects include a three-acre truck garden worked co-operatively by the employees, work with castor beans as a field crop, and the growing of a new soybean. An additional eight acres was planted to Harbinsoy beans and twelve more acres planted to hybrid corn. These last two fields were in the bottom-land near the Meramec River.

Due to the difficulty of obtaining parts the T-20 (crawler) tractor was used only 78 hours during the year—all of the time either logging or in farm work. During December this tractor was returned to the repair shed for a complete overhauling. Since the year 1940 it has been used a total of 1616½ hours, and burned 2194½ gallons of fuel; to this must be added another 500 hours for 1939—the year it was purchased as a "used" machine.

Tractor mowing of the open fields required 686½ hours—less than usual since many fields were mowed but once. A single mowing is not sufficient even in a dry fall because the late grasses grow so high that they hide the Narcissus the following spring and increase the fire hazard throughout the fall and spring. The time saved in mowing open fields just once was devoted

The Panamanian Dove Orchid *(Peristeria elata)*

to mowing new areas from which the brush was removed during the summer and fall. Brush was removed from 200 to 300 acres of the tract toward the north and east of the Nursery. This required 1,047 man hours of labor and several hundred hours of tractor mowing.

On the whole, the rainfall for the year has been sufficient; at least no group of plants has suffered greatly. However, about half a million gallons were pumped for irrigation from the Pinetum lake to the greenhouse reservoir, requiring a total of 241 hours, more than in any other year. A quantity of water was also used from the new reservoir at Crabapple Hill; refilling this required 88,400 gallons, or 13 hours of pumping from the well near the river.

About 12,000 gallons of water were hauled by tank truck for irrigation, fire fighting, and concrete work. This truck-tractor also made thirteen trips in logging work, and was used to haul 10 large boxwoods from Ste. Genevieve, Missouri, as well as 10,000 gallons of sludge to continue the experimental work on this material as a fertilizer.

The two Ford trucks were driven a total of 7,223 miles during 991 hours of operation and used 899 gallons of fuel. This is approximately one gallon of gasoline and about seven miles per hour of use. Both trucks are seven years old and have long since passed the peak of engine efficiency, although the motor overhaul received in January appears to have increased the mileage from 4½ per gallon in 1942 to about 7 for this year.

Due to the lack of visitors very little road maintenance was required; in fact, portions of the stabilized roads became rather weedy. Some new gravel was hauled to the roads, however, a truck load being hauled back to the Pinetum each time a load of rubbish was taken to the dump in Pacific, Missouri.

While much planting has been done during the fall and spring, most of this merely increased an existing plantation. For instance, many hundred more azaleas were added to the two groups in the Pinetum. Planting for the year required 1,119 man hours and 42 hours use of the tree-mover; this last to move many very large conifers to and within the Pinetum. The most spectacular planting was in the Boxwood Garden, southwest of the Pinetum. We were able to obtain fourteen 45-year-old boxwoods from Ste. Genevieve, Missouri, which were dug, balled, and transported to the Arboretum by our own men with our own equipment, and on our own trucks. This work, together with all the other activities at the Arboretum, was under the direction of Mr. A. P. Beilmann, Manager of the Arboretum.

"*Friends of the Garden.*"—This fund, reserved for permanent improvements at the Arboretum, continues to accumulate awaiting a more favorable

Group of twenty-five Peristeria plants

opportunity for expending it. Two new roads which will add greatly to the accessibility of the more beautiful parts of the tract will be constructed when men and material are available. In spite of the lull in activities the interest in the fund continues as in the past, $3,641.77 having been contributed by "Friends" and Garden Clubs during 1943.

Orchids.—While the public do not expect to see chrysanthemums in April or poinsettias in June, they always take for granted that orchids will

be on display at the Garden, no matter what time of year. Since the Garden collection embraces genera and species from all parts of the world this is possible, the blooming season of orchids varying with the country from which they come and the altitude at which they grow. For example, *Cattleya Trianaei* from Colombia flowers during December and January, *C. labiata* from Brazil, during September and October, *Paphiopedilums* from India, in December, while those from the East Indies flower from June through August. Over 50 plants in flower of the Panamanian dove orchid *(Peristeria elata)* were shown in July and August, making an unusual mass display of this rare flower. Easter is the time for the showy *Cattleya Mossiae*, while the magnificent *Cattleya gigas* from Colombia blooms during the summer months. Hybrids derived from many of the Cattleya group give a display at various times during the year, depending upon their parentage. The less showy botanical orchids, in which the Garden collection excels, bloom at various times throughout the year and although not particularly attractive to the public they are extremely interesting to the specialists.

Outstanding displays, aside from the annual orchid show in February which comprised Cattleyas, Paphiopedilums, Calanthes, Laelias, Cymbidiums, and Dendrobiums, included *Oncidium ampliatum* from Panama in May, and the Brazilian Oncidiums in September, as well as mass effects of blooming plants.

Some unusual specimens flowering this season were *Laelia harpophylla, L. crispa, L. flava, L. pumila, Cattleya Walkeriana, C. Rex, C. guttata, C. amethystoglossa, Sophronitis cernua, Dendrobium Sanderae, Bulbophyllum virescens* and *B. Medusae.*

To keep this orchid display continuous, plants are transported weekly from the Arboretum greenhouses. No small part of presenting such a show is the maintenance of some 20,000 plants, necessitating the repotting during the year of some 17,000 plants. The immediate care of the orchid collection, comprising twelve greenhouses, continues under the direction of Mr. Fred Wegloener, Orchid Grower.

Sunshine Record.—

COMPARATIVE HOURS OF CITY AND COUNTRY SUNSHINE

Month	*City Garden Hours*	*Arboretum Hours*
January	137	137
February	192	209
March	183.15	192
April	170.30	207
May	131.15	145.30

June	235	236
July	325	320
August	265.15	267.30
September	187.30	216
October	197.30	208
November	144	174
December	81.15	111.30
	2,249.30	2,423.30
		2,249.30
Excess of sunshine hours at Arboretum		74.00

CITY GARDEN MAINTENANCE

Primary attention has again been paid to the central heating system. During the summer it became necessary to replace the old main from the upper valve chamber to the Museum, originally for hot water, but used for steam since 1913. The work was done in the most approved manner, and this main should require no further attention for many years to come. The steam line leading to the Linnean House was also renewed, as well as some 300 feet of underground water pipe. A major item of maintenance was the complete overhauling and renewal of parts of the two automatic stokers, which should result in more efficient operation than when they were installed three years ago. Minor but important repairs included renewal of all pipe leading from the three boilers to the water columns, packing all valves and expansion joints, cleaning and replacing new parts of 365 thermostats when necessary, installing new piston rods, guards, valves and springs in feed pumps and new tile arch in No. 3 boiler. The concrete slabs were placed on the steam tunnel leading from the upper valve chamber to the Administration Building.

The sewer from the Administration Building and Old Residence was practically rebuilt, and a new 10-inch drain was laid in the Medicinal Garden, replacing the open ditch connecting the hardy lily pools.

Routine repair and painting occupied the entire time of the few men available for this purpose. The pergola at the west of the Italian Garden was painted with aluminum paint, and all the fence bounding the Garden—both wire and iron—was repainted.

FLORAL DISPLAYS

The annual orchid show was held during the month of February. Cinerarias were on display March 7, and a week later azaleas were added to the show. During April the display consisted of annual chrysanthemums, marguerites, nasturtiums, roses and schizanthus. Pelargoniums (Martha Washington geraniums) were on exhibit April 25 and hydrangeas followed on May 16. For the occasion of the annual flower sermon at Christ Church Cathedral, May 16, numerous pot plants and cut iris were sent to the church.

The St. Louis Horticultural Society held its spring show in the Floral Display House on May 22 and 23. Fancy-leaved caladiums and other foliage plants were displayed during June, July and August. The annual dahlia show of the St. Louis Horticultural Society was held October 2 and 3. The chrysanthemum show opened the first Sunday in November. On Sunday, November 28, the *St. Louis Post-Dispatch* published a full color-page of chrysanthemums photographed in the show, and this attracted an unusually large Sunday afternoon crowd. Despite gasoline rationing some members of the Book and Flower Guild distributed the chrysanthemums at the close of the show to various charitable institutions in the city. The Christmas show of poinsettias opened on December 12.

In order to support the Victory Garden movement to its fullest extent demonstration plots of vegetables were planted in the Main Garden, the Economic Garden, and in the model Victory Garden. Altogether, some 43 kinds of vegetables were grown, which represent practically all that can be grown successfully in this region. Since the tomato is the most popular vegetable the variety tests begun in 1942 were continued during the past summer, 30 varieties of tomatoes being grown in two separate plots.

In the last few years the Garden has acquired 250 of the newer varieties of iris, many of which were donations. As these iris become available they replace the obsolete varieties, and numerous changes of this kind were made during the year. An entire bed was planted with 48 varieties of Siberian iris, a class not previously grown in this garden.

The Italian Garden, the Linnean Garden, the perennial borders on the Knolls, and the Rose Garden were maintained in their usual manner.

All of these gardens, together with the planning and designing of the indoor floral displays, are under the supervision of Mr. Paul A. Kohl, Floriculturist to the Garden.

MAIN CONSERVATORIES AND EXOTIC RANGES

Another year has elapsed with no major changes in the Main Conservatories, except that new plant material has been added to the already large collection of exotics. Regularly each week some potted palms, aroids, bromeliads, orchids, cacti and other succulents, etc., were set out in beds of the various houses.

Perhaps more attention was given to the Palm House than to the rest of the range. It now presents a veritable jungle with araceous vines clambering up the trunks of palms, with clusters of orchids, bromels and epiphytic cacti hugging the tree trunks, and with brilliant undergrowth decorating the jungle floor. Both slender and massive palms, such as Livistona, Sabal, Chamaerops, Phoenix, Thrinax and Washingtonia, lend themselves perfectly

as hosts for the epiphytes. The picturesque *Billbergia thyrsoidea*, with its torches of bright red flowers issuing from the vivid green, cup-like rosettes, presented a wonderful floral display in early September. This species is grown lavishly as an aerial and terrestrial plant and seems to thrive exceedingly well under both conditions. Several other Billbergias are scattered throughout the jungle and all are profuse bloomers. This genus possesses the most

Vanilla orchid flowers in Main Conservatory

gorgeously colored flowers in the Bromeliaceae, but they last only a short time. The Aechmeas, on the other hand, bear inconspicuous flowers but their bracts and colorful fruits remain longer. Two of the outstanding Aechmeas adorning the trunks of palms are *A. fulgens discolor* and *A. miniata discolor*. Other prominently featured bromels are *Billbergia macro-*

calyx and *Quesnelia Liboniana* growing in dense clumps at the bases of palms. The former has a very densely farinose inflorescence and light sky-blue flowers, while the latter is much brighter with coral-red and deep bluish-violet blooms. Native Florida Tillandsias also grace the trunks of date and

Vanilla pods raised in Main Conservatory

Jamaica thatch palms. For the first time, orchids—Dendrobiums, Cattleyas, Oncidiums, Aerides, and Epidendrums—were attached to the palm specimens. The tulipan orchid, *Cattleya Trianaei*, has produced a number of flowers too high to be reached by the visitor and yet low enough to be admired by everyone. Dendrobium hybrids were generous with their blooms, a number of flower stalks arising from a half dozen plants on the Chinese fan palm, with three to five pale rose to deep purple moth-like blossoms on each stalk. The vanilla orchid has grown faster than the ubiquitous Philodendron, and if stretched in a straight line would measure nearly a hundred feet. There are several of these vanilla vines stretched from trunk to trunk or hanging in graceful festoons from the topmost leaf-stalks. Individual flowers were

hand-pollinated to produce the "beans" from which the commercial vanilla is extracted. The amaryllidaceous *Eucharis grandiflora,* which looks like a glossy succulent edition of the common Aspidistra, thrives exceedingly well on the semi-shaded jungle floor and produces fragrant daffodil-like flowers several times a year.

During the past year no roof shading was applied to the Cycad and Coffee Houses. However, none of the plants seemed to mind the summer heat at all except the staghorn ferns which were sunburned. The vitaceous curtain vine, despite a heavy spring pruning, looks more luxuriant than ever before, while the Nephrolepis ferns have formed a dense green cover over the naked ground. Even the cycads look much healthier. The coffee and banana plants were heavily manured in February and the result was a more abundant crop of fruit. The scarlet wax-mallow bushes, after being pruned earlier in the year and fertilized along with the coffee trees, are now densely covered with lush foliage and a super-abundance of flowers.

A rabbit, which got into the Economic House in October and defied traps set for his capture for ten days, did considerable damage to the herbaceous material before he was finally killed in the Palm House. The two wintersweet bushes, *Acokanthera spectabilis,* were heavily pruned for the first time since they were set out many years ago. The Zanzibar coffee *(Coffea Zanguebariae)*, golden apple *(Spondias lutea)*, and the African rubber vine *(Cryptostegia grandiflora)* produced flowers for the first time. *Ficus benghalensis, Hura crepitans* and *Parkia Roxburghii,* three of the largest trees now growing in the Economic House, were heavily pruned. A nice specimen of a variegated rubber plant, *Ficus elastica,* was obtained to enhance the collection of economic plants.

Space in both Succulent Houses is now at a premium. New plants have been added steadily during the year, the most notable being a number of choice desert bromels in the Cactus House. Most of these are very thorny and are native to some of the driest sections of tropical America. The outstanding representatives of the Pineapple family now growing in this House include *Ananas bracteatus alba, Bromelia serra* and *B. antiacantha, Cryptanthus bahiensis, Hechtia texensis, Hohenbergia catingae, Pseudananas macrodontes, Puya chilensis,* and four species of Dyckia.

One of the finest displays of cactus flowers was borne on the tall trellisses which support the night-blooming Cerei. Selenicereus and Hylocereus bloomed abundantly, as did the Epiphyllums and Eriocerei. The Selenicereus species were late with their flowers, the first ones unfurling in July and the last on August 7. The undue amount of gloomy days in the spring apparently had something to do with the formation of buds. The Henry Shaw Cactus Society, an enthusiastic crowd of cactophiles which meets at

the Garden on the second Sunday of each month, viewed the gorgeous blossoms on two separate nights. Some of the members had not previously seen these aristocrats of the Cactus family and were truly astounded by their beauty.

Euphorbia Tirucallii, the fish poison of the East Indies, was heavily pruned. As in past years, the massive specimens of *E. Hermentiana, E. similis, E. neutra* and others again produced an abundance of conspicuous yellow-green involucres along the upper stems. These cactus-like spurges are not as colorful as the herbaceous poinsettia and the scarlet plume *(E. fulgens)*, but the involucres crowded along the winged stems have a beauty of their own. A spurge destined to become better known economically is *E. lancifolia* of Mexico and Guatemala, a specimen of which is now thriving in the Cactus House.

In the Exotic Range *Clerodendron fallax* and *Ixora coccinea* put on one of their finest displays and remained in bloom for many months. No doubt this was due to the application of manure in large quantity. The dwarf *Strelitzia Reginae* (Bird-of-Paradise) and *Plumeria acutifolia* likewise responded to this treatment. Work on the bromel collection has been steadily maintained, and Mulford B. Foster, outstanding collector of Orlando, Florida, has contributed about 50 species, some of them not to be found anywhere else outside his own private collection. At the present the Garden has over 120 species and varieties in the Bromeliaceae, distributed in 27 genera. The work of recording in word and picture each species as it comes into bloom has progressed satisfactorily. About half of the species in our collection have been accounted for through the efforts of Mr. Ladislaus Cutak, who is in charge of the entire range.

EXPERIMENTAL GREENHOUSES

The research work on the growth of orchid plants, under the direction of Dr. D. C. Fairburn, Horticulturist to the Garden, has progressed steadily during the past year, and is now one of the most important projects under way. Thousands of hybrid seedlings of carefully selected parentage are being raised by various methods, and now occupy half the bench area in the Experimental Greenhouses. Some of the investigations in progress are:

Growing orchid plants by gravel culture methods.—Instead of being potted in the usual orchid peat or Osmunda fiber, some 3000 seedlings, in two 50-foot benches, are now being raised by this nutrient culture method. Experiments during the past four years have yielded very favorable results, a summary of which will appear later in the Garden BULLETIN.

Supplementary feeding with nutrient solutions.—This is to improve the growth of seedlings potted in orchid peat.

Transplanting seedlings directly into gravel cultures.—This method has eliminated a lot of tedious work formerly involved in the use of small community pots of orchid peat, and has reduced the time element to less than one-half. Also, subsequent transplanting operations are readily accomplished with little or no setback to the young plants.

Correlation work.—Size of seedlings are correlated with quality, quantity, and earliness of bloom.

Effect of electric light at night on the growth of seedlings.—Results from tests made last winter were encouraging.

Effect of sunlight.—The optimum amount of sunlight for the growth of orchid plants in Missouri is being determined.

Increased concentration of carbon dioxide in the air.—Although this increase did stimulate the growth of orchid seedlings, the possibility of using the gas on a large scale in orchid greenhouses seems rather remote, considering its present cost.

Effect of various nutrient culture media.—Germination of orchid seed and the growth of seedlings in the flasks have, in all cases, been far superior when symbiotic cultures were used than by sterile culture methods.

New installations in the orchid laboratory include: wood and iron rod stagings on the two center benches; another 50-foot bench equipped for nutrient culture studies; insulation of side ventilators and west end of orchid house with Vitapane to prevent cold drafts on the plants; building wooden supports with wire and string attachments to hold plants firmly in upright position in the gravel cultures.

Considerable time and greenhouse space have been devoted to the propagation of various house and garden plants, many of which will be used for class work. Over 10,000 cuttings and innumerable seedlings were raised in the Experimental Greenhouses by members of the amateur garden class who later transplanted them to their own gardens. A large portion of the seedlings grown were vegetables for planting in backyard "Victory Gardens."

SUPERVISED INSTRUCTION FOR SCHOOL CHILDREN

While transportation difficulties have somewhat reduced the number of school children coming to the Garden in 1943, Miss Clara M. Heising, the special teacher provided in cooperation with the Board of Education, has conducted more than 6,000 pupils from elementary and high schools. Whenever possible the lessons were correlated with other subjects in the curriculum, giving pupils a clear idea of the flora of regions studied and a better understanding of the home life and problems of the people of those areas. Many teachers further correlated the Garden trip with activities in classrooms. Wherever possible plant material was given to classes for project work,

affording opportunity to develop the pupil's initiative. Pupils came for general field trips, plant studies including adaptation of plants and their parts, pollination, inter-relations of plants with insects and birds, conservation, etc. Particular interest was manifested in the healing of tree wounds, grafts, climbing methods of certain plants, and many other botanical subjects.

During the spring and autumn classes coming from congested districts, after completing the Garden trip, went to Tower Grove Park to picnic before returning to their respective schools.

Special classes of students coming after school for general field trips included one from the central Y.M.C.A., the Progressive Mothers' Club, etc. Scout leaders with groups of Girl Scouts came for creative work in Nature study. Early morning bird walks were conducted from 7:30 to 8:30 every Thursday, weather permitting, during April and May, and September and October.

RESEARCH AND INSTRUCTION

Dr. J. M. Greenman, Curator of the Herbarium and Professor in the Henry Shaw School of Botany of Washington University, has continued to devote the major part of his time to exacting curatorial duties in the herbarium. He has also conducted the work of graduate students majoring in taxonomy of the higher plants. During the present college year there are two graduate students, Mr. Charles Heiser and Mr. Norlan Henderson, working under the direction of Dr. Greenman for the degree of Master of Science. It is noteworthy also that Dr. Greenman has continued to pursue research on various groups of flowering plants and to further monographic and floristic studies long under way.

Dr. C. W. Dodge, Mycologist to the Garden and Professor in the Henry Shaw School of Botany of Washington University, has given the usual courses of instruction. Dr. Carl Lindegren has continued to give the course in general bacteriology in University College. Enrollments have been higher than usual in all courses. Beside routine determinations of various lichens and human and plant pathogens, work has continued on the Antarctic collections of the Australian expeditions. The collections of the United States Antarctic Expedition (Third Byrd Expedition) have been received but have not yet been studied.

Miss Dorothy Gaebler, Assistant in Bacteriology in the Henry Shaw School of Botany of Washington University, besides supervising laboratory work in Bacteriology, has been engaged in the study of a serious parasite of coffee. Miss Julia Guzmán-Naranjo, a graduate of the Universidad Nacional de Bogotá, has enrolled in the School of Graduate Studies.

Dr. Edgar Anderson, Geneticist to the Garden and Engelmann Professor of Botany in the Henry Shaw School of Botany of Washington University, holder of a Guggenheim fellowship, has been on leave of absence since February. Engaged with others on an investigation of native American food sources, he has spent the major portion of the year in California and is now in Mexico.

Dr. Robert E. Woodson, Jr., Assistant Curator of the Herbarium and Associate Professor in the Henry Shaw School of Botany of Washington University, continued during the year his studies of American Asclepiadaceae. He has also collaborated with Dr. Robert W. Schery on the "Flora of Panama," two fascicles of which were published, embracing the Spermatophytes from Gymnospermae through Cyclanthaceae. In addition to his duties at the Garden, Dr. Woodson continued his botany classes at Washington University, as well as classes in geography given for the army pre-meteorology cadets stationed at the University.

Dr. Henry N. Andrews, Paleobotanist to the Missouri Botanical Garden and Assistant Professor of Botany in the Henry Shaw School of Botany, has completed a study of the anatomy of some petrified Cycad (Cycadeoidea) stems from a new locality in the Ferris Mountains of Wyoming. This investigation has thrown some light on a previously imperfectly known feature of the structure of the cone axis in this extinct genus of plants. It is hoped that future exploration in the Ferris Mountain region will add still more to our knowledge of the Cycads.

Fossil ferns from the coal mines of southern Illinois have been studied and described in the November issue of the ANNALS. These ferns include the genus Senftenbergia (Schizaeaceae) previously unreported from the western hemisphere as well as a new species of Scolecopteris (Marattiaceae). Field work on the coal-mine plants came to a rather abrupt halt last spring when the Federal Government issued an order prohibiting non-employees from the shaft mines. In the summer of 1942 about one half ton of fine petrified trunks of a Cretaceous fern, Tempskya (Schizaeaceae?) were collected in southern Idaho. Some work has been started with this material.

Due to the war-time reorganization of the University curricula and the heavy burden placed on certain departments by the numerous Army training programs a considerable portion of Dr. Andrews' time has been devoted to teaching mathematics to both civilians and Army engineers.

Dr. Robert W. Schery, Research Assistant to the Garden and Instructor in the Henry Shaw School of Botany of Washington University, was called by the Rubber Development Corporation late in January to assist in the government's emergency program for strategic war materials. He is now in charge of rubber expansion in the State of Bahia, Brazil, the center of

production of wild Mangabeira and Manicoba latex. In spite of his arduous duties for the Rubber Development Corporation, Dr. Schery has continued collaboration with Dr. Woodson in preparation for the "Flora of Panama," and has been able to send to the Garden several hundred herbarium specimens of Brazilian plants collected during his travels in the interior.

Dr. Carl C. Lindegren, Research Associate, Gertrude Lindegren, Research Fellow, and Mrs. Amy Pabor, Research Assistant, in the Henry Shaw School of Botany of Washington University, have been engaged in an intensive study of the genetics of *Saccharomyces cerevisiae*. Analyses of numerous pedigrees in this species have led to a revaluation of the taxonomy of the Saccharomycetaceae, the conclusion being that Torulopsis and Zygosaccharomyces are variants of Saccharomyces. A new method of hybridizing Saccharomyces has been developed in which haploid cultures arising from single ascospores are simply mixed in test-tubes. This eliminates the difficulty of pairing individual ascospores with a micromanipulator. This work has had the support of Anheuser-Busch, Inc., St. Louis.

Dr. Lindegren, by action of the Board of Directors of Washington University, was appointed Research Professor in the Henry Shaw School of Botany, effective December 1, 1943.

Degrees.—No advanced degrees were awarded in the Henry Shaw School of Botany in 1943.

Graduates and Fellows: The following appointments were made in the Henry Shaw School of Botany for the year 1943-1944:

Graduate Assistants (half-time graduate students): Dorothy Marie Gaebler, A.B., Washington University (Mycology).

University Fellow: Charles Bixler Heiser, Jr., A.B., Washington University (Taxonomy).

Institute of International Education Fellow and University Scholar: Julia Guzmán-Naranjo, A.B., Universidad Nacional de Bogotá, Colombia, S. A. (Mycology).

Independent Student: Norlan Henderson, A.B., Asbury College (Taxonomy).

Published Articles.—

Allen, Paul A.: The Giant Herb. Mo. Bot. Gard. Bull. 31:158-160.

Anderson, Edgar: The Seeds of *Tradescantia micrantha*. Ann. Mo. Bot. Gard. 30:69; Some Indian Uses of Corn. Bull. Garden Club Amer. 16 (8th series):18-19; Two Fragrant Herbs. Mo. Bot. Gard. Bull. 31:73-75; Two Varieties of *Rosa alba*. Amer. Rose Annual 1943:12-14; A Variety of Maize from the Rio Loa. Ann. Mo. Bot. Gard. 30:469-476; Vegetable Gardening in St. Louis. Mo. Bot. Gard. Bull. 31:33-44; with R. H. Barlow: The Maize Tribute of Moctezuma's Empire. Ann. Mo. Bot. Gard. 30:413-419; The

Tlacopintli. Tlalocan 1:159-160; with Frederick D. Blanchard: Prehistoric Maize from Cañon del Muerto. Amer. Jour. Bot. 29:832-834; with Isabel Kelly: Sweet Corn in Jalisco. Ann. Mo. Bot. Gard. 30:405-412.

Andrews, Henry N.: Contributions to Our Knowledge of American Carboniferous Floras. VI. Certain Filicinean Fructifications. Ann. Mo. Bot. Gard. 30:429-442; Notes on the Genus Tempskya. Amer. Midl. Nat. 29:133-136; On the Vascular Anatomy of the Cycadeoid Cone Axis. Ann. Mo. Bot. Gard. 30:421-427; with L. Wayne Lenz: A Mycorrhizome from the Carboniferous of Illinois. Bull. Torr. Bot. Club 70:120-125.

Beilmann, August P.: The Arboretum and the Sawmill. Mo. Bot. Gard. Bull. 31:108-117; The Arboretum Wolf Pack. Mo. Bot. Gard. Bull. 31:191-196; New or Noteworthy Plants for St. Louis. XV. *Prinsepia sinensis*. Mo. Bot. Gard. Bull. 31:160-161; Removing Some of the Bunk from Soil Analysis. Mo. Bot. Gard. Bull. 31:180-183; Some Hourly Observations of Tree Growth. Ann. Mo. Bot. Gard. 30:443-451; A White Oak over 300 Years Old. Mo. Bot. Gard. Bull. 31:147-149.

Cutak, Ladislaus: The Christmas Cactus and Its Culture. Mo. Bot. Gard. Bull. 31:187-191; *Coryphantha ramillosa*, a New Species from the Big Bend Region of Texas. Jour. Cactus & Succulent Soc. Amer. 14:163-164; Desert Plants in Winter Houses. Home Garden 2^6:39-40; The Life-saving Barrel Cactus—Myth or Fact? Mo. Bot. Gard. Bull. 31:153-158; Two Excellent Echeverias for the Home. Mo. Bot. Gard. Bull. 31:71-73; Two New Desert Shrubs for Midwest Gardens. Mo. Bot. Gard. Bull. 31:119-123, (Reprinted in Southern Florist 55:3-4, 31); Two Plants Associated with Holy Week. Mo. Bot. Gard. Bull. 31:106-108.

Erickson, Ralph O.: Population Size and Geographical Distribution of *Clematis Fremontii* var. *Riehlii*. Ann. Mo. Bot. Gard. 30:63-68; Taxonomy of Clematis section Viorna. Ann. Mo. Bot. Gard. 30:1-62.

Fairburn, David C.: Counter-attacks on Indoor Plant Pests. Home Garden 2^5:68-70; Garden Soils and Fertilizers. Mo. Bot. Gard. Bull. 31:79-102; House Plants Evaluated by Amateur Gardeners. Mo. Bot. Gard. Bull. 31:68-71; Outdoor Annuals for Indoor Bloom. Home Garden 2^3:20-21; Raising Nepenthes from Seed. Mo. Bot. Gard. Bull. 31:174-180.

Kohl, Paul A.: Vegetables and Their Varieties. Mo. Bot. Gard. Bull. 31:45-57; Vegetables Replace Flowers in Ornamental Planting. Mo. Bot. Gard. Bull. 31:57-59.

Lenz, L. Wayne, with Henry N. Andrews: A Mycorrhizome from the Carboniferous of Illinois. Bull. Torr. Bot. Club 70:120-125.

Lindegren, Carl C. and Gertrude: Environmental and Genetical Variations in Yield and Colony Size of Commercial Yeasts. Ann. Mo. Bot. Gard.

30:71-82; Segregation, Mutation, and Copulation in *Saccharomyces cerevisiae*. Ann. Mo. Bot. Gard. 30:453-468.

Moore, George T.: Orchids at the Missouri Botanical Garden. Amer. Orchid Soc. Bull. 12:191-197 (Reprinted from Mo. Bot. Gard. Bull. 30:31-52); Where is the Largest Ginkgo Tree in the United States? Mo. Bot. Gard. Bull. 31:105-106.

Pring, George H.: Chenille Plant or Red-Hot Cat-tail. Mo. Bot. Gard. Bull. 31:75-76; *Columnea gloriosa*. Mo. Bot. Gard. Bull. 31:129-130; The Five-fingered Swan-neck Orchid. *(Cycnoches pentadactylon)* Amer. Orchid Soc. Bull. 11:411-412 (Reprinted from Mo. Bot. Gard. Bull. 30:183-186); Golden-leaved Tapioca *(Manihot utilissima* var. *variegata)*. Mo. Bot. Gard. Bull. 31:145-147; Hybrid Forms of *Phragmopedilum grande*. Mo. Bot. Gard. Bull. 31:63-68; Nepenthes (Pitcher-plants). Mo. Bot. Gard. Bull. 31:169-174; The Octopus Flower from New Guinea *(Bulbophyllum virescens)*. Mo. Bot. Gard. Bull. 31:126-129; The Parachute Seed-Pod of Aristolochia. Mo. Bot. Gard. Bull. 31:123-125; *Renanthera Storiei*. Mo. Bot. Gard. Bull. 31:125-126; Showy Purple-striped Dendrobe *(Dendrobium Sanderae)*. Mo. Bot. Gard. Bull. 31:128; Tropical Water-lilies. American Eagle. August 3 (Reprinted from Mo. Bot. Gard. Bull. March, 1941); The Velvet-leaved Gloxinia. Mo. Bot. Gard. Bull. 31:161-162; Wild Ginger as a Ground Cover. Mo. Bot. Gard. Bull. 31:163-164; with Helen Van Pelt Wilson: Day- and Night-blooming Water-lilies. Home Garden 1^{5}:31-33; How to Propagate Tropical Water-lilies. Home Garden 2^{5}:71-73; The Summer Care of the Garden Pool. Home Garden 1^{6}:4.

Schery, Robert W., with Robert E. Woodson, Jr.: Contributions toward a Flora of Panama. VII. Miscellaneous Collections, chiefly by H. von Wedel in Bocas del Toro. Ann. Mo. Bot. Gard. 30:83-96; Flora of Panama. Part II, Fascicle 1. Ann. Mo. Bot. Gard. 30:97-280, Fascicle 2, Ann. Mo. Bot. Gard. 30:281-403.

Woodson, Robert E., Jr.: A New Amsonia from the Ozarks of Missouri. Rhodora 45:328-329; Behind the Scenes of a "Flora of Panama." Amer. Jour. Bot. 29:20s. 1942. (Abstract); with Robert W. Schery: Contributions toward a Flora of Panama. VII. Miscellaneous Collections chiefly by H. von Wedel in Bocas del Toro. Ann. Mo. Bot. Gard. 30:83-96; Flora of Panama. Part II, Fascicle 1. Ann. Mo. Bot. Gard. 30:97-280, Fascicle 2. Ann. Mo. Bot. Gard. 30:281-403.

Scientific and Popular Lectures.—

Dr. Edgar Anderson, Geneticist to the Garden: January 19, before the Garden Club of St. Louis, "Vegetable Gardening in St. Louis"; March 2, before the genetics staff seminar of the University of California, Berkeley,

"Problems in the Genetic Differentiation of Maize"; March 6, before the Biosystematists at the University of California Faculty Club, "Genetic Patterns of Speciation"; June 21, before the genetics seminar of Leland Stanford University, Palo Alto, "What is *Zea Mays?*"; August 24, before the biology seminar of the California Institute of Technology, Pasadena, "The Races of *Zea Mays*"; September 13, before the Anaximandrian Society of the California Institute of Technology, "The History of *Robinia Pseudacacia.*"

Mr. August P. Beilmann, Manager of the Arboretum: October 11, before the Chevy Chase Garden Club, "Trees."

Mr. Ladislaus Cutak, in charge of Succulents at the Garden: February 7, before the Henry Shaw Cactus Society, "The Art of Grafting Cacti"; February 16, before the Poplar Bluff Garden Club, Poplar Bluff, Mo., "A Cactus Hunt in Old Mexico"; February 25, before the Spectrum Camera Club, "Adventures in Cactus-Land"; March 9, before the Nazareth Brotherhood of the Nazareth Evangelical Church, and May 5, before the Mother of Perpetual Help Auxiliary of St. John Nepomuk Church, "A Cactus Hunt in Old Mexico"; May 9, before the Henry Shaw Cactus Society, "Growing Succulents from Seeds"; October 12, before the Young Adult group of the Shaw Avenue Methodist Church, "Plant Hunting in Old Mexico"; November 4, before the Maplewood Garden Club, "Cacti and Succulents"; November 5, before the Missouri chapter of the St. Pius branch of the Holy Name Society, "Wonders of the Cactus World"; December 12, before the Henry Shaw Cactus Society, "Gardens of Florida."

Dr. Carroll W. Dodge, Mycologist to the Garden: February 1, before the Monday Club of Webster Groves, "Understanding Central American Problems"; February 5, before the St. Louis Horticultural Society, "Central American Gardens"; February 25, before the Tau Pi Epsilon Fraternity, "Interesting Skin Diseases in Guatemala"; April 2, before the geology section of the St. Louis Academy of Science, "The Geology of Guatemala in Relation to Current Problems"; April 19, before the Practical Arts Club of College Women, "Obstacles to the Realization of Our Good Neighbor Policy in Central America"; November 24, before the Institute of Middle America, "The Contemporary Culture Pattern."

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

Mr. Paul A. Kohl, Floriculturist to the Garden: February 4, before the Garden Appreciation Club of University City, "Four Seasons in the Missouri Botanical Garden"; February 22, before the Little Gardens Club of University City, "The Victory Garden"; March 5, before the St. Louis Horti-

cultural Society, "Victory Gardens and Their Planning"; March 16, before the St. Louis Garden Club, moving-pictures of the "Missouri Botanical Garden"; "Victory Gardens:" March 27 and April 3, before the Senior Girl Scouts, March 28, over Station KWK, March 31, O. C. D. Block Workers at Beaumont High School, April 1, O. C. D. Block Workers at Carr Square Auditorium, and April 7, before the Neighborhood Gardens; May 11, before the Bel-Nor-Bellerive Civilian Defense Organization, "Four Seasons at the Missouri Botanical Garden"; September 27, before the Ladue War Garden School, "Varieties of Vegetables Grown at the Missouri Botanical Garden"; October 5, before the St. Louis Hills Garden Club, "Dividends from the Vegetable Garden."

Dr. Carl C. Lindegren, Research Associate, Henry Shaw School of Botany: April 8, Academy of Science of St. Louis, "The Improvements of Industrial Yeasts by Breeding."

Dr. George T. Moore, Director of the Garden: March 5, before the Clotho Club, "Victory Gardens, Pro and Con"; March 16, before the St. Louis Garden Club, "Science in the Garden"; March 25, before the Marguerite Krueger Conservation Club, "Henry Shaw and His Garden"; November 19, before Town and Gown, "Botany in the War."

Mr. George H. Pring, Superintendent of the Garden: February 8, before the Pi Beta Phi Mothers' Club of Washington University, "The Romance of the Orchid"; "Victory Gardens": March 2, before the Maplewood Rotary Club, March 22, before the Air Raid Wardens of Zone 2, March 29, O. C. D. Block Workers at Southwest High School, and March 31, O. C. D. Block Workers at St. Roch's Church; April 30, before the Springfield Nature League, Springfield, Ill., "Four Seasons at the Missouri Botanical Garden"; May 25, before the MacArthur High Twelve Club, and August 3, before the Kiwanis Club of Alton, Ill., "Tapping the Para Tree"; October 14, before the Brentwood Garden Club, "Landscaping the Small Lot."

Dr. Robert W. Schery, Research Assistant to the Garden: August 31, before members of the Garden staff, "The Brazilian Rubber Country."

THE HERBARIUM

The herbarium has completed another highly satisfactory year. The new accessions acquired during the year 1943 have been mostly from the western hemisphere, but a few collections have come in from Oceania, notably the Hawaiian Islands and the Fiji Islands.

The larger and more significant collections obtained are as follows:

New Accessions.—Paul Allen, 22 plants of Panama; E. Anderson, 25 plants mostly from horticulture selected for special interest; Arnold Arbo-

retum of Harvard University, 690 plants from the Fiji Islands; L. H. Bailey, 13 plants from Panama; C. R. Ball, 13 United States willows; A. A. Beetle, 55 grasses and sedges mostly from California; A. J. Breitung, 59 plants from Saskatchewan; W. B. Cooke, "Mycobiota of North America," Fasc. V, Nos. 116-150; G. D. Darker, 93 fungi; R. Darrow, 29 fungi of Arizona; O. Degener, 1100 plants from western United States and Hawaii; D. Demaree, 1745 plants mainly from Arkansas; De Pauw University by T. G. Yuncker, 190 plants of Indiana; Charles M. Ek, 612 plants of Indiana; Field Museum of Natural History, 137 plants of Guatemala and 146 algae, fungi, lichens, and mosses; Forest Service, U. S. Department of Agriculture, 22 plants of Panama; Gray Herbarium of Harvard University, "Plantae Exsiccatae Grayanae" Cent. XIII, and 718 plants of North America, Central and South America; R. M. Harper, 87 plants of Alabama; F. J. Hermann, 40 plants of Maryland; Leslie Hubricht, 100 plants of New York, Virginia, and Arkansas; Leslie James, 29 plants of Alabama; Henry Krueger and Paul Gillespie, 50 plants of Mexico; B. A. Krukoff, 701 plants of Brazil, collected by A. Ducke; Langlois Herbarium, 52 plants of Arctic North America; C. L. Lundell, 126 plants of British Honduras; Rogers McVaugh, 33 plants of Delaware and Virginia; Harold N. Moldenke, 75 plants of Ohio and western United States; Margaret Murley, 150 plants of Idaho; New York Botanical Garden, 1697 plants of China, India, Hawaii and the United States; New York State Museum, 300 plants of New York; Philadelphia Academy of Natural Sciences, 156 plants of Pennsylvania; Bernardo Rosengurtt, 106 plants of Uruguay; Mrs. H. T. Rogers, 268 plants of Montana; Paul O. Schallert, 291 plants of Arizona; Robert W. Schery, 66 plants of Brazil; State College of Washington, 500 plants of the "Pacific Northwest"; State Teachers College, River Falls, Wisconsin, 86 plants of Wisconsin; H. B. Parks, Texas Agricultural College, 670 plants of Texas; B. C. Tharp, 960 plants of Mexico, collected by H. LeSueur; W. L. Tolstead, 311 plants of Texas; U. S. National Museum, 359 plants of the United States Antarctic Expedition of 1940-41, and 279 plants mostly from Virginia; University of Illinois, 678 plants of Illinois; University of Michigan, 63 plants of Texas; University of Minnesota, 172 plants of Minnesota; University of Tennessee, 400 plants mostly from Tennessee and Wyoming; University of Texas, 3007 plants of Texas; University of Washington, 77 plants of California and Mexico; H. von Wedel, 356 plants of Panama; U. I. Waterfall, 657 plants of western Texas; H. H. Whetzel, 105 fungi of Wyoming and Bermuda; Eula Whitehouse, 29 plants of Texas; I. L. Wiggins and R. C. Rollins, 418 plants of Sonora, Mexico; R. E. Woodson, Jr., 25 plants of Panama; R. E. Woodson, Jr. and R. W. Schery, 99 plants of Panama.

Many smaller accessions have been received during the year; these have

been recorded in the current monthly issues of the BULLETIN. The above condensed record, however, gives a clear indication of those parts of America from which the largest amount of new material has been received. Thus, it will be seen that western and southwestern United States, Mexico, Panama, Brazil, and Uruguay are those particular regions of America whose flora has been most substantially augmented during 1943.

Mounting and Insertion of Specimens.—The mounting of herbarium specimens has continued throughout the year. This important work was carried forward through the first half year by Mrs. Nettie A. Bauer and Miss Violet Bauer. In early summer, however, when Dr. E. C. Berry resigned his Garden appointment to accept a teaching position at one of the United States Government institutions located in St. Louis, it became necessary to transfer Mrs. Bauer from mounter to general assistant in the herbarium. The relatively large amount of accumulated new material had to be taken care of; hence, its insertion was made during the summer by the Curator assisted by Mrs. Bauer.

As stated in the report for 1942, "already the herbarium is becoming unduly congested in places, so that it has become necessary to put certain groups of plants, namely, ferns, conifers, and grasses in temporary storage." It will be necessary to continue and to extend this policy until present unfortunate conditions incident to the war are removed.

Exchanges.—It is gratifying to record that a relatively large number of specimens has been acquired this year on the basis of exchange. The total number amounts to 12,142 specimens.

Field work.—On account of many routine duties in the herbarium it has been impossible for the Curator to carry on very much field work. However, a certain amount of field work has been done by special collectors, working under the auspices of the Garden, and by the staff personnel.

Use of the Herbarium.—The herbarium, like a large reference library, has been in constant use by members of the staff, graduate students, and visiting botanists in somewhat larger numbers than in 1942. The requests for loans of material for critical study have also increased many times over any previous year. These requests in most cases have been granted and have resulted in the satisfaction of both parties concerned.

Groups of Plants under Special Investigation and Floristic Studies.—Various groups of plants in the herbarium have received special study during at least a part of the year. Among these groups are the lichens by Dr. C. W. Dodge and Dr. E. C. Berry; *Psilostrophe* by Charles B. Heiser, Jr.; *Tetracarpum* by Norlan Henderson; Compositae and other special groups by J. M. Greenman; Apocynaceae and Asclepiadaceae by Dr. R. E. Woodson,

Jr. Intensive studies of the Panamanian Flora have been continued by Dr. R. E. Woodson, Jr. and Dr. R. W. Schery.

Statistical Summary (for the year ending December 31, 1943):

Number of specimens received during 1943:		
By purchase	2,517	
By gift	3,291	
By exchange	12,142	
By transfer	7	
By field work	480	
Total	18,437	
Number of specimens mounted and incorporated in 1943		18,536
Number of specimens carried forward from 1942		1,377,810
Total		1,396,346
Number of specimens discarded during 1943		84
Total number of specimens in herbarium		1,396,262

LIBRARY AND PUBLICATIONS

The usual routine work of the library has continued during the year, but naturally with fewer books received than before the war. However, contrary to what one might expect, there has been no lull in the use of the library. Not only is the library consulted by the students and faculty in the Henry Shaw School of Botany, but a glance at the list of visitors shows that it is recognized by those prosecuting the war, about one out of three outside users being either members of the Armed Forces or from some industrial firm investigating a technical problem either directly or indirectly connected with the war. In the spring, too, the Garden is looked upon as a mine of information for vegetable gardeners. So insistent was the appeal for help that all recent vegetable-gardening literature was assembled on a long table in the library folio room, and visitors were permitted to browse there as long as they wished. Most of the gardeners, however, were satisfied with the February and April Garden BULLETINS, in which gardening under local conditions was discussed.

Keeping the rare old leather-bound books in condition is a never-ceasing task at the Garden. Many of them do not deteriorate from use but from age, dry atmosphere, or because of their bulk. It would be very desirable to have special cases made whereby the large books could lie on their sides and be rolled out for inspection. However, such cases would not only be very expensive but would not be procurable during wartime. The only alternative is to be on the constant alert to catch the weak places in binding and to oil the leather bindings at least every other year to keep them from becoming brittle. The Garden has been fortunate in locating a skilled

European book-binder who calls for the books and repairs them at his home. With the sale of 49 duplicate books, funds were provided which enabled us to have an unusual amount of books reconditioned.

A weakness in the Garden library has always been the fact that many of our valuable serials were not indexed. With the pressure of routine work, cataloguing of articles in old serials cannot be accomplished on a large scale, but a point is now being made to catalogue the important papers as they come to our attention. Thus, while the number of works catalogued in 1943 is probably less than a few years ago, there has been more cross-referencing done.

The library is cooperating with the Library of Congress in a survey of the foreign periodicals being received since 1939. During the year publications were received from northern Africa, South Africa, Switzerland, France, Portugal, and Russia, in addition to those from the British dominions, South America, etc. Certain institutions, however, are holding their publications until after the war, and all our foreign subscriptions since 1941 are still being held for us by our European agent.

Publications.—Volume XXX of the quarterly ANNALS and Volume XXXI of the monthly BULLETIN were issued during the year. The volume of the ANNALS consists of 481 pages, 18 plates and 96 text-figures, and is noteworthy in that the first two installments of the "Flora of Panama" by Woodson and Schery are contained in the April and September numbers. Other important contributions were Erickson's researches on Clematis, two papers on yeasts by Carl and Gertrude Lindegren, three papers by Anderson and his co-workers on Mexican Maize, and further contributions on paleobotany by Andrews.

The volume of the BULLETIN contains 207 pages, 22 plates and 45 text-figures. The February number was devoted to vegetable gardening, and the April number to soils and fertilizers. Both were written with the average amateur gardener in mind, and judging from the demand for these bulletins they seemed to have fulfilled a long-felt want. They were sold by the hundred to Victory gardeners, vegetable-gardening classes, department stores, etc.

In order that Steyermark's "Spring Flora of Missouri" might be more widely distributed to wild-flower lovers, the price was reduced this year from $3 to $1.50 a copy, with a special price of $1 to clubs and dealers who purchase ten copies. The result was that nearly three times as many copies were sold as in 1942. On the other hand, the ANNALS price will be raised from $6 to $10 a volume, beginning with 1944. This new price was decided on as being more in keeping with a journal of the ANNALS size and standard.

The annual receipts for ANNALS, BULLETINS, "Spring Floras," post-cards, etc., was $2,714.59.

Contrary to the usual custom of mailing out ANNALS reprints in August, this year they were sent only to botanists and institutions especially requesting them or who had recently sent us reprints in exchange.

Visitors.—Besides the faculty and students of the Henry Shaw School of Botany, the following out-of-town visitors made use of the library during the year: Lt. Stanley Bettoney, of Camp Howze, Texas; Dr. William J. Bonisteel, Director expedition to Mexico sponsored by the Board of Economic Warfare to investigate drug plants; Corp. Louis G. Brenner, of the Topographical Engineers Battalion, Portland, Oregon; Rev. Robert R. Brinker, O.F.M., Instructor in Biology, Quincy College, Quincy, Ill.; Dr. John T. Buchholz, Professor of Botany, University of Illinois, Urbana; Dr. Alexander F. Bucholtz, Bacteriologist, Pabst Brewing Co., Peoria, Ill.; Miss Madelaine Chalette, of the Interstate Department Store, New York; Dr. K. Starr Chester, Head Dept. Botany and Plant Pathology, Oklahoma Agricultural and Mechanical College, Stillwater; Mr. F. D. Clark, Supervisor of Parks, Toronto, Canada; Lt. Robert B. Clark, of the Army Air Forces, Scott Field, Ill.; Dr. Marion L. Dawson, Professor of Botany, Lindenwood College, St. Charles, Mo.; Dr. Delzie Demaree, Chairman Natural Science and Mathematics, Arkansas Agricultural and Mechanical College, Monticello; Lt. Ralph W. Emons, of the Station Hospital, Greenville, Texas; Mr. Ralph O. Erickson, Chemist, Western Cartridge Co., Alton, Ill.; Mr. Mulford B. Foster, orchid grower, Orlando, Florida; Mr. Charles Gilly, Botanist expedition to Mexico sponsored by the Board of Economic Warfare to investigate drug plants; Dr. Laurentz Green, Professor of Botany, Purdue University, Lafayette, Ind.; Sgt. Willard L. Hagen, of the Army Air Forces, Herrington, Kansas; Dr. George B. Happ, Assistant Professor of Biology, Principia College, Elsah, Ill.; Mr. Norlan C. Henderson, Teacher of Biology, Enfield High School, Enfield, Ill.; Mr. Halldor Jonsson, graduate of the School of Horticulture, Reykjavik, Iceland; Dr. T. H. Kearney, Principal Physiologist, Bureau of Plant Industry, U. S. Dept. Agr., Washington, D. C.; Lt. Hubert C. Keith, of the Army Air Forces; Dr. Boris A. Krukoff, Honorary Curator of Economic Botany, New York Botanical Garden, Bronx Park; Dr. Mary Maxine Larisey, Assistant Professor of Biology, Judson College, Marion, Ala.; Ensign L. Wayne Lenz, of the U. S. Navy; Mrs. J. M. McClure, horticultural writer, of Washington, Mo.; Mr. Clint McDade, of Piedmont Nurseries, Signal Mountain, Tenn.; Pvt. Neil McGregor, of the Army Air Forces; Lt. Henry McQuade, of the Army Air Forces; Dr. T. D. Mallery, Senior Agronomist, Soils and Agricultural Engineering, Bur. Pl. Ind., U. S. Dept. Agr., now in Mexico; Dr. Mildred Mathias (Mrs. Gerald L. Hassler), of Altadena,

Calif.; Miss Antoinette Miele, Assistant in Botany, Cornell University, Ithaca, N. Y.; Sgt. (Dr.) Emery H. Moore, of the Medical Service, U. S. Army; Corp. Gerald B. Ownbey, of the U. S. Army; Dr. Marion Ownbey, Botanist on an expedition to Ecuador sponsored by the American Quinine Co.; Prof. Winslow Porter, Librarian, Southern College of Pharmacy, Atlanta, Ga.; Sr. Jeder T. Rezende, of the Divisão Fomento Vegetal, Ministerio da Agricultura, Rio de Janeiro, Brazil; Dr. H. W. Rickett, Bibliographer New York Botanical Garden, Bronx Park; Mr. C. R. Runyon, Superintendent of Spring Grove Cemetery, Cincinnati, Ohio; Miss Helen Schiefer, graduate student, Radcliffe College, Cambridge, Mass.; Dr. Henry Schmitz, Dean of the School of Forestry, University of Minnesota, St. Paul; Mr. Walter C. Scholl, orchid enthusiast, of Chicago, Ill.; Mr. Maunselle Van Rensselaer, Director Santa Barbara Botanic Garden, Santa Barbara, Calif.; Capt. Richard Walker, of the U. S. Army; Helen Bramsch Walker, former graduate student in botany, University of California, Berkeley; Dr. Frederick L. Wellman, Senior Agriculturist and Assistant Director, Cooperative Agricultural Experiment Station, San Salvador, El Salvador; Misses Eugenia and Peggy White, plant collectors, of Panama, C. Z.; Dr. M. G. Yatsevitch, Director of Research, Ordnance Dept., U. S. Army.

The following groups visited the library during the year: botany students from Southern State Normal College, under the guidance of Dr. William M. Bailey, Professor of Botany, and Dr. Walter B. Welch, Assistant Professor of Botany; botany students of the Moberly Junior High School, accompanied by Miss Esther Adams, Instructor of Biology; the Edgar Anderson Chapter of the Junior Academy of Science of the Southwest High School, accompanied by Mr. C. H. Sackett, Superintendent, and Miss Lilian Nagel, Teacher of Biology; the members of the Greater St. Louis chapter of the Special Libraries Association; the members of the Rover Club, an organization of Washington University faculty wives; science students of the Cote Brilliante School, under the leadership of their teacher, Mr. L. F. Pinkus; gardening class of School of Occupational Therapy, in a study of drug plants.

New Accessions.—Although few foreign book catalogues other than English ones are now being received, these have been listing valuable works on botany and gardening. The most interesting purchase of the year was probably the "Cruydeboeck" by Rembert Dodoens, a very beautiful woodcut herbal printed at Antwerp in 1563. Dodens was a court physician, and it was his interest in medical botany that led him to write the "Cruydeboeck." The library already owned a copy of the 1644 edition, but only the first editions can be considered as Dodoens' original work. Three gifts worthy of mention are: the first edition of Pierre Pomet's "Compleat

History of Druggs," 1725, presented by Mr. John A. Veazey, of Merck & Co.; 21 volumes of the *American Pharmaceutical Association Proceedings*, the gift of the University of West Virginia; and Dr. C. W. Dodge's gift of Volumes 35–45 of the *Journal of Bacteriology*, which completes our set of this journal.

The books purchased during the year, while neither rare nor expensive, are timely and of importance to the research worker and gardener, ranging from works on plastics to "Plowman's Folly." A new edition of Webster's "New International Dictionary" was purchased, as well as a second edition of the "Union List of Serials." Other important accessions were the following: British Antarctic New Zealand Antarctic Research Expedition, under command of Sir Douglas Mawson, Reports. Vol. 2 (Geology), Parts 1–7; Boyson, The Falkland Island, with notes on natural history by Rupert Vallentin, 1924; Coker and Beers, The Boletaceae of North Carolina, 1943; Cram's Atlas. 63rd edition, 1943; Dictionnaire botanique et pharmaceutique . . . . 1768; Dodge, Gourd growers of the South Seas . . . . 1943; Erdtman, An introduction to pollen analysis . . . . 1943; Fairchild, Garden islands of the Great East . . . . 1943; Forbes and Hemsley, Eunumeration of all the plants known from China Proper, Formosa, Hainan, Corea, the Luchu Archipelago and the Island of Hongkong. 3 volumes. 1886–1905; Gisvold and Rogers, The chemistry of plant constituents. 1943; Hayes and Immer, Methods of plant breeding . . . . 1942; Henrici, Molds, Yeasts and Actinomycetes . . . . 1930; Hogg, A supplement to the practical treatise on the culture of florists' flowers . . . . 1833; Karling, The simple holocarpic biflagellate Phycomycetes . . . . 1942; Klages, Ecological crop geography . . . . 1942; Gordon, The Pinetum . . . . 1880, new edition; Markham, A memoir of the Lady Anna de Osorio, Countes of Chinchon and Vice-Queen of Peru (A.D. 1629–39) . . . . 1874; Record and Hall, Timbers of the New World . . . . 1943; Robbins, Craft and Raynor, Weed Control . . . . 1942; Roxburgh, Flora Indica; or, descriptions of Indian plants, reprinted literatim from Carey's edition of 1832; Royal horticultural society. Horticultural colour chart. vol. 2; Schaeffer, Botanica Expeditor. 3 vols., 1760; Schopfer, Pflanzen und Vitamine; Thornton, The genera of exotic and indigenous plants that are to be met with in great Britain . . . . [1798–1808]; Schuchert, Stratigraphy of eastern and central United States . . . . 1943; Smith, An introduction to industrial mycology. 2nd edition, 1942; Van Dersal, The American land, its history and its uses . . . . 1943; Wulff, An introduction to historical plant geography. 1943; Youngken, Textbook of pharmacognosy. 5th edition. 1943.

Statistical Information.—There have been donated to the library or

received in exchange during the year 300 books valued at $729.13 and 1948 pamphlets valued at $396.29. One hundred and fifty-four books were bought at a cost of $870.29, and 64 pamphlets at a cost of $76.81. One hundred and seventy-five seed catalogues were accessioned. The library now contains 55,470 books and 91,126 pamphlets. With the donation of one manuscript in 1943 there are now 352 manuscripts valued at $1,719.70. The number of index cards now totals 1,091,949, of which 6,792 were added during the year, 926 having been written by Garden employees and 5,866 purchased at a cost of $125.25. One hundred and twenty-two books were bound, and 70 were rebound or repaired.

ANNUAL BEQUESTS

The annual flower sermon "On the Goodness of God as shown in the growth of flowers, fruits and other products of the vegetable Kingdom," provided for in the will of Henry Shaw, was preached on May 16, by Dr. Walter H. Judd, Congressman from Minnesota, at Christ Church Cathedral.

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

ATTENDANCE FOR 1943

(Not including visitors to Arboretum)

	Week-days	*Sundays*
January	2,989	4,129
February	5,615	7,810
March	4,139	6,306
April	8,261	10,402
May	9,722	16,646
June	8,428	6,268
July	10,560	6,630
August	10,551	8,570
September	7,961	7,919
October	8,428	12,395
November	11,715	18,274
December	3,456	4,863
Total	91,825	110,212
Total		202,037

GEORGE T. MOORE,
Director.

STATISTICAL INFORMATION FOR DECEMBER, 1943

GARDEN ATTENDANCE:	
Total number of visitors	8,139
PLANT ACCESSIONS:	
Total number of plants received as gifts	11
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	12
Total number of books and pamphlets donated	45
HERBARIUM ACCESSIONS:	
By Gift—	
Greenman, J. M.—Plant from Horticulture	1
Harper, Roland M.—Plants of Alabama	87
Johnson, W. E.—Plant of Horticulture	1
Kohl, P. A.—Plant of Horticulture	1
Yamoda, Masachi—Plant of Horticulture	1
By Exchange—	
Rosengurth, Bernardo—Plants of Uruguay	25
Whetzel, H. H.—Plants of Bermuda	100
Total	216

STAFF
OF THE MISSOURI BOTANICAL GARDEN

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

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MISSOURI BOTANICAL GARDEN BULLETIN

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SOME FACTS ABOUT THE GARDEN

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

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

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

CINCHONA OFFICINALIS BLOOMING IN THE ECONOMIC HOUSE

Missouri Botanical Garden Bulletin

Vol. XXXII FEBRUARY, 1944 No. 2

QUININE OR MALARIA

In the Pacific malaria is more deadly than the Jap, and quinine is almost as important to our fighting forces as ammunition itself. Quinine was as generally available as aspirin until the beginning of this war, but now you can't go to the drug-store and buy it for that head cold. To-day all of our quinine is going to those who suffer from malaria, and its use is prohibited for anything else except certain heart ailments for which it is almost as indispensable as it is for malaria.

Malaria has a bad reputation. It is reported to kill more than any other disease, three to four million people a year, and statisticians also tell us that a third of the world's population suffer from it every year. We faced it before in the building of the Panama Canal and in our earlier wars, but it was nothing then compared to what we are up against to-day. Soldiers are returning home from malaria-infected areas with the disease. As many as 50 per cent of our men in the Southwest Pacific contracted it, and 85 per cent of our men on Bataan were malaria victims. We learned what happened when their quinine supply gave out. Even with treatment 5 per cent of our forces have malaria. Rear Admiral Ross T. MacIntire, the Navy's Surgeon-General, knew what he was talking about when he said, "It is a much more deadly enemy than any foe we may be called upon to face, and it continues to be our main problem . . ." Surgeon-General Parran, of the U. S. Public Health Service, voiced the same sentiments, when he said that no major military objectives would be possible in the tropics without quinine or the substitute, atabrine. Quinine is part of our war strategy, and to-day all our men in tropical areas carry it.

Malaria is caused by an animal parasite which kills the red blood corpuscles and is transmitted by the Anopheles mosquito. Inoculations and vaccines, such as protect against typhoid, yellow fever, and smallpox, have not as yet been developed for malaria. The chief methods of fighting it are the destruction of the breeding places of the mosquito and dosing the patient with quinine once the disease has gained a hold. Just how quinine inhibits

the growth of the parasites is still a mystery which is quite in keeping with the amazing history of the drug.

Quinine comes from the bark of the cinchona tree which is a native of the Andean countries of Bolivia, Peru, Ecuador, and Colombia. From the time the Spaniards conquered Peru, cinchona bark has played an important part in the history of the world. Men have fought, died, and gone insane over it. It has made the conquest of the tropics possible and saved millions of lives.

Its early history is hidden behind a maze of legends, superstitions, and inaccuracies. Whether the healing properties of the bark were known by the Incas before the coming of the Spaniards is unknown. One of the earliest accounts of the use of the bark is an Indian fable reported by one of the first explorers in South America. To ease his burning thirst, an Indian, sick with fever, was crawling toward a small lake in which had fallen several cinchona trees. Although the taste of the water was bitter the Indian drank and was cured, and thus was made known the febrifuge property of the fever tree. However, some of the other early explorers, including the famous Humboldt, say that the Indians would rather die from malaria than use the poisonous bark. Physicians in many parts of South America were forced to call the drug by some other name before administering it to the Indians.

From the time of the invasion of Peru in 1513 until a century later we do not hear of the bark. One reason for this is that if the Indians used the bark they probably kept the secret from the Spanish whom they bitterly hated. It is generally accepted that the Indians taught the secret of the fever tree to the Jesuits, who then got the credit for the discovery. Then, in 1630, the date generally given and celebrated as that of the first use of quinine by a European, the Corregidor of Loja, who was more or less of a governor, was cured by an infusion of cinchona, which was probably made by letting the bark stand in water for some time.

Two years before the Corregidor was cured the King of Spain had sent Don Luis Geronimo Fernandez de Cabrera, Bobadilla y Mendoza, fourth Count of Chinchon, to Peru as viceroy. In 1638 his wife was stricken with malaria, and after the failure of the royal physicians to cure her, the Corregidor of Loja sent her some cinchona bark which brought about her recovery. The Countess was so delighted with the bark that she ordered a supply sent to her which she took back to Europe, thereby introducing it to the continent. This is mostly legend. Recently some doubts have been thrown upon the whole story of the Countess' illness by the finding of the official diary of the Count. In the first place, the first wife of the Count,

who is supposed to have been the one treated, died in Spain, and it was his second wife who came to America. Furthermore, she seems to have been a very healthy woman. The Count did have malaria, but there is no record of his having used cinchona bark. Moreover, it was impossible for the Countess to have taken bark back to Europe because she died in Carthagena, Colombia, without ever returning. Whatever the truth may be, the legend about the Countess will probably live on.

To add to the confusion Linnaeus, the Swedish botanist, to whom the plant specimens were sent for naming, either on purpose or accidentally, left an "h" out when he named the plant *Cinchona,* in honor of the Countess.

After discovery of the healing powers a study of the trees themselves was made, which was accompanied by many misfortunes and hardships. This was first undertaken by La Condamine, who surprisingly enough was not a botanist but an astronomer. He went so far as to try to ship some of the living plants to Europe, but a huge wave washed the plants off the deck as the ship was off the coast of Brazil. Bad luck was also to pursue the next persons who were to try to send plants to Europe. There almost seemed to be an Indian curse on those who tried to take the fever trees from their native countries. Joseph de Jussieu, a French botanist, made large collections of dried plants of cinchona for fifteen years. Upon his decision to return to France he packed the precious plants, but the night before his departure a servant stole the entire collection, thinking that the packages contained money. The blow was too much for Jussieu, who returned to France completely deprived of his reason. Sometime later a species was named *Cinchona Josephiana* in his honor.

It wasn't until the middle of the next century that Weddell, whose name stands out for naming the trees and separating the false species from the true, sent seeds to France from which the first tree was grown outside of South America. Much had been learned about the fever trees by this time. The plants themselves are evergreen, ranging from low shrubby plants to large trees which bear a profusion of small flowers, much like our lilac, of many shades from deep rose to white. The seeds are papery and minute, and several thousand of them are required to weigh an ounce. The tree is not easily grown. Soil and temperature conditions must be exact, and it definitely does not grow in the steaming jungle but prefers the eastern slope of the Andes at rather high elevations where there is plenty of rain and cool nights without frost. The cinchonas are members of the madder family (Rubiaceae), to which the coffee tree and the gardenia belong. In fact, at one time the bark of the gardenia shrub was used in an effort to cure

the fevers. In our country, before the discovery of quinine, the bark of the dogwood had a similar usage.

In the middle of the seventeenth century there were many cases of malaria in Europe. The disease reached epidemic proportions in England where it was called ague. The word malaria came in later from the Italians who called the disease *mala aria* or *mal' aria* (*mal*, meaning bad, and *aria*, air), because they believed that the bad airs of the night were its cause. The Jesuit's or Countess' powder was introduced around 1640, but it was to be some time before it became the effective treatment that it is to-day.

Malaria was a much-dreaded disease in the seventeenth century, because few physicians knew what to do for it. That was when Robert Talbor or Tabor entered the scene. He seems to have been a quack in many ways but was very clever in putting the new Jesuit's powder to use. While he seemed to discredit its use, to throw other physicians off the trail and to disguise the bitter taste he added the powder to his preparation along with some other ingredients, such as wine. As he began to have success in case after case of malaria his fame spread, and his preparation became more in demand. In fact, he was so successful that he was attacked by the other physicians because he was not a member of the College of Physicians, and he was forced to appeal to the Royal Court for protection. Tabor came out of this with first-place honors, and the King gave him a title to boot. He became still more widely known when Louis XIV, who had been relieved of the intermittent fever by the use of the bark some years before, asked Tabor to come to France and try his skill on the Dauphin, who was ill with malaria. Tabor brought about the Dauphin's recovery, and Louis XIV paid him to publish his secret. This publication, which appeared after Tabor's death, revealed that he had been using the ground powder of the Peruvian bark.

The use of cinchona didn't spread at once for a number of reasons. It was such a good treatment that some physicians hesitated to prescribe it because their patients wouldn't need their services long. Others wouldn't use it simply for the reason that Jesuits had had a hand in it. Still others considered it a heathen drug because it was first used by the Indians of South America. Many medical practitioners thought that it didn't fit in with the ancient theories, and some found force of habit too strong to change. Most of them didn't know how to use it anyway.

In the year 1820 two French pharmacists, Pelletier and Caventou, isolated quinine from the cinchona bark, and three years later the first quinine factory in the United States was established in Philadelphia. It was to this factory that Dr. John Sappington of Arrow Rock, Missouri, sent his son to purchase a number of ounces of quinine, but—so the story goes—the son

became confused and ordered pounds instead of ounces. With so much quinine on hand Dr. Sappington made up large numbers of his now-famous Anti-Fever Pills. This was in the years following the War of 1812 when colonists in great numbers began to come into the new territory acquired by the Louisiana Purchase. For a time it appeared that malaria would wipe out the settlements of the colonists, and so it was that Dr. Sappington's Anti-Fever Pills made it possible to live in what has become such an important part of our country. Dr. Sappington didn't think so much of quinine at first, but let this be said to his credit, he didn't advocate bleeding to cure malaria, the popular treatment for nearly everything in earlier times. In common with Sir Robert Tabor, Sappington soon learned the proper use of quinine at a time when more educated physicians opposed or showed little interest in its use.

In the meantime, back in South America, the Spanish were assiduously continuing their search for the bark which was becoming a lucrative business. Indian bark collectors or *cascarilleros,* whose lives were full of dangers, would go into the forests in search of trees from which to strip the bark. As more and more quinine was needed the *cascarilleros* recklessly cut down the trees without replacing them. Sometime earlier the church had demanded that they plant five trees for every one destroyed, but the Spanish and Indians paid little heed. Government laws were enacted, but they were ineffective or not enforced. There was also a great deal of waste in stripping the bark, and as the trees grew scarce the collectors began to substitute worthless bark instead of looking for new sources. The bark had to be sorted before shipping, and one buyer after sorting out and storing the false bark had it insured as true cinchona. Then, very conveniently, the storage shed burned to the ground, and the buyer collected his insurance money.

The Dutch and the English became interested in trying to grow the fever trees in their colonies, although the difficulties to be overcome were tremendous. Other countries have since tried it without much success. There was even an attempt to grow it in California, and it has been cultivated with some success in Guatemala. The Dutch got the jump on the British and sent the botanist Hasskarl into the cinchona regions where he was successful in obtaining plants and seeds by disguising himself as a South American.

Clements Markham, who was later knighted, was sent by the British government a few years later to obtain plants for India, and it is largely to him that India owes the beginnings of her cinchona plantations. He went into Bolivia at a time when it was prohibited by law to take seeds or plants out of that country. In spite of this, the journey to obtain the seeds was

easy compared to getting them out. By chewing coca leaves as his Indians did, he forced his weary body through the rainy jungles and over the high, cold Andes. Pursued by jealous government officials and burdened with his precious plants, he found his way along unknown trails.

Once the Dutch and British had taken the seeds and plants to their colonies success was still far from won. In fact, the first attempts to raise the tree in India and Java were miserable failures. For one reason, there are nearly seventy species of Cinchona, and only a very few of these have bark with a high yield of quinine. Unfortunately, the British and Dutch had collected many species that were practically worthless.

An English merchant in South America, Charles Ledger, heard of these efforts to obtain the plants and decided that a little collecting of his own might prove profitable. He sent his Indian servant, Manuel, to collect seeds and had them shipped to his brother in London to sell to the British government. In this he was not successful, and finally, afraid the seeds would lose their germinating capacity, the brother sold part of them to the Dutch. Sometime later he sold the remainder to a British planter in India. It is safe to say that if Ledger's brother had not sold some of the seeds to the Dutch they would never have achieved the success they did. When old Manuel was sent once more to collect seeds he was thrown in jail, where he suffered miserably, and died a short time later from the treatment he had received.

It was seen at once that Ledger's seeds produced plants with an extraordinarily high yield of quinine, and as it was a new species it was given the name, *Cinchona Ledgeriana*. The Dutch were determined to succeed, for quinine was very important in their malaria-ridden colonies. By careful selection of the trees with the highest yield of quinine and bark and by grafting the Ledger plant onto a hardier species, they raised the yield of quinine from the original 2 per cent to as much as 18 per cent. They began to produce tremendous quantities of quinine, and as they put it on the market the price fell, forcing many of the English planters to turn to tea instead of quinine.

Dr. A. R. Van Linge, who until his retirement was head of the Nederlandsche Kininefabriek, at one time didn't know whether he should go to Java, so he talked it over with a young lady, and she said, "Yes, I think you could do very nicely in a bamboo house in the mountains of Java, with sixty dollars a month." He asked her if she would share the bamboo house, and she did. From such small beginnings the Dutch quinine industry prospered until it was producing nearly 95 per cent of the world's supply.

After the invasion of Holland the Dutch refused to sell quinine to the Axis powers. When Java fell and the plantations were burnt to prevent

the valuable trees falling into enemy hands, the prospect was alarming. Our government, however, had remembered the drug shortage of the last war, and in 1939 the Treasury Department started building a large stock-pile of quinine. Private interests were asked to contribute their supplies on hand, all to be used mainly for the armed services. But at the most we had only a two years' supply and early in 1942 the Reconstruction Finance Corporation announced that 500,000 ounces had been lost at sea. How could the annual consumption of 2,500,000 oz. at home be supplied, with many areas of the U. S. subject to outbreaks of malaria? Part of the answer was to go back to South America. Only Bolivia had kept alive any semblance of a cinchona industry, and South America had been producing very little of the world's supply, far too little for our needs. Fortunately, one private American company had started their own plantations in Guatemala some years back, and these trees were producing some quinine. The Board of Economic Warfare, the Office of the Coordinator of Inter-American Affairs, and private interests began investigating the possibilities in Latin America. Contracts were signed with Ecuador and Peru to sell us all the bark not needed for domestic consumption, and discussions were undertaken with Guatemala, Costa Rica, and Bolivia from where bark is now coming in. A seed station of the Department of Agriculture sent high-quality seedlings of Cinchona to the Latin American Republics.

This program was very necessary. Botanists from the United States were sent to survey the existing stands and to investigate the possibilities for new plantings. Chemists followed the botanists into the mountains with portable equipment to test the percentage of quinine in the bark. However, this South American bark couldn't measure up to that of the superior Javanese bark which had come about through years of selection. In fact, the amount of quinine to be expected from American trees was very low.

But another important discovery had been made. Besides quinine, the bark of the cinchona contains a number of other alkaloids, the most important ones being cinchonine, which probably has many uses not yet known, quinidine, and cinchonidine, which also are useful against the malaria parasite. The use of all four drugs is very much like the earlier preparations made from infusions of the bark, such as was given to the Countess of Chinchon, that is, if she ever took any such preparation. The new preparation, called totaquine or totaquina, has been used for a number of years in India because it is much cheaper than quinine sulphate, and when used in twice the dosage of pure quinine it is almost as effective. Although the quinine yield of the South American barks was low, totaquina could be made from them.

So once more the *cascarilleros* of Latin America are working. The

methods of taking the bark have not changed radically since its early history, except that less wasteful and destructive means are employed. The trees are usually ready to be cut after the fourth to seventh year, although some of the trees are cut earlier in a thinning-out process, and recently a method has been developed of growing the trees so that they may be harvested after the second year. The trees are felled and uprooted, because a number of years ago it was found that the roots have a higher yield of quinine than the trunk and branches. The bark is pounded with wooden mallets, after which it is easily stripped from the tree. It is then placed in the sun to dry, or over fires if there is too much moisture in the air. After drying it is ground and packed in bales ready for shipment to the factories in this country.

Totaquine was put on the market for civilians, while quinine was going to the army and navy. Another answer to our malaria needs was the newly developed near-synthetics, atabrine and plasmochin. These are both coal-tar derivatives developed by German scientists since 1930. Recently, when the government eliminated patent and other trade restraints on atabrine, drug companies not only stepped up production but also turned out a better product. According to the latest report, 2,500,000,000 pills are being manufactured annually. Plasmochin is not as effective a treatment, but it helps prevent the spread of the disease by killing the parasites in the body. Atabrine cannot be substituted for quinine in the most severe cases of malaria, and both it and plasmochin frequently have unpredictable effects. However, atabrine does not produce the buzzing in the ears and the dopey sensation that quinine often does, and some doctors prefer it to quinine. Efforts are now being made to develop a true synthetic quinine, and in the future something may be discovered in the laboratory that will prove even superior to quinine.

Malaria is far from being wiped out, and its eradication after the war when millions of soldiers come home from infected areas will be an international problem. With world-wide airlanes, planes will have to be fumigated after each flight. At present both planes and automobiles are fumigated at posts in infested regions of the tropics. A single fertilized mosquito may start an epidemic. However, the outlook is not too unpleasant. Our troops in the tropics have quinine, the exact amount a military secret, and the death rate from malaria should be comparatively small. And at the same time on the home front our southern states will have totaquine and atabrine with which to fight their annual 3,000,000 cases. No one should suffer because of the lack of quinine.

CHARLES HEISER, JR.

SOME SECONDARY RUBBERS IN CEARÁ BRAZIL

Much has been written recently of the well-known Para rubber, Hevea; of vast projects being undertaken in the Amazon country and in Central America to provide Hevea rubber for our war and even post-war needs. However, few people, aside from specialists, are familiar with two common secondary rubber plants, Maniçoba (Manihot of the Euphorbiaceae family) and Mangabeira (Hancornia of the Apocynaceae), or of the climate, people, and customs of the region in northeast Brazil where they are most abundant. This article is designed to present a brief, non-technical picture of these secondary rubbers, and of the region in which they grow. For this purpose we shall confine ourselves to typical localities in the Brazilian state of Ceará where Maniçoba is often called "Ceará rubber."

The state of Ceará, in spite of being only a few degrees south of the equator, is very dry, greatly resembling west Texas in general appearance. It has a rainy season during our winter, when the vegetation becomes leafy and green; a dry season the rest of the year during which herbs shrivel and dry and most trees shed their leaves. Trees are small and scrubby and the people are poor, with water almost everywhere the limiting factor to existence for man, beast, and plant. Small ponds of water are collected in dammed-up creeks in which water flows only during the rainy season. In drought years, mass migrations occur from the interior, some folks becoming charges of the Government, others wandering up the Amazon country, but all seemingly longing to return to their beloved Ceará, in spite of the harsh treatment received at her hands.

In Ceará, Maniçoba rubber is the most important of the "secondary" rubbers (so called because they can only be used for non-essential purposes, unless mixed with a large proportion of Hevea rubber, and because they have not been able to compete with Hevea in peace-time). Maniçoba is a small, somewhat fountain-shaped tree, with lobed leaves, inconspicuous flowers, and seeds resembling a small castor bean. The bark is usually a light gray-brown, quite scaly, and with a hard horny outer coating which protects it in the dry season and gives the rubber-tapper unending difficulty. The tree is found in abundance, growing wild on the sides of Ceará's small mountains. Occasionally it has been planted, as it was during the first world war boom when rubber prices were high, but during peace-time the small, difficult, lower-yielding Maniçoba cannot compete with Hevea; and between war booms many thousands of both wild and plantation trees have been cut down to make pasture lands, and for the wood used in sandal soles.

Mangabeira is a small, well-branched tree, with willow-like drooping branches, small oblong leaves, inconspicuous flowers, and an edible fruit. The

bark is dark brown, rough in appearance, thick, quite soft, and hence easily cut with a tapping knife. It is not cultivated, but grows wild in the more moist zones along the seacoast and on top of the flat-topped hills called *taboleiros*.

Botanically considered, Ceará is relatively poor in number and variety of species. Palms offer the most picturesque floral element and one of considerable economic importance. Among the palms are found the "Carnauba" (Copernica), which supplies the United States with furniture and floor polish from the waxy coat of its leaves; the "Babassu" (Orbignia), which furnishes an oil-rich fruit for industry; the stately "Buriti" (Mauritia) with an edible fruit; the omnipresent and well-known "Coconut" *(Cocos nucifera)*, and its relative "Catole" *(Cocos edulis)* with less robust stature and

Foliage of Maniçoba *(Manihot pianhyensis)*

smaller fruit. "Oiticica" (Licania), of the rose family, produces a fruit that is the basis of a large drying-oil industry. "Juaseiro" (Ziziphus), of the Rhamnaceae, which remains green throughout the year, furnishes welcome shade during a sun-scorched dry season, as well as forage for stock. "Atta" (Annona) of the Annonaceae furnishes a delicious table fruit. The fruit of "Cajá" (Spondias) of the Anacardiaceae supplies food for stock and welcome refreshment to man when made into a drink. Other families of plants with numerous representatives especially conspicuous and important in Ceará include the Leguminosae, Cactaceae, and Euphorbiaceae.

In the very south of Ceará there is a rather mountainous region near the city of Crato, that is one of the most picturesque and wealthy localities of the state. Fine-flowing springs make this *Cariri* region (as it is affectionately called by the inhabitants after an old Indian name) a fertile oasis in dry Ceará. More rice is produced here than anywhere else in the state. Other crops grow luxuriantly in a place where drought is of slight consequence. Yet, as in most of northeast Brazil, all agriculture practice is by hand, done by methods and with tools which were ancient a hundred years ago. A hundred men till a field with the ponderous hoe-like *enxadas*, while a plow rusts near by in a government agricultural station. Yet if these hundred men were displaced by one man with a plow, a new problem would arise. Then they would be unable to gain their miserable "15 cents a day" they now receive for this work from their landlord, the *Fazendeiro*, who is usually absent.

The inhabitants of the region, as in most of northeast Brazil, are a mixture of Indian, European, and negro races. Like their agriculture, their habits have changed little since colonial times. To-day the men still take snuff; a patriarchal table is the custom with the women standing to serve the men, and the more "important" members receiving the best and most, or all, of the food; children kiss the hand of an oldster, and women bid one another adieu by the same token; the father may yet select a daughter's husband; etc. In 1846, George Gardner, an Englishman who resided for a time in the Crato region, wrote regarding the resistance against modernization: ". . . . the principal cause, in my own opinion, is their lazy and indolent habits, and the great horror they entertain of any thing like innovation on the customs of their forefathers; were the country in the possession of an industrious people, this would, no doubt, become one of the richest districts in the north of Brazil." To-day you will find the majority of the hospitable north Brazilian folk ever ready to talk about what they are going to do—willing to agree to anything—but almost certain to do nothing.

Outlying this *Cariri* region is the Fazenda Serra Verde, an immense *fazenda* as large as a small European state. On it are thousands of Maniçoba trees, but of a million trees planted in the early 1900's few remain. Like much of interior Brazil, the *fazenda* is for practical purposes beyond reach of the strong arm of the law (which remains rather close to the sea-coast and transportation). The manager of this *fazenda*, and thus master of the Serra Verde mountain range, told me one day: "I am the Emperor of Serra Verde; this rifle is my sceptre, and this whip my crown." Mounted on horseback he goes many kilometers to settle arguments between *moradores* of the *fazenda*. If he finds that Sr. X's mule trampled Sra. Y's maize, Sr. X pays without question any indemnity assessed.

Tapping the Maniçoba tree, Serra Verde, Crato region, Brazil

Maniçoba latex dripping to cup, Crato region

I was a guest for seven days in the home of the manager. (No more gracious hosts or hostesses could be found than most men and women of northeast Brazil.) Anything they have—and often this is not much—is at one's disposal. A week's normal rations will be used to make a banquet for guests. In the dim lamplight at one supper at Serra Verde, I noticed that the half piece of cheese remaining on my plate was crawling a bit. I looked at it inquiringly, whereupon my hostess took the cheese, shook the maggots to the floor, put the cheese back on my plate, remarking that she couldn't understand development of maggots in anything as salty as cheese.

On Fazenda Serra Verde the Maniçoba trees are tapped on the trunk. (In some regions, as in Piaui, a hole is dug in the sandy soil at the base of the tree and the root is tapped.) A slanting or a V-shaped cut is made about half around the trunk with a special cutting tool. The milky latex runs down the slanting cut into a small cup stuck into the bark. In the cup the latex coagulates naturally, and after thorough drying is ready to sell. At least ten tons of such rubber could come from Fazenda Serra Verde this year. An unfounded superstition among Serra Verde rubber workers is that tapping Maniçoba with a steel tapping knife will give better yield, but damage the tree more, while the opposite will be true if an iron tool is used. An illiterate people such as this offers a fertile field for superstition, and this example is by no means the only one.

The region just south of Sao Francisco (about 130 km. west of Fortaleza) typifies a *sertao* Maniçoba locality. "*Sertao*" signifies the dry, flat, cattle-country of Central Ceará. Maniçoba is found only in a small, scrubby, mutilated form on the sides of occasional *serrotes*. The region is too dry and hot, the trees too poor, for latex to flow into a latex cup as is the case in more moist areas. Here workers scar the bark of the tree trunks with a small hatchet. In the course of days the latex oozes out of the scars in small drops, coagulating on the bark as "*Choro*", tear-drop rubber. The worker twice a month collects these tears, often stuck with pieces of bark and other debris. This type of rubber is dirty and sticky and has low commercial value. One hundred tons of such rubber should come through Sao Francisco in 1943.

Sao Francisco, the metropolis for the neighboring *sertao* country, is only a few blocks square, with ill-constructed one-story buildings, unmade streets, and no electricity, water, or sanitary improvements (as is the case with most cities in the interior). Sao Francisco does not appear to be one of the more important interior cities. For sleeping, one must bring his own hammock to the hotel, and hang it from the ever-ready hooks found in the walls of all north Brazilian dwellings. From our standpoint this makes for good hygiene, because a guest who may be particular knows he is in imme-

Termite nest on Maniçoba, Crato region

Amazonas panel on Maniçoba, Piaui, Brazil

diate contact with louse-free, clean cloth for the night, or responsible to himself for the opposite.

The inhabitants of the *sertao* are dependent for livelihood upon cattle. Almost all native foods are cattle products—jerked meat, milk, coagulated milk, cheese, butter-cheese. Aside from these foods and a purchased bag of *farinha* (Mandioc) little else is eaten, or can be afforded by the ordinary

Collecting Mangabeira latex, Maranhão, Brazil

sertao dweller. The cattle are free to roam, being identified by brand. In drought years there is often heavy mortality in this main source of wealth.

Tending the cattle is the north Brazilian cowboy, the *vaqueiro*. He clothes himself in tough leather from head to foot, to protect himself from the thorny scrub into which he rides full-force, low in the saddle, in pursuit of errant cattle. He prefers a small, wiry, well-trained horse to take him through the *matta*, to keep him as low as possible when he passes under the

many thorny branches. Proud of his profession, picturesquely attired in hand-worked leather, he forms as distinctive an element of Brazilian *sertao* as did the United States cowboy of our West.

At the "*sertao*" Fazenda Santa Maria, permission was asked of the Government in 1932 to build an *acude*, to make a small lake for dry season and drought times. After due Government investigating and surveying, permission was granted. The *acude* is now under construction—scheduled for completion in 1944, just twelve years after permission was sought.

For a United States citizen it is hard not to be embarrassed with *sertao* hospitality. I was never able to feel at ease being served wine at the table, while others went without; being served mountainous quantities of chicken and delicacies while the children at the far end of the table would probably have given a year of their lives to sit down to such a plate; being given a room alone, while a half dozen folks of the house huddled together on the cold floor of another room less sumptuous. Upon leaving the home of Sr. Martins Salles, in keeping with this custom of hospitality, I was given one of the family's remaining five cheeses.

Transportation in the *sertao*, as in most of northeast Brazil, is mostly by horse. Often it is necessary to spend a week in the saddle, evaluating Maniçoba stands, riding as much as sixty kilometers in a day. However, across the flat *sertao* one can also make a way along old cattle trails in an automobile, always watching for boulder-like rocks which may strip the belly-side of a modern car. After education, efficient transportation is probably the most pressing need of interior Brazil.

Although a small quantity of Mangabeira is found on certain mountain tops of *Cariri*, the localities already discussed are, from the rubber standpoint, Maniçoba areas. However, the region near Cascavel, a fair sized, sleepy city built on the loose white sand of the coastal zone, produces only Mangabeira rubber. Mangabeira trees are tapped much as are trunk-tapped Maniçoba, the latex being collected below an angled tapping-cut in any available cup or container. But, different from Maniçoba, the Mangabeira latex flows fast and abundantly for only a few minutes. A short time after tapping, the rubber worker returns to collect the latex, as it does not coagulate naturally in the cup as does that of the Maniçoba. All latex is then brought to a central depository where it is coagulated by smoking on a paddle, by heat, or by chemicals, usually salt or alum. The coagulum is pressed free of excess water, then hung in a cool, dark, moist storage place until sufficient quantity has accumulated to sell.

The loose sand of the Cascavel Mangabeira area makes travel in a modern pleasure car impossible except on the main road. However, trucks with much racing of motors and disregard of tires, manage to pass over the minor

Tapping Mangabeira, Maranhão, Brazil

Trunk of Mangabeira, Maranhão, Brazil

roads. I accompanied one group of interested Brazilians in a truck on a Sunday expedition to investigate a Mangabeira stand near Cascavel. In an effort to introduce latex cups into the locality, we had brought along several gross of a type manufactured in the United States. The use to which these Brazilians put the cups could not have been forseen by the manufacturer. As the truck was repeatedly stopped in the midst of sandy waste, numerous gin-tonics were mixed and served to the entire party—in Rubber Development Corporation #2 Latex cups!. A *secondary* use for latex cups, designed for *secondary* rubber!

ROBERT W. SCHERY.

THE RUBBER COUNTRY OF COLOMBIA

Perhaps the United States has never appreciated the value of a knowledge of tropical botany as acutely as since the loss of our rubber, quinine, and spice resources in the East Indies. The problem confronting the nation has been not only the manufacture of synthetic substitutes, in the case of rubber, but a search for the natural commodity in the vast forests and jungles of tropical America. For this task, the Missouri Botanical Garden has provided our federal government with eleven of its scientific personnel or graduates. Although these men have been sent to their tropical posts for urgently utilitarian purposes which they are fulfilling with distinction, as men of science they are profiting from their experiences, as may be seen from the following extract of a recent letter by Paul H. Allen, formerly Manager of the Garden's Tropical Station, now Associate Field Technician of the Rubber Development Corporation in Colombia, and representative in the tropics for the Missouri Botanical Garden.

"This stay in Bogotá has been fairly hectic, since the authorities have seemed pleased with my humble efforts and have put me in charge of production in the Bajo Vaupes area, our biggest producing territory. I am frankly pleased, as it is Indian country throughout, and has at least six species of Hevea to make it interesting. A shrubby species collected on this last junket has been described by Dr. Schultes as a form of his new *Hevea toxicodendroides*. I will be much surprised if we don't turn up some more new ones

"I would like to send you a complete copy of my diary, but time does not permit. However, the following excerpts may give you some idea of the country. The Bajo Vaupes is typical of the entire Amazonian shield, being flat or slightly undulating, crossed by a network of meandering streams which are often flanked by ox-box lakes. Most of the underlying rock is diorite with occasional veins of white quartz or red granite. A range of long rounded hills and isolated mesas composed of tilted sandstone strata crosses the area, having in general a NE–SW orientation. By tracing this range to the southwest, you will note that it terminates in the Cerros de Araracuara, the type locality of many of Martius' species. These hills and mesas are elevated above the general forest level about 200–300 meters, and from their sandstone character present an entirely different set of ecological conditions. While collections are as yet too meager for any definite conclusions, present indications are that these elevated areas, often separated from one another by hundreds of kilometers, have developed micro-floras of a highly endemic nature.

Sub-paramo above Bogotá, about 9500 feet

Typical rubber camp on the Caño Cuduyari, Bajo Vaupes

RIO CUDUYARI, BAJO VAUPES

"December 4—A gray, rainy morning. Packed frantically to get an early start for the overland trip to the Cubiyu, but did not get off until 7:30 a. m. Arrived after about two hours of paddling at the huge *maloca* (communal house) of 'Yararaca' (snake) where I bought eight fine ripe pineapples for trade tobacco. Since our only available guide had gone to the falls of 'Bacuraba' (goatsucker) to help Gomez pass his *batalon,* we hung up our hammocks and waited. This is a large and very well-equipped *maloca* measuring 20 x 24 meters (about 65 x 78 feet), thatched with 'Ubi' *(Manicaria Martiana),* the fronds being braided by their petioles onto split strips of the trunk of *'Pachuda Zancona' (Socratea exorrhiza),* then tied, shingle fashion, one above the other. The pitched roof, in all cases facing the river, is continued to within about a meter of the ground, being finished off with fronds of 'Carana' *(Mauritia Carana),* 'Wiba' *(Gynerium* sp.*)* bark, or whatever may have been handiest. Front and rear walls are of split strips, set vertically, of the same *Pachuda Zancona,* to a height of about three meters, being faced on the outer side by broad strips of the bark of an unknown tree called 'Mi-a-cuh' in Cubeo, bound on with tough vines and braced by horizontal strips from the trunk of *'Pachuda Barriguda' (Iriartea Corneto).* Sometimes, particularly on the side most exposed to the weather, there will be an intermediate layer made of plaited fronds of the 'Caranauba' *(Parascheelea anchistropetala)* known as 'Yapo' to the Cubeos. All uprights are of 'Acaricuara' *(Cenostigma* sp.*?),* these being termite-resistant, set in three parallel rows in descending order of height, leaving the center of the *maloca* open for the periodic ceremonial dances.

"The front and rear above the facing bar are thatched with shaggy fronds of Parascheelea, blackened by smoke as a protection against insect damage. Doors are in the center of the front and rear, being hinged by tough vines at the top, propped up by a stout pole when the Indians are in residence. These doors are made of a rectangular mat of split canes of 'Pimpin' *(Iriartella setigera?)* with an inner layer of the fronds of the 'Ubi wasu' *(Manicaria atricha),* the whole being bound together with vines and strengthened by a central pole. During the day when the door is propped open, the doorways are protected by screens of split canes from the leaf rachis of the 'Pataba' *(Jessenia Bataua),* somewhat resembling a Venetian blind. These structures are, on first entrance, very dark, the interior thatch being entirely blackened by the smoke from the cooking fires. This darkness is a decided advantage, since it affords protection from the swarms of black flies which make life almost unbearable in the late afternoon. Once one's eyes become accustomed to the gloom the furnishings may be seen. These commonly consist of many hammocks of woven palm fiber, often forty or more in number, those of the children being hung under the eaves in ascending tiers. Several fires are usually going, one to each family group, and the grating, sieving, pressing and drying of *fariña* are always in progress. Usually there are one or several huge hollowed trunks, with paired handles at the upper ends, for 'Cachiri', a fermented *fariña* beer drunk during ceremonials. Scattered about are blow-guns, basket quivers with poisoned arrows, short bows, and long reed fishing arrows, thrust with macaw tail feathers into crevices in the thatch, black clay pots, long woven *fariña* presses, huge shallow clay pans for drying *fariña,* beautiful woven circular trays, low wooden stools, *fariña* grating boards, the South American counterpart of the omnipresent Central American *metate,* long and short log mortars for the preparation of Coca, Mauretia fiber rectangular boxes hung by long strings containing ceremonial feathers, pan pipes, etc.

"During the evening a woman's regular task is the preparation of Coca *(Erythroxylon Coca)* called 'Pato' in Geral and Cubeo. The green leaves had been collected during the day in a small narrow-mouthed basket and promptly dried on the shallow earthen pan used in the preparation of *fariña,* thus retaining their green color. They are now placed in a short, stout, cylindrical mortar of 'Mirapiranga' *(Tabebuia* sp.*)* called 'Coco cuh' in Cubeo, and beaten to a powder with a stout pestle of the same wood about 1½ meters in length. The powder is then placed in a bag made from the inner bark of an unknown tree called 'Ta cuh', this bag being stretched over the point of a long slender pole, and fastened to the point by cords at the neck. The pole, with its attached bag, is next inserted in a long cylinder of 'To tai bwuh' (probably *Ochroma* sp.), the pole being held so that the bag may be rapidly vibrated against the walls of the cylinder for the removal of the fine dust. In the meanwhile dried fallen leaves of the 'Hwacumo' *(Cecropia* sp.*)* have been burned and the fine ash held in readiness. The Coca still remaining in the bag is now removed, placed in the erect 'Coco suh' mortar, beaten thoroughly, mixed with equal parts of the 'Hwacumo' ashes, and replaced in the bag. The bag is again inserted in the long cylinder for a second

Astrocaryum acaule, vicinity of Yurupari Falls, Bajo Vaupes

"Ferdinandina"

vigorous vibration. The resultant powder or dust, olive-green in color, after being carefully decanted into an awaiting *calabash*, is ready for consumption. It is usually taken in doses of about a teaspoonful with tobacco, the latter being smoked while the Coca is being held in the cheek. The taste is not unpleasant, but there is considerable danger, from the extreme fineness and dryness, of breathing it into the lungs. The tip of the tongue is rendered slightly numb within a few seconds, and the general effects are those of a cup of strong tea.

"December 5—A velvety, still, clear night. The feathery crowns of the surrounding 'Pupuña' palms *(Guilielma Gasipaes)* were stenciled in black against the sky. There was a brilliant half moon, and stars hung low like golden lamps above the roof of our *maloca*. Toward morning it turned chilly, and the Indians sat up in their hammocks and warmed their feet at small fires. Packed and left for overland about 6:45 a. m., our guide packing my duffle bag by a bark tump line, and carrying a broken Brazilian percussion trade gun bound together with vines. Began shortly to ascend a steep scarp in a heavy rain forest, grading through low, boulder-filled 'Catinga' woods to a vast area of open, undulating sandstone, called 'Yapoboda' (the savanna of Parascheelea palm) by the Cubeos.

"To one who has traveled for months through the river corridors in the heavy rain forest the effect of emerging on such an area of stony grassland was stupendous. It would be impossible to describe the sensations of isolation and grandeur under such conditions. Far-away calls of mourning doves were heard, and the howler monkeys roared hoarsely in the western fringing forest. Pools of white mist lay between the blue hills toward the south, with a high castellated peak appearing briefly from out of the mists to the southwest. Sandstone in very rugged outcrops was encountered, striking generally NW–SE, the dip being about 10 degrees to the southwest. We walked over long parallel stretches of exposed rock almost like pavement, lines of rugged blocks, pedestals and natural bridges, with narrow herb-filled swales alternating with the stone. Grotesque, dichotomously branched, shrubby Vellosiaceae were confined to the sandstone outcrops, brilliant yellow terrestrial orchids (Catasetum and Laelia) covered boulders, and clouds of bright pink Epidendrums and hundreds of white and rose-pink Sobralias *(Sobralia liliastrum* and S. *decora)* attracted attention. Incidentally, our S. *panamensis* will have to be reduced to S. *decora*, since they are obviously the same thing. We saw a tilted ledge of limey sandstone having pool-filled chambers called 'Taqué cuname' (House of the Monkey) in Cubeo, and, a bit further along, a truly remarkable structure having a perfect maze of rooms, corridors, and vaulted chambers in the smooth sandstone. Saw a beautiful golden male Cock-of-the-rock flitting his wings and looking nervously about, calling *kwe* to another bird farther away. Several of the semi-circular mud and straw nests were plastered swallow-fashion to the walls of the cave, all explaining the Cubeo name of 'Cunacuma cuname' (House of the Cock-of-the-rock). A short geko-like cave lizard was seen, and several remarkably accurate Indian drawings on the walls proved that the Cubeos had seen them too, as well as red paintings intended to represent the great savanna cat, monkeys, men, and geometric signs. Illegible inscriptions were noticed in a combination of Indian drawings and Spanish, only '*Sitio de todos los Santos*' remaining. A few isolated groups of Mauretius, species unknown, and lines of *Astrocaryum acaule* following fissures in the sandstone made up the palm flora of the open savanna. Other plants noted were a dozen or more species of Eriocaulon or Paepalanthus, varying from two inches to four feet in height, dozens of Juncaceae, common conspicuous clumps of Pitcairnia, with tall inflorescences of white flowers, low-branching clusters of Navia? in several species, a thick-leaved shrubby Bombax originally described by Martius and seemingly not seen since, four sand Utricularias, blood-red rosettes of Drosera, four species of Burmanniaceae (Dictostegyia?), a shrubby Ternstroemia, sub-shrubby Mandevillas, Norantea, etc., etc.

"This area seemingly receives the same torrential rain to which the surrounding forest is subjected, yet the plants are of a pronounced xerophytic character. This is undoubtedly due to the sharp run-off of water from the bare stone, the intense radiation, and probably an excessive acidity in the slight accumulations of sandy soil. I believe an exceedingly interesting series of comparable plant structures such as the basal rosette of leaves, bulbs or pseudo-bulbs, tuberous roots, water-holding tanks, coriacious, succulent or deciduous leaves, etc., might be built up for true deserts, or desert of physiological drouth due to acid, or other mineral toxic substances, and alpine meadows or *paramos*, where the inhibiting influence is cold. There is a striking superficial resemblance between the plants of the 'Yapoboda' and the *paramos* above Bogotá."

PAUL H. ALLEN.

NOTES

An article by Mr. A. P. Beilmann, Manager of the Arboretum, entitled "A Goldenrain in Missouri" was recently published in *Trees* (6[1]:13).

Mr. Ladislaus Cutak, in charge of Succulents at the Garden, has recently been elected president of the St. Louis Horticultural Society.

Dr. H. N. Andrews, Paleobotanist to the Garden, spoke before the Junior Academy of Science at the Cote Brilliante School, December 8, on "Exploring for Fossil Plants."

Mr. A. P. Beilmann, Manager of the Garden Arboretum, gave a talk to the Rural Fire-fighting Class at Pevely, Mo., January 19, on "Reducing the Fire Hazards in Fields and Wood-lots."

The Gardeners' Chronicle of America has reprinted in its January number (48:23-24) the article "Raising Nepenthes from Seed" by Dr. David C. Fairburn, Horticulturist to the Garden, from the November 1943 Garden BULLETIN.

Mr. George H. Pring, Superintendent of the Garden, has given the following talks recently: "Collecting Para Rubber," before the Clipper Club, at the Tyler Place Presbyterian Church, January 27, and the Ladue Garden Club, February 1; "Orchids throughout the Year," before the alumni chapter of Kappa Alpha Theta, February 13.

An article "Good House Plants," by Mr. Ladislaus Cutak, in charge of Succulents at the Garden, appeared in the *New York Times*, December 5, 1943. Mr. Cutak's article, "The Christmas Cactus and Its Culture" from the December 1943 Garden BULLETIN was reprinted in the January 7 number of *Southern Florist* (56[4]:13-14).

Recent visitors to the Garden include: Miss Camilla Bradley, of New Orleans, Editor of *Home Gardening;* Sgt. Louis G. Brenner, of the U. S. Engineers; Dr. William E. Hoffmann, Director of the Lingnan Natural History Survey and Museum, Lingnan University, Canton, China; Corp. (Dr.) W. L. Tolstead, of the Med. Det., U. S. Army, formerly instructor in Botany, University of Nebraska; Lt. Robert B. Clark, of the U. S. Air Forces; Pvt. Dara E. Emery, of the A.S.T.P. at the Missouri School of Mines, Rolla, Mo.

STATISTICAL INFORMATION FOR JANUARY, 1944

GARDEN ATTENDANCE:

Total number of visitors	15,552

PLANT ACCESSIONS:

Total number of plants and seed-packets received as gifts	480

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	29
Total number of books and pamphlets donated	202

HERBARIUM ACCESSIONS:

By Purchase—

Hinton, James C.—Plants of Mexico	1,000
University of California, by Mrs. H. P. Bracelin—Plants of Mexico and South America	245

By Gift—

Clemens, Mrs. M. S.—Plants of Queensland, Australia	27
Conard, Henry S.—Mosses of Iowa	35
Cornman, Mrs. M. Alice—Plants of Florida	44
Hopkins, L. S.—*Morchella* from Missouri	1
Moran, E. C.—*Parmelia chlorochroa* Tuck. from Montana	1
Richards, Donald—*Alectoria Fremontii* Tuck. from California	1
Tolstead, W. L.—Plants of Texas	15

By Exchange—

Gray Herbarium, Harvard University—Misc. duplicates including plates and photographs	54
New York Botanical Garden—Plants of India	199
Total	1,622

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SOME FACTS ABOUT THE GARDEN

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

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

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

BOXWOOD AT GATE HOUSE AT ARBORETUM

Hedge at left is 100 feet long and consists of 57 plants, all propagated from those brought from Ste. Genevieve in 1934

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BOXWOOD IN MISSOURI

The history of Boxwood is lost in antiquity. Apparently it was used as a garden subject just as soon as man reached a point in his development where he could devote a little time to the ornamental plants. Boxwood is not indigenous to the United States but is common throughout southern Europe and is known from parts of Asia and Central America. It was introduced into the United States in early colonial times and was used attractively in many gardens. The large size of those planted about the Lincoln Memorial in Washington, D. C., and the great number to be found in Washington's garden at Mount Vernon and other Virginia gardens leave no doubt about the high regard in which it was held by early gardeners. Some European boxwood was carried by settlers from the east coast to the Middle West, where even now a few specimens are found in certain isolated communities. One such community is in Ste. Genevieve, Missouri, and just recently another Boxwood planting has been found in Washington, Missouri. There seems little doubt but that these plants were hauled across country during the early days. The gardener is a confirmed optimist and always enthusiastic when he is able to find and grow the unusual plant. Because of this, many of the old specimens of Boxwood from Ste. Genevieve were dug and hauled to St. Louis where they found a ready sale. Perhaps the most of those brought up in the years 1933 to 1935 have died. A few have persisted and done well, notably those about the home of Charles Fullgraf on Geyer Road in St. Louis Co., and two specimens at either side of the Gate House at the Arboretum (pl. 10).

Diligent search has so far failed to show how Boxwood was introduced into Ste. Genevieve. Since Boxwood is seldom grown from seed, it must have arrived as either rooted cuttings or growing plants. The difficulty of keeping either plants or cuttings alive during a long river trip would appear to rule out their introduction during the early days of the village. When the west bank of the Mississippi was either Spanish or French territory nearly

all traffic was to and from New Orleans. The trip up the Mississippi to Ste. Genevieve often required six to nine months, and a year or more might elapse before goods ordered in Europe arrived. However, early travellers recall that the gardens in Ste. Genevieve boasted many kinds of vegetables and many homes had "orchards." We do not know what varieties of fruit were grown nor where they were obtained, but it would seem that the transportation difficulties of the early days would preclude the shipping of nursery stock. Of course, new plants were introduced, especially those which could be shipped as seed, but hardly planting stock of either fruits or ornamentals.

If the above hypothesis is correct, then we can assume that Boxwood was brought into Ste. Genevieve when transportation had improved and when shipping distance had decreased. With the Louisiana Purchase in 1804, there was an increase in immigration from the East and no doubt an appreciable improvement in transportation. When the Ohio River became the great travel way, the distance between the established gardens, orchards and nurseries of the east coast and the new country was greatly shortened. There are several other reasons why Boxwood probably reached the village many years after its founding. In fact, it is almost possible to prove that there are no Boxwood in Ste. Genevieve—except for the evidence. Many of the first French settlers came by way of Quebec. If they had remained for any length of time in Canada the plants they brought with them from Europe would have perished. In addition, the difficulties of the southward journey were so great that only the most essential baggage would have been taken; no ornamental plants would have found space. Although the French were rated as gardeners by all travellers, they had a limited vocabulary of plant names; even many of the wild plants had no special name. The Rt. Rev. Mgr. Charles L. Van Tourenhout, who has labored in this territory for over fifty years, says that the plant has always been called "English Box." This would seem to indicate that the plant was brought in at a time when the wholly French character of the settlement began to change. One more reason for believing that the plant was introduced late in the history of the village is the size and apparent age of the plants themselves. The largest and oldest, those at St. Joseph Convent, those at the Misplait House, and those east of the Philipson-Valle House (pl. 11), in the writer's opinion, are somewhat over 100 years old, but hardly 150 years old.

However, since Boxwoods are found in Ste. Genevieve, in spite of all the reasons why they shouldn't be, it might be well to investigate other leads. The most interesting appears to be that Dr. Lewis F. Linn imported these plants. Dr. Linn came from Kentucky in 1816 to settle in Ste. Genevieve.

LARGE SPECIMEN BOXWOOD EAST OF PHILIPSON-VALLE HOUSE, STE. GENEVIEVE, MO.

Digging and balling Boxwood in Calvary Cemetery, Ste. Genevieve

Truckload of Boxwood leaving Calvary Cemetery for the Arboretum

He was elected to the state Senate in 1830, and sent to Washington in 1833 as Senator from Missouri. He was keenly interested in all things which might better this frontier community, so much so that in 1839 he made a trip to Europe to study mining machinery which he hoped might be introduced in the lead mines near his home. While traveling from Boulogne to Paris he stopped off at Beauvais, and in a letter to his wife recalls that this town was the birthplace of the parents of so many of his friends in Ste. Genevieve. We, of course, have no proof that Senator Linn ever shipped Boxwood to his home, but there are several reasons to believe that he might have become interested in the plant. He may have seen it near or in Beauvais, France, and recognized it as the same hedge used so extensively about Washington and in Virginia. His former home in Ste. Genevieve is to-day the only place in the town where old Boxwoods have been kept trimmed as a hedge in the European fashion. Most of the old plants have been allowed to grow as specimens without shearing. Finally, the largest plants are about 100 years old, the correct age to prove the theory. On the basis of this information, we shall credit Senator Lewis F. Linn as the introducer of Boxwood to Ste. Genevieve, and a century later, through other channels, to the whole state.

Many propagations of Boxwood have been made from time to time, and good specimens of considerable size can be found in many gardens in Ste. Genevieve and near-by localities. An excellent planting is reported at Weingarten, about twelve miles southwest of Ste. Genevieve. At St. Mary's of the Barrens, a seminary just north of Perryville, Boxwood has been extensively used as a hedge. It appears that the plants have been propagated at three different times; the oldest hedge is six to eight feet high, the next five to six feet, and the most recent about three feet high. Most of the later propagations in Ste. Genevieve appear to have been made by Mr. Basler, Sr., who was sexton of Calvary Cemetery until his death. Through the enthusiastic assistance of Rt. Rev. George J. Hildner, who accompanied the writer on several expeditions and who has since become a noted discoverer of Boxwood, the Garden was able to obtain fourteen 6-foot specimens from Mr. Leo L. Basler. In a letter Mr. Basler states that his father set these plants out in 1916 when they were about ten years old, and that they were sheared annually until about fourteen years ago. To insure the most satisfactory handling, an Arboretum crew with equipment was sent to dig, ball and haul these plants. They can be found in the Box Garden at the Arboretum—the largest plants there.

In December Father Hildner located a group of four large Boxwoods within the city limits of Washington, Mo., near an abandoned zither factory.

These plants, which appear to be about sixty years old, are growing near the top of a bluff overlooking the Missouri River valley, and fully exposed to winter winds from the north. At the moment we have no knowledge of when and by whom they were planted. It is expected that they will be used for propagating plants at the Arboretum, and it seems unlikely that a hardier winter type can be found in this region.

There is little need to comment on the potential value of a hardy Boxwood for landscape work in this vicinity. It has always been a favorite with the gardener, and a hardy type able to thrive in Missouri should prove most welcome. Almost every garden would have a place for a dependable kind of Box. With this end in view much work has been carried on at the Arboretum during the past twelve years. At the moment we are growing the following species and varieties in our nursery:

Buxus Harlandii
Buxus sempervirens arborescens
Buxus sempervirens Handsworthii
Buxus sempervirens myrtifolia
Buxus sempervirens variegata
Buxus sempervirens suffruticosa
Buxus sempervirens "Charlottesville, Va."
Buxus sempervirens "Marion, N. C."
Buxus sempervirens "Ste. Genevieve, Mo."
Buxus sempervirens "Roumania"
Buxus microphylla japonica
Buxus microphylla koreana
Buxus microphylla sinica

Many of these are not old enough to indicate their ultimate development. For instance, *Buxus sempervirens arborescens* is described as a small tree or a tall shrub having elliptic leaves. The variety *Handsworthii* has also an upright habit with rather large leaves, while var. *myrtifolia* is reported as low with small leaves. The variety *variegata* might possibly have been developed from any of these forms. We might add that in our experience the variegated forms are not satisfactory in this climate. The variety *suffruticosa*, called the "edging box", is perhaps the smallest of all, and it might very well be the oldest horticultural form of Boxwood. In addition to these named varieties, we are growing Box from several stations on the east coast, as well as the location in Missouri. In time these may prove to represent a known variety, but for the moment they are being carried merely with a notation indicating their origin. Differences in these varieties are based very largely upon leaf shape, size, and general growth habit of the plant.

Ten plants of *Buxus Harlandii* Hance, a Chinese Box, were received in 1931 from the Bureau of Plant Introduction. From these and from others received in 1935 and in 1936, propagations have been made. This species is easily identified by its leaves, which are much longer than broad, in fact, longer than any other Box, rounded at the tip, and tapering toward the base. We do not know what its growth habit will be when mature. It is sometimes injured during winter, but usually recovers speedily in the warm days

of spring. This tenderness would make this species much less satisfactory than certain other varieties. It is an interesting plant, but does not have the classical features of the European Boxwood.

The following three varieties of Asiatic Boxwood *(Buxus microphylla)* have shown great promise.

1. *Buxus microphylla koreana.*—This Korean Box has proven the hardiest and perhaps the most dependable of all that we have grown. It was received from the late E. H. Wilson of the Arnold Arboretum in 1929, and has been propagated extensively. So far as we know, this plant will always be rather small, very compact, wide-spreading and less than three feet in height. It is entirely winter-hardy, and, unlike most Box, it produces great quantities of very fragrant flowers. These flowers are small and greenish-lemon in color and would not be conspicuous except for their great profusion. However, Boxwood hardly needs to produce flowers in order to find a place in the garden.

2. *Buxus microphylla sinica.*—From seeds imported in 1921 several thousand plants of this Boxwood were grown. Those lacking hardiness were destroyed, and at the present time we have about 100 plants which are now over two feet high. This variety also produces flowers, but it has never seemed quite as much at home here as the Korean Box. The leaves have a curious habit of turning red during the coldest part of the winter and quickly turning to green when the weather moderates, the color sometimes changing several times during the season.

3. *Buxus microphylla japonica.*—A specimen of this Box was received from Dr. J. Horace MacFarland in the fall of 1939, as an unrooted cutting. It is much less compact and tends to a more upright growth than either of the above varieties; also, it has much longer leaves. While it seems entirely hardy it has not been tested as long as the other two. As might be expected, better and distinct varieties may be selected from the two lots of plants grown from Asiatic seed. The largest plants can be found in the Box Garden, and a casual observation shows much variation among the individuals. It is proposed to grow these on until certain types might be selected for propagation, which may not be for many years, for the plants grow rather slowly.

Perhaps the most satisfactory of all the Boxwoods, if we are looking for the classical type, are some grown from seeds of *Buxus sempervirens* collected by Dr. Edgar Anderson in Roumania. Over 2000 seedlings were grown from this shipment, some of which now exceed two feet in height. These show all the variations common in plants grown from seeds, and it is hoped that the

six types singled out for propagation will be the start in the development of Boxwood more suited to the Middle West. In these seedlings it is possible to find some with large and some with small leaves; some with light green foliage, some dark, and some blue-green; some of compact growth, some spreading, and some narrow and upright. The nursery rows have been ruthlessly rogued, and any plant showing a poor growth or inability to stand the summer heat or winter cold has been destroyed. It appears that some very quick-growing types, or which at least outstrip any of the others in so far as rapidity of growth is concerned, can be segregated.

CULTURE OF BOXWOOD

In growing Boxwoods two factors are involved: first, a suitable location, and second, the care that they receive. The proper site for Boxwood should take into consideration the drainage, the exposure in relation to the wind in both summer and winter, the amount of sunshine the plant will tolerate as well as the amount required for maximum development. Our experience indicates that Boxwood should be grown in the open even though this may be a hotter location. In the Middle West a plant grown under partial shade or in the neighborhood of large trees suffers severely during a dry summer. While Boxwood will tolerate the partial shade cast by large trees, we have found it nearly impossible to supply a sufficient amount of water for both the large trees and the Boxwoods. So far we have not found that the summer sun was especially injurious, but exposure to wind is an altogether different story. As a general rule, one might say that Boxwood should not be planted in a location which is swept by wind in either summer or winter. However, we have successfully grown a hedge of Box in one of the most exposed situations in the Arboretum, at the south side of the Main Gate. The success of this planting seems due largely to the richness and the depth of the soil. This brings up the matter of culture, and it is on this that the ~~effects of a poor location can be partly overcome if the soil is main-~~

There are just two basic rules for the culture of Boxwood: (1) good soil, and (2) more good soil. Our experience indicates that we cannot over-emphasize the importance of fertile soil with good depth. It appears that the effect of a poor location can be partly overcome if the soil is maintained in the best possible condition. Either the hot dry winds of summer or the cold desiccating winds of winter may destroy a planting if it is grown in a shallow infertile soil. Mulching and irrigation may help but mulches are so necessary to the success of a Boxwood planting that we use them in some form regardless of the site or the exposure. The very best mulch, of course, is stable manure placed about the plant several inches deep. Where

success or failure of the planting hinges.

planting is extensive, enough manure may not be available, in which case we have successfully used sawdust. A mulch of hay or weeds might be satisfactory but it would be more difficult to use. Leaf mold, no doubt, would be effective, but we have not had the opportunity to try it. No matter how good the soil nor what mulching material is used it will be necessary to supply water at times. We must expect to irrigate through some parts of July and August to compensate for the great water loss at that season, and it is also necessary to see that the ground is thoroughly saturated and remains so throughout most of the winter. Mulching conserves water, and this is as important in winter as in summer. A heavy mulch late in the year will tend to keep the soil about the roots from freezing, and also some water will be available to the plant regardless of how cold and dry the winter may be. The ideal place for Box would be a sunny location, sheltered from summer and winter winds, but not too far from a hose connection. The soil should be the very best in the garden, and an ample supply of mulching material should be within wheelbarrow distance.

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A. P. BEILMANN.

THE HARDY BEGONIA

For a number of years *Begonia Evansiana* has been grown in one of the perennial borders of the Linnean Garden, and since the plants have reappeared each spring there is no doubt about their surviving a winter. Occasionally, horticultural journals describe *Begonia Evansiana* as the only Begonia which may be left outdoors during the winter, giving the impression that it is the entire plant that persists. This is not true: it is the underground tuber which is hardy. From this the plant grows to a height of two feet in a season and blooms during September and October until stopped by the first frost.

The tubers resemble those of the tuberous-rooted Begonia except that they are smaller. In some years many young plants spring up around the parent, being propagated from bulbils which had dropped to the ground. These bulbils, produced in the axils of the leaves, are small, varying from 1/8 to 1/4 inch in diameter. In the spring they should be planted about 1/2 inch deep in their permanent location. Most of them will produce plants bearing a few

The hardy Begonia (*Begonia Evansiana*) growing in the Perennial Garden

Bulbils of *Begonia Evansiana* at the base of a plant of the previous year

flowers the first season. They will grow to two feet or more in height the second year, and in succeeding years other tubers and bulbils will develop from the mother plant. To preserve these bulbils they should be gathered in the fall, packed in dry sand and kept in a cool place. In the spring they may be started in small pots and planted in their permanent quarters when they are large enough to handle. Good bulbils are slightly green and firm, while the immature or dead ones are brown and soft.

In the fall a mulch of oak leaves, straw or excelsior should be placed over the plot of ground where the Begonias grew to protect the tubers and the many bulbils. If this is not done and the winter is an open one many of the bulbils will not survive. Cultivating the soil, or lightly forking it in the spring, forgetting for the moment just where the Begonias stood the previous summer, is probably the main reason why many plants fail to appear the second year. If the mulch of leaves or straw is the "X" which marks the spot where the Begonias grew, there should be no difficulty in treating the plant as a perennial.

The best location for *Begonia Evansiana* is partial shade. There are no particular requirements as to soil except that it be well drained and always kept moist during the growing period. Leaf mold and sand should be added if it is inclined to be heavy.

Begonia Evansiana is illustrated and described in *Curtis' Botanical Magazine, pl. 1473,* published in 1812. The plant was first collected in China and introduced into England about 1804. Unfortunately, few catalogues list this Begonia, but it may be obtained from bulb and Begonia specialists.

PAUL A. KOHL.

NOTES

Mr. Emanuel Grunberg, graduate student at Yale University, is enrolled in the Henry Shaw School of Botany for the second semester, to study medical mycology under Dr. Carroll W. Dodge, Mycologist to the Garden.

Mr. Paul A. Kohl, Floriculturist to the Garden, gave two lectures on "Victory Gardens" at the East Richmond Heights School, February 21 and 28, and two at the West Richmond Heights School, February 24 and March 2. This Victory Garden project was sponsored by the Red Cross.

Mr. George H. Pring, Superintendent of the Garden, gave an illustrated talk on "Tapping the Para Rubber Tree" before the Little Gardens Club of University City, February 28, before the Maplewood Rotary Club, February

29, and at the noonday meeting of the West End Kiwanis Club at the Forest Park Hotel, March 1. On March 8, he spoke before the Rotary Club of Kirkwood, Mo., on "Hunting Orchids in the Tropics."

Dr. Carroll W. Dodge, Mycologist to the Garden, addressed the Mothers' Club of the Alpha Xi Delta sorority of Washington University, February 16, on "Central American Culture." He spoke on "The Working of Our Good Neighbor Policy in Central America" before the Quota Club International at its twenty-fifth anniversary celebration, February 24, and before the St. Louis College Club, March 10.

Dr. David C. Fairburn, Horticulturist to the Garden, has given the following talks recently: "Spring Gardening," before the Ladue Garden Club, January 4; "The Fragrant Garden," before the Four Seasons Garden Club of Webster Groves, January 24; "Seed Sowing and Transplanting," before the Gardening Clinic of the East-Central Region, sponsored by the Missouri Federation of Women's Clubs and the Federated Garden Clubs of Missouri, February 24; "Gardening," before the Botany 1 class of Washington University, March 3.

Recent visitors to the Garden include: Dr. George J. Goodman, Assistant Professor of Botany, Iowa State College, Ames; Lt. George Lindsay, cactus collecter and writer and former Director of the Desert Botanical Garden, Papago Park, Phoenix, Ariz.; Mr. Ralph O. Erickson, Assistant Chemist, Western Cartridge Company, Alton, Ill.; Mr. John O. Lines, orchid grower at Piedmont Nurseries, Signal Mountain, Tenn.; Mr. C. H. Bowen, Assistant State Entomologist, Missouri State Department of Agriculture, Columbia; Dr. George B. Happ, Professor of Biology, Principia College, Elsah, Ill.; Miss Ruth M. Webster, student of fossil botany, formerly of Coe College, Cedar Rapids, Ia.

Mr. Ladislaus Cutak, in charge of Succulents at the Garden, spent two weeks in Florida, February 15–29, principally studying plants of the Bromeliaceae (Pineapple Family) in the collection of Mulford and Racine Foster, at Orlando. Through Mr. Cutak, a mutual exchange of new species of Bromeliaceae and other ornamental exotics was established between the Garden and the Fosters, who have the largest and finest collection of these plants in the country. Mr. Cutak also secured some fine clumps of *Epidendrum tampense* and *Tillandsia utriculata*, while on a collecting trip in the woods below Kissimmee in the Tohopekaligo Lake region.

STATISTICAL INFORMATION FOR FEBRUARY, 1944

GARDEN ATTENDANCE:

Total number of visitors	12,305

PLANT ACCESSIONS:

Total number of plants and seed-packets received as gifts	57

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	36
Total number of books and pamphlets donated	72

HERBARIUM ACCESSIONS:

By Gift—	
Clemens, Mrs. M. S.—Plants of Australia	25
Giles, Norman—*Aneilema geniculatum* (Jacq.) Woodson from Mexico	1
Harper, R. M.—Photographs and notes of Alabama plants	74
McVaugh, Rogers——Plants of Costa Rica	2
Pring, George H.—Plant of horticulture	1
Whitehouse, Eula—Plants of Texas	32
By Exchange—	
Chicago Natural History Museum—Cryptogams from various localities	92
Rocky Mountain Herbarium, by C. L. Porter—Plants of the Rocky Mountain region	250
Rosengurtt, Bernardo—Plants of Uruguay	24
State University of Iowa, by G. W. Martin—Fungi from various localities	51
University of Wisconsin, by N. C. Fassett—Plants of Wisconsin	101
Total	653

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MISSOURI BOTANICAL GARDEN BULLETIN

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SOME FACTS ABOUT THE GARDEN

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

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

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

ULMUS FOLIACEA VAR. *UMBRACULIFERA*, ABOUT 12 YEARS OLD

Missouri Botanical Garden Bulletin

Vol. XXXII APRIL, 1944 No. 4

SOME ORNAMENTAL ELMS

Ulmus is the ancient Latin name of the Elm. It is one of the most important and perhaps the best known of all the shade trees. There are from fifteen to eighteen species known from the whole world—all from the cold and the temperate regions, none from the Tropics and none west of the Rocky Mountains. Most of the ornamental kinds have been developed from the Wych Elm *(Ulmus glabra)*, the Dutch Elm *(Ulmus hollandica)*, and the Smoothleaf Elm *(Ulmus foliacea)*.

In addition to the importance of the tree as an ornamental subject, it has many economic uses. The bark of the native Slippery Elm *(Ulmus fulva)* has been used in medicine for a long time. Lumber to the extent of 155,000,000 board feet is cut from our native Elms annually for use in varied industries. The wood of American, Rock, and Slippery Elm is used indiscriminately for slack cooperage; for spokes, rims, and body parts in vehicles; for boxes, crates, etc. Quantities of it are used by the woodenware industry for pails and step-ladders, and some is made into veneer. The wood is shock-resisting and especially satisfactory for bending purposes. However, it twists and warps very badly, and special pains are taken to store and kiln-dry the better grades. On the whole, it is not considered a "construction wood" but it can be used out of the weather for rough construction work where the specifications are not too rigid.

Perhaps the tendency of the Elm species to mix is due to the fact that the tree does not grow in pure stands. It is scattered throughout the forest, and as many as three species may be found in one tract of timber. The American Elm, of course, outnumbers the other kinds.

It is seen then that the Elm has a place in our national economy and that it would be quite important even though it were not used as an ornamental tree. Undoubtedly, most people think of the Elm as a shade tree, and beyond question it is the best known and perhaps the commonest shade tree in the United States. It is the ornamental forms of this tree with which we are mostly concerned, and a very formidable list of orna-

mental types has been grown in the Garden and at the Arboretum.

The American Elm, quite common throughout the country east of the Rocky Mountains, is of course well represented here. There are many types of this tree; in the woods no two are exactly alike. To study the general forms of the American Elm it would be necessary to go farther East where many mature specimens can be found serving as shade trees. Some of these

Ulmus americana
Seedling of Daniel Boone Elm planted in 1922

are called "vase-shaped", since they gradually flare to a wide top which often is nearly flat. There are some narrow types and the "Moline Elm" is the best example of this. This tree grows upright rapidly, spreads very little, and makes an ideal specimen for narrow street planting. Then there are types called "Feathered Elms" which produce a mass of short spurs along the trunk and main branches. Although they have not been propagated nor given a common name, semi-pendulous types can often be seen lining the village commons in some eastern towns.

Perhaps the Slippery Elm *(Ulmus fulva)* is the second most important native Elm. Since it does not grow much north of the Great Lakes, its distribution is just a little less than that of the American Elm. Like its relative, it does not occur in pure stands but certain wood-lots may contain a high percentage of this tree. In most respects it differs from the American Elm: its branches are very heavy, the twigs hairy, and the buds much larger. The tree is seldom symmetrical, and it has a curious light-colored longitudinally fissured bark. This is the only native Elm whose wood can be readily split with an ax. The color of a sawed board is much darker than that of the other Elms. A good distinguishing feature of this tree is its hairiness both as to leaves and branchlets. The inner bark, another aid in identification, is very mucilaginous. Chewing a small twig at almost any time of the year, but especially in spring, will give us a clue to its identity and the reason for its common name.

The third native species, the Rock Elm *(Ulmus racemosa)*, is confined to the region north of Mississippi and is probably the least common Elm in this vicinity. The tree develops cork wings along the smooth branches and produces flowers in pendulous racemes. It is, however, twice as big as the fourth species found in this vicinity, the Winged Elm *(Ulmus alata)*. This tree grows from southern Missouri south and eastward. It is never a big tree, and while very interesting it probably is seldom cut for lumber.

Two Asiatic Elms have come into prominence recently, the Chinese and the Siberian. The one most commonly planted is the Chinese Elm *(Ulmus parvifolia)*. This is a true "real-estate" tree, lacking the structural strength of the other Elms and often broken in storms. However, its growth rate has been so favorable that it has been used extensively throughout the United States and often planted in situations poorly suited to its habit. A detailed description of the tree would seem out of place to-day because it has been planted by the millions. Experience at the Garden has shown that it reaches maturity and begins to break in storms any time after fifteen years. Present-day strains of this tree appear to grow somewhat slower than those first imported and consequently they seem to withstand sleet and wind somewhat better. Although it has been planted everywhere and in every possible situation, it does have certain requirements which must be met. It does require fairly fertile soil and good drainage; it will not do well on a very dry graded hill nor when planted over hardpan. It flowers along with the other Elms in spring.

There is considerable confusion concerning the Siberian Elm *(Ulmus pumila)* and the Chinese Elm, but there is not much similarity. The

Chinese Elm is a tall fast-growing tree flowering in spring, while the Siberian Elm is a dwarf tree seldom exceeding 20 feet and flowering in late summer. The Siberian Elm makes a very satisfactory tree for the small garden. It never produces suckers or fertile seeds in this vicinity and it requires very little pruning.

Most of the horticultural varieties have been developed from the European Elms. From the Wych Elm *(Ulmus glabra)* kinds with purple leaves, with weeping branches, and with fastigiate or dwarf habit have been selected. Perhaps the best-known dwarf is the Camperdown Elm,

Ulmus glabra var. *nana* (Dwarf Wych Elm)

which is often grafted on some other root stock to form a global head. Most of the kinds with oddly colored leaves do not do well in the Middle West, the one exception being the Silverleaf English Elm *(Ulmus campestris* var. *argentea)*. The English Elm *(Ulmus campestris)* was a favorite of Mr. Shaw's, and Tower Grove Park has a number of mature specimens that must have been planted by him some ninety years ago. This tree does very well in the Middle West and retains its leaves longer in some seasons than the American Elm. It can usually be identified when mature from its

habit of producing many suckers. Another Elm that does very well in this vicinity is the Globe Elm *(Ulmus foliacea* var. *umbraculifera)*. Relatively few of the Elms mentioned above can be found in the Middle West, and only one variety of the American Elm, the Moline Elm, has been planted to any extent.

Generally speaking, the Elms are not difficult to grow. They require a deep soil for best development, but they are not as exacting in regard to soil moisture as might be expected although they do grow better where moisture is available. The Elms probably have as many serious diseases and insect pests as any shade tree. The Dutch Elm Disease has done much harm in the East. It has been almost unknown in the Middle West but several equally serious diseases of the conducting system have been found here. These attack the water-conducting tracheids, closing them and shutting off the water to the leaves as effectively as if the tree had been cut with an ax. Some of these diseases are known and have been described; of others only part of the life history is known. They may cause the death of a single branch or they may kill the entire tree in a very short time. Sometimes the disease can be eliminated by pruning the infected branches, but sometimes pruning only serves to spread the disease. These troubles become most noticeable in hot dry years. It is possible that the diseases have little effect upon a normal tree supplied with sufficient water and food. On the other hand, some infected trees can be found each year regardless of the weather.

Elm trees generally respond to modern tree surgery. Often they need bracing and cabling because of the habit of forming sharp forks. Generally, pruning wounds, if sufficiently large, begin to decay, but the Elm responds to cavity work; that is, the decay may be successfully removed and the cavity filled with concrete. There is another difficulty common to the Elm—a condition known as "slime flux." This is an exudation from water-logged areas of the trunk which appears on the surface of wounds. It seems to be a dietary upset and so far no control has developed. In many cases the condition causes no serious harm but it is unsightly and may retard the healing of pruning cuts.

The insect pests of the Elm are rather numerous. In addition to those which attack only species of Ulmus almost every leaf-chewing insect, when in epidemic numbers, will feed on this tree. There are several enemies among the scale insects, and one, the Elm Bark Louse, is found only on the Elm. It will be obvious then that if we propose to grow the Elm as a shade tree we must be prepared to irrigate and fertilize to ward off disease, and to spray in winter and summer to control the insect enemies. The Elm, how-

ever, is a very satisfactory shade tree. Some of the better-than-usual varieties are worth the extra effort required to keep them growing.

Perhaps the following resumé will be of some value in choosing an Elm for a particular location:

The American Elm *(Ulmus americana)* is a very big tree suitable for large gardens or wide streets. It may be possible to purchase weeping and upright types from certain nurseries. The Moline Elm is a columnar variety of the American Elm and may be used where space is limited.

The Winged Elm *(Ulmus alata)* is an excellent small tree having interesting corky wings on the branches. However, it is not dependable much farther north than St. Louis.

The Rock Elm *(Ulmus racemosa)*, a northern tree not often planted, is inferior to the other native Elms as a shade tree.

The Slippery Elm *(Ulmus fulva)* is a very common tree in our woodlots but is probably shorter-lived and far less satisfactory as a shade tree than the American Elm.

The Chinese Elm *(Ulmus parvifolia)* needs little discussion. Almost every one has planted it and therefore it has been tried in every possible location. Its chief claim to distinction is its rapid growth. It has no other good characteristics.

The Siberian or Dwarf Asiatic Elm *(Ulmus pumila)* is an excellent tree for the small garden. In the Middle West it will probably never exceed 25 feet in height. It is a slow-growing tree with many desirable habits. Several varieties of this are reported, and it may be possible in time to obtain other forms.

A great many varieties of the Smoothleaf Elm *(Ulmus foliacea)* are in cultivation. The best is the Globe Elm (var. *umbraculifera*). The enthusiast may find additional varieties listed in the nursery catalogues. Some of the pyramidal types should prove quite interesting.

The English Elm *(Ulmus campestris)* holds its leaves much longer than the native Elms. It is generally pyramidal in outline, often as big as the American Elm, and entirely satisfactory as a shade tree. A number of varieties are reported but most of those with variegated leaves are not suitable for our climate.

The Wych Elm *(Ulmus glabra)* is also a large tree, usually spreading more than the English Elm and seldom producing the root suckers common in that species. It is a good tree for park or lawn planting, retaining its leaves even longer than the English Elm. It has been in cultivation for a very long time, and many horticultural forms have been developed. The

Camperdown Elm is one of the best varieties. Most of the horticultural forms, however, have not been tried extensively in this region, and in our experience most of them are somewhat unsatisfactory.

A. P. BEILMANN.

THE PINES IN MR. SHAW'S GARDEN, 1875

Recently a list of twenty-seven Pines in Henry Shaw's careful handwriting was discovered at the Garden, bearing the title: "Pinus—in Hort. Bot. Mo. November 18 1875." It is well known that Mr. Shaw grew many evergreens—not only Pines, but also Spruces, Firs, Taxads, and others—and the list indicates how comprehensive his collection was even at that time. The list follows:

Pinus sylvestris
" *mughus*
" *pungens*
" *pinaster*
" *pinea*
" *maritima*
" *inops*
" *rubra (resinosa)*
" *mitis*
" *taeda*
" *rigida*
" *strobus*
" *cembra*
" *Benthamiana*

Pinus austriaca
" *Jeffreyii*
" *ponderosa*
" *flexilis*
" *edulis*
" *pumilio*
" *excelsa*
" *Banksiana*
" *laricio*
" *pyrenica* Lapeyr.
" *peuce*
" *macrocarpa*
" *canariensis*

In the light of our own experience—some sixty-eight years later—it may be interesting to examine each one of the species that Mr. Shaw grew and make some comments on their behavior. It is not often possible to compare an old list of plants with what is available after half a century. This could be done only with the woody plants, particularly of a group in which there had been a limited introduction of horticultural forms. From Mr. Shaw's list we can determine only that the trees were growing, not how many, how old, or how long they lived. There have been certain changes in nomenclature, and some names have been reduced to synonymy, but on the whole this list contains things comparable with what we are growing to-day.

Pinus sylvestris (Scots Pine).—This, of course, is a common Pine found growing in many of the larger gardens. Its life span in our region probably will not exceed twenty years. The tree grows over most of western Europe from Scotland almost to the Mediterranean. It is a very variable species and seeds from most parts of Europe produce short-lived stunted trees. A variety from Latvia *(Pinus sylvestris* var. *rigensis)* is a tall straight timber tree and is the only one which should be planted.

Pinus Mughus (Swiss Mountain Pine).—This tree, in some form or other, is doubtless the most commonly planted ornamental Pine. Its life span appears to be about a quarter of a century. The specimens available from nurseries are usually of the small globe-shaped type. Tall straight types are not well known in the United States although we have grown the varieties *uncinata* and *rostrata*, which are reported as single-stem trees native to the Alps. All the plants which we have started from seed have had multiple trunks and grew into globe-shaped specimens of various sizes. On the whole, this is an excellent ornamental Pine for the Middle West.

Pinus pungens (Table Mountain Pine).—This is a native Pine reaching from 30 to 60 feet in height and growing from New Jersey to northern Georgia. It would seem to have limited ornamental value, in addition to lacking hardiness, and has not been grown at the Arboretum.

Pinus Pinaster (Cluster Pine).—A native of the Mediterranean region, recommended for seaside planting and reported as a handsome Pine of rapid growth. However, it is not hardy except in the southern states.

Pinus Pinea (Italian Stone Pine).—A large tree from the Mediterranean region and hardy only in California and the southern states. Seeds have been imported a number of times, but no plants have been successfully grown at the Arboretum.

Pinus maritima.—This is a synonym of *Pinus Pinaster.*

Pinus inops.—This name has been reduced to synonymy, and the accepted name to-day is *Pinus virginiana* (Scrub Pine). It is a large tree growing from New York to Georgia along the coast. When planted in the proper location the tree may reach 60 feet in Missouri. A group of one hundred specimens is growing at the Arboretum. In its native habitat this Pine is symmetrical only in youth and is not very ornamental when full grown.

Pinus rubra.—No such specific name is in use to-day, but in parentheses Mr. Shaw had added "resinosa." This is the Red Pine of the North which grows into a valued timber tree. No large trees are growing at the Arboretum but a hundred small plants from Pennsylvania seed are in our nursery. It is possible that seed from trees in certain localities may produce a type which would be entirely satisfactory in Missouri.

Pinus mitis (the "Spruce Pine" of Michaux).—The accepted name of this tree to-day is *Pinus echinata* (Shortleaf Pine). It is the only species of Pine native to Missouri. Of all the Pines grown at the Arboretum none are more difficult to start or to keep alive than this one which can be found growing naturally from St. Clair, Missouri, on south to the Gulf. At the moment, six 8-foot specimens are growing near the Main Gate, and some 1800 seed-

lings have been planted at another location. It would be interesting to know if Mr. Shaw encountered the same trouble when trying to introduce this Pine to his garden. The tree reaches its greatest development in eastern Texas, although it is a valuable timber tree wherever it grows naturally. As an ornamental tree it is interesting but not especially beautiful. When mature the tree has an open crown and appears rather leggy due to the loss of the lower branches.

Pinus Taeda (Loblolly Pine).—Just two specimens of this Pine are growing at the Arboretum. The species grows farther south than the "Shortleaf" and is its active competitor in Arkansas and Texas where their ranges overlap. It is a much more ornamental tree than the Shortleaf Pine but it is of very doubtful hardiness. If Mr. Shaw grew this Pine in his garden we are inclined to believe that our weather at present differs greatly from that of his time.

Pinus rigida (Pitch Pine).—Here is a native Pine recommended for dry situations and found from New Brunswick to Georgia. However, in spite of many seed sowings no specimens are growing at the Arboretum. It is possible that a careful selection of seed might yield plants suitable for this region.

Pinus Strobus (White Pine).—This is the most famous North American Pine. It does well at the Arboretum and some very old specimens—no doubt planted by Mr. Shaw—can be found in Tower Grove Park to-day. In addition to being the backbone of the northern timber industry for several generations, it is one of the most beautiful and the largest of our Pines. When used for ornamental purposes it must be remembered that it is a timber tree. It may reach a height of 30 feet in twenty years and is obviously not suitable for foundation planting.

Pinus Cembra (Swiss Stone Pine).—A winter-hardy tree native to the European Alps and growing eastward to Mongolia. Like the White Pine, it has five needles in a cluster. No specimens are growing at the Arboretum, as our experience has been that it cannot withstand our hot dry summers. Several horticultural forms can be obtained from nurseries but we doubt if any of them would endure a Missouri summer.

Pinus Benthamiana.—The accepted designation for this tree to-day is *Pinus ponderosa*, the Western Yellow Pine. It grows from British Columbia to Mexico. Types hardy in this vicinity can be obtained. An excellent group can be found at the Arboretum, while the very largest tree known to the writer is on an estate at Alton, Illinois. Ornamentally, this tree has much to recommend it. The leaves are nearly ten inches long.

When planted in good soil it does well and should be accepted in most gardens.

Pinus austriaca.—This is another synonym for *Pinus nigra* and will be discussed with *Pinus Laricio.*

Pinus Jeffreyi (Jeffrey's Pine).—This is a distinct ornamental Pine from Oregon and California, having blue-green needles from 8 to 12 inches in length. It is reported as being hardy in the Middle West, but in spite of many attempts we have not been successful in establishing it.

Pinus ponderosa.—This was described under its synonym *Pinus Benthamiana.*

Pinus flexilis (Limber Pine).—Because this tree grows in the mountains from the Canadian border to western Texas, we might expect that hardy kinds could be found. It is one of the distinct trees of the West, growing spire-like when young. It would be a welcome addition to the Pines in the Middle West, but we have not been successful in growing it beyond the nursery stage. It is believed that a careful selection of seed might yield perfectly hardy types.

Pinus edulis (Nut Pine).—The accepted botanical name of this tree is *Pinus cembroides* var. *edulis*, and there are several related species growing from southern Wyoming to Mexico. Our experience indicates that in this region they grow very slowly, producing an ill-shaped plant little better than a shrub.

Pinus Pumilio.—This is merely a Balkan variety of the Mugho Pine *(Pinus Mughus* var. *Pumilio)*, previously described. In so far as we are able to determine there are but minor differences in all of the forms of the Mugho Pine. We have imported seed from many stations in Europe, but very few of the trees started have grown to fruiting size. Only the types available from nurseries seem to withstand summer weather, and even these do not live longer than twenty-five years.

Pinus excelsa (Himalayan White Pine).—This is one of the most beautiful of all the Pine trees, having needles up to 10 inches in length. Of many seed importations none have produced plants with the exception of *Pinus excelsa* var. *Griffithii* (Griffith's Himalayan Pine). This tree does well in Wooster, Ohio, and Dr. von Schrenk grew a specimen at his home in St. Louis County for fifteen years only to have it killed in the winter of 1940. Our specimens at the Arboretum are doing well. It is certain that this tree cannot be grown without special care, but its outstanding beauty justifies that care.

Pinus Banksiana (Jack Pine).—This is a northern tree growing from the timber-line on the Mackenzie River in Canada south to Michigan. It has

never been highly regarded as a timber tree, but its short needles are distinctive and it is a worth-while addition to the list of ornamental Pines for this region. The tree begins to bear fruit at about twelve years of age and if planted in good soil it appears likely to flourish for thirty years or more. The best specimens at the Arboretum are about 25 feet tall.

Pinus Laricio.—This name is a synonym for *Pinus nigra*, the Austrian Pine. It is probably the most important timber tree in central Europe and quite a number of varieties have been segregated. We have been unsuccessful in growing many of these varieties from imported seeds but the species is well represented in our collection. This is one of the last trees to survive the smoke of St. Louis. Most of the Pines left in Tower Grove Park are of this species, and many of them were planted by Mr. Shaw. In our experience it will reach its maximum height in about twenty years. After that it grows but little although it may live for forty more years. It is a very satisfactory tree for the Middle West but it is always too large for the small garden and it is entirely out of place in a foundation planting.

Pinus pyrenaica.—This is a variety of the Black Pine from the south of France. As has been stated, we have not successfully grown these varieties although we have grown "*Pinus pyrenaica* David," but not beyond the nursery stage.

Pinus Peuce (Macedonian Pine).—This Pine from the Balkan Mountains appears to be entirely hardy here. However, it grows very slowly, our largest plant being but 30 inches tall after ten years. It is possible that this Pine can be made to feel at home if planted in exactly the right location although our experience indicates that it has limited ornamental value.

Pinus macrocarpa.—The accepted name of this Pine to-day is *Pinus Coulteri* (Coulter's Pine). The tree is one of those confined to a rather restricted area of southern California, and not at all hardy in this region. No plants have been grown from numerous seed importations.

Pinus canariensis (Canary Island Pine).—This is reported as a very big tree long grown in southern Europe, but not hardy even in the southern states. Evidently grown under glass by Mr. Shaw.

In reading Mr. Shaw's list of Pines we find that he devoted much attention and time to assembling all the Pines which could be obtained. In many cases there was little hope for success especially when growing the species from the far South. It is also true that there was little chance of succeeding with the northernmost or the alpine Pines. During Mr. Shaw's time there was much talk among European foresters about "races" of trees. In 1862 deVilmorin became interested in the races of the Scots Pine (*Pinus*

sylvestris), and two varieties based on their origin were described. One was var. *lapponica* and the other var. *rigensis* found growing in the region about Riga in Latvia. The Scots Pine from Riga was prized for its clear straight trunk suitable for ship-masts, and it differed greatly from *P. sylvestris* from other parts of Europe.

We might add a few more names to Mr. Shaw's list of Pines, some of which we have attempted to grow. Often, when a tree is reported as not being hardy in this location, special efforts are made to obtain seed from a region which has comparable climate. It is not unlikely that superior types can be found if the entire range of a single Pine were investigated. Many of the alpine kinds will prove winter-hardy but quite unable to stand our summers at the much lower elevation of the Mississippi Valley. On the other hand, trees capable of enduring the heat of Texas and New Mexico may not be able to survive our winters. However, most Pines have a wide distribution and are found growing from north to south through several states. If we bear in mind that we require winter hardiness in southern Pines and summer hardiness in northern Pines and carefully choose locations from which to collect seed, other species might be added to a list for the Middle West. Seeds of European and Asiatic Pines should also be collected from a region having a climate somewhat like our own. It is possible that some species not common here might be added to our list of ornamentals. The Asiatic Red Pine *(Pinus densiflora)* has been known since 1854, and has been one of the most successful at the Arboretum. This is a 2- to 3-needle Pine having several trunks—not likely to grow into a timber tree—but entirely satisfactory in the Middle West. Another related species is the Asiatic Black Pine *(Pinus Thunbergii)*. This tree appears entirely at home at the Arboretum, and, unlike its relative, it grows more upright with fewer trunks. Both of these species are of fruiting age and some seedling hybrids have been found. The Lodge-pole Pine *(Pinus contorta* var. *latifolia)* from Montana and Colorado has survived for ten years at the Arboretum. It resembles the Jack Pine and has the same growth habit. We do not know its maximum development nor its life span under our conditions. Another species from China and introduced in 1864 is the Lace-bark Pine *(Pinus Bungeana)*. This is reported to reach a height of 75 feet, but in our climate it grows very slowly and is not particularly interesting while young.

The attempt to grow all species and varieties is still the function of an Arboretum, no less so than it was in Mr. Shaw's day. A great deal more information is available to-day; perhaps the wealth of information has merely added to the confusion. At any rate, more and more effort will be

made in the future to acquire tree seeds of known origin. The forester will demand it, and only by knowing the seed source will he be able to extract any information from the experimental introduction of new species at the Arboretum. To cite an example: The Douglas Fir *(Pseudotsuga taxifolia)* does very well at the Arboretum. However, foresters recognize several races of this tree, some of which are much more suited to our conditions than others. Many more similar examples might be given. In 1937 Dr. E. Munch wrote, "Pine in different places of its range belongs to the same species only in external appearance." This modern concept of the problem holds much promise. In time we may expect that there will be an increase in the number of Pines which can be grown in our region. Hardy types of Lebanon Cedar *(Cedrus libani)* have been found, and if enough attention is paid to the collection of seed and if the source of that seed is known, we may anticipate a good deal of improvement in the Pines suitable for the Middle West.

A. P. BEILMANN.

NOTES

Chronica Botanica (**7**:378-380) contains an article on "Mass Collections" by Dr. Edgar Anderson, Geneticist to the Garden.

Mr. George H. Pring, Superintendent of the Garden, spoke before the Webster Groves Garden Club, March 15, on "Trees."

Dr. Edgar Anderson, Geneticist to the Garden, has been asked to serve as a member of the Daffodil Committee of the American Amaryllis Society.

Mr. Ladislaus Cutak, in Charge of Succulents at the Garden, gave an illustrated lecture "Cacti and Succulents," before the Grantwood Gardens Club, at Affton, Mo., April 4.

The annual Flower Sermon, provided for in the will of Henry Shaw, was preached at Christ Church Cathedral on Sunday, April 16, by the Rt. Rev. Karl Morgan Block, Bishop of California.

Dr. David C. Fairburn, Horticulturist to the Garden, spoke on "Planning, Planting and Maintenance of Victory Gardens," before the Parent-Teachers' Association of the Meramec School, March 14.

The article "Quinine or Malaria," by Charles Heiser Jr., graduate student at the Garden, published in the February Garden BULLETIN, has been reprinted in the March 15 *Chemurgic Digest* (3:74-78).

The third and completing fascicle of Part II of the "Flora of Panama,"

by Robert E. Woodson, Jr. and Robert W. Schery, was recently issued as the February number of the ANNALS OF THE MISSOURI BOTANICAL GARDEN (Vol. 31, No. 1).

Recent visitors to the Garden include: Dr. L. H. Leonian, Professor of Mycology, West Virginia University, Morgantown; Dr. George J. Goodman, Assistant Professor of Botany, Iowa State College, Ames; Miss Kathleen Snyder, Assistant Editor, *Chemurgic Digest*, Columbus, Ohio.

After a year's leave of absence, Dr. Edgar Anderson, Geneticist to the Garden, has returned as a member of the staff. Under fellowships of the Guggenheim Foundation and the Rockefeller Institute he has been investigating variation in Indian corn *(Zea Mays)* in Mexico and the Southwest.

The December 1943 number of *Flora*, an Ecuadorean botanical publication, contains an article entitled "Botanicos que estudian la Flore Ecuatoriana," in which are given portraits and biographical sketches of North American botanists now in Ecuador. Among those included are Dr. Julian A. Steyermark and Dr. F. Marion Ownbey, both of whom did their graduate work in the Henry Shaw School of Botany and are now with the U. S. Office of Foreign Economic Administration which cooperates with the Ecuadorean government in a project to explore for Cinchona trees in Ecuador.

STATISTICAL INFORMATION FOR MARCH, 1944

GARDEN ATTENDANCE:	
Total number of visitors	7,474
PLANT ACCESSIONS:	
Total number of plants and seed-packets received as gifts	38
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	31
Total number of books and pamphlets donated	86
HERBARIUM ACCESSIONS:	
By Gift—	
Cutak, Lad.—*Tabebuia* sp. of Horticulture	1
James, Leslie—Plants of Alabama	3
By Exchange:	
Chicago Natural History Museum—Plants of Hawaii	12
Iowa State College, by Ada Hayden—Specimens and photographs of *Asclepias* of Iowa	27
New York Botanical Garden—Plants of the Great Basin	177
Rosengurtt, Bernardo—Plants of Uruguay	20
Total	240

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MISSOURI BOTANICAL GARDEN BULLETIN

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SOME FACTS ABOUT THE GARDEN

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

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

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

PLACING DEAD BRANCHES ON THE CONTOUR TO CHECK EROSION IN WOOD-LOTS

Missouri Botanical Garden Bulletin

Vol. XXXII MAY, 1944 No. 5

FIFTEEN YEARS OF EROSION CONTROL AT THE ARBORETUM

Erosion is a constant threat to an Arboretum, just as it is to farm land and even to the smallest gardens. Soils are carried away by many agencies, but in this vicinity rain causes the spectacular damage which we have come to think of as erosion. Although most people assume that erosion control or soil conservation is a recent development, 2500 years ago Confucius was reported to have advised his listeners not to interfere with seasonal farming nor to let woodsmen operate in the forest except at the proper time. He believed that only with these precautions could the national well-being continue.

The need to protect the top soil, the medium in which most of the foods we require grow, has been understood for a very long time. Terracing, in one form or another, has been practiced by many people from the very beginning of agriculture. However well it might have been understood elsewhere the great advance in soil conservation in this country goes back but a few years. As a nation we have attacked the problem on a huge scale and used much machinery and developed new techniques. Many state and federal agencies have been set up to assist the landowner in conserving soil and to reclaim degraded areas. It will not be amiss, while this subject is attracting such attention, to examine the problem as it applies to an Arboretum and to review the work which has been carried on at Gray Summit.

Terraces were first constructed in the Pinetum in 1929. Terracing is a fundamental method of conserving soil and checking erosion and consists of forming a low ridge of soil at a particular elevation across the slope of a hill. There may be but a few or as many as a dozen such ridges depending on the size of the field and the slope. Terraces tend to divide a field into narrow bands having a relatively gentle slope. These first terraces were rather high and difficult to cross with machinery, but they have served the purpose and none have broken down. Present-day terraces are of a standard type, generally lower and easier to cross with farming tools. Additional

terracing was done in 1930, when the apple orchard was planted; altogether some 60 acres were terraced.

Since 1930 other methods of keeping the soil on the hill have been used. One method that has been practiced even more extensively than terracing is mulching. In its simplest form this consists of spreading straw or some such material on a freshly graded slope, either before or after seeding, for the purpose of slowing the runoff of rain. There are many forms of mulching, but here we are interested only in mulching to reduce erosion.

Broadly speaking, landscape grading as usually practiced must be considered a very serious type of erosion. In the ordinary "cut and fill" grading, the high spots are removed to fill the low places. The usual method is simply to begin cutting away the top of the hill and to fill in the

Roadside in rough stage

hollows, by the use of whatever machinery is available. In an Arboretum there is no more serious and certainly no faster kind of erosion. With modern machinery more soil can be moved in a few hours or a few days than can be eroded by rain in many years. If the top soil is disregarded (and it usually is), then a few hours of grading will do more harm than all the rain which may fall in fifty years. Since 1939 all road grading, and in fact all grading, has been carried on with the thought that top soil must be preserved. To do this, a bull grader is used to shove the top soil in piles near the edge of the area until the necessary cutting and filling is completed. After the lower mineral soil has been moved about to get the

proper grade the pile of top soil is brought back and replaced. This procedure has been followed in all road work, and it might be added that the more naturally a road fits into a landscape the more certain it is that much grading was needed. Occasionally both sides of roadside slopes have been covered with straw and hay for a quarter of a mile. In many cases weedy growth from adjoining fields has been used. If such an area is seeded to grass after the original top soil is replaced and then mulched, the first summer will usually heal and remove much of the evidence of fresh grading. While an objection to the cost of removing and replacing the top soil might be raised, the value of this soil is so great that special pains in grading are justified. It is easy to cut down a hill with heavy tractor equipment and fill in an adjoining low spot, but after all the good soil has been removed

Finished grading

from the hill it might take half a century to form enough top soil to support plant life.

A rather extensive lot of machinery is required for this kind of work: the usual farm tractor, with plows and discs, as well as graders, rollers, drags designed for crawler tractor use, etc. No matter what tools are used nor how large or small the area, it is the practice today to remove the top soil before grading and to replace it when the sub-grade is established. Where washing has occurred it has been controlled by driving in stakes to hold the mulch. Sometimes both mulch and sod are used as a filler. Deep roadside ditches have no place in an Arboretum. The same water-way can

be provided by making the ditch quite shallow but very wide.

The very best demonstration of the effectiveness of the methods used recently in the Arboretum is shown in the "Story of the Two Bridges." Both are on Brush Creek, which bisects the Arboretum. The upstream (West) bridge is about 2200 feet east of the Robertsville road; the other is 2500 feet downstream. The region west of the property line is normal farm land and subject to the usual erosion, while within the Arboretum area very little erosion occurs. Although these bridges and dams are but 2500 feet apart the amount and kind of water which passes them are quite different. That part of Brush Creek draining the farm land to the west is either entirely dry or a raging flood. At the lower dam, water flows for

Grading finished and shoulders mulched with straw

all of the year except part of the dryer summer. The creek itself, as well as its tributaries, are free from muddy water. The actual volume of water passing the two bridge sites happened to be measured while the bridges were under construction. At the West Bridge a small centrifugal pump, with a capacity of 1500 gallons an hour, was all that was required to keep the excavation dry most of the time. Occasionally as much as 25,000 gallons per hour were pumped, but this was only during a rain or while the snow was melting. At the East Bridge, a minimum of 30,000 gallons an hour was handled by pumps for weeks at a time and while the snow melted as much as 55,000 gallons were pumped hour after hour for a week. During the time of the peak flow at the East Bridge a four- and a three-inch cen-

Pool at West Bridge before sedimentation

Flood in Brush Creek, East Bridge

trifugal pump were used. Often there was but little water passing the upstream bridge while the rate of flow at the downstream bridge exceeded 30,000 gallons an hour. Essentially the same situations have occurred time after time at these bridges since their completion. A hard shower causes a very rapid rise in the creek, the muddy water flows away quickly and the flowage at the West Bridge soon stops. On the other hand, a week may elapse before all of that hard shower reaches the creek at the East Bridge.

The result of water-shed control is clearly seen at either pool behind the dams. Originally 750,000 gallons of water were impounded at the West Bridge and about 500,000 gallons at the East Bridge. The dams were closed on May 22, 1940. In just three years, so much silt has been washed into these pools that there is barely eight inches of water left, and this is confined to a stream three or four feet wide. The original lakes were from 45 to 60 feet wide, approximately 250 feet long, and 4½ feet deep. The amount of mud deposited in them is roughly equivalent to one inch of top soil evenly spread over 50 acres. This demonstration of the effectiveness of erosion control can be observed at almost any time, but especially within six hours after a hard downpour. After the flash flood has passed and the muddy water has receded at the West Bridge, a walk along the banks of Brush Creek between the two bridges will disclose only clear water entering the creek from the Arboretum.

Mulches, check dams, and a good plant cover are needed to prevent erosion in the open field. In the woods a different technique is required. Here a thick layer of leaves will prevent erosion, and the first step in obtaining this is fire prevention. While the leaves on the tree and the tree trunks tend to shelter the ground from a beating rain, sufficient rain eventually reaches the ground to cause erosion unless a deep leaf mold is present. The best method of holding the leaves in place is to lay all small dead trees and branches across the slopes, following the practice of making terraces. If many branches are laid across the slope, as shown in the illustration (pl. 15), it might be difficult to walk through the woods. However, the evidence of this work usually disappears within three years because decomposition has taken place and the branches, as well as the leaves, are reduced to plant food. The deep leaf mold acts as a sponge during rainy periods, and the forest floor remains damp long after a similar but unmulched site becomes dry. The effectiveness of this control method has been demonstrated on a number of wooded slopes in the Arboretum. Even during continued rains in the spring no muddy water enters the water-ways and creeks, while on places where fire or cattle or some other agency has prevented the accumulation of leaf mold, the muddy water rushes down

Two views of Brush Creek—West Bridge, July, 1943

the woody slopes.

It is seen that rainfall is a most serious eroding agent, but through the uses of good cover, terraces, and other methods, erosion can be controlled. The exact method to be used in any particular case depends largely on local conditions. Terracing may be required or mulching alone may be satisfactory, or a combination of these, or other methods which have not been touched upon may be the solution. However, heavy rainfall is not the only soil destroyer. Landscape grading is equally effective and is sometimes much faster than any natural agency. But if good gardening is combined with the grading the erosion problem is usually solved. Not enough attention has been devoted to increasing the forest litter and thus holding the rain.

It is certain that the peak flood of any creek or river could be lowered if the watershed were made to retain a maximum amount of rainfall. Reducing runoff from farm land is difficult and not entirely effective, and it seems that more attention to the condition of the woods might be of greater benefit in erosion control. Most rivers in this section have some scattered timber on the watersheds. If each wood-lot would hold the water a very marked decrease in flood peaks might follow. The two bridges at the Arboretum and the watershed of Brush Creek might be looked upon as a laboratory and serve as a guide toward erosion control. If, in addition to the accepted soil conservation practices, the cover of pastures and open fields were increased and if the wood-lots were manipulated to act as a sponge then top soil should build up annually instead of washing away. The erosion problem in an Arboretum, as well as a farm, begins with the first drop of rain on the highest hill. This drop and those that follow must be absorbed by the ground to prevent erosion and runoff. If fire is kept out of the woods and the litter built up the forest becomes a reservoir. When accepted conservation practices are used to check erosion in an Arboretum then it is necessary to revise grading methods. Otherwise the inevitable "cut and fill" becomes the greatest destroyer of top soil.

A. P. BEILMANN.

A TRIP TO THE FLORIDA TROPICS

It was in February when this writer arrived in Orlando, Florida, and while blustery winds were chilling much of the North the tropic and semi-tropic trees and shrubs were lushly blooming in the Land of Flowers. Hedges of Azaleas were ablaze with red, white, salmon, purple and every conceivable shade of pink. Dark green bushes of Camellias were resplendent

with soft blush-pink to deep red blossoms. Pyrostegia covered roof-tops, fences and walls with a dazzling flame color. Carolina Jasmine overran low shrubbery or reached for the tall trees where it produced clusters of delicate lemon-yellow trumpets. These were the outstanding flowering plants, but there were many others, perhaps a trifle less spectacular, that formed pictures of bewildering beauty.

The purpose of the trip to Florida was to study the Bromeliaceae in the vast collection of Mulford and Racine Foster in Orlando. These two people have discovered more than seventy species and varieties of that plant family

In the Orchidario at the Fosters

in Brazil alone—a remarkable record indeed when you consider that such outstanding specialists as Martius, Ule, Mez, Lyman Smith and others had gone over the same region prior to the Fosters' expeditions in 1939 and 1940. Their living collection of Bromeliads is perhaps the largest in the World, about 400 distinct species being grown in the Orchidario. Before the present World War, Mr. and Mrs. Foster made plant excursions to Central America, Cuba, Mexico and South America and are even now planning further trips to regions where new discoveries might be made.

Mr. Foster hails from New Jersey, but for the past eighteen years he has been a faithful son of Florida where he has become established as a land-

scape architect. Many of the finest subdivisions, parks and private gardens in that state are the result of his painstaking work. When he was unable to get all the plant material that he needed he branched out into the nursery business. The present site of his nursery was originally a marsh where only bog plants thrived. It was drained, filled up, and planted with Bamboos, Palms, and other tall-growing trees and shrubs until today it is a veritable "plant paradise." The front grounds are landscaped with a nice lawn and hedge-rows of varicolored Azaleas and other flowering plants, beds of semi-tropic ferns, cycads, succulents, and low perennials, and avenues of graceful Arecastrum, Phoenix, and Roystonea palms. In the back are the lath sheds, greenhouses and nursery beds.

The main greenhouse is known as the Orchidario. As the name suggests, it is the permanent home of orchids and other epiphytic plants such as the bromels which in their native habitats grow mostly on the trunks and branches of tropical trees. The house serves chiefly as a display room for exotic flowering plants. Adjoining houses are devoted strictly to the Bromeliads, the passion of Mr. Foster. Rock-bordered beds and a small pool occupy the center of the main room, while along the sides is a waist-high stone wall with niches or pockets to hold the potted plants. A lush Javanese Cissus or grape vine drapes the ceiling and serves as a shade for the orchids and bromels which require this protection. The roof supports are covered with tree-fern blocks brought from Brazil, and from the simulated "trunks" hang curious dwarf orchids, Rhipsalis cacti, and Tillandsias. Several pots of *Laelia flava,* a dainty Brazilian orchid with medium-sized flowers of the richest golden-yellow, were in bloom. A mass display of them would indeed be a glorious sight. This species was sent to the Garden by Mr. Foster as an exchange, and it lived up to its expectations when it was first exhibited at the Orchid Show in 1943. *Laelia harpophylla* is another striking species collected in Brazil, and at the time of my visit its bright orange-scarlet blossoms were ready to burst open. Laelias, for the most part, contain many outstanding members and, as the blossoms clearly show, are closely allied to Cattleyas. A dwarf, flattish Sophronitis displayed its burnt orange flowers against a background of thick, leathery, dark green leaves and the blackboard of pressed fern roots on which it was growing. All these dainty-flowered orchids are quite rare in collections although they were discovered more than a century ago. Numerous other species were in bloom or about to bloom—Cattleyas, Dendrobiums, Epidendrums, Oncidiums, and genera with which I am not so well acquainted.

Despite the wealth of rare exotics housed in the Orchidario, sooner or later one will get accustomed to the host of bromels which are everywhere

—hanging from the rafters, attached to posts, in pots on the benches or planted in the beds. There are approximately 1600 known species of Bromeliads, about 400 of which are found in Foster's collection. Nearly one-fourth of these are relatively new to science and are found only in the few collections in this country where Foster distributed them. Our Garden has come into possession of many of these species in the past two years.

The Bromeliaceae is strictly an American plant family, just like the Cactaceae, although a recent report states that a Pitcairnia has been found in Africa. The common Spanish Moss *(Tillandsia usneoides)* and the ubiquitous tropical Pineapple *(Ananas comosus)* are well-known members of this family even though to the layman these plants are so strikingly dissimilar. The odd rootless Spanish Moss is the most widely distributed species, found as far north as the Dismal Swamp in Virginia and extending south to the central reaches in Argentina and Chile. It does not occur very far inland but prefers to stick to the lowlands along the seacoast. Next in wideness of distribution is *Tillandsia recurvata,* which grows in a compact, ball-like mass on more inland-situated trees and shrubs. It even attaches itself to telephone and telegraph wires—a sight not uncommon in Florida. Along the Pan-American Highway in Mexico that is the common air plant seen growing on the stems of the columnar cacti.

As a rule, the greatest diversity of types will be found in plant families that have a wide distribution, and this is particularly true in the Orchidaceae, Cactaceae, Euphorbiaceae and the Bromeliaceae. Some of the bromels have extremely beautiful foliage, others gorgeous blooms; some are diminutive, others attain gigantic proportions. They are either epiphytic, saxicolous or terrestrial. They can be found in humid tropical jungles, on cold bleak mountains and as companions to the cacti in sun-baked deserts. Many of them inhabit trees, growing on moss-covered trunks and large branches where they have a chance to multiply and be relatively safe from browsing animals. A surprising number are found in the earth and form impenetrable thickets, their foliage armed with vicious prickles. A few prefer rocky slopes and are happiest in the crevices of perpendicular cliffs and mountain-sides.

But, getting back to the Bromels in the Orchidario, the visitor is apt to find some species blooming the whole year round. During my visit stragglers of *Aechmea Racinae* were producing pendulous spikes of small, stiff flowers of a vivid red, black and yellow combination, reminding me of the beautiful "corn candy" that used to be sold in dime stores. The species was named for Mrs. Foster, who always accompanied her husband on plant-hunting expeditions. Another very striking Aechmea in bloom was *Ae.*

victoriana. It also produces a pendulous flower spike with rather showy blossoms of peach, red, white and raisin-purple which at anthesis become nearly blackish purple or charcoal-black, just as if they were charred over a fire. It is very difficult to describe the colors of bromel flowers because of the variety of shades, tints and hues which either deepen or become paler with age. In many Aechmeas the perianth is quite small and withers shortly after opening but the ensuing berries remain colorful for many weeks. One of the most stunning Aechmeas, in my estimation, is *Ae. fasciata.* Its flowering spike comes out straight from the vase-like rosette of leaves and bears at the top a capitate inflorescence of shell-pink bracts and deep blue

Aechmea fasciata

Vriesia gladioliflora

flowers. Even when not in flower this species is remarkably handsome with distinct white bands marking the dark green leaves.

Very few Billbergias were in flower when I was at the Fosters. The most desirable seemed to be *B. Euphemiae* and the various forms of *B. amoena.* The former possesses drooping flowers of delicate pink and azure-blue, while the latter has bright green flowers with blue tips and large reddish-orange bracts. Unfortunately, Billbergia flowers are open for only a short time but they certainly are gorgeously arrayed while they last.

Nearly 400 species of Tillandsia are recognized and without a doubt they possess the most diversified forms of any of the Bromeliaceae. One of the

oddest in Foster's collection is *T. decomposita*, a small octopus-like air-plant that hangs on a limb without any care whatsoever yet blooms year after year. It has lost its rudimentary roots but the slender leaves, curled at the ends, serve as tentacles by which the plant is able to suspend itself. Another oddity is *T. streptophylla*. The whole plant, including the inflorescence, is covered with tiny crystal scales that cause it to glisten in the light. The leaf sheaths form an inflated pseudobulb which looks like a fat kohlrabi, and the elongated leaf blades curve downward over the bulbose base. The queen of the bloomers is the flamboyant *T. Lindeniana*. It forms dense tufts of gracefully recurved leaves and sends forth flower spikes with closely imbricating bracts of a most magnificent rosy pink. The broad flattened inflorescence is six inches long, and the flowers of the richest amethyst-violet are produced in succession from between the apices of the imbricating bracts.

The genus Vriesia is relatively close to Tillandsia, and many of its members are brilliant in foliage and flowers. They produce large distichous spikes bearing showy bracts which retain their exquisite colors for a half year or more. Several potted specimens of the beautiful hybrid, "Mariae," graced the entrance in the Orchidario. From the center of the bright green rosettes spring foot-long flower-spikes topped by inflorescences of bracts and flowers of the most brilliant hues—carmine, amaranth-purple, lettuce-green, bright yellow, etc. A Vriesia which attracted my attention for its oddness was *V. gladioliflora*. The plant was of an olive-green color, even the inflorescence, although the individual flowers were more of a seafoam green, rather large for the genus, and bore a striking resemblance to gladiolus blooms.

Certain Vriesias possess outstandingly beautiful leaves and therefore are much sought after by plant connoisseurs. The most distinctive of all the bromeliads is the Brazilian *V. hieroglyphica*, which is becoming rather scarce in collections. Its broad foliage is thin-textured, of a bright green color and marked with very conspicuous irregular transverse bands of almost blackish-green. In order for the plant to be fully appreciated it should be seen perched on a branch with the sun shining through it. Another showy Vriesia is *V. splendens*, which is well worth growing for its foliage alone. The gracefully recurved leaves, arranged in a broad vase-like rosette, are bright green marked with distinct broad cross-bands of purplish black. Many other equally attractive bromels with beautifully mottled, striped, marbled and spotted foliage are grown by Foster, besides numerous hybrids which he has originated.

A word must be said here regarding the two rarest bromels discovered by Foster. *Cryptanthopsis navioides*, which was found on perpendicular rocks

above a stream in an isolated ravine in Brazil, greatly resembles a seedling Dasylirion with yellow-green leaves that turn terra cotta to brick-red in the crown. *Dyckia Fosteriana*, in my opinion, would create a sensation in any collection. It is a desert species with conspicuous platinum-toothed, dark green, lepidote leaves. Only one plant withstood the long journey but it is now producing a nice sucker, thus insuring a double chance of surviving.

In the city of Winter Park, which adjoins Orlando on the north, there is a city park which no visitor to Florida should miss. It is the Azalea Garden, situated on the lower end of Lake Maitland. I was introduced to this beautiful spot by Bob Mitchell, of the Shore Acres Nursery, a former student at the Missouri Botanical Garden. Picture Cypress trees 50 feet or more tall, draped with long festoons of Spanish Moss; groups of feathery-leaved Arecastrum palms swaying in the breeze; Cabbage Palmettos with immense crowns of leaves; while below Azalea flowers covered the bushes with solid mantles of brilliant hues. Here too were massive tree ferns, *Alsophila australis*, with huge lacy yellow-green fronds, spectacular Orchid Trees *(Bauhinia purpurea)* with blossoms so thickly set that the plants looked like gigantic lavender balls on pedestals. This particular species usually drops most of its foliage just before the heaviest blooming period in late winter. White-flowered forms were conspicuous in many gardens of central Florida. The Azaleas in this lakeside park presented pictures of unparalleled beauty, both the Indian and the Kurume varieties being featured. The robust *A. formosa* appealed to me most.

Another attractive spot in Winter Park is the Mead Botanical Garden, which is being developed as a memorial to the late Dr. Theodore L. Mead. This scientist moved to Florida in 1881 and for fifty years was active in collecting, hybridizing and propagating rare plants. The Garden occupies an area of about 55 acres, nearly a third of it being low muck land covered with native verdure. How well I know that! While inspecting the grounds with Dr. Edwin O. Grover I stepped off the board walk and quickly sank ankle deep in the muck. No telling how far I would have sunk had I not grabbed a branch of an overhanging tree. In some spots the peat is said to be 35 feet deep. In one place enough peat has been excavated to form a small lake. There is also one natural pool, and a picturesque clear-water stream runs through the entire length of the property connecting Lake Sue in Orlando with Lake Virginia in Winter Park. On the banks of the brook grows the deep-rooted Osmunda fern, the medium used for potting epiphytic plants. A lush woodland tract of indigenous trees in the center of the park might be developed into a most charming jungle garden. Conspicuously absent, however, is the common Spanish Moss, but if it could be introduced it certainly would create a fairyland. Everywhere along the wooded trails

the marlberry *(Ardisia crenulata)* was planted luxuriously. This ornamental shrub comes from southeastern Asia and produces abundant clusters of coral-red berries which remain colorful for many months. There is also a white-berried form but this is not so attractive as the red.

Although a few cacti and succulents are used rather extensively in front lawns throughout Florida, particularly in the southern portion, there are not many desert gardens to enthuse about. For that reason the Xerophytic Gardens of Mr. and Mrs. William Rowland at Daytona Beach came as a surprise. These are within a short distance of the Atlantic Ocean and occupy the length of a city block on Auditorium Boulevard. They are one

Xerophytic Gardens, Daytona Beach

of the show places of Florida, and the hundreds of tourists, for this is a famous resort town, who have seen them in the last four years have expressed the same opinion. The xerophytes seem to be happy in the mixture of salt air and coquina soil, for every specimen appeared to be thriving. Tall branched Spanish Daggers *(Yucca aloifolia)* dominated much of the scene. Plantings of both spiny and spineless forms of tuna-producing Opuntias were interspersed with the Aloes. Century Plants and other rosette-forming individuals made their home in pockets of coquina rock. There were golden-spined globes of *Echinocactus Grusonii* and flame-colored barrels of *Ferocactus Wislizenii*, bewhiskered Old Man cacti, stunning

clusters of Mammillarias, flowering Nopals or Cochineal cacti, and many others. Over the tannish sea limestone spread neat carpets of purple, pink, yellow and white Mesembryanthemums. Kalanchoes and Bryophyllums gave an additional note of gaiety with their brilliant flowers rising on tall slender stems.

The low 43-foot greenhouse is painted pink on the outside. Inside, benches of the same coquina as the outside rockeries occupy the sides and center. Originally Cacti were grown as a hobby by Mrs. Rowland, but when visitors in increasing numbers asked for souvenirs she began selling seedling plants and dish gardens. Mr. Rowland gradually succumbed to the cactus lure and now he too is a bona fide cactus enthusiast.

Foster detaching a mass of the Florida Butterfly Orchid *(Epidendrum tampense)*.

Florida's largest bromel *(Tillandsia utriculata)* perched high on a tree

A visit to Florida would not be complete unless a botanizing trip were included. Woodlands and primeval forests offer lush native flora, both epiphytic and terrestrial. A party composed of plant lovers—Mulford Foster, Alex Hawkes, James Lambert of the University of Pennsylvania, and myself—ventured into the woods below Kissimmee, some 25 miles south of Orlando, for the purpose of collecting orchids and bromels. In this region Live Oaks predominated, their massive horizontal branches festooned with streamers of the ornamental Spanish Moss and covered with dense clusters of other bromels, ferns, and orchids. There were also majestic Cypress trees and fine specimens of the Cabbage Palmetto. Small trees of *Chio-*

nanthus virginica were coming into bloom and showing prospect of a magnificent sight a few weeks hence. This is the Fringe Tree which when covered with feathery white flowers in the early spring is much admired by visitors to our Garden and Tower Grove Park. Not every tree in the woods is given over to the air-plants, but the Live Oak seems to be a favorite host. High up in the branches, as well as on the trunk, we espied dense masses of the Florida Butterfly Orchid, *Epidendrum tampense,* a common species in central Florida. It produces pseudobulbs of one to two narrow leaves and a graceful inflorescence of brownish-green flowers about 1½ inches across. In its company we often found another close relative, *E. conopseum,* the only epiphytic orchid in the United States which grows outside Florida. Its range extends to North Carolina in isolated colonies. Florida's largest bromel, *Tillandsia utriculata,* which often attains a height of two and three feet, was common on many trees, but the largest specimens always seemed to be out of reach. The small *T. recurvata* and *T. festucoides* were found in abundance, the latter often growing on the forest floor where it had dropped from the trees. The strangest plant seen was the Grass Fern *(Vittaria lineata)* which was found only on the trunks of *Sabal Palmetto.* It is composed of long tufts of linear dark green leaves, and one would never guess that it was a fern by looking at it. Another strange plant was the small acaulescent Butterwort or Pinguicula, a herb of carnivorous habit growing on the edge of the woods in great quantities. LADISLAUS CUTAK.

NOTES

Dr. Edgar Anderson, Geneticist to the Garden, spoke to the genetics and botany seminars of Iowa State College, at Ames, April 24, on "The Genetics of Species Crosses."

Dr. Edgar Anderson, Geneticist to the Garden, and Mr. Paul A. Kohl, Floriculturist, acted as two of the garden "experts" in the Garden Quiz Clinic at the meeting of the St. Louis Horticultural Society, May 5.

Mr. Ladislaus Cutak, in charge of Succulents at the Garden, gave an illustrated lecture "Gardens of Florida" before the Zeta Beta Chi Sorority at the Gatesworth Hotel, April 18, and before the Business and Professional Women's Group of the Y.W.C.A., on May 2.

The description of *Tripsacum australe* by Hugh C. Cutler and Edgar Anderson from the Garden ANNALS (**28**:259-260) has been reprinted in the *Revista Argentina de Agronomia* (**9**:249) under the title "Una nueva especie de Maidea sudamericana del género Tripsacum."

The second number of Volume XXXI of the ANNALS OF THE MISSOURI

BOTANICAL GARDEN has recently been issued with the following contents: "The Development and Systematic Position of *Arachniotus trisporus*," Elizabeth Heuser Rosenbaum; "Instability of the Mating Type Alleles in Saccharomyces," Carl C. and Gertrude Lindegren; "A Comparison of the Kinetics of Enzymatic Adaptation in Genetically Homogeneous and Heterogeneous Populations of Yeasts," S. Spiegelman and Carl C. Lindegren.

Recent visitors to the Garden include Mrs. Fleeta Brownell Woodroffe, Associate Editor *Better Homes and Gardens*, Des Moines, Iowa; Mr. George Proctor, graduate student, University of Southern California, Los Angeles; Mr. Clint McDade, of Piedmont Nurseries, Signal Mountain, Tennessee; Dr. George J. Goodman, Associate Professor of Botany, Iowa State College, Ames; Dr. Charles D. Swingle, of the Soil Conservation Service, U. S. Department of Agriculture, Petoskey, Mich.; Lt. Ralph W. Emons, of Majors Field Station Hospital, Greenville, Texas; Dr. S. H. Ou, of the Department of Plant Pathology, University of Wisconsin, Madison; Mrs. Roy Arthur Hunt, of the Garden Club of Allegheny County, Pa., Garden Literature Editor *Bulletin Garden Club of America*.

STATISTICAL INFORMATION FOR APRIL, 1944

GARDEN ATTENDANCE:	
Total number of visitors	22,887
PLANT ACCESSIONS:	
Total number of plants and seed-packets received as gifts	648
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	9
Total number of books and pamphlets donated	161
HERBARIUM ACCESSIONS:	
By Gift—	
Anderson, E.—Plants from Horticulture	4
Bettis, Mrs. James R.—*Evonymus* sp. from Missouri	1
Garrett, A. O.—Plants from Utah	5
James, Leslie—Plants of Alabama	3
Killip, E. P.—Ferns of Panama	17
New York Botanical Garden—Plants of South America	2
By Exchange—	
U. S. National Museum, by E. P. Killip—Plants of Colombia, South America	57
U. S. National Museum—Plant of Panama	1
University of Oklahoma—Plants of Oklahoma	125
University of Texas—Plants of Texas	468
By Field Work—	
Woodson, R. E.—Plants of Panama collected by H. von Wedel	4
Total	687

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MISSOURI BOTANICAL GARDEN BULLETIN

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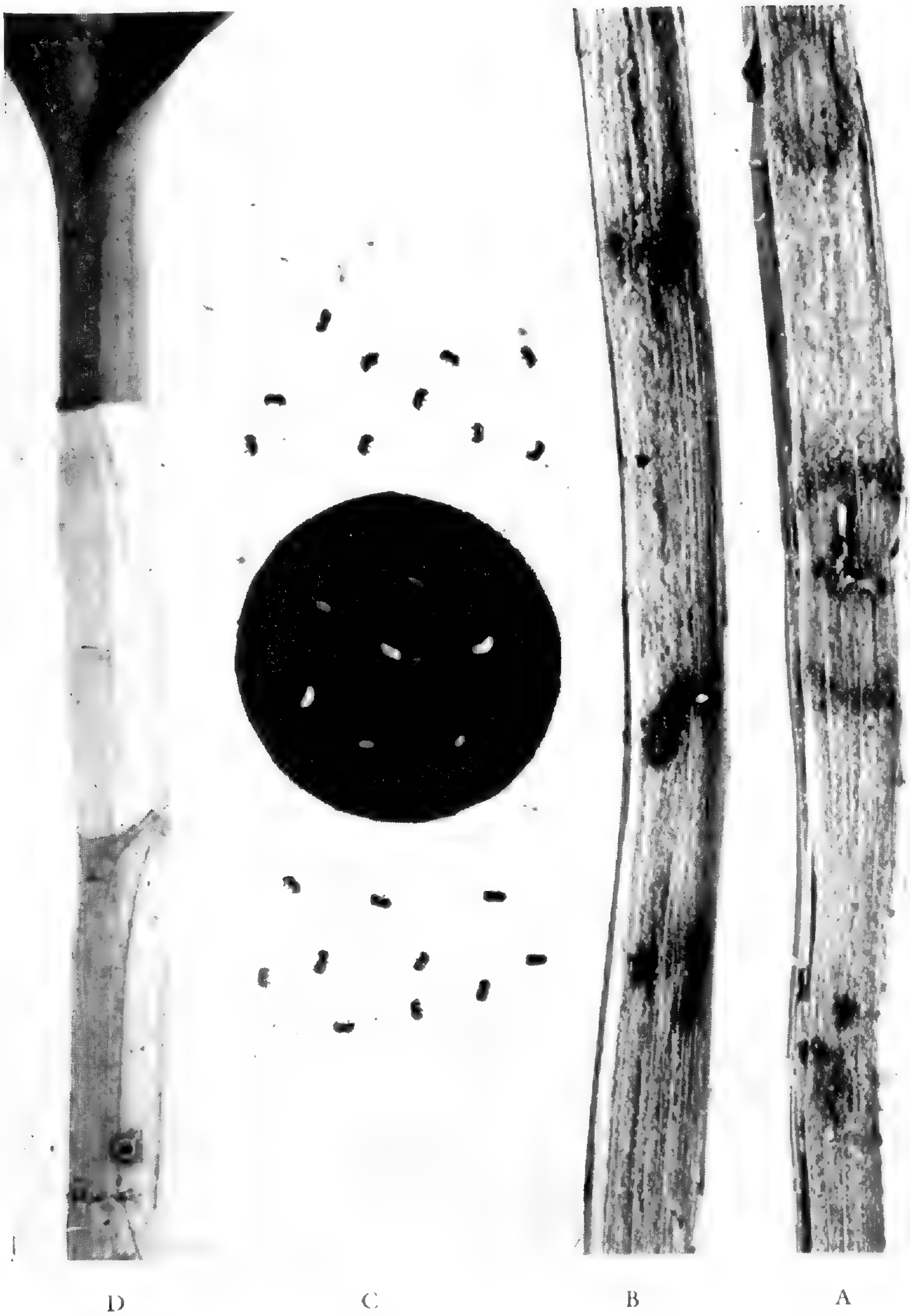
SOME FACTS ABOUT THE GARDEN

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

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

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



D C B A

DENDROBIUM BEETLE

A-B. Banded areas showing grubs within hollowed chambers. C. Grubs (within circle), beetles (outside circle). D. Showing hole through which insect emerged.

Missouri Botanical Garden Bulletin

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SOME ORCHID INSECT PESTS

The insects which the orchid grower usually encounters include the thrip or one of the scales. Of these he has no fear, for they are easily controlled. He is filled with consternation, though, at signs of one of the boring insects, knowing that their presence might mean the loss of his whole orchid collection. However, there is no reason why eradication of these insects cannot be accomplished if taken in time. The first step, of course, is identification.

During the many years that orchids have been grown extensively at the Garden studies have been made of three insects which attack the sympodial type of orchids—the Cattleya fly, the Dendrobium beetle, and the Orchid weevil. The Cattleya fly was first observed at the Garden in 1915. The Dendrobium beetle was a later infestation, but it is now understood and has been completely eradicated from the Garden plants. The Orchid weevil, fortunately, so far has not been seen at the Garden, the infested material having been studied from that found in an eastern greenhouse.

The most successful method of controlling infestations of the Cattleya fly and the Dendrobium beetle was found to be by spraying under pressure with nicotine or rotenone. As a precautionary measure the whole plant has been dipped in a weak solution of nicotine and kept submerged long enough for the insect, if present, to be driven out from the peat. It seems like a drastic treatment, but it is a good insurance against loss. When an infestation is already apparent, a high-pressure knapsack sprayer or a motor-driven one is used. The U. S. Department of Agriculture uses methyl bromide as a fumigant, but this is dangerous in the hands of an inexperienced person. It is extremely toxic, and, being odorless, is sometimes inhaled before the operator realizes it. A gas mask should be used, of course, and warning signs posted.

For the benefit of the many orchid growers throughout the country, the results of the experiments and study at the Garden are here brought

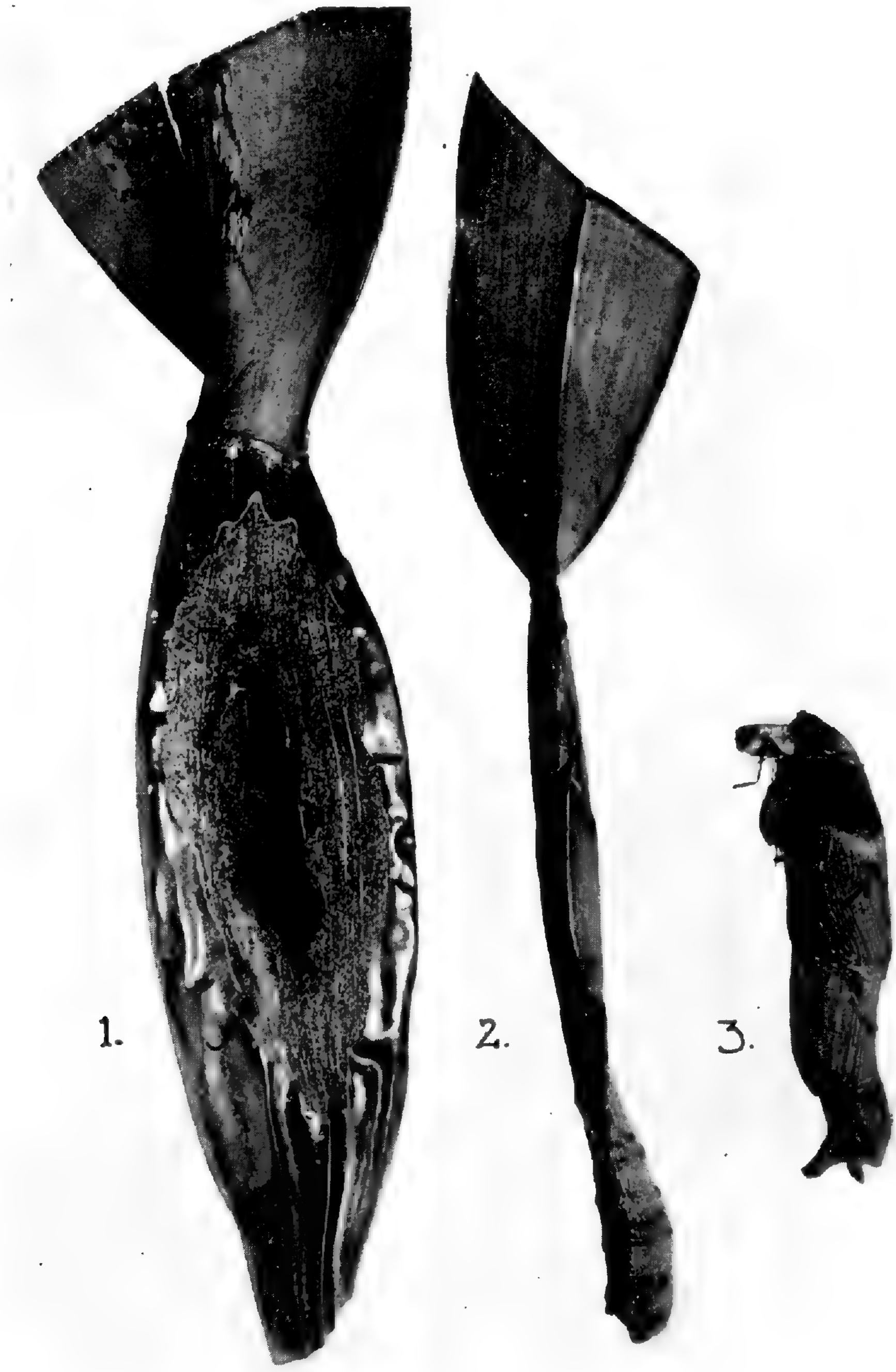
together. Although the Orchid fly has already been dealt with (April, 1916, BULLETIN), the article has been condensed and brought up to date in order that the grower might have the information on these three insects in one bulletin.

The Dendrobium Beetle.—Some years ago a shipment of *Dendrobium Phalaenopsis* and its natural hybrids was imported from Australia for floral displays and breeding experiments at the Garden. On their arrival the plants appeared to be healthy and normal, and it was not until several weeks later, after the plants had become established, that colored marmorated bands were noticed at the nodes of the new canes. These seemed worthy of investigation, and when an infected pseudobulb was cut longitudinally small white larvae were found feeding on the soft cellular tissue (pl. 18, A-B). All plants showing the discolorations were immediately isolated and kept under observation. Within a few weeks the larvae (pl. 18, center) had changed to small shiny black beetles ⅛ inch long, two to four insects being seen in each chamber. After a few days they would bore their way out of the pseudobulb. Although in their natural state the orchids are apparently not injured by this insect, under cultivation the growth is crippled and of no value for flower production. Evidently the beetles wait until the new growth is half grown before depositing their eggs within it, unlike the Cattleya flies, which deposit their eggs immediately the young growth pushes out from the base of the parent bulb. The possibility of an insect being brought from the tropics is therefore greater with Dendrobium than with Cattleya.

The beetle may be effectively controlled by opening the banded area during the larval period and spraying with or immersing the hollowed portion in a contact insecticide, rotenone if it can be obtained. Fumigation with cyanide may be used as a final control but a tobacco preparation sprayed under pressure is considered safer.

In the *Australian Orchid Review* (March, 1938) Mr. G. Bates, of Cairns, Australia, mentions the Dendrobium beetle as attacking orchids in their native state. Heinrich Voss, of Naumberg, Germany, in an article in the same journal (December, 1938) states that in an importation of Dendrobiums, 1700 out of 4500 plants had to be burned to control the infestation. This drastic treatment might have been avoided had the orchid grower recognized the characteristic banding on the new growth and immediately isolated the plants affected.

The Cattleya Fly.—The Cattleya fly, which causes such havoc to orchids in greenhouses, does not seem to harm them in their natural environment. During plant-collecting trips in Central and South America the author



CATTLEYA ORCHID FLY

1. Normal imported pseudobulb cut to show the effect of the larvae. 2. Abnormal pseudobulb incapable of producing flowers. 3. Permanently injured growth. The arrows indicate the holes through which the insect escaped. About natural size.

Fig. 1. CATTLEYA ORCHID FLY

1. Three abnormal growths containing pupae, the middle one cut to show cavity and pupae. 2. Pupae just before changing into the winged insects. 3. Normal growth not attacked by the insects. About twice natural size.

paid particular attention to the effect of this insect on the sympodial types of orchids. Rarely was a clump of Cattleyas collected that did not show some infestation, yet they seemed to flower normally in spite of it.

The female of the Cattleya fly deposits its eggs only in the young succulent growth, and the larvae, feeding from within, emerge a few weeks later as winged insects. For this reason it is rarely possible to introduce the insect into cultivation unless young growth has been collected. During 1923, upwards of 4000 plants of *Cattleya Trianae*, *C. gigas*, and *C. Schroederae* were collected during the dry season in the Andes of Colombia.

As a precautionary measure clumps which showed insect infestation were segregated during the packing operations and upon arrival at the Garden were established in a separate house. Final check showed no sign of the Orchid fly, which is further evidence that the insect is transported only with the young growth.

The only infestation of the Orchid fly at the Garden was brought in twenty-nine years ago through a commercial grower, at which time the life history and methods of eradication were studied. The first actual indication of the insects are the small holes in the pseudobulb which they bore for their exit. Another significant symptom is the shape of the pseudobulb. Normally the young growth is strap-shaped and slightly rounded at the base, but when infested it is pear-shaped and gradually tapering to a point (see fig. 1). If this deformity is noted the young growth should be cut off close to the parent pseudobulb and burned, as it usually contains eight to ten small black pupae which would eventually develop into adult or winged insects. The parent pseudobulb will develop a new growth after the infested growth is removed and will produce flowers almost as fine as the lead.

Even though the insect has been located and the infested growth removed it is advisable to fumigate the greenhouse as an added precaution. Formerly cyanide gas was used as a fumigant at the Garden, and while satisfactory for the sympodial orchids the monopodial kinds were damaged. No matter what fumigant is used, extreme care must be taken. The house should be absolutely dry or the leaves will burn and an overdose of the gas will kill the plants. First, though, the infested growth should have been removed, for the gases cannot reach the eggs contained in the young growth. Much safer than a gas, however, is a tobacco or a rotenone spray, under pressure.

The Orchid Weevil.—A few years ago some specimens of an orchid insect were sent to the Garden with a request for its determination and

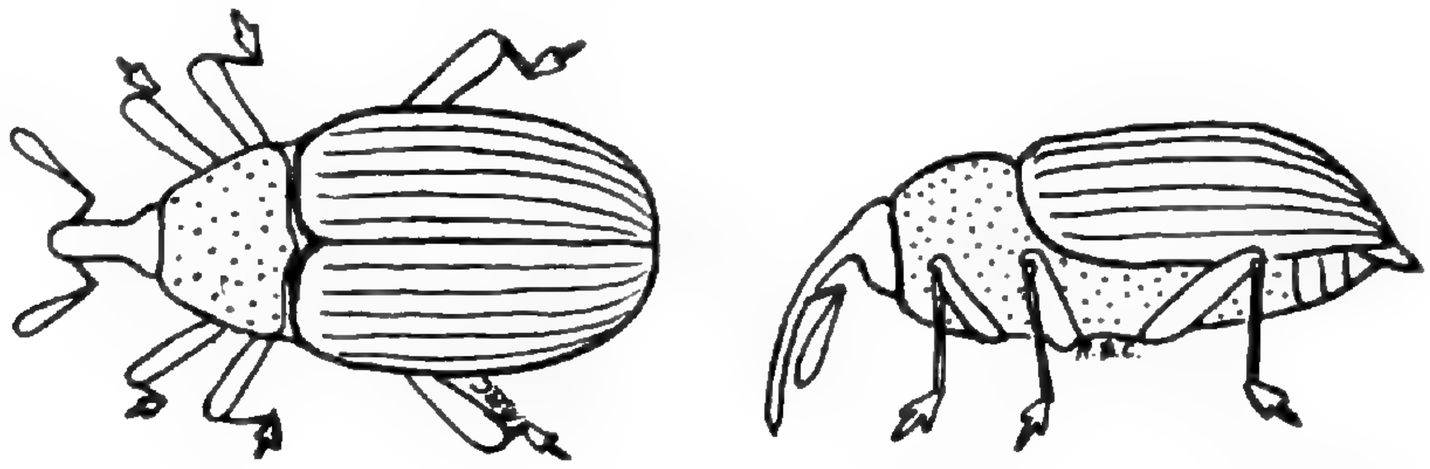


Fig. 2. Dorsal and ventral view of Orchid weevil. X about 12.

methods of control. The insects were about ⅛ inch long, one-half as wide, shiny black all over, with a sharp-pointed probosis, saucer-shaped

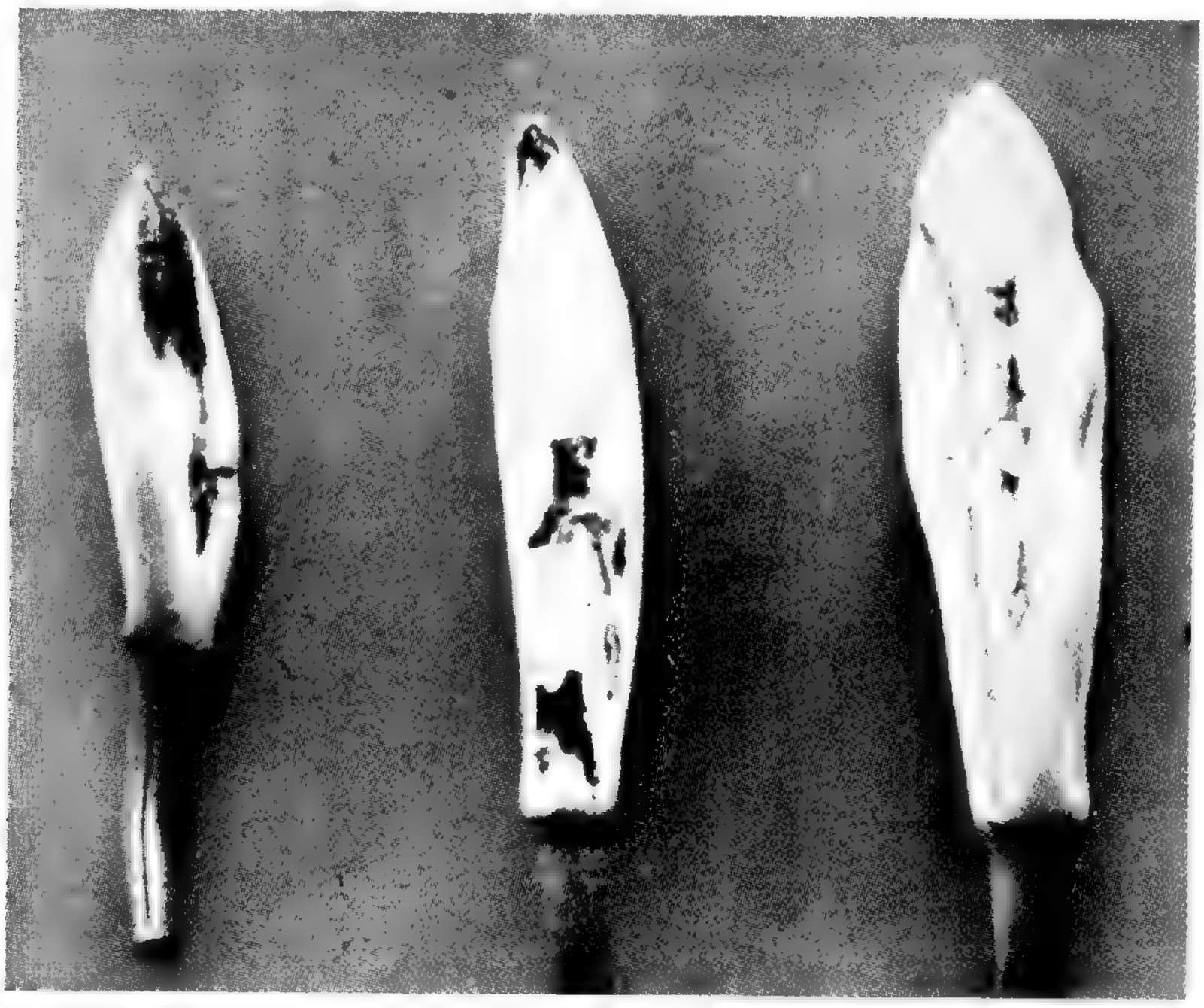
depressions on the thorax, and, as the artist expressed it, with "antennae that feel around like the arms of a boxer" (see accompanying drawing). There was no difficulty in recognizing it immediately as the Orchid weevil *(Diorymerellus laevimargo)*, an insect which infests Cattleyas and Dendrobiums. They do not feed upon the older parts of the plants, except to some extent upon the roots, but eat small holes in the tender young leaves,

Fig. 3. Orchid weevil on roots of Cattleya. X about 5.

in the sheaths surrounding the flower buds, or the flower petals. This results in the rotting of the flower sheaths or the blossoms becoming so mutilated as to be unfit for exhibition. Fortunately the Garden has never been troubled with the Orchid weevil but it is common enough so that methods of eradication were familiar. Perhaps no better account of the

experiments with infestation control could be given than the following paragraphs taken from correspondence and various journals:

Dr. V. H. Hunkel, orchid grower of Milwaukee, in a letter to the author, stated that anything he might say on the Orchid weevil would be nothing more than a reprint of the earlier work of Clyde C. Hamilton, of the New Jersey Agricultural Experiment Station. Mr. Hamilton has written several papers on this insect, but in the *Jour. Econ. Entomol.* (**31**:189. 1938) there is a resumé of all his previous work. The most common control method, it seems, is to pick off the beetles by hand, several times daily,—a most laborious and unsuccessful method, for the insects hide in the peat.



From *Amer. Orchid Soc. Bull.*

Fig. 4. Orchid buds showing damage by weevils. Natural size.

At one period he had applied para-dichlorobenzene crystals to the surface of the peat in which the orchids were growing. Excellent control was apparently achieved by this method, but he thought that after a time his plants were somewhat injured. He had already conducted a series of control experiments, using various chemicals and such materials as nicotine solution with and without soap and water, naphthalene, and pyrethrum powder with and without soap and water. When soap and water were mixed with the insecticide materials a fungous growth resulted. Some of the chemicals were found to be toxic to the roots of the plants. Naphthalene flakes were not so effective as para-dichlorobenzene. In a later experiment with various

From *Amer. Orchid Soc. Bull.*

Fig. 5. Injury on old orchid leaf caused by Orchid weevil feeding when leaf was growing. Natural size.

dusts *Dry Pyrocide* and pyrethrum powder were concluded to be more effective than derris powder.

Dr. Hunkel states that he had used 3 parts *Dry Pyrocide*, 1 part rotenone juice, 6 parts talc or walnut shell juice, the rotenone being used to control other insects. At one time he had used methyl bromide as a fumigant, but not on orchids.

In the last word on the subject to date (C. E. Wilson, Jr., of California, in *Orchid Digest*, March, 1943), the treatment recommended is para-dichlorobenzene again. Mr. Wilson reported that their plants had been severely damaged before they were certain as to what was the cause. In the meanwhile they had sprayed the orchids for "everything imaginable

whether they found it present or not." Finally one Orchid weevil was located, but only one, because they had not searched at the right time (early morning or late night) or in the right places (in and around the flower sheaths, on the flowers where the petals, sepals and lips join together, green root tips, etc.). They also hide in the peat, where "it is impossible to find them." Various products were tried, some *not* according to directions and with disastrous results. Finally at Mr. Thomas C. Kirkwood's recommendation, para-dichlorobenzene ("PDB" in the trade) was used, and the orchids were saved. Great care must be observed in its use, however. The house must be dried out two or three days previous; and on "a rising temperature, probably 10 o'clock, when you know you will have a hot day" the crystals (½ to 1 teaspoonful to each 6-inch pot) are shaken on top of the peat. The ventilators are then closed tight until the following day, and no water should be applied until all the crystals have evaporated. Mr. Wilson states that 100 per cent elimination has been secured with one application.

GEORGE H. PRING.

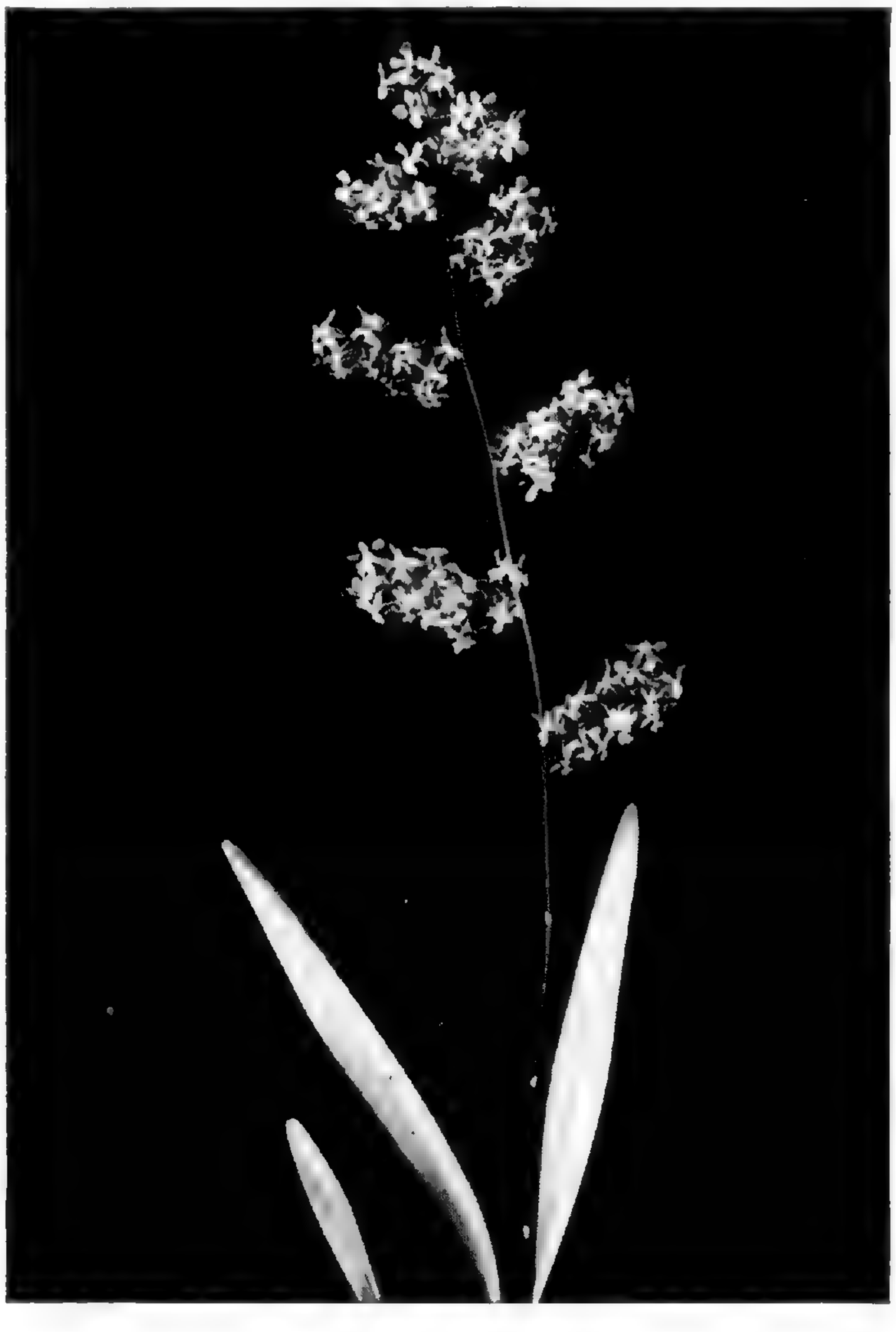
THE LIFE OF AN ORCHID PLANT

Visitors to the Orchid Houses frequently ask: "What is the life of an imported orchid plant when grown in this country?" The answer is: An

Spray of *Epidendrum oncidioides*

indefinite period when grown under the right conditions. *Epidendrum oncidioides* and *Angraecum Chailluanum* are examples of the many species in the Garden collection whose history substantiates this statement.

Despite the fact that the specimen of *Epidendrum oncidioides* is small enough to fit in a 5-inch pot, it will be forty-one years old in August. It might be referred to as the grandfather of the orchid collection. According to the Garden records, this plant was contained in a shipment of unidentified orchids received from Mr. A. Muller, of Williamsburg, New



Epidendrum oncidioides

York, August 24, 1903. When it flowered it was identified by the writer as *Epidendrum oncidioides*, a notation in the record giving the date of flowering as August 6, 1906.

According to John Lindley, the English orchidologist (in *Bot. Reg.* **19**:*pl. 1623*), *Epidendrum oncidioides* is doubtless a native of South America but he was uncertain just what country. The bulbs are narrowly pear-

shaped, about 6 inches long and 2 inches wide. The leaves are strap-shaped, 2 feet long and about 2 inches wide. The flower spike of the Garden specimen averages 8 spikelets, the largest bearing 13 flowers. The flowers are golden-yellow streaked and suffused with brownish-purple, the lip cream-colored with fine purple lines on the crest. The flowers are said to sometimes last a fortnight but those on the Garden plant lasted a month and were so fragrant that they perfumed a room. Generally, in cultivation the plants are so weak that they do not bloom.

A plant of *Angraecum Chailluanum* (sometimes listed as *Listrostachys Chailluana*), a species of West Tropical Africa, was purchased with a large botanical collection from Sander & Sons, of St. Albans, England, in April, 1904. The drooping flower spikes are about 12 inches long, with 6 to 10 flowers to a spike. The flowers are somewhat star-shaped, 4 inches long, white with greenish spurs. The leaves are leathery, 4 to 6 inches long, 1½ inches wide, and 2-lobed at the apex. The species is now represented at the Garden by several plants which bloom annually during early April.

GEORGE H. PRING.

NOTES

Mr. George H. Pring, Superintendent of the Garden, spoke over Radio Station WIL, May 26, on "Victory Gardens." The Kiwanis Club sponsored the broadcast.

Mr. Ladislaus Cutak, in charge of Succulents at the Garden, gave an illustrated talk, "A Cactus Hunt in Old Mexico," before the Bible class of the Y.M.C.A., June 8.

The Marguerite Krueger Conservation Club dedicated a Redbud tree at Jensen Point, Highway 66, May 28, honoring the memory of the late Lars Peter Jensen, who was Manager of the Garden Arboretum.

Dr. Edgar Anderson, Geneticist to the Garden, has an article in the April number of the *Journal of the California Horticultural Society* (Vol. 5, No. 2) on "Maiz del Paiz."

The May number of the *Flower Grower* contains an article (**31**:253, 276-277), "How to Graft Cacti," which is an excerpt of one by Ladislaus Cutak in the September, 1935, Garden BULLETIN.

Under the auspices of the Inter-American Center of St. Louis, Dr. Carroll W. Dodge, Mycologist to the Garden, spoke to the University City

Kiwanis Club, May 9, and the Northside Kiwanis Club, May 17, on "Central American Problems."

The *Southern Florist and Nurseryman* has reprinted A. P. Beilmann's article on "Some Ornamental Elms" from the April Garden BULLETIN, in its May 19 number (**57**:3-5), and Ladislaus Cutak's "A Trip to the Florida Tropics" from the May BULLETIN, in its May 26 number (**57**:5-6, 10).

Schoolchildren, after being conducted through the Garden by Miss Heising, the representative of the Board of Education, sometimes write expressing their appreciation of the trip. The letter quoted below, sent by a third-grade pupil, is a sample of how a child may be impressed in an unexpected way:

May 16, 1944.

Dear Miss Heising,

I enjoyed the trip very much. I liked the tomb of Mr. Shaw very much. The man who chiseled out Mr. Shaw must have been one of the best chiselers in the world. I guess Mr. Shaw was one of the smartest people in those days,

Your friend,
Trevor Thornton.

Recent visitors to the Garden library and herbarium include the following: Lt. Hubert C. Keith, of the Army Air Forces, Greensboro, N. C.; Dr. Rogers McVaugh, of the Division of Plant Exploration and Introduction, U. S. Dept. of Agr., Washington, D. C.; Pvt. Carl Busch; Corp. Fred G. Meyer, of the Hospital Corps, Camp Ellis, Galesburg, Ill.; Miss Jean Nicholson, of the Benvenue Laboratories (Penicillin), Bedford, Ohio; Mrs. Edward Rodeman, of the Jefferson City Garden Club; Mr. Harold Arrowsmith, graduate student, Cornell University; Dr. Mary Maxine Larisey, Chairman Division of Science, Judson College, Marion, Ala.; Mr. Henry N. Steece, Senior Agronomist and Administrator, Office Experiment Stations, Washington, D. C.; Dr. André Dreyfus, Professor of Biology, University of São Paulo, Brazil; Mr. Adolph Jordahn, Superintendent Montgomery Palmetum and Fairchild Botanic Garden, Coconut Grove, Florida; Mrs. Jan Jansen, of Sault Ste. Marie, Michigan.

STATISTICAL INFORMATION FOR MAY, 1944

GARDEN ATTENDANCE:

Total number of visitors	20,143

PLANT ACCESSIONS:

Total number of plants received as gifts	5,707

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	14
Total number of books and pamphlets donated	209

HERBARIUM ACCESSIONS:

By Purchase—

University of California, by T. H. Goodspeed—Plants of Colombia, South America	143

By Gift—

Anderson, Edgar—Plants of Mexico	57
Bauer, Bill—*Trillium ozarkanum* Palmer & Steyermark	1
Cottam, W. P.—*Asclepias* from Utah	2
Goodman, George J.—*Senecio salignus* DC. from Mexico	1
Van Sickle, Mrs. Elmer—Plant of Horticulture	1
Von Schrenk, Hermann—*Syringa villosa* Vahl from Horticulture	1
Whetzel, H. H.—*Sclerotinia scirpicola* Rehm from Denmark	1

By Exchange—

California Academy of Sciences—Plants of California	5
Gray Herbarium, Harvard University—Ferns of Mexico	12
Stevens, O. A.—Plants of North Dakota	250
Total	474

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MISSOURI BOTANICAL GARDEN BULLETIN

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Missouri Botanical Garden Bulletin

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CATTLE AND GRASS IN AN ARBORETUM

An Arboretum, according to Webster, is "a place where trees are cultivated for scientific or educational purposes." If the narrowest definition of the term were used no thought would be given as to what would grow between those trees, and any place could be called an arboretum so long as more than one tree was being grown for "scientific or educational purposes." However, since no two arboreta the world over are very much alike we may assume that there are as many kinds as there are arboreta. Probably there are none containing just a few trees, but there may be some so old and thickly planted that no thought need be given to the ground cover between the trees. The greater number, however, would have grassy walks, and some would have plantations separated by vast meadows. Those established more recently and those with ample acreage for expansion may at some time or other have many more grass problems than tree problems. Likewise, the need to control erosion, or even the type of soil in a particular area, may make the growing of a turf very important. In fact, some sections of an arboretum may never support trees and therefore the maintenance of a meadow would always be an important task.

At the present stage in the development of the Missouri Botanical Garden Arboretum at Gray Summit, portions of the summer are given over almost entirely to the growing and harvesting of grass. Every activity is so directed that the growth of blue grass will be furthered at the expense of the weeds. With the acreage involved it seems likely that fields and meadows will always separate plantations, and therefore the growing of blue grass or the maintenance of an existing turf will always be a major consideration. At the Arboretum, grass is needed to check erosion; it is very essential as a background for certain flowering plants, notably the crabapples; and a turf is a very pleasant way of separating plant groups. There is another esthetic reason for growing grass. The greenness of grass is usually associated with spring, but with blue grass it is possible to have a green meadow the year

round. With the exception of an occasional field of small grain and the battered green of Junipers, we in eastern Missouri see very little green from early fall to late spring, and it is a delight to gaze across a meadow of blue grass when the rest of the country is dull and brown. By carefully timed mowing we have succeeded in keeping a green cover on the Arboretum hills throughout the year. Although few people realize it, this is probably the reason why visitors find the landscape of interest, even in winter.

Brushy field in winter

It may not be generally known that until recently less than half the acreage in the Arboretum was developed and accessible by road. For various reasons those sections not readily reached by car were allowed to grow up as they would, as is customary with abandoned farm land. The history of such fields is about as follows: First, various rough weeds invade the corn ridges and after they have reached a point where they shade the soil the nearest light-seeded trees come in. The trees are usually Persimmon and Sassafras, but in the Arboretum the nearest trees of seeding age are the Elm, some Maple, and a scattering of Hackberry. Arising from seed such trees grow very slowly. Erosion is generally rapid and ditches are scoured out, and then a few Junipers invade the field. In the succeeding years, after the deciduous trees have begun to shade the ground, many of the early plants disappear. Here and there we can find some blue grass, and in more fertile sections Goldenrod and Asters predominate in the fall. We now have a field containing a rank growth of vegetation; a scattering of blue grass on the

ground, masses of perennials, the blackberries, and finally the tallest, the Elm seedlings. On a good piece of land the Elms may grow so rank and become so dense that all ground cover is killed.

It has been said that the invasion of an abandoned field first by herbs and grasses and finally by trees represents a "determined natural effort toward reforestation." In the region around Gray Summit it is true that the abandoned fields are not immediately taken over by the Oaks and Hickories which grew there before man cleared the ground. However, the woody species which invade these fields are residents only until the biological balance has been re-established. The Elms, Maples, and Locust were never part of a hill-side climax forest but grew along streams, and several generations of careless timber cutting have removed all the Oaks, Hickories, and Sugar Maples from even the smallest contiguous patches of woods. Abandoned fields are therefore taken over by those species which, being worthless, were left by man and are now the only species of fruiting age. If mature Oaks were still growing along the field edges, perhaps more seedlings would be encountered near by; at least this has been noted at one location. To-day the Elm is considered a pioneer but it does not follow that it was a pioneer in 1844. In the absence of Oaks the succession is about as follows:

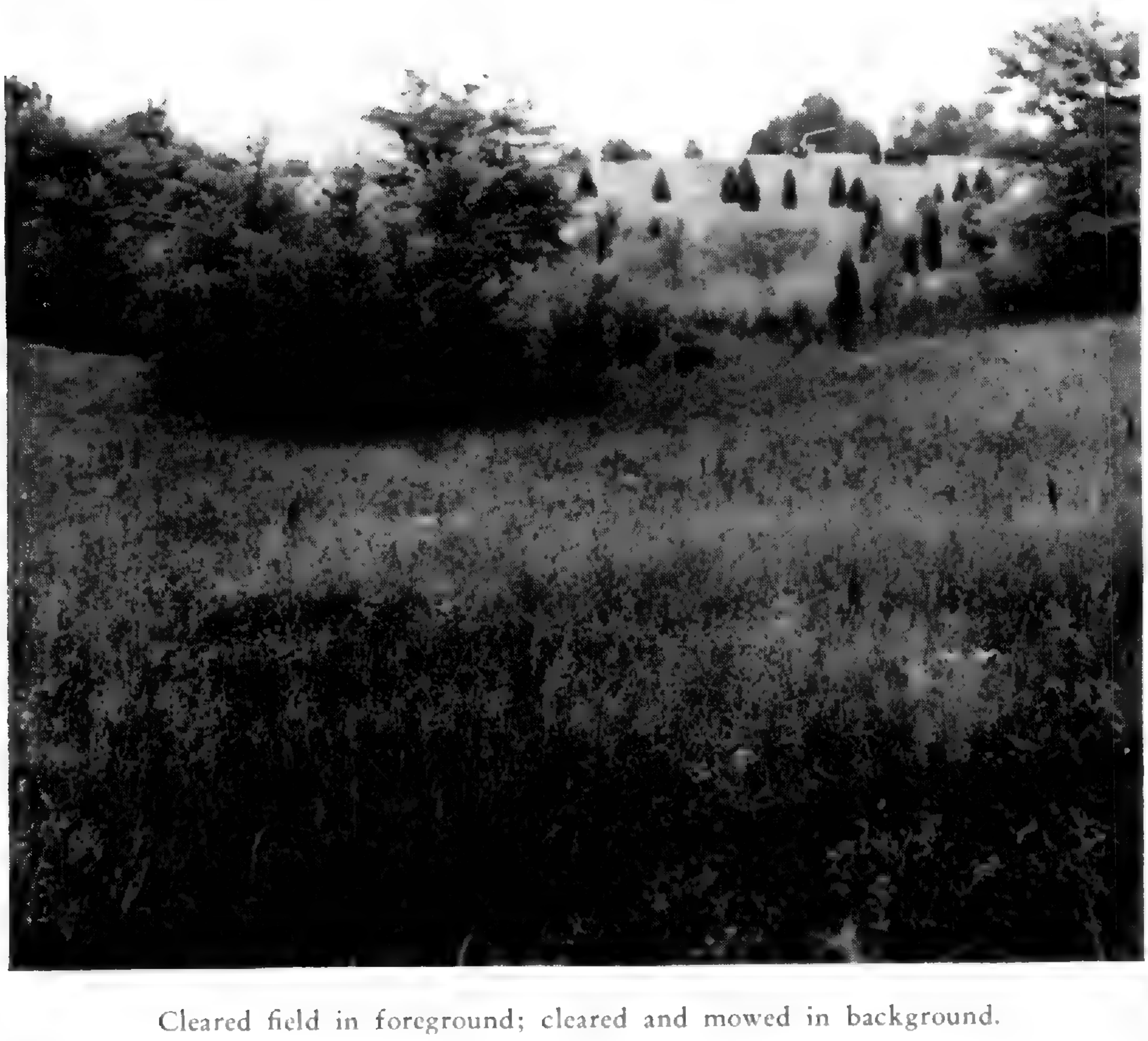
	Three years	*Ten Years*	*Fifty years*
Field	Sumac—Dewberry	Elm—Locust	Oak—Hickory

Thus in about three generations "nature will reforest" an area which required less than two generations to destroy. The Elm has been outstanding in its ability to begin the reclamation of such tracts. After fifteen years such fields become a liability; they support no game, only a few wild flowers, and they constitute a serious fire hazard.

In order to convert these fields from a liability to a usable condition several things can be done. First, they may be set on fire. This would kill off some sprouts but the destruction of the humus would set back the field a full fifteen years. Fire is a tool commonly employed in Missouri but the consequent destruction of the ground cover favors erosion. Another method is to chop out the unwanted brush with an ax or other tools. The chief objection to this is the extraordinarily high cost. Once the brush has been removed the field must be mowed to keep the brush from returning at the expense of whatever grass may be present. Both fire and axes have been used but the disadvantage of fire outweighs the economy. A third method, or rather a combination of methods, appears to be the solution—the use of beef cattle and mowing.

In 1938, Mr. Spencer Groff, of Gray Summit, was invited to place a

herd of beef cattle on a section of several acres at the Arboretum to determine the effect of grazing. When the cattle were released no foot trails or paths existed in this overgrown field. During the succeeding five years the paths opened by the cows made it possible to walk from one end of the area to the other without a suit of armour. After the third year of grazing blue grass began to appear in many places, and the seedling Elms



Cleared field in foreground; cleared and mowed in background.

were less evident. After five years a greater amount of blue grass was seen and the seedling Elms had been set back so much that the clearing of the remaining brush became a far less difficult task. During the winter of 1943-44 almost 2700 man hours were devoted to brush clearing. This opened up portions of about 300 acres in sections where the most clearing

could be obtained for the least effort. There still remains much brush on some of the area but at least it is now possible to walk around it and to see the grass without too much effort.

Experimental clearing done in previous years has shown that blue grass rapidly took over a field if it were given a good chance to grow. When the field was cleared during midsummer it was the practice to begin mowing

First summer after clearing—uncleared portion at the left.
Notice cattle grazing in background.

immediately after the blue grass had ripened seed. Usually by the second summer the blue grass has developed a turf in the more fertile sections where originally it constituted but a fraction of the ground cover. But this is not the end of the problem by any means. The same seed trees are found around the edges of these clearings, and annually they shed enough seed to restock the whole area. Without attention such a field would soon revert to its original bushy growth. It is possible to maintain the field as an open

meadow only by carefully timed operations. We have demonstrated in other sections that blue grass can be grown and that weeds can be checked if no mowing is done until the blue grass has ripened seed. If this procedure is followed these newly cleared areas will in less than five years support a 100-per cent stand of blue grass. If, on the contrary, mowing is begun early in the spring, the blue grass has but little chance to grow and shortly the weeds take full possession. The solution appears quite simple: in order to maintain a blue grass meadow don't mow until July. The one very valid objection to this proposal is the amount of equipment needed for such carefully timed mowing. During 1944 it appears that we shall have about half of the Arboretum area or about 800 acres to mow. Since 1942 we have used two tractors both equipped with a 7-foot sickle bar mower, and the mowing, exclusive of the most recent clearings, has required about 900 hours of actual operation. It will be seen, then, that the time is not far distant when either more equipment or some supplementary mowing method must be devised. The solution appears to lie in a combination of mowing and grazing. During the past six years the effect of pasturing forty to fifty head of beef cattle on the cleared and semi-cleared fields has been studied, and we have found no objection to the use of cattle in maintaining an open meadow.

Cows appear to fit in the picture in still another way. Over a period of years we have learned that abandoned fields can be brought to grow grass by the use of machinery. But there comes a time in the year-after-year maintenance of such fields when the grass seems to slowly disappear. There may be a number of reasons for this. Perhaps too much litter left on the ground produces the surface humus of a fence row rather than the clean short turf of a pasture. Perhaps the tramping of cattle, particularly in the fall, is necessary to break up the stoloniferous roots of blue grass. Certainly some light traffic of sharp-wheeled machinery appears to improve the sod. Regardless of the exact cause, we have seen, in June 1944, some blue grass fields which appear to be slowly reverting to their early condition in so far as the growth of annuals and perennials is concerned. From this observation it appears, at the moment, that fields of blue grass must include actual pasturing by cattle at some stage in their development. It is proposed to use a disc during the early fall to determine the value of cutting up the roots, but it would be quite impossible to treat more than a small part of our grass land in this manner. The time to do this work is short, and the necessary equipment will not be available in that season.

A herd of beef cattle at the Arboretum will allow us to continue our study of blue grass as well as to assist in the maintenance of pastures. A study of blue grass of value to a gardener was published in the September

1940 number of the BULLETIN, and a more technical study appeared in the ANNALS in November 1941. There are few agricultural problems as important in Missouri as the maintenance of a blue grass pasture. The flora of a pasture is a very complex community of plants which are not as easily handled as most other crops. In addition to the pasture studies carried on at farms and experiment stations, grass needs to be studied at the Arboretum where the entire flora is under observation and the inter-relationships can be studied in detail. A herd of beef cattle at the Arboretum would permit us to continue the study of grass supplementing those papers which have already appeared dealing with lawns and grass breeding.

SUMMARY

Abandoned fields at the Arboretum are usually invaded with a succession of weeds. In fifteen years they support a 100 per cent growth of Elms, which are obviously out of place.

Such overgrown fields are sterile. They support no game and grow only a limited number of wild flowers. The trees which grow there have no economic possibilities. The danger from fire is very great.

Experience has shown grazing to be an economical method of maintaining cleared fields. The indications are that either grazing or mowing, or both, can be depended upon to keep a cleared field free of brush.

Previously, reliance has been placed upon tractor mowing over the greater portion of the Arboretum.

A point has now been reached where either additional mowing equipment must be obtained or grazing must be resorted to in order to keep about 800 acres from becoming a liability and a fire hazard.

AUGUST P. BEILMANN.

THE SUCCESSION OF PLANTS IN BOMBED AREAS

The recolonization by plants of areas which were almost or completely devoid of vegetation has long been a subject of interest to botanists. The way in which a new flora establishes itself, the successions of different genera as they appear, the vitality of certain seeds, and similar questions may be answered by a study of such a situation as in no other way.

The classical case of this kind is the sterilization of the Island of Krakatoa, which lies between Java and Sumatra. In August, 1883, occurred the most violent volcanic eruption of which there is any record. As a result Krakatoa, which had been covered with a dense forest and its attendant vegetations, was entirely covered with hot ashes and pumice destroying

every vestige of plant life. The island so effectively sterilized afforded a unique opportunity for studying the establishment of vegetation of a large area absolutely barren, with nearest land nearly one hundred miles away. Fortunately, the proximity of the Botanical Garden at Buitenzorg, Java, made it possible for botanists to visit the island within three years of the eruption, and again in 1897 and 1905. Thus, the re-establishment of a new flora on a barren island was traced from the early arrival of bacteria and algae to a fruiting coconut grove twenty-five years later. The means whereby the new flora was introduced could also be determined with fair accuracy. The earliest immigrants—bacteria, blue-green algae, and mosses —which formed the soil in which seed plants could germinate, were wind-borne. Perhaps the most important agency was ocean currents which, with driftwood, carried seeds and fruits to the shore. Birds also played their part in the introduction of seeds, especially of plants with fleshy fruits, such as the grape and fig.

Now, sixty years later, another opportunity comes to make somewhat similar observations under totally different conditions. In the report of the *Botanical Society and Exchange Club of the British Isles,* Volume XII, Part 5, there is an article by J. Edward Lousley on "The Pioneer Flora of Bombed Sites in Central London," which records a study of the recolonization of localities which were botanically speaking almost or completely sterile. Because this paper is not generally accessible, it seems desirable to include here a major part of Mr. Lousley's observations.

"The 'bare area' so often postulated by writers on ecology as the place colonised by the first stage of a plant succession, and so very rarely to be seen in this country, would appear to be attained on a large scale as a result of the bombing. Viable seeds of phanerogams are unlikely to exist in large numbers in the mortar and brickwork of the old buildings destroyed, though algae and bryophytes doubtless grew on their walls and roofs. Thus by making a survey of the sites of buildings destroyed in the air-raids we may feel confident that the phanerogams listed have arrived since the date of the destruction.

"The sites discussed in this paper, twenty-one in all, are in densely built-up areas of the City, Holborn, and by the main road which runs south from London Bridge through Borough High Street and the Elephant and Castle to North Kennington. They were damaged between September 7, 1940, and May 11, 1941—in most cases on the nights of December 29, 1940, and May 10, 1941. Great care was taken to make records only from places which were known to have been completely built over, such as restaurants, banks, churches and shops with which I was familiar before the war.

"The extent to which even the extremely valuable land of the 'square mile' of the City of London contained places where weeds might flourish is probably not fully appreciated even by Londoners. In the alleys and courts, behind the mighty facade of enormous blocks of offices and shops, many disused and often neglected churchyards, 'squares,' backyards, and even pleasant gardens, harboured plants which were seldom to be seen by the casual enquirer. Some of these species are somewhat unexpected. For example, on the mediaeval masonry of the short length of so-called 'Roman Wall' opposite St. Alphage, the Pellitory-on-the-wall (*Parietaria diffusa* M. & K.) has flourished for several years. It may well have been originally planted there, but the other species such as *Cirsium vulgare* (Savi) Airy Shaw with which it is accompanied, and which also survive the surrounding desolation, have certainly not been deliberately introduced. The care which has been taken in the selection of the sites for observation makes it certain that any such pre-war floras have been excluded even though their habitats may now be indistinguishable from surrounding cleared areas.

"For about a year after the heavy air-raids very little phanerogamic vegetation appeared on the tumbled masses of masonry and brickwork, doubtless because of the absence of suitable soil in the crevices. Under such conditions *Epilobium angustifolium* was the only species which occurred at all frequently. Its most surprising achievement to come under my observation occurred near the Elephant and Castle, where the plant flowered in the summer of 1941 on the stump of the wall of a building destroyed the previous autumn. Seed must have arrived and germinated very shortly after the damage took place. The three Senecios—S. *squalidus*, S. *viscosus* and S. *vulgaris*, all with wind-borne fruits, were almost the only other species to arrive in 1941.

"Clearance and levelling of the sites exposed much soft rubble and dust which provided favourable conditions for many additional species. These included a number of species with wind-borne fruits such as *Epilobium angustifolium*, *Erigeron canadensis*, *Tussilago Farfara*, *Senecio squalidus*, S. *viscosus*, S. *vulgaris*, and *Sonchus oleraceus*. Others whose fruits probably arrived on the wheels of lorries and carts engaged on removing the debris, or on the boots of the workmen, may include: *Capsella Bursa-pastoris*, *Cerastium vulgatum*, *Stellaria media*, *Plantago major*, *Chenopodium album*, *Polygonum Periscaria*, *P. heterophyllum*, *Rumex crispus* and *R. obtusifolius*. Finally four plants, *Trifolium pratense*, *T. hybridum*, *Lolium perenne* and *L. multiflorum*, almost certainly came in the nosebags of the horses engaged in the work.

"The small ruined 15th century church of St. Olaves's, Hart Street,

Crutched Friars, is of exceptional interest. William Turner, the 'Father of English Botany' and author of a famous Herbal, was buried in the south aisle of this church on July 9, 1568, where there is an inscription to his memory. Enemy action has brought down the roof and upper walls, and access to the interior is impossible, but from the road *Epilobium angustifolium*, *Tussilago Farfara*, *Senecio vulgaris* and *Sonchus oleraceus* may be seen growing in the north aisle. St. Mary's Church, Kennington Park Road, is a larger modern church which has been less seriously damaged by the bombing. Access is again not possible, but inspection through a crack in the charred door showed a most luxuriant vegetation growing in the pavement of the aisles, in which *Epilobium angustifolium* was the dominant species.

"The extent to which the invading flora could endure shade was often surprising. For example, a small shop in Newington Causeway was damaged and left unused. Three of the walls were intact and the ceiling though sagging appeared to be water-tight; only the shop front was missing. Towards the back of the shop, behind the ruined counter, several plants of *Tussilago Farfara* and *Senecio vulgaris* were growing under dimmer, drier conditions than one would have supposed possible.

"The lists on which this paper is based were all made in the last fortnight of October 1942, at a time when most of the sites had only been cleared for a few months and others were still uncleared. As might be expected the pioneer vegetation was very scanty, averaging only about four species to each locality. The two richest places will illustrate the comparative frequency of species:—

(1) Site in Fenchurch Street, near Mark Lane.

Senecio vulgaris—abundant.
Poa annua—abundant.
Erigeron canadensis—frequent.
Capsella Bursa-pastoris—a few plants.
Matricaria inodora—a few very young plants.
Senecio squalidus—one small plant.
Galinsoga parviflora—one small plant.

(2) Site formerly occupied by 'Isaac Walton's' shop, Newington Causeway.

Senecio vulgaris—abundant.
Epilobium angustifolium—abundant.
Poa annua—abundant.
Senecio viscosus—common.

Tussilago Farfara—frequent.
Sonchus oleraceus—several plants.
Polygonum Persicaria—one plant.
Plantago major—one plant.

"Observations in the West End of London suggest that pioneer colonists there usually comprised the same species. In the suburbs the range of invading species was much wider owing to the proximity of numerous gardens and other open ground. The purpose of this paper is to record the pioneer flora of bombed sites in Central London in 1942. There can be little doubt that in 1943 a richer and more luxuriant flora will appear.

"There were 88 records, of 27 species, from 21 bombed sites selected as known to have been completely built over before the war."

GREATER ST. LOUIS VICTORY GARDEN HARVEST SHOW

SPONSORED BY THE VICTORY GARDEN COUNCIL
OF THE ST. LOUIS OFFICE OF CIVILIAN DEFENSE
MISSOURI BOTANICAL GARDEN, SEPTEMBER 9 AND 10

PRIZE AWARDS **$1,000 IN WAR STAMPS AND BONDS**

SHOW REGULATIONS

1. *Eligibility:* Any amateur may compete, an amateur being one who grows for home use only.
2. *Fees:* No entry fee is required.
3. *Dates:* The show will be opened to the public on Saturday, September 9, from 2 P. M. until sunset and on Sunday. September 10, from 9 A. M. until sunset.
4. *Exhibits:* Entries for competition must be brought to the entry tables at the Shaw's Garden Display House before 10 A. M. on Saturday as judging will start promptly at 10:30. Exhibitors are limited to one entry in each class.
5. *Preparation:* Facilities for preparing entries are provided in a building adjoining the Display House, entrance on Alfred and Castleman avenues. Each entry must have a card bearing required information attached—cards will be provided free.
6. *Display:* Section chairmen of the show committee will place and arrange the entries on their respective tables. All entries must remain on display until 9 A. M. Monday, September 11.
7. *Awards:* Judges will place seals on winning entries: first prize, Blue Seal; second prize, Red; third prize, White. Prizes of War Stamps and Bonds will be awarded in addition to the seals. Sweepstakes prizes of War Bonds will be awarded on the basis of points in some sections and a Grand Prize War Bond will be awarded for the largest total number of points won by any one exhibitor in the entire show.
8. *Liability:* The O.C.D. Victory Garden Council and Show Committee and Missouri Botanical Garden will exercise due care in protecting exhibits and exhibitors' containers from damage or loss, but will in no way assume any responsibility.

Schedule of Exhibits

This Show is for non-commercial amateurs. All exhibits must be grown by the exhibitor, a person who does not sell plants, fruits or vegetables for profit and who is not employed as a gardener. Paper plates for exhibits will be furnished at the Display House by the Council.

NOTE: All exhibitors are asked to use the entrance on Alfred and Castleman Avenues.

— FRESH VEGETABLES AND FRUITS —

SECTION A—VEGETABLES

Class

1. Mass display of vegetables (5 or more kinds)
2. Beans, Lima bush, 12 pods
3. Beans, Lima pole, 12 pods
4. Beans, Snap bush, 12 pods
5. Beans, Snap pole, 12 pods
6. Beans, Snap yellow, 12 pods
7. Beets, 5
8. Broccoli, green, 3 heads
9. Cabbage, 1 head
10. Cabbage, largest head in section, 2 lbs. or more
11. Carrots, 5
12. Cauliflower, 1 head
13. Celery, 1 stalk
14. Corn, white, 3 ears
15. Corn, yellow, 3 ears
16. Cucumbers, 3
17. Eggplant, 1
18. Onions, dry, 5
19. Onions, rope or trace
20. Peppers, 5
21. Parsnips, 5
22. Potatoes, 5
23. Pumpkins, 1
24. Radishes, 5
25. Rutabagas, 1
26. Salsify, 5
27. Soybeans, 12 pods
28. Squash, summer, 1
29. Squash, winter, 1
30. Sweet Potatoes, 3
31. Swiss Chard, trimmed, 1 plant
32. Tomatoes, red, 5
33. Tomatoes, any other color, 5
34. Tomatoes, small fruiting, 12
35. Tomatoes, largest by weight in show
36. Turnips, 3
37. Any other vegetables (not for competition)

SECTION B—FRESH FRUITS

38. Mass display of fruits (5 or more kinds)
39. Apples, green, 3
40. Apples, red, 3
41. Apples, yellow, 3
42. Grapes, blue, 3 bunches
43. Grapes, red, 3 bunches
44. Grapes, white, 3 bunches
45. Melons, 1
46. Peaches, 3
47. Pears, 3
48. Watermelons, 1
49. Any other fruits (not for competition)

SECTION C—DECORATIVE DISPLAYS

50. Arrangement of vegetables in flat dish or bowl.
51. Arrangement of fruits in flat dish or bowl.
52. Mixed arrangement, fruits and vegetables.

Schedule of "Canned" Foods

All canned foods must be in glass containers. The canned exhibits must be home-preserved but need not be home-grown vegetables and/or fruits. In case of close scoring, judges may open containers, but only with such types of entries as will not spoil because of opening.

SECTION D—CANNED VEGETABLES

Class

53. Asparagus
54. Beans, Snap green
55. Beans, Snap yellow
56. Beets
57. Carrots
58. Corn, cut from cob (pints only)
59. Peas
60. Pumpkin
61. Spinach
62. Soup Mixture, vegetable
63. Tomatoes
64. Tomato Juice

SECTION E—CANNED FRUITS

65. Apples
66. Applesauce
67. Apricots
68. Blackberries
69. Cherries
70. Gooseberries
71. Peaches
72. Pears
73. Pineapple
74. Plums
75. Raspberries, black
76. Rhubarb

SECTION F—BRINED AND PICKLED FOODS

77. Beet Pickles
78. Bread-and-butter Pickles
79. Catsup
80. Chili Sauce
81. Mixed Pickle Relish
82. Piccalilli
83. Sauerkraut
84. Senfgurken Pickles
85. Small Pickled Onions
86. Sweet Pickled Peaches
87. Sweet Pickled Watermelon Rind

SECTION G—SUGAR-PRESERVED FRUITS

88. Cherry Preserves
89. Peach Preserves
90. Strawberry Preserves
91. Best 6 Uniform Containers of Jelly

SECTION H—BEST CANNED BALANCED MEAL

92. Entry should include not less than 5 jars (either pints or quarts, all uniform) which make up a well balanced meal. A meat may be included. Award will be judged on basis of:
    a. Individual scoring of jars.
    b. Scoring of total jars for well balanced nutritious meal based on nutrition standards.

SECTION J—BEST VARIETY DISPLAY

93. Entry should include 12 jars (either pints or quarts, all uniform) of different fruits, vegetables, etc., with scoring according to program score card.

SECTION K—GARDEN CLUB MASS DISPLAYS

94. Exhibit should cover table space of 3 x 7 feet and may include either vegetables, fruits and canned goods or any combination. Arrangements and accessories must be furnished by the Club.

WAR STAMP AND BOND AWARDS

War Stamps and Bonds as well as Seals will be awarded in each Section. Watch newspaper for full listing of prizes—$1,000 in all—which will be announced previous to the Show.

IMPORTANT:

1. No entry fees.
2. All prizes in war bonds and stamps.
3. All fresh fruits and/or vegetables must be grown by exhibitors.
4. Canned exhibits must be home preserved but need not be home-grown.

For further information and entry blank write to

O. C. D. VICTORY GARDEN INFORMATION CENTER
4th Floor, Civil Courts Bldg.,
St. Louis, 1, Mo.

or

Missouri Botanical Garden
2315 Tower Grove,
St. Louis, 10, Mo.

NOTES

Dr. Edgar Anderson, Geneticist to the Garden, spoke over Radio Station KFUO, July 3, on "Flowers in the City Art Museum."

As has been customary for a number of years, a wreath of orchids was placed on the tomb of Henry Shaw in commemoration of his death.

A group attending the International Circulation Managers Association meeting in St. Louis was conducted through the Garden by Dr. Fairburn, June 20.

Mr. Charles Heiser, graduate student at the Garden, spent a week during August at the Museum of Northern Arizona, Flagstaff, studying variation in sunflowers.

Mr. George H. Pring, Superintendent of the Garden, gave a talk, illustrated with colored films, to the Clayton Rotary Club, June 15, on "Collecting the Para Rubber."

Dr. D. C. Fairburn, Horticulturist to the Garden, showed the films "Orchids from Seed to Flower" to a group of garden club members at Girard, Pennsylvania, and at Syracuse, New York.

"Some Orchid Pests," an article in the June Garden BULLETIN by

George H. Pring, Superintendent of the Garden, has been reprinted in the August number of the *Gardeners' Chronicle of America* (**48**:243-244).

One of the Wartime Conducted Tours provided by the National Park Service to places of historic interest in St. Louis was a trip to the Garden, August 19, the party starting from the Old Courthouse in the Riverfront Memorial area.

The June number of the *Journal of the Cactus and Succulent Society of America* (**16**:81-83) contains an article by Louis Wheeler, Ladislaus Cutak (in charge of Succulents at the Garden), and Alain White on "Confusion Among the Slipper Flowers."

The Franklin-Gasconade Firemen's Association, with their families and friends, were entertained at the Garden Arboretum, July 20. After a tour of the grounds and a business meeting in the Shelter House, Mr. George H. Pring, Superintendent of the Garden, showed the colored films "Orchids from Seed to Flower."

Visitors to the Garden library and herbarium during the summer months include: Dr. Gladys E. Baker, Assistant Professor of Botany, Vassar College, Poughkeepsie, N. Y.; Sr. Alejandro Bordas, of the Museo Argentino de Ciencias Naturales, Buenos Aires; Sgt. Louis G. Brenner of the U. S. Army; Sr. Alcides Carvalho, of the Engenheiro-agronomo, Instituto Agronomico, Campinas, Sao Paulo, Brazil; Dr. Delzie Demaree, Chairman Natural Science and Mathematics, Arkansas Agricultural and Mechanical College, Monticello, Ark.; Sgt. Cedric Flewellyn of the U. S. Army; Mr. Frank J. Heinl, Director Illinois State Historical Society, Jacksonville; Mr. Leslie Hubricht, of Norfolk, Virginia, formerly research assistant to Dr. Edgar Anderson at the Garden; Miss Elizabeth McSwain, graduate student in botany, University of Arkansas, Fayetteville; Sgt. Samuel French Morse, of the U. S. Air Corps; Miss Violet Munger, teacher at San Domingo Day School, Bernalillo, New Mexico, and a member of the Cactus Society of America; Mr. J. N. Spaeth, State Forester of Illinois; Mr. Hugh A. Steavenson, Manager of the Soil Conservation Nursery, Elsberry, Mo.; Sr. Gino A. Tomo of the Facultad de Agronomia e Veterinaria, Buenos Aires, Argentina; Mrs. E. C. Van Barnevelt, of Chatsworth, Calif.; Mr. Frank D. Venning, research student in botany, University of Miami, Coral Gables, Fla.; Mr. George O. White, State Forester of Missouri; Pvt. Daniel E. Wonderly, of Fort Leonard Wood, Mo.; Mrs. Isabel Zucker, Garden Editor *Detroit Times*, Detroit, Michigan.

STATISTICAL INFORMATION FOR JUNE-JULY, 1944

GARDEN ATTENDANCE:

Total number of visitors in June	17,529
Total number of visitors in July	19,826

PLANT ACCESSIONS:

Total number of plants and seed packets donated in June	137
Total number of plants donated in July	10

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought in June	4
Total number of books and pamphlets donated in June	111
Total number of books bought in July	13
Total number of books and pamphlets donated in July	48

JUNE

HERBARIUM ACCESSIONS:

By Gift—	
Anderson, Edgar—Plants of Horticulture	2
Botanical Garden, Rio de Janeiro, Brazil—Photostat and photograph of *Marsdenia amylacea* (B. Rodr.) Malme	2
Davis, Ben—*Serinea oppositifolia* (Raf.) Ktze. from Missouri	1
University of Illinois, by J. T. Buchholz—Photostats and one specimen of *Podocarpus*	15
Von Schrenk, Hermann—Plants of Missouri	19
By Exchange—	
Arnold Arboretum, Harvard University—Plants of Cuba	232
Cornell University, by R. T. Clausen—Plants of New Jersey and Alabama	4
U. S. National Museum—Plants of Cuba	114
U. S. National Museum—Plants of United States, Mexico and Central America	63
TOTAL	452

JULY

By Gift—	
Buettner, Charles E.—*Pinus Coulteri* Lambert	3
By Exchange—	
Rosengurtt, Bernardo—Plants of Uruguay	20
State University of Iowa, by G. W. Martin—Fungi from various localities	11
TOTAL	34

STAFF
OF THE MISSOURI BOTANICAL GARDEN

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

GEORGE T. MOORE,
Director

HENRY N. ANDREWS,
Assistant to the Director

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Geneticist

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DAVID C. FAIRBURN,
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JOSEPH CUTAK,
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LADISLAUS CUTAK,
In charge of Succulents

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Hove, Sussex, England

SOME FACTS ABOUT THE GARDEN

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

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

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

MISSOURI BOTANICAL GARDEN BULLETIN

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

Missouri Botanical Garden Bulletin

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"GRAVEL" CULTURE FOR ORCHIDS

The culture of plants in gravel or sand saturated with nutrient solutions is not a new idea. Scientists have used this method for years to study the effects of various chemical compounds on plant growth. Not until recent times, however, has it become apparent that "soilless culture" or "hydroponics" has possibilities far beyond the limits of research laboratories. Commercial growers of flowers and vegetables are now experimenting with it on an impressive scale. Amateur gardeners are trying it out too in one form or another even though stories of the abundant harvest rarely occur except on the paper of popular magazines.

In 1938 a series of experiments with orchids in "hydroponics" was started at the Garden. Prior to that date scarcely anybody had given the matter serious consideration, and apparently only in one instance had worthwhile results been obtained. In this particular case Phalaenopsis orchids were used.

Preliminary experiments at the Garden were designed to find out the best type of "gravel" to use, what the composition and concentration of the nutrient solution should be, how to apply the solution, etc. Porcelain jars, each containing a different nutrient solution, were used. Small wire baskets, coated with paraffin and lined on the inside with a thin layer of sphagnum moss, were filled with (1) washed and screened cinders, (2) gravel from the Meramec River in Missouri, (3) Haydite gravel. According to available information, Haydite is a crushed clay or shale heated at high temperatures to form an inert, light weight, porous material that is ground down to the various sizes of gravel used in concrete. A dozen seedling Cattleyas (6 months old) taken directly from the culture flask were planted in each basket. These baskets were then suspended in the porcelain jars just deep enough to touch the nutrient solution, thus keeping the gravel, cinders and Haydite moist. Water was added occasionally to compensate for evaporation, and the solution was held at pH 5.0 by using phosphoric acid. Leaf and root growth were recorded for one year.

Results of this test may be briefly summarized as follows:

1. Hybrid Cattleya seedlings grew well in most of the nutrient cultures.
2. Haydite was superior to cinders and Meramec gravel as a rooting medium.
3. Seedlings "damped off" or rotted if the gravel, cinders or Haydite were kept too wet.
4. The following solution produced the best root and top growth:

Calcium nitrate	1.00 gram
Ammonium sulphate	0.50 gram
Magnesium sulphate	0.25 gram
Mono-basic potassium phosphate	0.25 gram
Ferric phosphate	0.25 gram
Distilled water	1.00 liter

It will be noted that this formula is the one commonly used in flask cultures, except the iron content has been increased.

With these results in mind the writer proceeded with a more elaborate set-up consisting of a metal tank 3 ft. x 2 ft. x 4 in., with a combined intake and drain pipe at the center. Two 5-gallon pails, each with an outlet spout at the bottom 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. Iron rods attached to the greenhouse roof were used as hooks for the pails. Both the tank and the pails were given two coats of Asphaltum (Grade A) paint to avoid chemical reactions of the solution with the metal. After the solution had been in the tank for two or three hours, perfect drainage was accomplished merely by setting the pails on the floor. The tank was filled with Haydite ($\frac{1}{4}$–$\frac{1}{16}$-inch grade) and the orchids planted. This time Dendrobium seedlings, Cattleya seedlings, mature Cattleyas, and Paphiopedilums (Cypripediums) were used to include both age and variety. Hydrant water was added whenever necessary to keep the pails full, and the pH was held at 5.0 by using phosphoric acid. The tank was flooded with nutrient solution every other day when the weather was clear. During spells of cloudy weather the Haydite remained moist, making flooding unnecessary or even harmful. The solution was completely renewed every six weeks.

After this experiment had been in progress almost two years, it was possible to tabulate the following results:

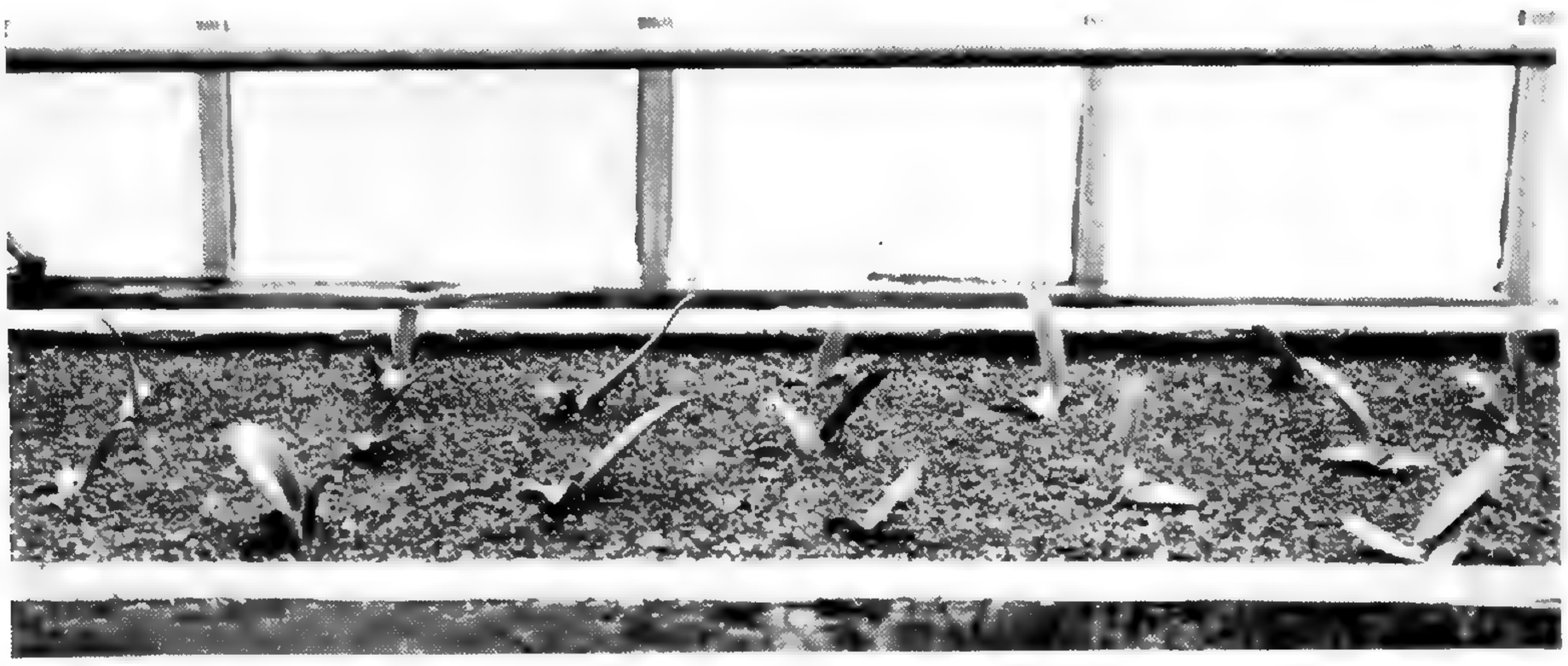
1. Cattleya seedlings did fine—good leaf development and splendid roots. In fact, one plant produced a flower at the early age of 3 ¼ years. Several others bloomed when they were 4 years old. In order to emphasize this point and avoid possible confusion regarding subsequent statements involving the age of seedlings, time will be calculated in all cases from the date of *seeding in the flask*, not from the date of transplanting from the flask.
2. Dendrobium seedlings did not do so well. Roots were all right, but leaf growth was inferior.
3. Mature Cattleyas made good root growth, but the tops were mediocre.
4. Mature Cypripediums grew fairly well, with roots and tops about average.

In the meantime another and larger tank (7 ft. x 3 ft. x 6 in.) of galvanized sheet iron reinforced with a wooden frame on the outside was prepared for action. A 50-gallon oil drum (carefully cleaned) served as the reservoir, and the nutrient solution was forced through a ½-inch pipe into the bottom of the tank by a centrifugal pump. The tank and drum received two coats of Asphaltum paint on the inside surfaces. Then the tank was filled with Haydite and 450 hybrid Cattleya seedlings, 20 months old, were planted in it. The solution used was identical with the one already mentioned except for the addition of the following minor elements:

Boric acid	2.86 grams	1 cc. of this stock solution used for each liter of nutrient solution
Manganese chloride	1.81 grams	
Zinc sulphate	0.22 grams	
Copper sulphate	0.08 grams	
Water	1.00 liter	

The solution was pumped into the tank every other day, weather permitting. Water was added to compensate for evaporation, and the pH kept at 5.0 with phosphoric acid. The solution was completely renewed every two months.

In one year the seedlings in this tank had grown so well that they were definitely over-crowded, and it was necessary to transplant them to new quarters. By this time the results were so encouraging that it was deemed advisable to proceed on a larger scale. Consequently, a concrete bench (50 ft. x 2½ ft. x 7 in.) in the greenhouse was remodeled for this purpose. The bench was made water-tight by filling all drainage holes with concrete. Then a hole was drilled in the bottom of the bench (center) through which the intake and drainage pipe was attached to a 150-gallon reservoir containing the nutrient solution in the basement. A piece of



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

1/8-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. Both the pipe and wire screening were anchored firmly in place with cement.

A wooden box with a removable glass frame lid was built in over the intake pipe. This intake box was necessary to avoid severe washing of the Haydite when the nutrient solution was pumped into the bench rapidly. Wire screening tacked on the bottom edges kept the gravel from entering the box. To facilitate uniform distribution of the solution throughout the bench, 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 pipes to keep out particles of gravel. All this equipment, including the galvanized metal storage tank in the basement, received two coats of Asphaltum paint.

Two grades of Haydite gravel were used: coarse (⅜–5/16-in.) for the bottom 2 inches, thus allowing rapid drainage through the perforated pipe, and fine (¼–1/16-in.) for the top 5 inches. The gravel was thoroughly washed before putting it in the bench. The following orchids were planted (8 inches apart) in the gravel:

1. One hundred seedling Cattleyas, 2 to 3 years old, transferred from the large tank mentioned in the previous experiment.
2. Thirty *Dendrobium Phalaenopsis* seedlings 4 years old.
3. Thirty *Dendrobium nobile* seedlings 2½ years old.
4. Ten mature hybrid Phalaenopsis.
5. Three mature Cymbidiums.
6. Several mature (but weak) Cypripediums and Calanthes. These were used mainly to see if the gravel treatment could revive them.

Three methods of planting the seedlings were used: 1, bare root, with all peat removed; 2, pot removed and ball of peat, with roots undisturbed, plunged in the gravel slightly deeper than previous planting depth; 3, pot and all plunged to the rim in the gravel.

An equal number of check plants identical in parentage, size, age, and quality to those put in the gravel, were potted in orchid peat (Osmundine) and grown according to standard procedure. They received no nutrient solution at any time. Thus it was possible to compare accurately the progressive development of the plants in gravel with those in peat.

It required almost 100 gallons of solution to flood this bench. The centrifugal pump mounted over the storage tank in the basement was contacted

All these Phalaenopsis plants were the same size and really looked sick at the beginning of the experiment. Plants at the left were then given the hydroponics treatment in Hadyite, those at the right were grown in orchid peat and transferred to the gravel bench to show accurate comparison of relative growth when the photograph was taken 1½ years later. The tall plants at the extreme left are Dendrobiums.

by a pull-cord attached to an ordinary light socket near the bench so that the operator would have rapid control over the amount of solution pumped in. A control valve on the intake-drain pipe under the bench (near the pull-cord for the pump) made it an easy matter to switch off the pump, close the valve and hold the solution in the bench as long as desired. When this valve was opened, the solution gradually drained back by gravity into the storage tank in the basement. During clear weather the solution was pumped into the bench every other day; when it was damp and cloudy, the gravel remained moist enough without further pumping. On warm days the plants were given a light spray of water whenever necessary.

The nutrient solution used in this experiment was considerably stronger than the one previously mentioned. Its composition was as follows:

Calcium nitrate	378 grams	
Mono-basic potassium phosphate	378 grams	
Magnesium sulphate	378 grams	
Ammonium sulphate	378 grams	
Ferric phosphate	95 grams	
Minor elements—		
Boric acid	2.86 grams	378 cc.
Manganese chloride	1.81 grams	
Zinc sulphate	0.22 grams	
Copper sulphate	0.08 grams	
Water	1.00 liter	
Hydrant water	100 gallons	

This nutrient solution was acidified to pH 5.0 with phosphoric acid at the beginning and throughout the duration of the experiment. At 3-month intervals fresh solution was substituted for the old to keep the concentration of the chemicals from getting too far out of balance.

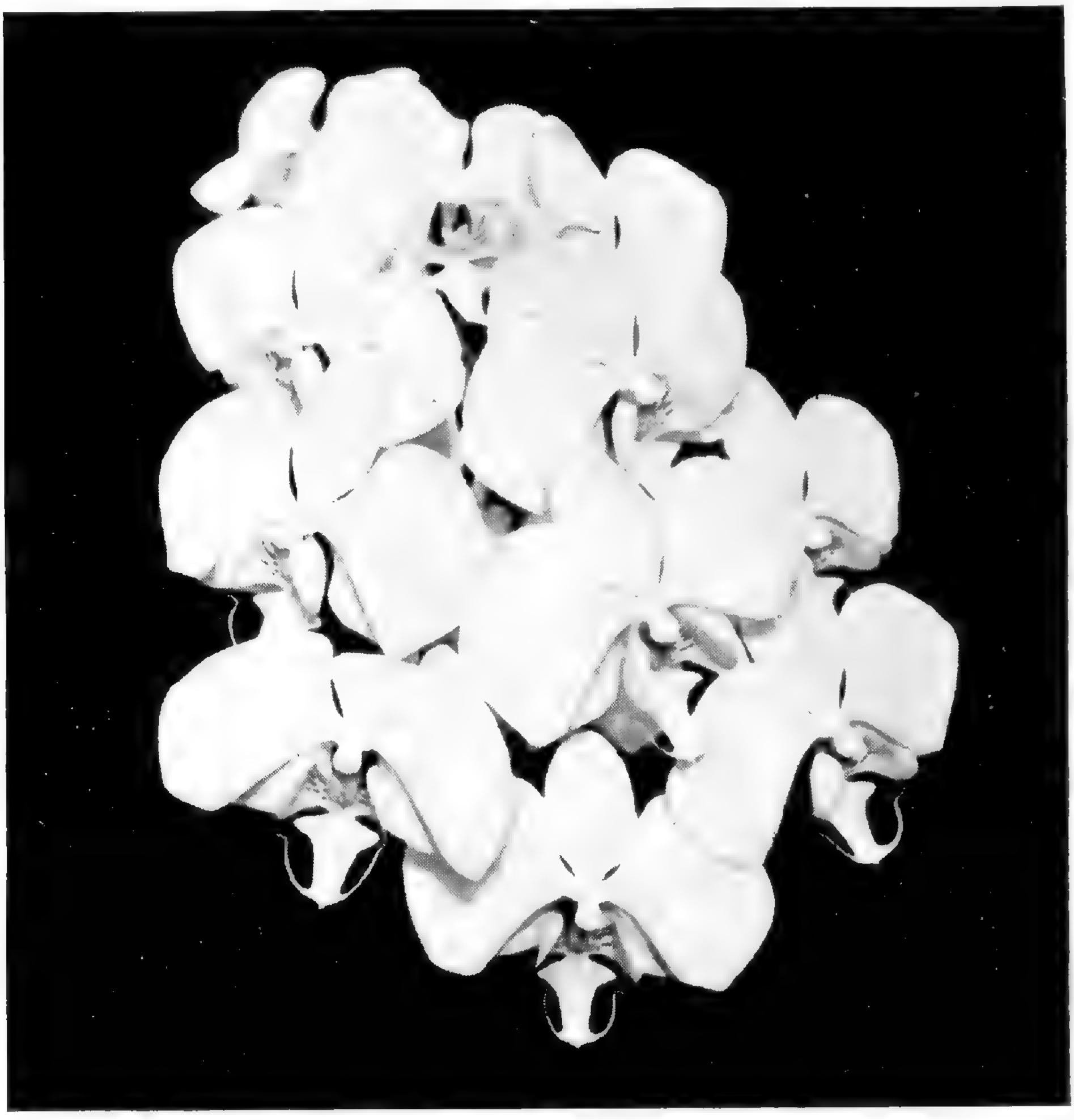
For 2½ years now this experimental gravel bench has been in constant operation. To put it mildly the results have been extraordinary. Photographs were taken periodically to record the progressive development of the plants. Intentions are to continue this particular experiment for another year or more, depending on how crowded the plants become in that length of time.

Any one who raises orchids soon comes to realize that patience is a great virtue. To draw hasty conclusions about plants having such slow growth responses is risky business. Consequently, publication of the following results has been delayed until they could be definitely verified.

1. Hybrid seedlings of Cattleya, Brassocattleya, Laeliocattleya,

Phalaenopsis and Dendrobium all 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 new lead growth per plant at a time while those in gravel seldom made less than two or three. In fact, it was not unusual to find four new growths on a plant in gravel, and some even produced five when dormant buds on "back bulbs" became active voluntarily. Orchid growers will readily grasp the significance of such results.



Spike of Phalaenopsis flowers from a plant raised in Haydite

3. The plants in gravel remained in active growth with no rest period such as occurs when grown in peat. It might be expected that continual growth like this would seriously weaken the plant and eventually lead to its collapse. So far, all the

evidence points exactly in the opposite direction.

4. One of the outstanding features about the plants in gravel was the extensive root growth. Unrestricted by pots, they fanned out in all directions, and it was unusual to find any that had turned brown or had disintegrated. In St. Louis, where the air still contains quite a bit of sulphur in spite of smoke regulations, orchids potted in peat seldom retain their new roots very long, especially if the roots are outside the pots. In gravel, however, such damage is practically reduced to zero. With more active feeding roots it is logical that the plants would grow faster.

A Cattleya seedling raised in Haydite blooming when 4 years old

5. The seedling Cattleyas in Haydite started to flower one or two years earlier than the check plants in peat. In addition, the flowers were larger and more abundant. One group of Cattleya seedlings (43 plants) in gravel started to flower in October, 1943. They were at that time only *3½ years old from seed*. To date (September, 1944) these plants have produced a total of *96 flowers*, which is a remarkable record for Cattleya seedlings of this age. Meanwhile the checks (43 plants) potted in peat have produced only *11 flowers*, or *85 less* than those in gravel.

The climax in the life of a seedling orchid comes of course when its first flower opens. The sooner this can be accomplished the better, as relatively few hybrids (maybe 25 per cent) will show the desirable characteristics for which the cross was made. The rest may vary from average to poor. Consequently, quite a number of seedlings eventually come to rest on the scrap heap or fall into the eager hands of beginning amateurs. By using the gravel method, this weeding-out process can be speeded up a year or two, which means a considerable saving in labor and materials as well as time.

6. The color, size, shape and texture of the flowers from plants grown in gravel have been superior thus far to the flowers from the checks in peat. In gravel the flowers seem to be a bit more susceptible to smoke injury, but further evidence is needed before any definite statements can be made along this line. Naturally, the parentage of a seedling will have a controlling influence on the keeping qualities of the flower. Some of the flowers in gravel have remained in good condition on the plants for one week, others two or three weeks, but most of these differences have been directly associated with heredity, not cultural practices.
7. It may have been pure coincidence, but the plants in gravel have suffered practically no damage from scale, slugs, or other pests that thrive so well under ordinary conditions. Of course, when the bench is flooded, all the insects that might be hiding in the gravel have to come out "or else." Repeated disturbances like this apparently discourage them from setting up housekeeping on a permanent basis. It may be, too, that certain chemicals absorbed from the nutrient solution render the plant tissues unpalatable to insects. Now that would be something! Slugs do not relish a long haul over rough gravel, so they seldom get a chance to eat holes in the flowers. With peat the story is considerably different. Bugs of all sorts can hide among the fibers or roost underneath the pots where they are fairly safe from sprays and dusts.

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. Flood the bench with solution to within one inch of the surface of the gravel. Complete coverage leads to extensive growth of algae on top, which can become quite a nuisance. Stirring up the gravel helped discourage this pest.
3. The bench can remain flooded for several hours to permit the roots to take full advantage of the nutrient solution. Accidentally, on several occasions the solution was left in the bench overnight, but the plants did not seem to mind.

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 when the photograph was taken).

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. Mature plants of Cattleya, Cypripedium and Oncidium did not respond satisfactorily when transferred from peat to gravel. However, only a limited number of plants was involved, so further tests are necessary before drawing definite conclusions.
6. Transplanting young seedlings from peat to gravel and *vice versa* was done easily, quickly, and with no set-back to the plants. Roots come out of the gravel very readily, making it

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.

possible to move crowded plants to a new location in the bench without any injury whatsoever.

7. A wire and string support to hold the leaves upright was added to the bench when the plants grew large enough to require bracing. Within two years the plants were sufficiently crowded to hold each other erect, and no supports for the leaves were necessary.

In November, 1943, another 50-foot "hydroponics" bench, identical in arrangement to the one set up in April, 1942, was put in operation. This time the bench was divided into three sections, each of which contained a different type of "gravel" as follows: (1) Haydite, (2) red granite, (3) cinders (thoroughly weathered, washed, and sifted to size through a ¼-inch mesh screen). The plants used in this experiment were:

1. Hybrid Cattleya, Laeliocattleya and Brassocattleya seedlings 1½ to 2 years old. Over 1,400 of these were put in the different types of "gravel", using three systems of planting: (1) bare root with all peat removed; (2) ball of peat left on roots, but pot removed; (3) pot (with ball of peat) not removed and plunged to rim in the gravel.
2. Phalaenopsis.—About 50 mature, but decidedly weak, plants were put in to see if they would revive.
3. Seedling Cattleyas 1 year old.—Fifty 6-inch community pans, each holding about 100 plants, were plunged to the rims in the Haydite to see if they would respond favorably to subirrigation with nutrient solution.

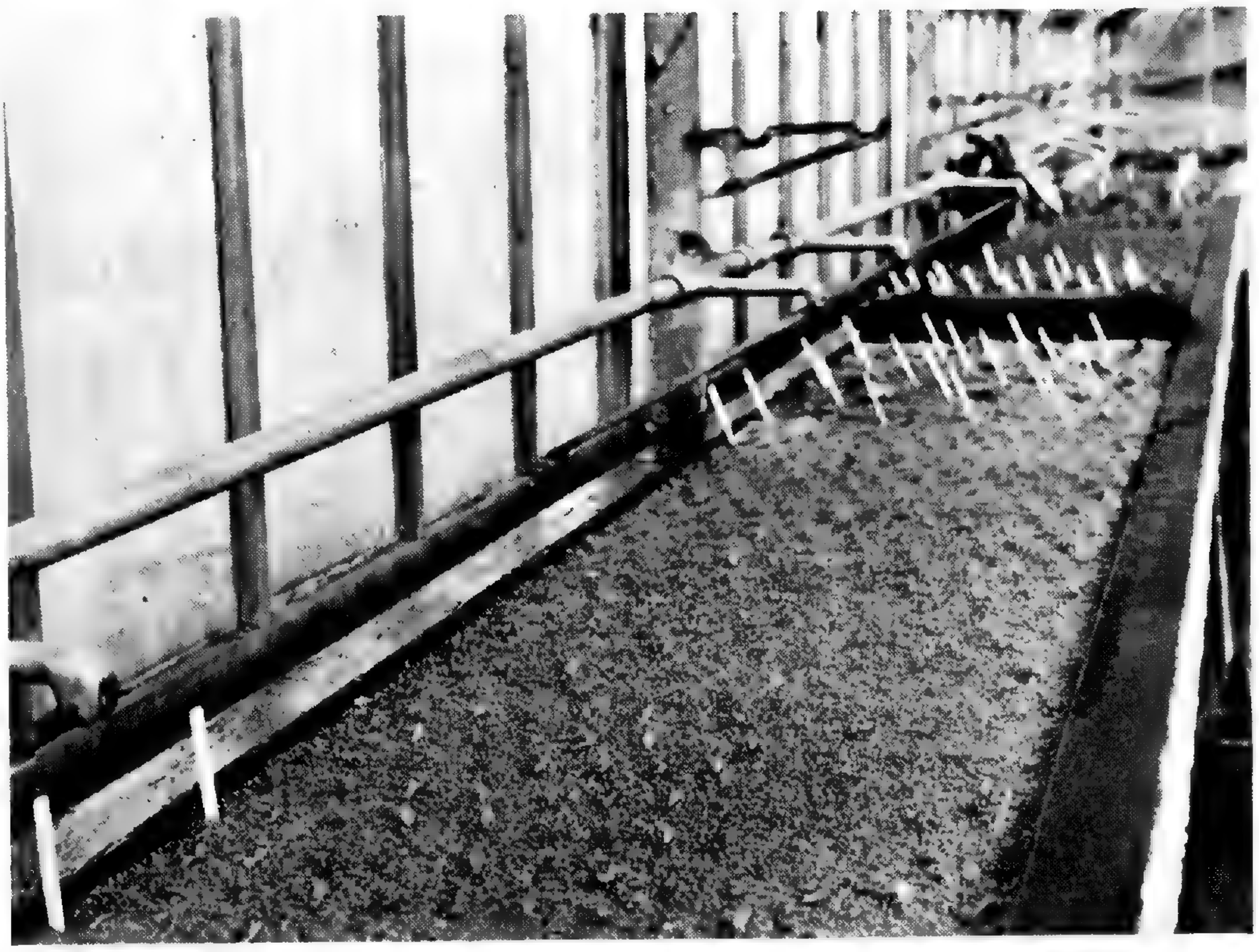
Obviously, this was quite an assortment of materials and methods to be using all in the same bench, but one can usually manage to get by with some very peculiar ideas by simply branding them "experimental."

The nutrient solution was identical to that used in the other bench. In fact, both benches were irrigated from the one reservoir by installing a few valves to control the direction of flow. This system worked out fine, since each bench was flooded every second day when the weather was clear.

Bench No. 2 has now been in operation almost one year. The seedlings are becoming crowded, and will require thinning out to develop properly. So every other seedling will have to be transplanted into another gravel bench or potted in peat.

The results to date on Bench No. 2 have been as follows:

1. Plunging community pots of seedlings in the gravel did not work out satisfactorily. They remained too wet and many of

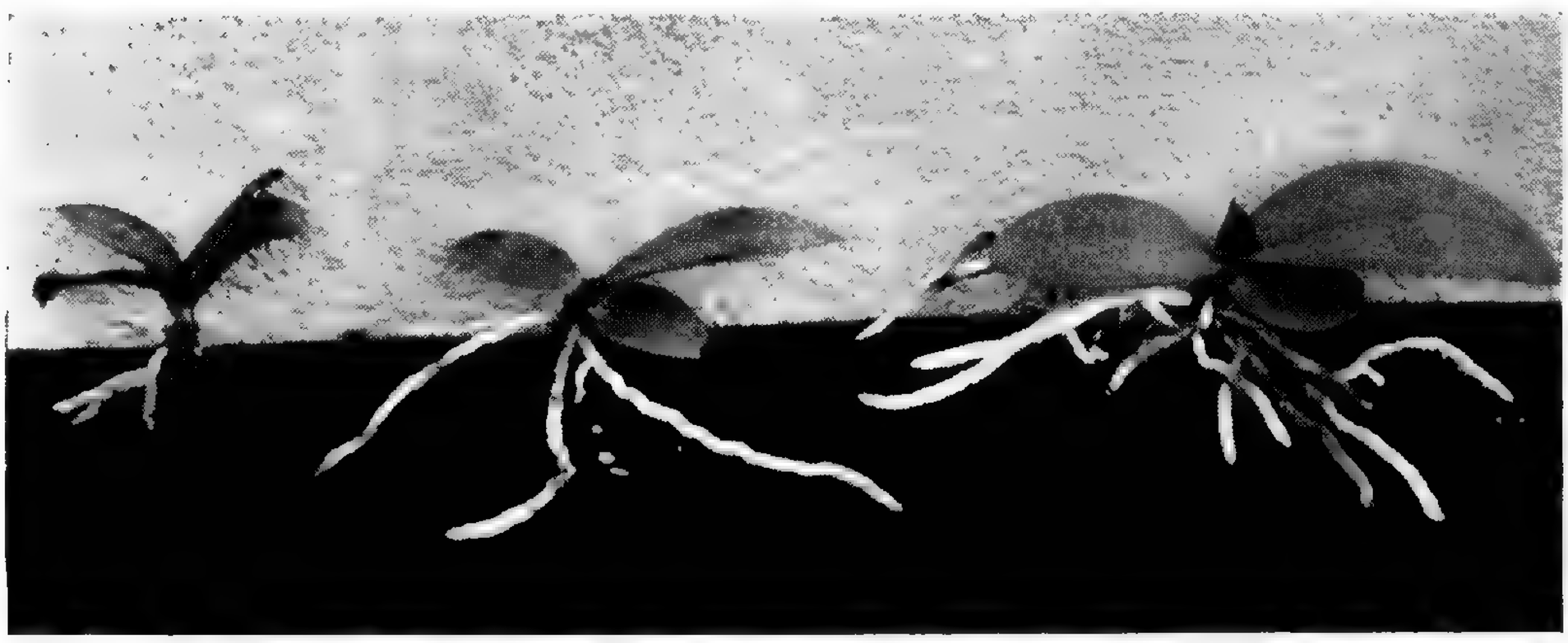


Cattleya seedlings (1½ years old) in granite at start of experiment. Phalaenopsis plants near the intake box were very small and weak.

The same plants nine months later

the seedlings "damped off." These community pots were removed from the gravel at the end of six weeks and the space filled with more seedling Cattleyas 1½ years old.

2. The cinders were a failure. In spite of weathering for a year out of doors and thorough washing, they apparently retained enough sulphur to be definitely toxic. Roots were dwarfed and in many cases dead; leaves were small and turned black at the tips; new leaf growths seldom appeared; the plants looked very sick. So the cinder experiment was discontinued after



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

six months' trial. The cinders were replaced with a mixture of ½ Haydite and ½ granite. In this mixture 250 Phalaenopsis "Helvetia" seedlings were planted, and they have made excellent growth.

3. The bare-root method of planting in gravel has proved best. Leaving a ball of peat on the roots or plunging pots and all in the gravel resulted in almost constant "wet feet", a condition the orchids did not enjoy. Of course, if one uniform method of planting were used throughout the bench, it would be possible to control the moisture to better advantage. For potted plants plunged in gravel, pumping the solution into the bench once a week or less might be sufficient.

4. The mature Phalaenopsis plants, which were very small and feeble at the beginning, have literally taken a new lease on life, and apparently will be back in top-notch condition within another six months.

   The growth of Phalaenopsis in these nutrient gravel cultures is most extraordinary. Nothing like it has been seen in this

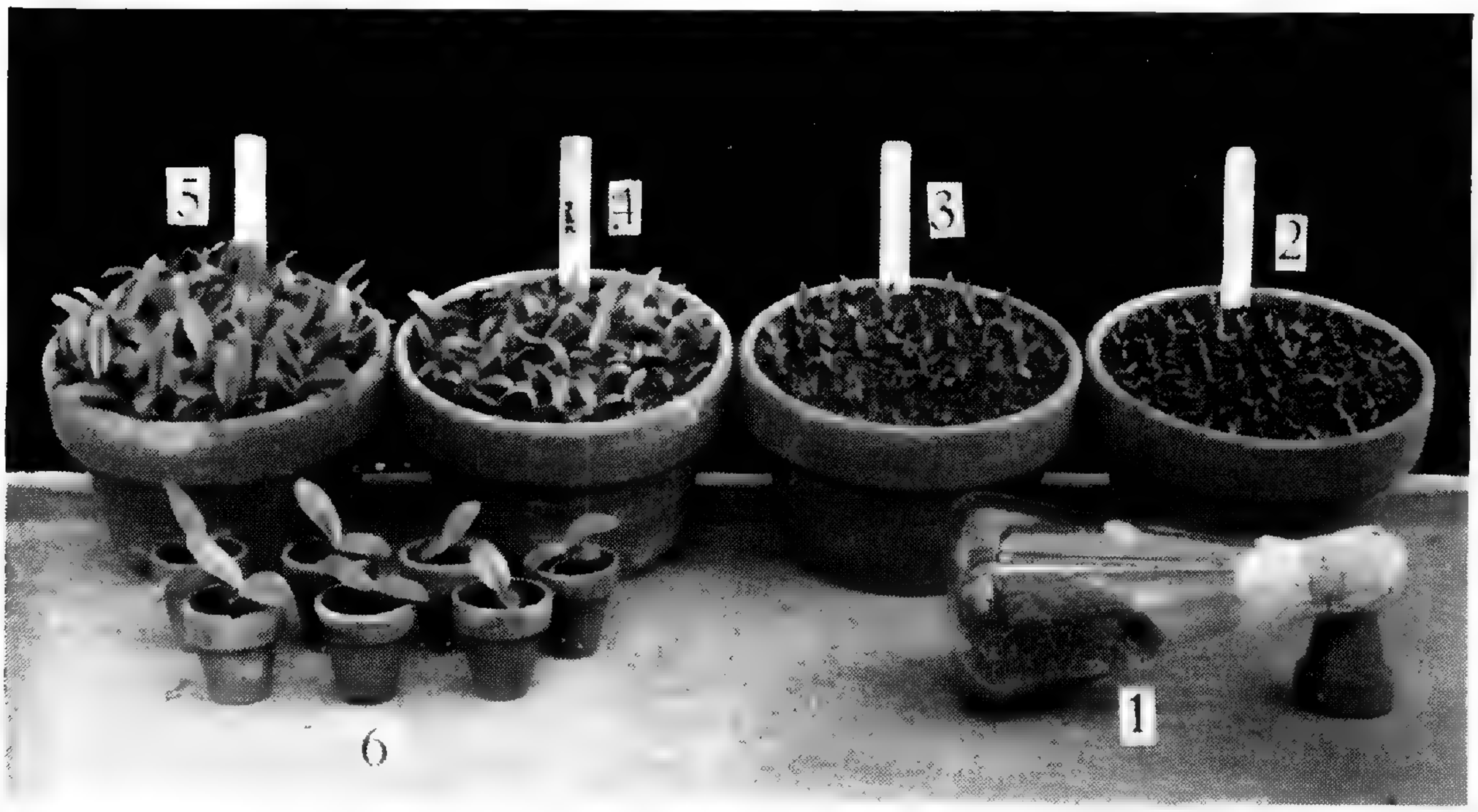
part of the country. Flower production occurred in direct proportion to the growth.

5. Results in granite have been slightly better than in Haydite, especially with Phalaenopsis. The fine grade of granite (averaging about ⅛ inch) retains moisture longer than Haydite and therefore requires less irrigation with the nutrient solution.
6. One thing is certain: For best results an entire bench should be devoted to one type of orchid, not several types. For example, it is a mistake to mix Dendrobiums (which require only limited moisture at the roots during their normal rest period) in with Cattleyas or Phalaenopsis that remain in active growth most of the time in gravel. With large-scale production we would carry this idea further and have one or more greenhouses devoted to gravel culture of nothing but Cymbidiums, or Vandas, or Cattleya hybrids, etc., so temperature, ventilation, moisture and light requirements of these orchids could be closely coordinated with nutritional factors. Under such conditions, maximum results would be achieved.
7. It is questionable whether or not the addition of minor elements, such as copper, zinc, manganese and boron, to the nutrient solution is necessary. In fact very slight over-doses are positively fatal.

While the bench tests were in progress, another idea took root. Why not transplant seedlings out of the culture flasks directly into community pots of gravel instead of peat? Any one who has spent months, weeks, or even days, transplanting tiny orchid seedlings into orchid peat knows it is a very slow, tedious job. Anything to relieve the strain at this critical stage would be most acceptable. For the past two years experiments along this line have been tried, with great success. In fact, the writer now uses gravel in the community pots entirely instead of peat.

Details of this new method of transplanting are as follows:

1. Use porous clay flower pots that are not too large. The standard 5-inch bulb pan is ideal for this work. Wash the pots thoroughly.
2. Cover the hole in the bottom of the pan with a piece of broken pot, and add coarse, washed Haydite until the pan is a little over half full. Then fill almost to the rim with Haydite or granite put through a ⅛-inch mesh screen and thoroughly washed. Mixing the top layer of gravel with about ⅓ chopped peat, sifted through a ⅛-inch screen, has given good results too.



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 ⅛-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.

3. Tamp down the gravel firmly, and sterilize the prepared pans in an autoclave (pressure cooker) at 15 pounds for half an hour. This steaming process eradicates all "damping off" organisms that might be present in the gravel or peat.
4. Take seedlings out of the culture flasks when roots start to develop. They should be planted about ½ inch apart in the gravel, so each pan contains anywhere from 50 to 75 seedlings, depending on their size. An experienced worker can transplant 1500 seedlings a day by this gravel method.
5. Place community pans in a Wardian Case that can be carefully ventilated and sprayed with water whenever the gravel becomes dry. If no peat is used with the gravel, acidify the water to pH 5.0 by adding phosphoric acid.
6. Once a week give the pans a thorough watering with nutrient solution of the same type as used in the gravel benches.
7. Allow seedlings to remain in the community pans six months to a year, depending on rapidity of growth. Then transplant them into a gravel bench or pot them in peat as may be desired. Transplanting seedlings from the culture flask directly into a

gravel bench is not feasible unless the plants are unusually large with well-developed roots.

Separating seedlings grown in community pots of peat is often quite a struggle. The roots become interwoven and cling so tightly to the peat fibers that it is almost impossible to get them apart without considerable breakage. In gravel this difficulty is entirely eliminated.

A great deal of time and patience is needed in the potting of young plants. Transplanting 200 seedlings into 1½-inch pots would be a good

Cattleya seedlings (1½ years old) raised in community pots of gravel

The same plants after growing 1 year in the gravel bench

day's work. In a gravel bench an agile person could set out 200 seedlings an hour, provided the root 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. Much remains to be done, however, before sufficient information is available to convince the more skeptical observers. 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. To answer these questions and others, a new concrete bench, specially designed for gravel-culture studies and capable of holding over 10,000 young orchid plants, has been constructed at the Garden and will soon be in operation.

DAVID C. FAIRBURN.

NOTES

Mr. A. P. Beilmann, Manager of the Arboretum, Gray Summit, spoke before the Clayton Garden Club, September 15, on "Tree Care."

Dr. David C. Fairburn, Horticulturist to the Garden, gave an illustrated talk to the Webster Groves Garden Club, September 15, on "House Plants."

Mr. Ladislaus Cutak, in charge of Succulents at the Garden, is the author of an article in *Garden Life* (17:10) entitled "Deserts Offer Shrubs for our Gardens."

"A Trip to the Florida Tropics," an article by Ladislaus Cutak, in the May 1944 Garden BULLETIN was reprinted in the June 15 number of the *American Eagle* (**39**:1, 4–5).

Dr. Ralph O. Erickson, formerly graduate student at the Garden (1939–1944), has been appointed instructor in botany at the University of Rochester, Rochester, N. Y.

Mr. George H. Pring, Superintendent of the Garden, spoke to the Rotary Club of Edwardsville, Ill., September 21, on "Collecting Para Rubber." The talk was illustrated with colored slides.

The July number of the *National Horticultural Magazine* (**23**:180, 182) contains an article on "Tropical Water-lilies" which features the hybrids originated at the Missouri Botanical Garden by Mr. G. H. Pring, Superintendent of the Garden.

The September number of the ANNALS OF THE MISSOURI BOTANICAL GARDEN has recently been issued, with contents as follows: "Miscellaneous New Asclepiadaceae from Tropical America," Robert E. Woodson, Jr.; "Notes on Variation in *Tithonia tubaeformis*," Edgar Anderson; "A Method for Recording and Analyzing Variations of Internode Pattern," Edgar Anderson and Dorothy Schregardus; "A Monographic Study of the Genus Palafoxia and Its Immediate Allies," Elizabeth Ammerman Baltzer; "Monograph of Psilostrophe," Charles B. Heiser, Jr.

Recent visitors to the Garden include: Lt. Reid Moran, of the U. S. Air Forces; Mrs. James H. Hyde, of Oklahoma City, a member of the Oklahoma Cactus and Succulent Society; Dr. Gustav Mehlquist, Instructor in Floriculture, University of California at Los Angeles; Mr. Walter Scholl, orchid enthusiast, of Chicago, Ill.; Lt. Frederick Russe, of the U. S. Navy; Lt. Bradford Pring, of the U. S. Air Forces; Prof. Carl Sauer, Professor of Geography, University of California, Berkeley.

During the fifteen years that the Arboretum has been protected, many new animals as well as plants have made it their home. Most of these have been beneficial, or at least have done no harm, but on occasion their food habits make it necessary to protect plants or to stop growing them. The most peculiar food preference which we have so far observed has been that for Regal Lily shoots. Many Regal Lilies were planted in 1942 in the Pinetum, and while ordinarily lily bulbs will send up a shoot regardless of how poor the planting site, curiously enough almost none of them grew. To explain their non-appearance more bulbs were planted, and in the spring of 1943 the whole question was answered over night. At the time that some special lilies were just appearing above the ground the very succulent shoots proved so attractive to deer that the entire frame of some 500 plants was eaten. Emerging lily shoots are used as food by many Asiatic peoples, and it is interesting to discover that the Virginia White Tail Deer likewise considers them a delicacy.

STATISTICAL INFORMATION FOR AUGUST-SEPTEMBER, 1944

GARDEN ATTENDANCE:

Total number of visitors in August	17,827
Total number of visitors in September	21,782

PLANT ACCESSIONS:

Total number of plants and seed packets donated in August	99
Total number of plants and bulbs donated in September	696

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought in August	7
Total number of books and pamphlets donated in August	61
Total number of books bought in September	21
Total number of books and pamphlets donated in September	224

AUGUST

HERBARIUM ACCESSIONS:

By Gift—

Brenner, Louis G., Jr.—Plants of Oregon	21
Fraser, Rev. Father S. V.—Plants of Kansas	2
Gorton, G. R.—Plant of Horticulture	1
Hinckley, L. C.—Plants of Texas	15
Massey, A. B.—*Asclepias phytolaccoides* Pursh from Virginia	2
Murrill, W. A.—Plants of Florida	143
Poixão, José—Plants of Brazil	9
Reed, H. Earl—*Ambrosia bidentata* Michx. from Missouri	1
Thomas, George E.—*Arisaema Dracontium* (L.) Schott. from Missouri	1
University of Texas—Plants of Texas	45
Von Schrenk, Hermann—*Pinus* sp. from Idaho	1

By Exchange—

Rosengurtt, Bernardo—Plants of Uruguay	24
Schallert, Paul—Plants of Arizona and California	146
University of Texas—Plants of Texas	465
TOTAL	876

SEPTEMBER

By Gift—

Barus, M. F.—*Thecaphora* sp. from Venezuela	1
Chicago Museum of Natural History—Lichens of Alabama and Venezuela	2
Fesler, Son—*Juniperus virginiana* L. from Missouri	2
Heiser, Charles B., Jr.—Plants of Arizona, New Mexico and Kansas	48
Hubricht, Leslie—Plants of Virginia	188
Shaver, Jesse M.—*Pellaea glabella* Mett. from Tennessee	1
Von Schrenk, Hermann—Photographs of *Pinus* sp. from Idaho	8
Whetzell, H. H.—Plants of New York, Wisconsin, and Winnepeg	4

By Exchange—

U. S. National Museum—Ferns chiefly from Tropical America	85
University of Illinois, by George Neville Jones—Plants of Illinois	1,008

By Transfer—

Cutak, Lad.—Plant of Horticulture	1
TOTAL	1,348

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MISSOURI BOTANICAL GARDEN BULLETIN

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CONTENTS

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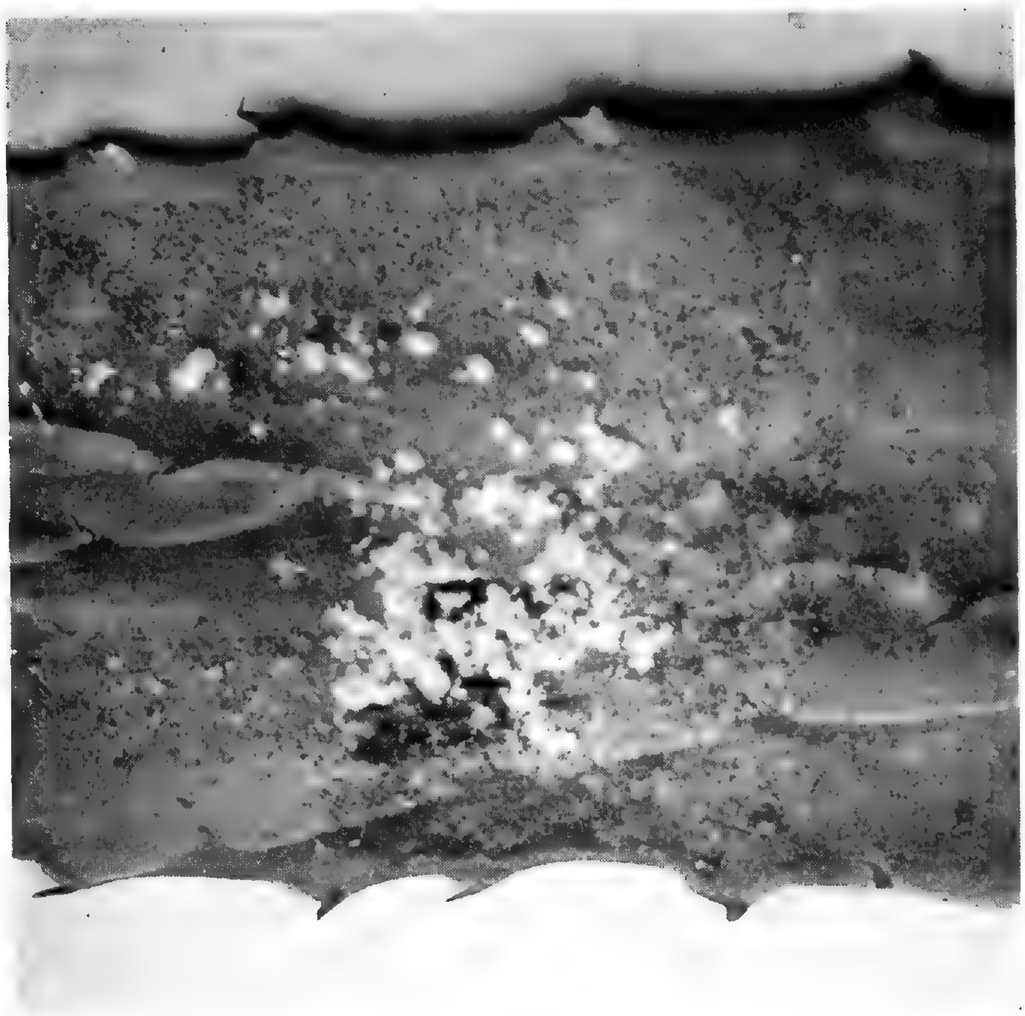
SOME FACTS ABOUT THE GARDEN

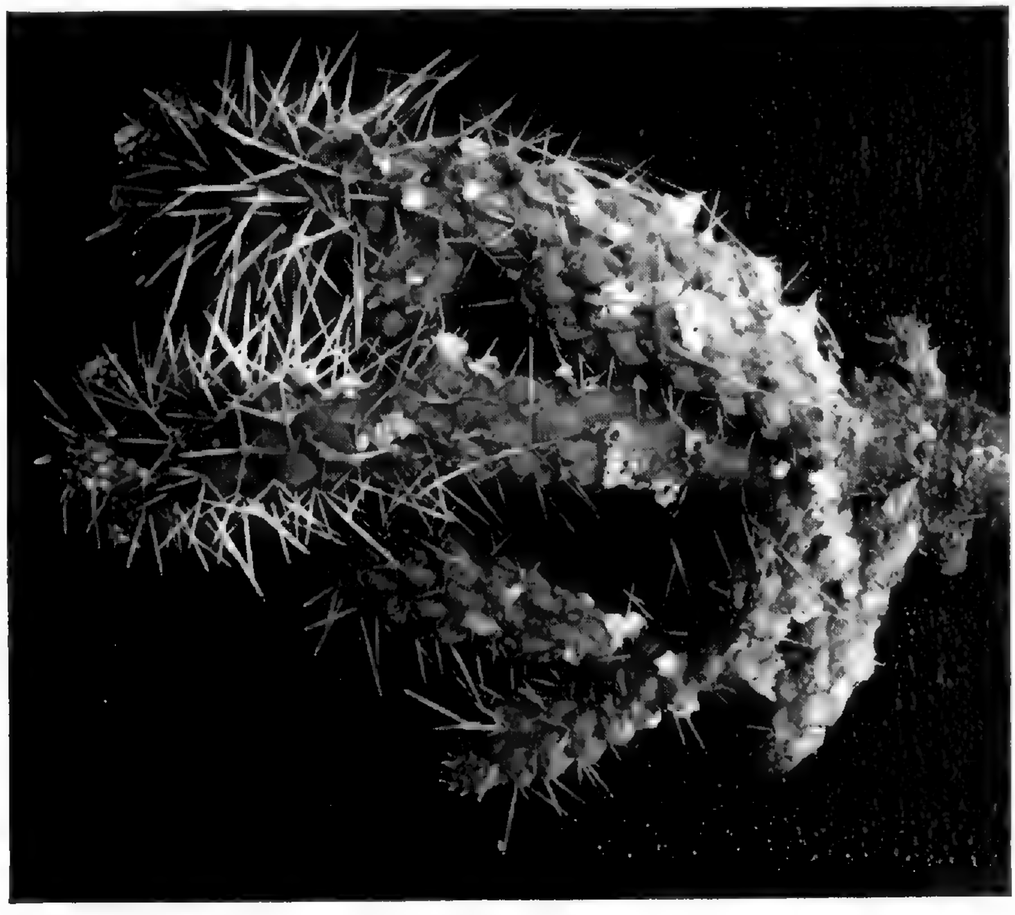
The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated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

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

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



Leaf of Century Plant (*Agave atrovirens*) showing discoloration caused by mealy bugs



Opuntia Whipplei attacked by mealy bugs

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Vol. XXXII NOVEMBER, 1944 No. 9

INSECTS THAT ATTACK CACTI AND SUCCULENTS

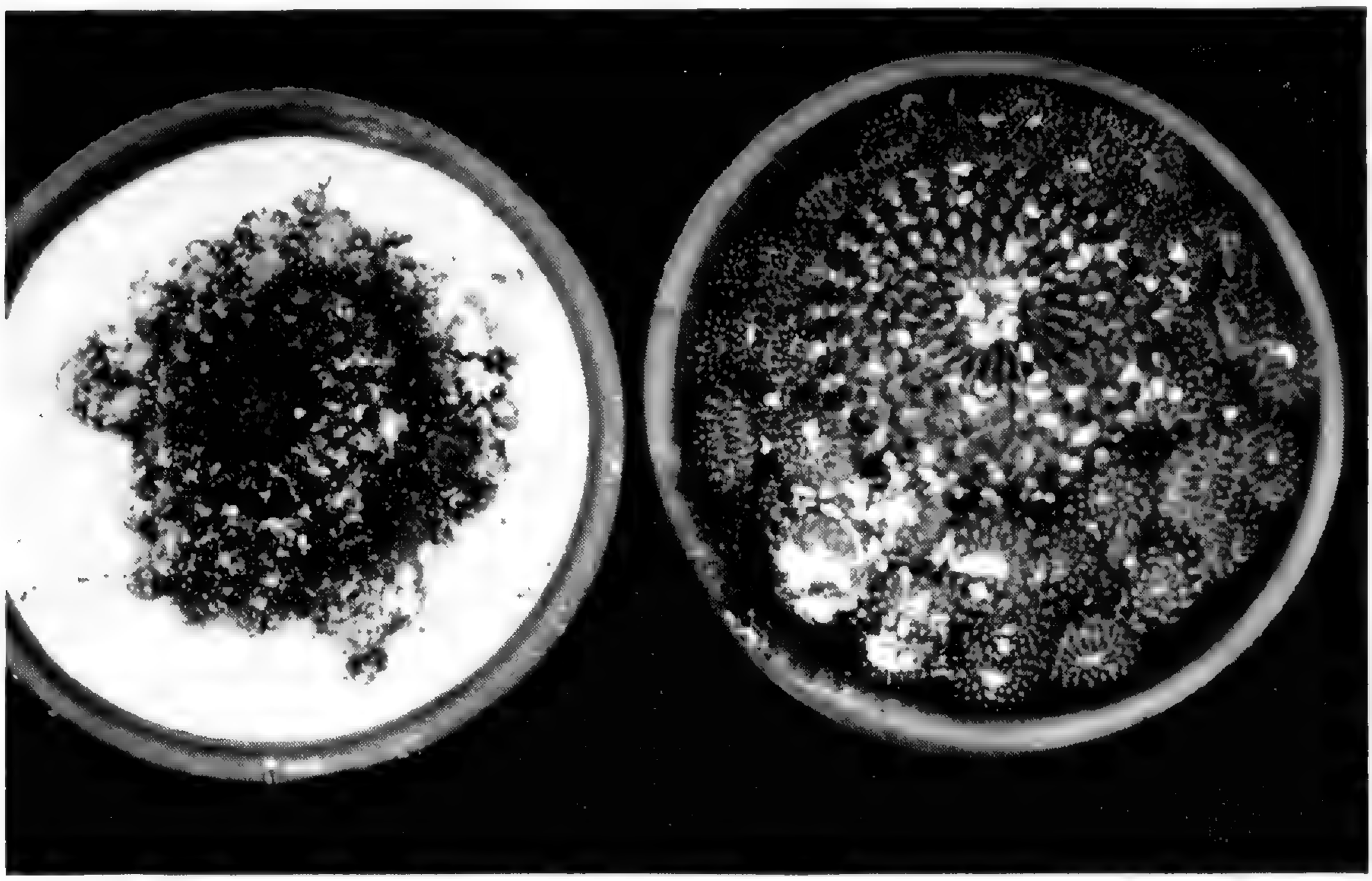
In the deserts one will find innumerable insects associated with cacti and succulents; some of these are beneficial in that they visit the flowers and act as agents of pollination, while others damage the plants either directly or indirectly. The United States Department of Agriculture made a study of cactus insects in 1912 and discovered that there were 324 species associated with these prickly plants. Not all were of the harmful type, but the greater number did cause damage of some consequence. Of course, in the native haunts of these plants, through various agencies such as birds, snakes, lizards, frogs, toads, and certain parasitic and predaceous insects, a natural balance of order prevails which helps to control the pests.

In the home or greenhouse very few native pests will infest cacti or succulents, but there are several common ones that do considerable harm if a careful watch is not kept. During the summer, grasshoppers, crickets, caterpillars, etc. are present in the flower garden and will get into a cactus bed or in a greenhouse where they may overrun the plants before a remedy can be applied. Such greenhouse pests as the mealy bugs, scales, and thrips will also be difficult to control if a dense infestation is allowed to accumulate. Vigilance is the price demanded of a clean collection.

Where injurious insects appear it will be expedient to use insecticides especially designed for the particular pest. The grower must learn whether the "bug" is a chewer or a sucker. The insects that bite and chew, such as the caterpillars and beetles, can be controlled by the use of poisons or poisonous gases. The poisoned food must enter the stomach to do the work of eradication. On the other hand, sucking insects (aphids and mealy bugs) can be controlled only by the use of contact insecticides or poisonous gases. Nature provides the suckers with needle-like mouth parts which enable them to pierce plant tissues and extract the juices. You could spread a thick layer of arsenate of lead on a leaf and a sucking insect will not be affected by it. However, in contact sprays the poisonous alkaloids, such as

nicotine, aid in sealing the insect's breathing pores and disintegrate the body tissue.

Arsenate of lead is probably the most widely used stomach poison. It can be applied as a spray or dust or used in poison bait. For a spray, a solution of about ten teaspoonsful to a gallon of water will be sufficient to kill most chewing insects. When used as a dust, part of the poison should be mixed with about nine parts of flour, talc, or hydrated lime. Paris green is another arsenical product which is highly efficacious when used in bait. Of the contact insecticides, nicotine is probably the most popular. It may be wiser for the individual with a small plant collection to get acquainted with some of the standard insecticides that are manufactured under various trade names.



Rebutia minuscula: right, a plant infested with mealy bugs; left, a plant totally destroyed by these pests.

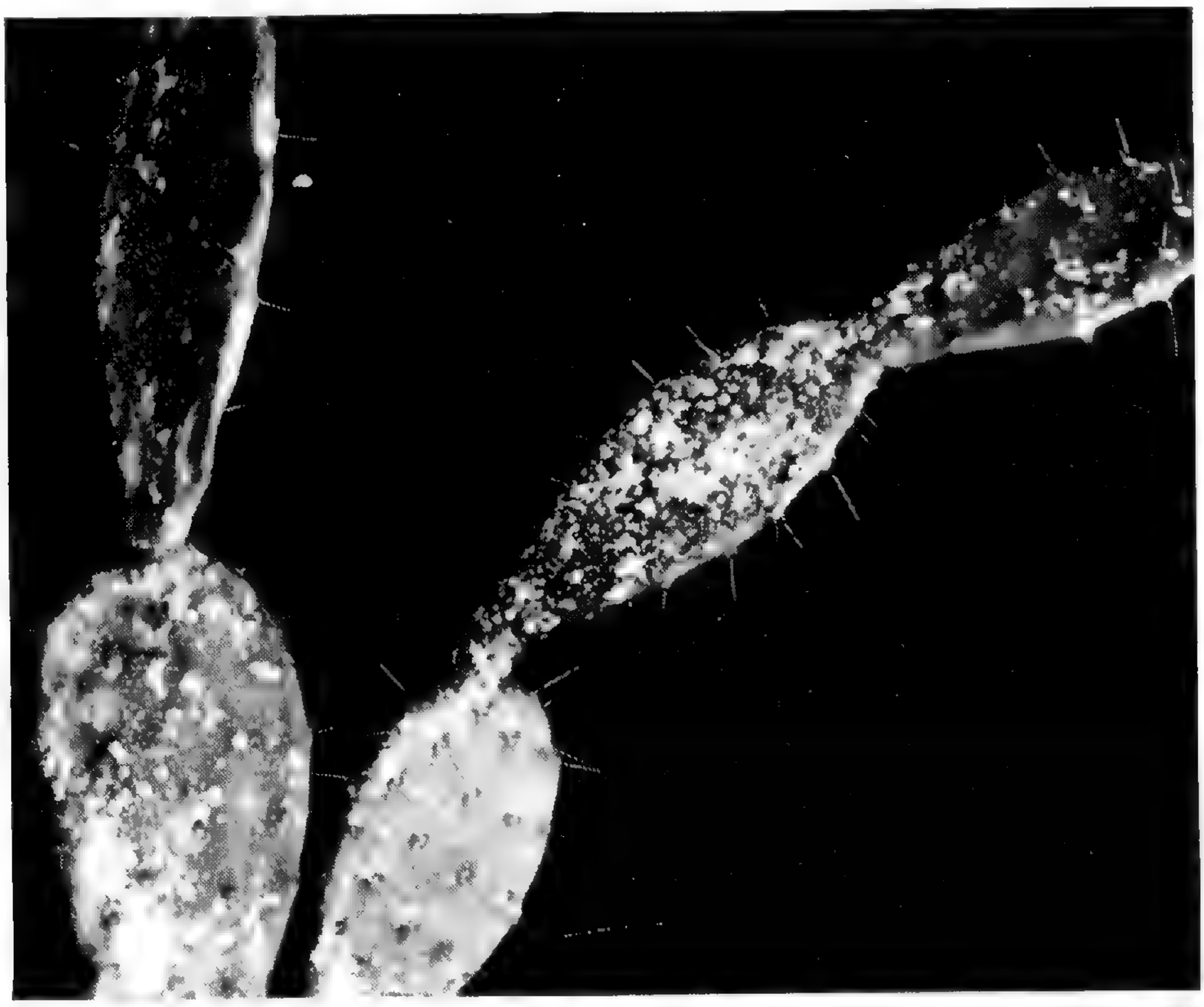
The most persistent and most serious pests of the cultivated cacti and succulents are the scale insects, in which group the mealy bug belongs. Many others exist but, as a rule, they are of minor importance, although it must be remembered that even these can do considerable damage. In the following paragraphs the common pests which are apt to do the most harm to greenhouse- or house-grown succulents are discussed and also various methods for their control.

Mealy Bugs.—Of all the insects that attack a cactus or succulent plant, none are of such importance as the mealy bugs. There are many species, most of which are easily recognized by the white cottony substance covering them. The "bug," because of its peculiar structure and the rapidity of its reproduction, is one of the hardest insects to hold in check. The female has the ability to lay about 500 eggs, secreting them in a mass of "cotton," which hatch out usually in ten days under greenhouse conditions. Since several generations are born in a year the immensity of an infestation is readily seen if no attention is paid to it. In the adult stage mealy bugs usually restrict themselves to a certain area on a joint or leaf where they sink their needle-like beak into the plant tissue and draw out the juice. The immediate area attacked soon becomes lifeless, drab in color, and eventually dies. The "bugs" usually collect in protected places,—in the grooves of new growth, under the leaves, in the clasping leaf sheaths, at the bases of joints, or hidden in the wool of the spine clusters. The destructive juice-suckers may attack any cactus, but they often single out the Echinocerei, Echinopsis, Mammillarias, Opuntias, Rebutias and Zygocacti. They also love to ravage the stapeliads, mesembs, kalanchoids, and most any other succulent.

When the tough cacti are heavily infested with mealy bugs a strong spray of water will dislodge the culprits and likewise wash off the sticky excrement that they leave. Cacti, as a rule, are sturdy enough to withstand a strong hosing, and this method is very effective where the mealy bugs have hidden behind a spiny armament. Tender succulents must be very gently sprayed, particularly the crassulaceous plants whose leaves and stems drop off at the merest touch. The writer prefers hosing to any treatment, although cyanogas fumigation is resorted to in the Cactus House when the infestation is widespread.

Root Louse.—This insect is similar to the mealy bug but is even more devastating in its work. The dormant season of a plant affords an ideal period for the development and increase of this pest, which attacks the roots and does its damage before its presence can be detected. Whenever a cactus or succulent plant appears sickly it will be a good idea to remove the plant from the pot and examine the roots. If any white cottony masses are noticed, shake off all the soil and dip the roots in denatured alcohol for about two minutes. After this operation permit the roots to dry thoroughly before repotting, a clean container and fresh soil being used for the purpose. If no alcohol is available, a thorough hosing or rinsing in cold water is advisable. The root-louse thrives in a dry soil, and if plants are grown too much on the dry side the infestation increases.

Scale Insects.—Many varieties of scale insects attack cacti and succulents. The pests can be recognized by their more-or-less arched, thick and rigid, shell-like covering. The adults fasten themselves tightly to the stems, joints or leaves of the plant, and suck out the juice. Scale readily attacks the pads of Prickly Pears (Opuntias) but other cacti do not escape. Tough-skinned Astrophytums, Echinocacti, Cerei and Gymnocalyciums collapse under a heavy infestation. Epiphyllums, Rhipsalis and Zygocacti dry up shortly if the insects are not controlled. Shrubby Mesembryanthemums and stemless mimicry plants wither away. In fact, hardly any succulent is immune to this pest.

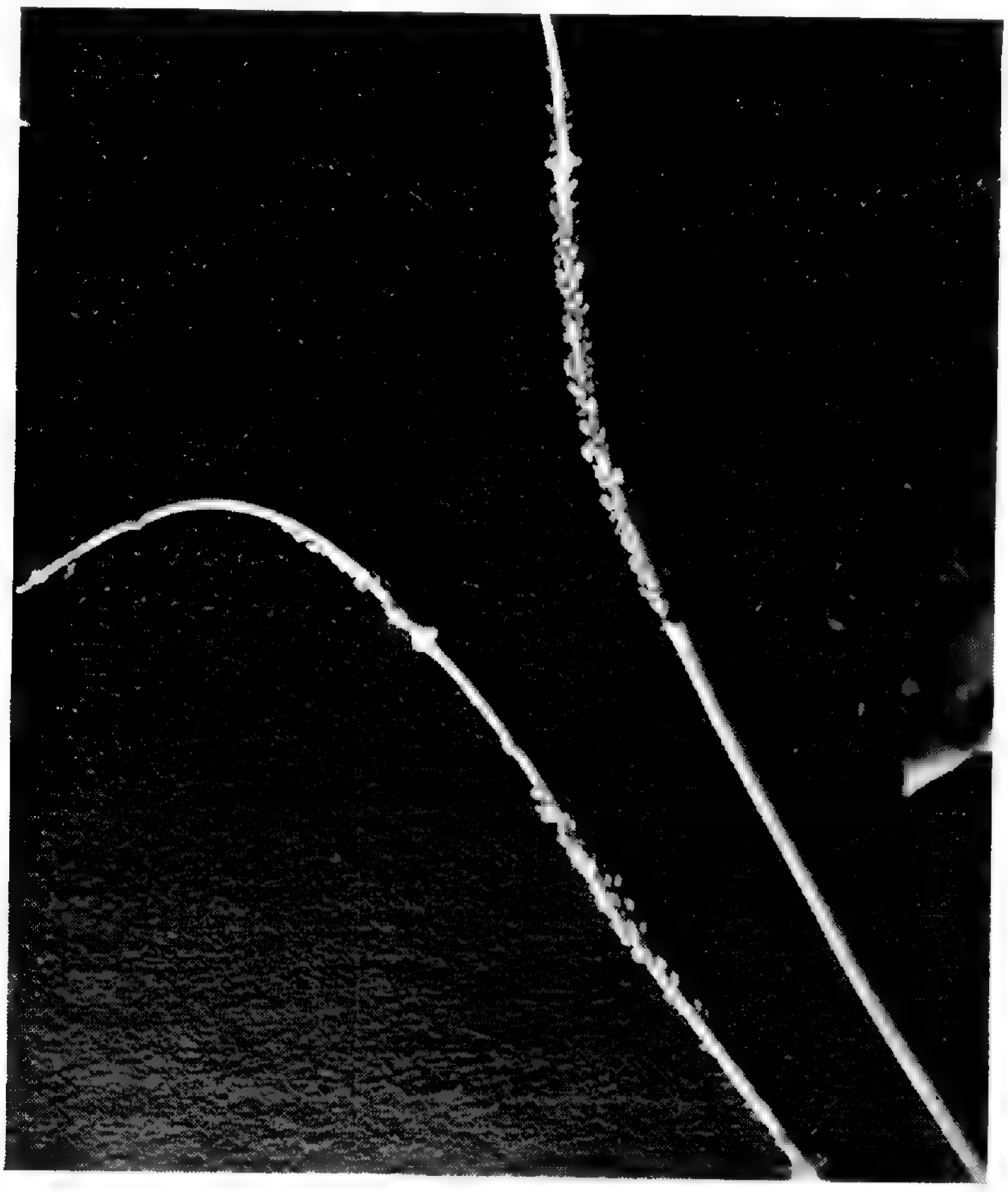


Joints of Prickly Pear Cactus (Opuntia) heavily infested with scale

To control scale insects a good contact insecticide with an oil emulsion base must be used. The writer has found that one thorough application will often do the trick. The oil spray forms a thin film over the insect and snuffs out its life. Because of this film, the plants may be burned if sprayed in sunlight. The operation should be performed on a cloudy day or else the plants should be moved to a shaded location. The writer has found "Greenhouse Volck" a satisfactory product in combating the insect. A stronger solution can be applied on the tougher cacti if caution is exercised, and a weaker mixture employed on the tender Faucarias, Glottiphyllums, Haworth-

ias, and the like. When a standard spray is not available, a soapy solution mixed with nicotine may be used. Use about a teaspoonful of Black Leaf 40 to a quart of soapy water.

Aphids.—As a rule, these soft-bodied insects attack only soft, tender growth. Consequently they do not cause extensive damage to cacti, but many succulents become stunted because of them. More frequently they infest flower buds and arrest their development, being often noticed on the flowers of the night-blooming Cereus and Opuntias. Aphids or plant lice



Aphids or plant lice feeding on apical shoots of *Sarcostemma viminale*

may be yellow, orange, brown or black, and in size slightly larger than a pin-head. Like the mealy bugs and scale, they congregate in dense masses and weaken the plant by sucking its juice. Aphids reproduce at a rapid rate and are active feeders, but it is hardly possible that they would cause the death of a mature succulent. They can be controlled with a contact spray consisting of one teaspoonful of nicotine (Black Leaf 40) to a quart

of water. Within a minute or two after the spray touches the aphid it is killed, and a few hours later the body has been reduced to a "burned" speck. If other insects could be controlled as easily as the aphid the gardener would have no great need to worry.

Thrips.—The damage caused to cactus plants by these minute insects is not alarming, as they attack only seedlings or very tender-skinned species. The very juicy Mesembryanthemums—Argyroderma, Glottiphyllum, Conophytum, Fenestraria and Faucaria—are more susceptible to their injury, and although the damage will not prove fatal the plants are left scarred or pitted and unattractive. Thrips are tiny brown or black insects, and when disturbed they seemingly jump quickly for cover. Nicotine solution, consisting of ½ ounce of Black Leaf 40 to a quart of water, is sufficient to kill thrips.

Red Spider.—This cosmopolitan little eight-legged insect is not a true spider, but is a mite and a constant menace to house plants. The insect is so small as to be hardly perceptible to the naked eye. However, its presence is easily recognized by the characteristic appearance of the infested leaves, being blotched and rusty, and covered with webs of silken threads under which the mites live. Red spider is known to attack the leaves of Pereskia and young growth of Hylocereus, Selenicereus, or Acanthocereus, but it seems to prefer many other succulents. The area attacked ultimately dries up. The mites love hot and dry conditions such as are given to desert plants. If frequent syringing does not control the pest, an oil emulsion spray is advocated.

Ants.—These diligent little workers often become a nuisance in a cactus or succulent plant collection. Directly they do not injure the plants, but indirectly they are responsible for the plant's death since the ants maintain aphids and mealy bugs. Ants are very fond of the "honeydew" which such insects give off, and for the sake of this sweet excrement they play the role of a virtual nursemaid. The most satisfactory control for ants is poison bait. If a drop of poisoned syrup is placed on a piece of cardboard in the ant trail, the following morning very few ants will be noticed crawling around. The procedure should be repeated once, and the remaining stragglers finished off with a contact spray consisting of one teaspoonful of nicotine to a quart of water. The writer has found "Terro Ant Killer" (procured at the drug store) efficacious in destroying ant colonies.

Sow-bugs or Pill-bugs.—This common greenhouse pest is not an insect but a crustacean. It carries a shell on its back, like an armadillo, and when

disturbed rolls itself into a ball or pill. Primarily it is a scavenger, living on decaying vegetable matter, but it often changes its habit and feeds upon juicy morsels such as the tender cactus seedlings and succulents. The writer has on several occasions seen with his own eyes the sow-bugs attack Lithops and Argyrodermas and even Opuntias. Usually they chew a hole or partially scoop out a cavity at the base of a plant; then the plantlet topples over or becomes infected with a rot disease. A poison bait composed of nine parts of brown sugar to one part of Paris green, scattered about the benches, under pots or on the soil, will aid in exterminating these pests. Several preparations for their control are also offered on the market. The cheapest remedy is half of a potato scooped out and placed on a bench as bait. During the night the sow-bugs will be drawn to the potato, and in the morning it will be easy to dispose of them.

Grasshoppers and Crickets.—Both these insects are voracious feeders which can do considerable damage before being apprehended. The plants most likely to be attacked are the Opuntias, Epiphyllums, Zygocacti and Rhipsalis, or any of the cactus or succulent seedlings. Grasshoppers usually gain entrance to greenhouses through unscreened ventilators and doors. Crickets live under rocks or hide in crevices. Both are destructive and should be hunted when injury is noticed on plants. Since they chew their food, a stomach poison must be used to exterminate them. However, if only a few are seen it is simpler to catch and crush them.

Millipeds.—These little animals, commonly known as "thousand-leggers," frequent greenhouses where an abundance of decaying organic matter is present. Although they feed mostly on decaying matter, they will often attack roots and stems of seedling cacti and succulents. The worms can be baited with a sliced potato dipped in a Paris green solution or in arsenate of lead. Tobacco dust worked into the soil will also give relief.

While there are a few more greenhouse pests that may add trouble to the cactus and succulent plant fancier, the damage they do is negligible.

LADISLAUS CUTAK.

SOME HONEY PLANTS

Utopia for a beekeeper would be a section of the country where the temperature is mild and flowers are always blooming—a place where his bees could gather pollen very early in spring and shortly after begin filling super after super with honey. Now, a botanical garden usually has some

species of plant in flower during practically nine months of the year, but many of these are of no special value to bees. On the other hand, some strange plants, and even some native kinds, may grow to be honey plants in a garden, though worthless otherwise.

Bees to the non-beekeeper, even though he is a gardener, may be just a nuisance, but the beekeeper examines all flowers with a yard-stick of his own. If they produce ample pollen or secrete nectar, he readily judges them "beautiful;" otherwise his enthusiasm is considerably less. Pollen is gathered by bees to be used in the making of "bee bread," and this is the only protein a young bee eats. Nectar, the everyday food of the adult bee, is finally evaporated and stored as honey. Since in a colony of bees there are many classes of laborers and a highly developed, "share-the-work" program, the beekeeper gets a surplus of honey only when he has a great number of field workers. The colony must begin to grow strong in early spring, and in this region a few Soft Maples and Elms are a great asset. Both of these trees may begin to bloom any time after January 5, and continue to flower after every frosty interruption, for another four weeks. Either tree will supply sufficient pollen for bees. After the uncertain weather of spring the apple tree is an important source of both nectar and pollen. By the latter part of April the weather has moderated and, except for rainy days, bees are able to fly regularly. Now the need for pollen and nectar has increased, since the young are emerging at the rate of 1000 a day.

Plants which produce nectar one year may not produce it in subsequent years. Sometimes the temperature is unfavorable, or perhaps moisture is deficient. But by the first of May, many honey plants are in flower, and the bees have a choice of species to visit. The little White Clover (*Trifolium repens*), common on our lawns, is the best honey plant of them all. And the clear "white" honey obtained is the standard by which all honeys are judged. However, bees may prefer Alsike Clover (*T. hybridum*) and when the Yellow (*Melilotus officinalis*) and White (*M. alba*) Sweet Clovers are in bloom, from late May through June, they prefer these over all other plants. The Melilotus species yield a superior honey, which is light amber in color. By the time the Sweet Clovers have finished there are relatively few honey plants in flower until fall. It is during this midsummer lull that some of the plants in a botanical garden furnish nectar and pollen at a rate faster than the bees can use it and thus contribute to the annual surplus. Buckbrush (*Symphoricarpus* sp.), for instance, attracts many bees in July. The ordinary "Beggar" weeds (*Desmodium* sp.) and the Chinese Spindle-tree (*Evonymus patens*) both appear as worth-while honey plants. The bees will not visit the Spindle-tree during the day, but two hours before sunset

the production of nectar begins and the bees are in an uproar until sunset. This activity, which lasts about a week, results in a great quantity of nectar. It appears that the Spindle-tree would be an excellent honey plant if enough of the trees were available to contribute to a nectar surplus. In some years the Sumacs are valuable honey plants. But throughout the late summer, even a botanical garden doesn't have enough of one kind of plant to produce surplus nectar although the bees are carefully combing a radius of one and one half miles from the hive and gathering everything which is available.

In late fall, when the fields are solidly covered with Asters and Goldenrods, bees are able to store a surplus of darker and stronger honey from such plants. It is at this time also that the Siberian Elm, the only fall-flowering species likely to be encountered here, produces nectar and pollen.

The following list includes the most dependable honey plants:

Soft Maple (Acer)
American Elm (Ulmus)
American Holly (Ilex)
Apples, Pears, Plums (Malus, Prunus)
Miami Mist (*Phacelia* sp.)
Wild Cherry (*Prunus serotina*)
Persimmon (Diospyrus)
Blackberry (Rubus)
Locust (*Robinia* sp. & *Gleditsia* sp.)
White Clover (*Trifolium repens*)
Alsike Clover (*Trifolium hybridum*)
Yellow Sweet Clover (*Melilotus officinalis*)
White Sweet Clover (*Melilotus alba*)
Basswood (*Tilia* sp.)
Buckeye, Horse chestnut } (*Aesculus* sp.)
Sumac (*Rhus* sp.)
Butterfly weed, Milkweed (*Asclepias* sp.)
Purple Loosestrife (*Lythrum* sp.)
Wafer Ash (*Ptelea* sp.)
Buckbrush (*Symphoricarpus*)
Smartweed, Heartsease } (*Polygonum* sp.)
Partridge Pea (Cassia)
Asters (Aster)
Goldenrod (Solidago)
Siberian Elm (*Ulmus parvifolia*)

The earliness or lateness of the season, the temperature and the amount of rainfall, all have a bearing on the value of a plant to the bee. If the weather is not cold the American Holly makes an excellent source of nectar. The plant produces nectar each year but sometimes the weather is so cold that the bees do not fly. In the spring of 1944 the Miami Mist was a notably good honey plant for about a week. Another year this plant may be far less important because competing plants may have almost crowded it out. The Wild Cherries are not visited every year, and the same is true of the Persimmon, in both bases the weather being the factor. Curiously enough, bees will pass up Clover to visit Honey Locust (*Gleditsia triacanthos*) for the few days it is in flower. The value of White and Alsike Clovers seems to vary from season to season and also from day to day in any one season. On the other hand, the Basswood and the Yellow and White Sweet Clovers are in all seasons a source of nectar. Bees visit these plants in the hot weather, and nectar production is not affected by temperature so long as moisture is not deficient. The Buckeye and Horsechestnut, being essentially garden subjects, are usually not available to bees. Then too their flowers last but a

few days, and while the bees do visit them it is not known how important they are as honey plants. Sumac has a flowering period which usually lasts a week, the only objection being that this period coincides with that of the Sweet Clovers. Most of the Milkweeds are very good honey plants, but since they are scattered and somewhat limited in number they are of value largely because they bridge the midsummer gap. Through the hotter and dryer parts of the summer the "Beggar" weeds (*Desmodium* sp)., the Purple Loosestrife, the Wafer Ash and Buckbrush furnish more or less bee pasture. A little later the Heartsease and the Smartweeds may become the outstanding plants of the time. It is possible to detect the odor of Smartweed nectar at the hive when the bees have had access to a considerable quantity of the plant. The Partridge Pea and some relatives may or may not be of value depending entirely upon the season and number of plants which can be found. In late fall the Asters and Goldenrods are the dependable honey plants. Unless frost cuts short the season, bees are certain to gather a surplus from this source.

By no means is this a complete list of all the native plants which produce nectar available for bees, but it does include the most important and the most dependable. There are a number of exotic plants which may be particularly good as bee pasture. The common Privet (Ligustrum), the Chinese Spindle-tree (Evonymus), the Pagoda Tree (Sophora) and the Honeysuckles (*Lonicera* sp.) are all very important to the bees which have access to them. In some seasons even Buckwheat, Salvia, and Hollyhock contribute their share to the honey surplus, and there are many more annuals and perennials which are visited by bees during the midsummer when nectar is scarce. Relatively few of these do more than supply the day-by-day needs of the colony. In a botanical garden the most interesting plants from a bee's standpoint might be Boxwoods in spring, water-lilies in summer, and orchids any time of year.

AUGUST P. BEILMANN.

TWO UNUSUAL BENEFICIAL PLANTS

The greatly increased use of plants and their products, occasioned by new and unusual demands due to the war, is well recognized. From the floss of the wild Milkweed to the yield of penicillin and other vitally important germicides obtained from mold and certain soil bacteria, the plant kingdom is demonstrating its place in both industry and medicine as it has not done since the old days of *materia medica*.

How a plant which possesses distinctly beneficial qualities, but because of neglect or being superseded by something better, no longer is favorably

regarded, is well illustrated by the following account of *Tradescantia erecta*. The quotation is one of many which Henry Shaw had copied from some British publication, he being constantly on the alert for any reference to the economic value of plants.

> Among the thousands of emigrants who annually leave our shores to carve out for themselves new homes in the backwoods of our various colonies, there must be a considerable number who at some time or other have cause to regret the incautious use of the axe or other tools, whereby wounds are unintentionally inflicted when far from medical aid. Under such circumstances the knowledge of some simple, cheap, yet efficacious styptic might save many a life, or at least hasten a tardy convalescence.
>
> In John Tradescant's garden at Lambeth, during the days of Charles I, there flourished one plant whose merits and uses, if then known, seem speedily to have been forgotten.
>
> But this plant, "*Tradescantia erecta*," a native of Mexico, although possessing nothing attractive in either shape or colour, deserves to be inscribed in every emigrant's notebook on account of its extraordinary efficiency in arresting the flow of

Tinantia fugax (formerly known as *Tradescantia erecta*)

> blood from wounds. When Mexico was visited by a French army some years ago, a native suggested that the commanding officer, Gen. Martroy, should store in his camp a supply of what he described as "the blood staunching weed," which proved to be the same plant to which the English king's gardener in 1629 gave his name. On his return to France, the General, having brought some specimens with him, planted and cultivated them at Versailles, and enjoyed the satisfaction of finding the plant taking kindly to the soil and retaining all the original styptic properties attributed to it by the enthusiastic Mexican peasant.
>
> Indeed, its power of suspending haemorrhage, on being crushed or chewed and applied to a wound, is said to surpass every hitherto known means. The Vienna press has lately been strongly advocating its regular cultivation, and the suggestion might well be adopted in other countries. The plant is easily cultivated, and would no doubt thrive in both our tropical and our temperate colonies.

This plant, now known as *Tinantia fugax*, in honor of the Belgian botanist Tinant, is a native of tropical America. It is seldom seen even in greenhouses, although it has been grown as an herb in southern gardens. From the horticultural standpoint there is nothing particularly attractive about it, and it is not offered in the trade. In fact but few botanical gardens possess it.

Under the title "The Orchid as a Benefactress" there appeared in the *Florists Exchange* for August 9, 1924, the following:

> To the several qualities upon which the orchid can base its claim to recognition and value—such as rarity, exotic beauty, delicacy of coloring, wide variation in form and cultural interest—there can now be added another, thanks to the research work of scientists in a new and unusual field. A Dr. Rous of Paris*, according to a recent despatch to the New York Times, has discovered that certain essential oils obtainable from the orchid flower and injected into a person suffering from tuberculosis will aid him considerably in his fight against the disease. In other words this erstwhile luxurious beauty of the plant world has now shown its ability to take off its coat, so to speak, roll up its sleeves and take an active part as an effective weapon in the war against the White Plague.
>
> All honor to the orchid, new found benefactress of humanity and to modern science, which has revealed it in this new role.

*Presumably Dr. Roux, the French bacteriologist, formerly Director of the Pasteur Institute, awarded the Nobel prize for work on serum therapeutics.

Can it be that the orchid flower, heretofore reserved chiefly for weddings and balls, could take a place with the truly beneficial plants, if man would seriously investigate its possibilities?

NOTES

Mr. George H. Pring, Superintendent of the Garden, spoke at the regular meeting of the St. Louis chapter of the Daughters of the American Revolution, October 12, on "Activities of the Missouri Botanical Garden."

The Southern Florist has reprinted in three installments (October 27, November 3, November 10) the article from the October Garden BULLETIN

on "Gravel Culture for Orchids," by David C. Fairburn, Horticulturist to the Garden.

Dr. Edgar Anderson, Geneticist to the Garden, conducted the Clintonia group of Scout Leaders on a field trip, October 26. He lectured to the Junior Academy of Science of St. Louis, October 26, on "Maize in Mexico."

During October, Dr. Edgar Anderson visited the Peabody Museum of Harvard University, Cambridge, Mass., and the American Museum of Natural History, New York, where he studied collections of prehistoric corn.

Dr. Edgar Anderson, Geneticist to the Garden, and Mr. A. P. Beilmann, Manager of the Arboretum, recently visited the arboretum of the Spring Grove Cemetery, Cincinnati, Ohio, and arranged for exchanges of plant material to be used at Gray Summit.

"The History of the Succulent Collection at the Missouri Botanical Garden," an article from the June 1941 Garden BULLETIN, by Ladislaus Cutak, in charge of Succulents at the Garden, has been reprinted in the October 12 number of the *American Eagle*.

Mr. Ladislaus Cutak gave an illustrated lecture, "A Cactus Hunt in Old Mexico," before the Webster Groves Garden Club, Group No. 2, October 19. On November 10 he spoke before the Founders Circle of the Rosemary Garden Club at Pattonville, Mo., on "Cacti, the Ideal House Plants."

Recent visitors to the Garden include: Rev. Robert R. Brinker, O.F.M., Instructor in Biology, Quincy College, Quincy, Ill.; Mrs. Merrill A. Newman, of San Mateo, Calif.; Dr. Chi-tun Yung, professor of botany at Lingnan University (formerly Canton), China; Miss Helen Azevedo, Librarian Museu Nacional, Rio de Janeiro, Brazil, who is spending the winter in this country in a study of scientific libraries.

STATISTICAL INFORMATION FOR OCTOBER, 1944

GARDEN ATTENDANCE:

Total number of visitors	24,442

PLANT ACCESSIONS:

Total number of plants and seed-packets received as gifts	229

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	16
Total number of books and pamphlets donated	188

HERBARIUM ACCESSIONS:

By Purchase—

Avenue Camera Store—Copy of photograph of the type specimen of *Asclepias tuberosa L.*	1

By Gift—

Anderson, Louise—Asclepiadaceae from Ohio	2
Bartholomew, Elizabeth A.—Asclepiadaceae from West Virginia	2
Clausen, Robert T.—Asclepiadaceae from New York	8
Cory, V. L.—*Tradescantia* from Texas	2
Garrett, A. O.—Asclepiadaceae from Utah	4
Heiser, Charles B., Jr.—Plants of Indiana	2
Hubricht, Leslie—Plants of Virginia	365
Hunt, K. W.—*Asclepias tuberosa* L. from South Carolina	1
McFarland, Frank T.—Plants of Kentucky	7
Pinkus, R.—*Tonduzia longifolia* (A.DC.) Woodson from Guatemala	1
Shinners, L. H.—Plants of Indiana and Illinois	4
U. S. National Museum—Plants of Cuba	22
Total	421

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MISSOURI BOTANICAL GARDEN BULLETIN

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SOME FACTS ABOUT THE GARDEN

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

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

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

1934

HEMLOCKS IN MIDDLE FOREGROUND A FEW YEARS AFTER PLANTING

1944

SHOWING SAME GROUP OF HEMLOCKS, NOW QUITE LARGE

Missouri Botanical Garden Bulletin

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THE ARBORETUM PINETUM AFTER TWENTY YEARS

After the various farms now comprising the Arboretum had been purchased, one of the first projects was the development of a Pinetum. For this purpose a tract of about 90 acres in the northwest corner of the area was selected. Most of the land had been farmed and a large ditch bisected it. Plans were made to enlarge the ditch and thereby create a lake as the central feature of the future Pinetum. The general exposure was to the south, although the development of the lake at the lowest point exaggerated some minor east and west exposures. Hardly a square foot of the whole area but what was shifted about or graded. Some of the slopes were terraced and much seeding and sodding was done. To encourage the growth of ground cover, carloads of manure were used, but almost twenty years later some parts of the tract will grow nothing but Lespedeza. Orders were placed for the nursery stock available in this country, and arrangements were made to obtain seed, through other channels, from all over the world. Among the first nursery shipments to arrive was one from D. Hill Nursery Company, Dundee, Illinois. Some of this material was of the size known as "lining-out stock", and some was "XX-B & B" (small plants shipped with a ball and several times transplanted). Many of the trees in the Pinetum today are from this nursery lot. As quickly as possible other plants were started from seed, and additional purchases, collections and exchanges were made and have been continued.

With the help of the accompanying photographs we can reconstruct the development of the Pinetum, and after twenty years it will be interesting to check the value of the many evergreens which have been tried. In this time nearly 450 species and varieties of 22 genera have been tested. Of these some have been obtained only once and others as often as twenty-one times. A total of 1400 individual shipments of conifers—either plants or seeds—have been received.

The following list of conifers has been taken from the accession file, and indicates the effort which has been made to test all possible evergreens in this climate. Common names have not been used, because sometimes they might add to the confusion and sometimes there are no common names. The brief remarks following each variety are not based upon the behavior of a plant for a season or two, but rather upon its value as demonstrated during twenty years of observation.

It will be noted that the same plant has been obtained under several names. Where seeds have reached us under a synonym, we have not always had the opportunity to check and to correct the names. For instance, if the seeds fail to germinate the accession was carried without correction. The notation "not hardy" may often mean that the plant was unable to stand our summers, and it may also mean that the plant was not cold-resistant. In some cases we are uncertain as to the reason for the failure.

Plant	Number of Trials	Remarks
Abies alba	10	Has not grown
amabilis	3	Not hardy
arizonica	5	Partly satisfactory
balsamea	5	Partly satisfactory
balsamea macrocarpa	1	Behavior unknown
brachyphylla	1	Behavior unknown
cephalonica	4	Hardiness doubtful
cephalonica Apollinis	1	Hardiness doubtful
cilicica	3	Has not grown
concolor	9	Excellent in right place
concolor pyramidalis	2	Excellent in right place
concolor violacea	1	Behavior unknown
Delavayi	1	Unknown
Faxoniana	1	Doubtfully hardy
firma	8	Very difficult to grow
Fraseri	3	Doubtfully hardy
grandis	5	Doubtfully hardy
holophylla	8	Difficult to grow
homolepis	10	Difficult to grow
homolepis umbellata	1	Behavior unknown
koreana	2	Behavior unknown
lasiocarpa	6	Probably *arizonica*
lasiocarpa arizonica	1	Probably *arizonica*
magnifica	2	Hardiness doubtful
magnifica shastensis	1	Hardiness doubtful
Mariesii	3	Behavior unknown
Maryana	2	Behavior unknown
nephrolepis	3	Behavior unknown
nobilis	5	Hardiness doubtful
nobilis glauca	1	Not hardy
Nordmanniana	9	Not hardy
numidica	3	Not hardy
pectinata	1	Not hardy
Pinsapo	2	Not hardy
Pinsapo glauca	1	Not hardy
Reginae	1	Not hardy

1934

BLUE COLORADO AND WHITE SPRUCE ABOUT 10 YEARS OLD

1944

SAME GROUP OF TREES 10 YEARS LATER

Plant	Number of Trials	Remarks
religiosa (?)	2	Not hardy
sachalinensis	2	Not hardy
sachalinensis nemorensis	1	Not hardy
sibirica	6	Not hardy
Veitchii	6	Very unadaptable
Webbiana	1	Not satisfactory
Webbiana brevifolia	1	Not satisfactory
Araucaria excelsa	1	Not hardy
imbricata	1	Not hardy
Cedrus atlantica	6	Not hardy
atlantica argentea	3	Not hardy
Deodara	5	Not hardy
libani	1	Difficult to grow
libanotica	8	Difficult to grow
Cephalotaxus drupacea	14	Not hardy
drupacea nana	2	Not hardy
Fortuni	5	Not hardy
Chamaecyparis Lawsoniana Boursieri	9	Short lived, not hardy
Lawsoniana erecta	2	Short lived, not hardy
Lawsoniana Fletcheri	1	Short lived, not hardy
Lawsoniana pendula glauca	1	Short lived, not hardy
nootkatensis	10	Not hardy
obtusa	11	Not hardy
obtusa Sieboldii	1	Not hardy
pisifera	6	Subject to winter-killing
pisifera aurea	1	Subject to winter-killing
pisifera plumosa	1	Subject to winter-killing
pisifera squarrosa	1	Subject to winter-killing
sphaeroidea	2	Not hardy
thyoides	1	Not hardy
Cryptomeria japonica	11	Not hardy
japonica araucarioides	2	Not hardy
japonica Lobbii	1	Not hardy
Cunninghamia lanceolata	6	Not hardy
Juniperus Ashei	1	Behavior unpredictable
bermudiana	1	Not hardy
californica	1	Not hardy
canadensis	2	Very satisfactory
canadensis aurea	1	Very satisfactory
chinensis	3	Very satisfactory
chinensis columnaris (blue)	2	Very satisfactory
chinensis columnaris (green)	1	Very satisfactory
chinensis globosa	1	Very satisfactory
chinensis Lemeeana	1	Unknown
chinensis lucayana	4	Unknown
chinensis Mas	1	Unknown
chinensis mascula	1	Partially satisfactory
chinensis oblonga	1	Unknown
chinensis nana	1	Unknown
chinensis Pfitzeriana	3	Very good
chinensis procumbens	1	Very good
chinensis procumbens Sargenti	1	Very good
chinensis pyramidalis	2	Good plant
chinensis Sargenti	4	Good plant
chinensis variegata	2	Uncertain
communis	7	Good
communis aurea	3	Good
communis canadensis	2	Good

Plant	Number of Trials	Remarks
communis cracovia	1	Uncertain
communis Dayi	1	Uncertain
communis depressa	2	Very good
communis depressa aurea	2	Very good
communis depressa plumosa	2	Very good
communis hibernica	3	Injured in snow storms
communis montana	1	Good
communis montana nana	1	Fair
communis nana	1	Fair
communis pendula viridis	1	Unsatisfactory
communis prostrata	1	Good
communis succica	1	A good small plant
conferta (litoralis)	7	Interesting, but slow grower
cupressifolia	5	Unsatisfactory
drupacea	2	Unsatisfactory
excelsa	8	Unsatisfactory
excelsa stricta	2	Very good
foetidissima	2	Unsatisfactory
foetidissima squarrosa	1	Unsatisfactory
formosana	1	Very satisfactory
fragrans	4	Unsatisfactory
horizontalis	2	Good
horizontalis Douglasii	2	Very good
isophyllus	1	Behavior unknown
japonica	7	Among the best
japonica nana	1	Among the best—slow grower
japonica nana aurea	1	Unsatisfactory
litoralis	1	Same as *conferta*
macrocarpa	4	Unsatisfactory
mexicana	1	Not hardy
monosperma	5	Not hardy
oblonga	1	Unknown
Oxycedrus	10	Unsatisfactory
Oxycedrus rufescens	2	Unsatisfactory
pachyphloea	7	Not ornamental—poor grower
phoenicea	14	Unsatisfactory
polycarpa	2	Unsatisfactory
procera	2	Unsatisfactory
rigida	5	Unsatisfactory
Sabina	3	Subject to blight
Sabina fastigiata	1	Unsatisfactory
Sabina horizontalis	10	Very good
Sabina prostrata Hilli	2	Very good
Sabina pyramidalis	1	Very good
Sabina tamariscifolia	2	Subject to blight
Sabina "Von Ehron"	2	Very good
scopulorum	6	Good
scopulorum "Hill Silver"	1	Among the best
scopulorum horizontalis Hilli	1	Among the best
scopulorum pyramidalis	1	Among the best
scopulorum viridifolia	1	Among the best
sibirica	1	Unknown
squamata	1	Uncertain
squamata Meyeri	3	Very good
thurifera	1	Unsatisfactory
turkestanica	2	Unsatisfactory
utahensis	4	Unsatisfactory
virginiana	2	Common in Missouri
virginiana Burkii	1	Very good

Plant	Number of Trials	Remarks
virginiana Canaertii	2	Very good
virginiana cinerascens	3	Very good
virginiana elegantissima	2	Very good
virginiana fastigiata	1	Very good
virginiana filifera	1	Very good
virginiana glauca	3	Very good
virginiana globosa	2	Uncertain
virginiana Keteleeri	2	Very good
virginiana Kosteri	2	Very good
virginiana nana	2	Unknown
virginiana pendula	3	Good
virginiana pyramidalis	4	Good
virginiana pyramidiformis Hilli	1	Good
virginiana Schottii	2	Very good
virginiana tripartita	1	Uncertain
Larix crincopis Ruprechtii	1	Very poor
dahurica B.P.I. #78403	1	Very poor
dahurica B.P.I. #90663	2	Very poor
dahurica	7	Very poor
decidua	2	Very poor
eurolepis	1	Very poor
europaea	6	Very poor
europaea glauca pendula	2	Very poor
europaea pendulina	1	Very poor
Gmelini	1	Very poor
Kaempferi	8	Very poor
kurilensis	6	Very poor
laricina	2	Very poor
leptolepis	7	Very poor
leptolepis Murrayana	2	Very poor
occidentalis	2	Very poor
sibirica	4	Very poor
Libocedrus Bidwillii	1	Unsatisfactory
decurrens	6	A good plant—slow to grow
Picea sp.	1	Identity unknown
ajanensis	4	Not hardy
alba	5	Good
albertiana Engelmanni	1	Unknown
bicolor	1	Unknown
canadensis	9	Good
canadensis (Black Hills)	1	Uncertain
canadensis alba	2	Good
canadensis alba glauca	1	Good
canadensis Albertiana	1	Good
canadensis coerulea	1	Good
Engelmannii (Dwarf)	1	Uncertain grower
Engelmanii	11	Uncertain grower
excelsa	14	Very good
glauca	2	Good
glauca Albertiana	3	Very uncertain
glauca densata	1	Slow to grow
Glehnii	4	Not satisfactory
jezoensis B.P.I. #90666	1	Not satisfactory
jezoensis	5	Not satisfactory
jezoensis hondoensis	2	Not satisfactory
koraiensis	2	Uncertain
koreana	1	Good
Koyamai	3	Good
mariana	4	Not satisfactory

Plant	Number of Trials	Remarks
Meyeri	1	Not satisfactory
Morinda	1	Not satisfactory
obovata	2	Not satisfactory
Omorika	7	Very slow
orbiculatus	1	Uncertain
orientalis	2	Good
Parryana	2	Not hardy
polita	2	Slow grower
pungens	12	Very good
pungens glauca	5	Very good
pungens Kosteriana	2	Good
pungens Moerheimi	1	Good
purpurea	1	Identity not established
rubra	5	Good
sitchensis	10	Very uncertain
Smithiana	1	Not satisfactory
Smithiana B.P.I. #123244	1	Not satisfactory
Smithiana	2	Not satisfactory
Pinus albicaulis	4	Unsatisfactory
aristata	2	Unsatisfactory
Armandi	7	Unsatisfactory
attenuata	4	Unsatisfactory
Ayacahuite	1	Hardiness uncertain
Banksiana	6	Good
Bungeana B.P.I. #89604	2	Good—very slow grower
Bungeana B.P.I. #92056	1	Good—very slow grower
Bungeana	7	Good—very slow grower
canariensis	9	Good—very slow grower
caribaea	7	Not hardy
Cembra	9	Not hardy
cembroides edulis	9	Poor grower
contorta latifolia	4	Some forms unsatisfactory
corsica	1	Not hardy
Coulteri	5	Not hardy
densiflora	6	Good
echinata	8	Difficult to grow
edulis	1	Poor grower
eldarica	1	Identity not established
excelsa	11	Some forms hardy
flexilis	10	Slow grower
funebris	1	Not hardy
Gerardiana	1	Not hardy
Griffithii B.P.I. #123245	1	Good
halepensis	9	Unsatisfactory
halepensis brutia	2	Unsatisfactory
halepensis Stankewiczi (?)	1	Unsatisfactory
insignis	1	Unsatisfactory
insularis	3	Unsatisfactory
Jeffreyi	4	Not hardy
koraiensis B.P.I. #71046	1	Not hardy
koraiensis B.P.I. #71125	1	Not hardy
koraiensis	21	Not hardy
Lambertiana	6	Not hardy
leiophylla	2	Not hardy
leucodermis	3	Not hardy
leucosperma	3	Not hardy
longifolia	2	Not hardy
luckuensis	1	Not hardy
maritima	1	Not hardy

Plant	Number of Trials	Remarks
Massoniana	4	Not hardy
mongolica	1	Not hardy
monophylla	2	Slow grower
montana	1	Slow grower
Montezumae	1	Not hardy
monticola	7	Good
Mugo	1	Good
Mugo carpatica	2	Good
Mugo compacta	6	Good
Mugo montana	5	Good
Mugo uncinata	1	Identity not established
Mugo sylvestris	8	Not hardy
muricata	3	Not hardy
Murrayana	6	Not hardy
nigra austriaca	16	Very good
nigra calabrica	1	Questionably hardy
nigra caramanica	1	Questionably hardy
nigra cebennensis	1	Questionably hardy
nigra Poiretiana	2	Questionably hardy
nigra tenuifolia	1	Questionably hardy
palustris	7	Questionably hardy
Parryana	1	Not hardy
parviflora	16	Unsatisfactory
patula	4	Unknown
pentaphylla	1	Unknown
Peuce	13	Slow grower
Pinaster maritima	10	Unsatisfactory
pinea	11	Unsatisfactory
pityusa	1	Unsatisfactory
pityusa Stankewiczi	1	Unsatisfactory
ponderosa	5	Good
ponderosa Jeffreyi	1	Uncertain
ponderosa scopulorum	1	Uncertain
pumila	11	Uncertain
radiata insignis	9	Uncertain
resinosa	7	Good
rigida	15	Hardiness doubtful
rigida serotina	1	Hardiness doubtful
Sabiniana	9	Unknown
sibirica	2	Unknown
sinensis B.P.I. #69819	1	Not hardy
strobiformis	1	Not hardy
Strobus	12	Very good
sylvestris	8	Short-lived
sylvestris mongolica	2	Short-lived
sylvestris rigensis	5	The best form
tabulaeformis	5	Not hardy
tabulaeformis B.P.I. #74805	1	Not hardy
tabulaeformis B.P.I. #82484	3	Not hardy
tanyosho globosa	2	Not hardy
taiwanensis	3	Not hardy
Taeda	5	Hardiness uncertain
Thunbergii	8	Very good
Thunbergii tortuosa	1	Very good
Torreyana	6	Not hardy
virginiana	3	Very good
yunnanensis B.P.I. #85697	1	Not hardy
Podocarpus macrophyllus	2	Not hardy
Nagi (?)	1	Not hardy

Plant	Number of Trials	Remarks
Pseudolarix amabilis	2	Not hardy
Kaempferi	3	Not hardy
Pseudotsuga caribaea	1	Not hardy
taxifolia "Snowy Mt."	1	Good
taxifolia (Washington)	12	Not hardy
taxifolia (Colorado)	1	Very good
taxifolia caesia	1	Not hardy
taxifolia glauca	1	Not hardy
taxifolia viridis	1	Not hardy
Sciadopitys verticillata	3	Not hardy
Taxodium ascendens	1	Very satisfactory
distichum	5	Very satisfactory
distichum pendulum	1	Very satisfactory
imbricarium	2	Very satisfactory
mucronatum	1	Not hardy
Taxus Andersonii	1	Hardy
baccata	6	Not wholly hardy
baccata adpressa	13	Not wholly hardy
baccata alba variegata	1	Not wholly hardy
baccata aurea	1	Not wholly hardy
baccata canadensis	1	Not wholly hardy
baccata conica	1	Not wholly hardy
baccata Dovastoni	3	Not hardy
baccata fastigiata	8	Not hardy
baccata fructeo luteo	2	Not hardy
baccata gracilis	1	Not hardy
baccata pyramidalis	2	Not hardy
baccata repandens	3	Not hardy
baccata Sieboldii	1	Not hardy
baccata variegata	1	Not hardy
baccata Washingtoni	1	Not hardy
baccata brevifolia	2	Of doubtful hardiness
canadensis	4	Good
cuspidata	12	Good
cuspidata "Kallay Type"	1	Good
cuspidata brevifolia	2	Good
cuspidata brevifolia compacta	1	Good
cuspidata Brownii	3	Good
cuspidata capitata	2	Good
cuspidata compacta	1	Good
cuspidata densa	1	Good
cuspidata Hicksonii	4	Very good
cuspidata intermedia	1	Good
cuspidata nana	2	Good
cuspidata nana pyramidalis Hilli	1	Good
cuspidata (spreading)	1	Good
erecta	1	Good
Hunnewelliana	1	Good
intermedia	1	Good
media	1	Good
media Hatfieldii	1	Very good
media Hicksii	2	Very good
nana	1	Uncertain
Thuja filiformis	1	Not hardy
japonica	1	Not hardy
koraiensis	2	Not hardy
Mertensiana	1	Not hardy
occidentalis	7	Good

Plant	Number of Trials	Remarks
occidentalis compacta	2	Good
occidentalis Douglasii aurea	1	Good
occidentalis Douglasii pyramidalis	1	Good
occidentalis Douglasii pungens	1	Good
occidentalis Ellwangeriana	2	Good
occidentalis fastigiata	1	Good
occidentalis globosa nova	1	Good
occidentalis Hoveyi	3	Good
occidentalis "Little Gem"	1	Good
occidentalis lutea	1	Good
occidentalis pyramidalis	3	Good
occidentalis Rosenthalii	1	Good
occidentalis spiralis	1	Good
occidentalis umbraculifera	1	Good
occidentalis Wareana	1	Very good
occidentalis Wareana sibirica	2	Very good
occidentalis Woodwardi	2	Very good
orientalis	3	Good
orientalis aurea	2	Good
orientalis compacta	1	Good
orientalis compacta dom. (?)	1	Good
orientalis elegantissima	1	Good
orientalis meldensis	1	Identity uncertain
orientalis microcarpa	1	Identity uncertain
orientalis pyramidalis	1	Identity uncertain
orientalis stricta	1	Identity uncertain
plicata	3	Not hardy
plicata gigantea	12	Not hardy
plicata Lobbii	1	Not hardy
sp. (4629 Wilson)	1	Not hardy
Standishii	5	Not hardy
Thujopsis dolabrata	5	Good
Torreya californica	1	Not hardy
nucifera	5	Not hardy
Tsuga canadensis	11	Good
caroliniana	6	Not hardy
chinensis	1	Not hardy
diversifolia	5	Not hardy
heterophylla	3	Not hardy
Mertensiana	3	Not hardy
Sieboldii	5	Not hardy

Almost without exception the variegated conifers have been unsatisfactory. Perhaps the one exception is the Goldtip Juniper *(J. virginiana elegantissima)* and a few of the *communis* varieties among the low-spreading Junipers.

The Larch *(Larix* sp.*)* has been uniformly unsatisfactory. The only group still alive today was grown from seed from a mature tree collected locally, and this tree was killed in the dry year of 1936. Nursery stock of Larch seldom lives two weeks after transplanting. It dies so quickly that we have had no opportunity for experimentation.

Among the Firs *(Abies* sp.*)* only the White Fir *(A. concolor)* has been satisfactory. Of the following there are only a few left: Momi Fir *(A.*

firma), Cork Fir *(A. lasiocarpa* var. *arizonica)*, Balsam Fir *(A. balsamea)*, Needle Fir *(A. holophylla)*, Veitch Fir *(A. Veitchii)*, and Nikko Fir *(A. homolepis)*. Their growth rate, however, indicates that we have not found the proper location for them.

We now have only two plants of the true Cedar *(Cedrus libanotica,* var.). Both were obtained from the Arnold Arboretum and both are hardy types collected from near timber-line in Anatolia. Even under the most satisfactory conditions this tree will probably prove of questionable hardiness.

The Western Cypress *(Chamaecyparis* sp.*)* is never dependable, although a few trees, when well protected, escape injury in the worst weather.

The Spruce (Picea) as a group is generally very satisfactory, but there are many kinds which appear unsuited for our region. The Norway Spruce *(P. excelsa)* is one of the best when young. The White Spruce *(P. canadensis)* does well, at least when young, and the Colorado Spruce *(P. pungens)* and its blue varieties are among the best evergreens for this section. Some of the orientals such as the Tiger Tail *(P. polita)* and *(P. Koyamai)* are very hardy and very ornamental although of slow growth. The Serbian Spruce *(P. Omorika)* is an outstanding plant but it does not grow rapidly here and few people will have the patience required to grow it.

With the exception of the Junipers we are able to grow more varieties of Pine than any other conifer. The very best of all is White Pine *(P. Strobus)* and the most difficult to grow is the Short-leaf *(P. echinata)*, the only pine native to Missouri. The European Black *(P. nigra)*, at least some of its varieties, grows well for 20 or 30 years. In our experience the shortest-lived of all is the Scots Pine *(P. sylvestris)*, although we believe the variety from Latvia (var. *rigensis*) would be entirely satisfactory. There are some Pines such as the Himalayan Pine *(P. Griffithii)* which are very worthwhile even though a severe winter may kill them after 10 or 15 years. The Slash Pine of the south *(P. caribaea)* and the Loblolly *(P. Taeda)* are not hardy here, while both the Eastern Scrub Pine *(P. virginiana)* and the Northern Jack Pine *(P. Banksiana)* are satisfactory plants but not especially ornamental after 20 years. Two Asiatic Pines, the Black *(P. Thunbergii)* and the Red *(P. densiflora)*, do very well, although they appear to be short-lived and their grotesque branching habit makes them unsuited for many gardens. Of course, the Mountain Pines *(P. Mugo)* and varieties are grown in every garden. Few of these live for more than 25 years, and usually by that time they have outgrown their allotted space. There are a number of Western Pines, the Lodge-pole *(P. contorta* var. *latifolia)*, the Piñon Pine *(P. edulis)*, the Bull Pine *(P. ponderosa)* and some others, which should eventually prove satisfactory for Missouri conditions provided that great

care is exercised in collecting seed from localities having a somewhat comparable climate.

Douglas Fir *(Pseudotsuga taxifolia)* from Colorado and the drier regions of the Rockies is an outstanding tree in Missouri. Some of the varieties from the Cascade Mountains, however, appear to be of questionable hardiness.

We have grown many of the Cypress *(Taxodium* sp.*)* and almost all are satisfactory. The species common in the Mississippi Valley *(T. distichum)* is probably the only one easily obtained through nurseries.

There is considerable confusion in the identity of the Yews *(Taxus* sp.*)*, and while we have attempted to grow many of them only some of the Asiatic *(T. cuspidata)* and some of the supposed hybrids of the English and the Asiatic *(T. intermedia)* have been satisfactory. Two of the hybrids, *T. cuspidata* var. *Hicksonii* and *T. media* var. *Hicksii* are outstanding. The Yews are among the longest-lived of all conifers, and testing them requires great patience. We have thousands of Yews on test now, some of which, in addition to the two mentioned, appear to have possibilities. Our experience, however, indicates that the English *(T. baccata)* cannot withstand our summer heat.

Most of the varieties of native and Oriental Arbor-vitae *(Thuja* sp.*)* do very well if planted in a sheltered position somewhat protected from the summer heat, and if they are supplied with ample water. Most of the nursery varieties are superior to the species *(Thuja occidentalis)* found in the North. The west-coast *T. plicata* is not hardy in our region.

A small conifer—more or less an interesting novelty—is the Hiba Arbor-vitae, known technically as *Thujopsis dolabrata.* It grows into little more than a shrub, but is perfectly at home in Missouri.

The Incense Cedar *(Libocedrus decurrens)* from the Far West is a very handsome tree and apparently entirely hardy.

The Hemlocks have been treated in a recent BULLETIN (November, 1942), where it was pointed out that only the Canadian *(Tsuga canadensis)* is hardy and worth growing in this section.

A. P. BEILMANN.

THE LIFE EXPECTANCY OF SOME NATIVE SHADE TREES

It is usually very easy to write about big trees and somewhat sentimentally to discuss their age. There is something about a massive trunk that simply overtops the levee of the writer and causes him or her to spill prose and poetry all over the country-side. There is really nothing wrong

with showing delight in a big tree. After all, who ever met a gardener who wasn't boasting of the reddest roses or the biggest dahlias? We are all stimulated by superlatives, and this is probably quite normal. Nevertheless, although a person may be awed by the "biggest" tree of its kind, he will optimistically plant just any species of tree on his own grounds. Perhaps it would be well to examine a list of native trees with the idea of determining their chances of surviving one or more generations or of growing into the largest of their kind.

If we begin with the conifers of Missouri we find that the Juniper *(Juniperus virginiana)* is the most widely distributed, and although few gardeners would plant our native Juniper as an ornamental it makes an excellent windbreak. It can stand the greatest exposure to heat and drought and if given ample room may attain a trunk diameter of 18 inches in 150 years. Such a tree may be planted with the complete assurance that it has the ability to outlive the planter.

The Short-leaf Pine *(Pinus echinata)* is the only Pine native to Missouri. It could hardly be used as an ornamental as far north as St. Louis, but in a suitable location, and this is a very hard thing to determine, it will live 100 years and attain a girth of over three feet.

The most outstanding conifer in the state is the Bald Cypress *(Taxodium distichum)*. It has been said that no one has ever seen a Cypress swept away by floods. They are generally so well rooted that they can grow in the bottoms in standing water, and they are so adaptable that they can be grown as ornamentals in drier and higher gardens. The ultimate size and age of a Cypress will depend entirely upon the soil in which it is growing. Some Mexican relatives of our native tree are estimated to be 5000 years old and about 35 feet in trunk diameter. Very few gardens have room for such a tree, but in a drier situation it can not be expected to live so long. As a garden subject it may attain a diameter of 3 feet in about 90 years and show no evidence of decline.

Among the deciduous trees we customarily think of the Oak as outliving several generations of man. As a lawn tree this applies to the true White Oak *(Quercus alba)*. Most of the Oaks remaining after the development of St. Louis County are Post Oaks *(Quercus stellata)*, growing in an inferior soil. Generally this species does not live 100 years when growing close to civilization. It is seldom used as an ornamental, but if planted after all building operations are finished it might be expected to live and thrive for 50 years and reach a diameter of somewhat over 12 inches. The White Oak, however, may well live for a century if it is protected while the grading is carried on or if planted after the grading is finished. There are several of

the White Oak group which are seldom encountered as ornamentals but which may live for a century in their native Ozarks. This would include the Chinquapin Oak *(Quercus Muhlenbergii)* and the Cow Oak *(Q. Prinus)* from the hills, and two others which may grow to gigantic size in the wet lowlands—the Bur Oak *(Q. macrocarpa)* and the Overcup Oak *(Q. lyrata)*. The Overcup Oak will not be happy far from its swamp home, but the Bur Oak will grow in fertile soil with much less moisture for as long as 100 years and will develop into a very ornamental tree.

Among the Red Oaks, which is a loose term for all Oaks not included in the White Oak group, the Pin Oak *(Quercus palustris)* is the most successful and the one most frequently planted as an ornamental. The natural habitat of this species is wet low ground, but it is very adaptable and frequently planted as a shade tree. It would be rather difficult to estimate its maximum development under lawn conditions, but with ample moisture and good soil it may well exceed 50 years of age and attain a trunk diameter of 14 inches. In some parts of the country very large and mature Red Oaks and Black Oaks can often be found after the real-estate development has finished. If the same trees were planted as ornamentals they would probably not live longer than 25 years unless all their needs were supplied.

Of the Maples we find many kinds used as shade trees. The commonest and also the poorest is the Soft Maple *(Acer saccharinum)*. Under ordinary conditions it would hardly live half a century, and it is safe to say that 25 years would cover the life span of three-fourths of those planted in recent years. The Box-elder *(Acer Negundo)*, another Maple, is often planted on account of its rapid growth. However, it is native to the river bottoms and makes a poor showing on an inferior site after 25 years. Storms may break both these Maples and reduce their life span considerably. The New England Sugar Maple *(Acer saccharum)* is notably long-lived. Several generations of men may have tapped the trees for sap, and they will still appear vigorous and flourishing. The New England tree does not grow well here, but its Ozark counterpart *(Acer saccharum* var. *glaucum)* can be grown as a shade tree with the assurance that when its critical requirements are met it will live past 100 years. As a shade tree, the Red Maple *(Acer rubrum)*, so common farther north, occupies a place between the Sugar Maple and the Soft Maple. It has not been planted very often in this region, but in a good location, with ample moisture and good soil, it will live longer than the Soft Maple.

There are several kinds of Ash used for lawn trees, but perhaps the White Ash *(Fraxinus americana)* is planted most frequently. This is a

forest tree growing to a diameter of 40 inches in 150 years but often maturing much more quickly. Under cultivation, with good soil and ample moisture, it may very well reach a diameter of 18 inches in 60 years and prove to be a handsome shade tree. The Ash-tree Borer is one serious insect pest which often shortens the life of this tree to about 20 years. In the dry and rocky portions of the Ozarks, we find the Blue Ash *(Fraxinus quadrangulata)*, which is a rival of the Juniper in such locations. As a shade tree the Blue Ash is only partly satisfactory. It probably reaches maturity in 50 years, although it may exist in a very weather-beaten condition on a dry glade for 75 years. Both the Red *(Fraxinus pennsylvanica)* and the Green Ash *(F. pennsylvanica lanceolata)*, commonly found along streams, could be used as ornamentals, but their life span would hardly exceed 25 years unless growing near a water-course.

In Missouri we have but one birch, the River Birch *(Betula nigra)*, which, like all the Birches, will not thrive far from water. Trees 3 feet in diameter and 120 years old can be found occasionally, but the usual life span is a good deal less. This tree is seldom used for ornament, and it is usually no more dependable than its cousin, the White Birch from the North.

The Beech *(Fagus grandiflora)* is native only in parts of the southeastern counties of the state, and very few trees from that location are planted on our lawns. The species should be superior, however, to the northern Beech for our climate, although the northern, the European, and some of their many varieties are successfully established. The native Beech may be expected to live as long as 100 years, the great difficulty being in finding the right location. Ordinarily, good White-Oak land is suitable for Beech, but the horticultural forms require the best of soil. Some of the red-leaved varieties may reach a diameter of 14 inches in 60 years.

Another notably fine shade tree is the Basswood or Linden *(Tilia* sp.*)*. With the exception of the European variety, most Basswoods grow into giants. They will certainly reach a 2-foot diameter when planted in good soil with ample room, and they can be expected to live for half a century.

The Buckeye *(Aesculus* sp.*)* and the Horse-chestnut *(Aesculus Hippocastanum)* are also very large trees. Since they grow very slowly they may be used in a smaller garden while they are young, but it must be remembered that they are timber trees. Any variety of the Horse-chestnut (which is not native but has escaped from cultivation) will prove worth-while as an ornamental. The Buckeyes are not so spectacular in flower, but they are equally interesting. They may live for 80 or 90 years and exceed 2 feet in trunk diameter in that time.

One of the highly prized cabinet woods is cut from the Wild Cherry *(Prunus serotina)*. This tree is very ornamental for a short period in May when it is in full bloom. It grows rapidly and tends to rot when mature, but for the first 25 years of its life it is a satisfactory lawn tree. It may reach a diameter of 10 inches and a height of 30 feet in that time.

The Kentucky Coffee Tree *(Gymnocladus dioica)* is probably seldom planted, but it is a very interesting tree, having as many as 90 leaflets making up one compound leaf. When grown in good soil it may increase one-half inch in diameter each year.

The Cottonwoods *(Populus* sp.*)* are all native to wet ground and stream courses. They are not frequently used as shade trees, but they grow very rapidly, reaching a height of 50 feet and a diameter of 18 inches in 25 years. As an ornamental their life span will hardly exceed 20 years.

Probably more Elms *(Ulmus* sp.*)* are used as shade trees than all native trees combined. The American Elm grows over all the eastern part of the country and is uniformly a very satisfactory ornamental. Its height and maximum diameter depend upon the soil in which it is grown. An Elm, if free from disease, will live well over 100 years and eventually reach a height of 90 feet. While it is a very satisfactory tree, it would be well to avoid using just the American species, since that is threatened by one or more serious diseases. Most of the horticultural forms, as well as the Slippery Elm *(E. fulva)*, will outlive the planter if grown in good soil.

The Hackberry *(Celtis* sp.*)* is an excellent shade tree. It may reach 50 feet in height in 80 years, with a trunk diameter of 20 inches. While it will tolerate a poor site, it is dependable only when grown in better soil with sufficient moisture.

The Hawthorns *(Crataegus* sp.*)* are all small trees and suitable for smaller gardens. They are not effective as shade trees and only occasionally reach a height of 25 feet. There are innumerable kinds of hawthorns, but the common species *(Crataegus mollis)* grows into a large, wide-spreading tree which lives for 90 years. By that time decay has hollowed the trunk, leaving the tree as picturesque as an old apple tree.

Missouri is well supplied with Hickories, their natural habitats ranging from dry glades to swamps. With the exception of the Pignut *(Carya glabra)*, the Hickories grow into satisfactory shade trees provided that they are planted in good soil with sufficient water. Most of the Hickories grow into very big trees reaching from 100 to 120 feet in height in the swamps. Under lawn conditions they may reach 50 feet in 80 years.

The Holly *(Ilex opaca)*, native to southeastern Missouri, while seldom growing into a shade tree, will live for a century when taken from its

swamp home. It will grow about one foot in height and less than one-fourth inch in diameter annually.

The three Locusts in Missouri all grow into big trees, but only the Black Locust *(Robinia Pseudo-Acacia)* has conspicuous flowers. In a good location this tree will live for 60 or more years. It may reach a diameter of 18 inches in 30 years and grow upward about a foot a year. The wood is very durable. The other two Missouri Locusts are often called Honey Locusts, *Gleditsia triacanthos* and *G. aquatica.* The first one grows from the river bottoms to the hilltops, and its life span depends entirely upon the kind of soil and amount of moisture available. In the bottoms it may grow to a diameter of 10 inches in 10 years, while if grown on the hill it may reach 12 inches in diameter and collapse when 30 years old. The Swamp Locust *(G. aquatica)* will not live for more than 20 years away from its home in the wet land. It differs in the smoother bark, the absence of thorny clumps, and in the production of only one seed to a pod.

Of the native Magnolias only two are dependable. The Cucumber Tree *(Magnolia acuminata)* is a timber tree and rather short-lived around St. Louis. It probably will not grow more than 10 inches in diameter in 40 years, which is about its life span in this region. The Sweet Bay *(Magnolia virginiana)*, often planted as a shade tree, seldom grows into more than a large shrub or small tree. It may live to be 50 years old, and it often develops many trunks. A third member of the Magnolia family is the Tulip Tree *(Liriodendron tulipifera)*. This is a forest tree growing more than a foot in height a year and living for 90 years, by which time it may be 2 feet in diameter. It is frequently planted and is a very satisfactory tree, but it must have good soil and ample water.

No native wood lasts as long as that cut from the Mulberry *(Morus rubra)*. The tree itself grows rapidly, and while storms may break the top the trunk diameter will increase one-half inch annually. Normally the tree is wide-spreading and acts as a nursery for most of the caterpillars attacking shade trees. It probably will not live longer than 40 years as a shade tree, and it will look very unattractive long before that time.

The Osage Orange *(Maclura pomifera)* was introduced to Missouri and all the Middle West for fencing and hedge purposes long before barbed wire was developed. Although it comes from northeastern Texas, it is entirely at home here and its annual diameter growth may average almost one-half inch for 60 years. Planted on good soil it will probably live a century.

The Persimmon *(Diospyros virginiana)* usually invades abandoned fields and is commonly encountered as a brushy growth. It can, however, grow into a large tree and it may reach a diameter of 24 inches in 60 years. If

started in a good location it will be a perfectly satisfactory shade tree which is quite capable of living longer than the planter.

The Redbud *(Cercis canadensis)* is considered somewhat shrub-like, but if it suffers no set-back and is planted in a good location may reach a diameter of 12 inches and a height of 20 feet in about 35 years. Much larger specimens have been found, and the Redbud is definitely a tree, not a shrub.

Very little need be said about the Sycamore *(Platanus occidentalis)* as a shade tree. It grows everywhere but reaches its greatest development in the river bottoms. Trees 120 feet tall, over 150 years old, and from 4 to 11 feet in diameter, are not uncommon. However, it will not grow so large or so high when used as a street tree. The European Plane *(P. acerifolia)* is a much smaller tree and is better suited for lawn planting.

The Sassafras *(Sassafras albidum)*, like the Persimmon, is usually found as part of a thicket. However, when allowed to mature as a specimen on good ground it may grow to saw-log size.

The Black Walnut *(Juglans nigra)* is notably long-lived and attains great size. The biggest trees have usually watched the passing of three generations. As a shade tree, the Walnut is entirely satisfactory but to reach maturity it must have ample room and a good fertile soil.

Relatively few of the many native Willows *(Salix* sp.*)* are used ornamentally, and these, without exception, are short-lived. They rarely live longer than 20 years unless they grow on the banks of a lake or river. Some of the ornamental kinds, especially the "weeping" type, will not live longer than 12 years except along a stream. In the swamps they may reach 100 feet in height with a trunk diameter of 3 feet but they are not long-lived even under the best of conditions.

There are many more trees planted for ornament. Most of them, like the Tree of Heaven *(Ailanthus altissima)*, which appears everywhere and becomes an ornamental whether planted or not, are but short-lived. Notable exceptions are the Scholar Tree *(Sophora japonica)*, the Varnish Tree *(Koelreuteria paniculata)*, and the Maidenhair Tree *(Ginkgo biloba)*, all living longer than 50 years, the Maidenhair perhaps 200 years or more. The Varnish Tree and the Scholar Tree are both wide-spreading and rather low, with a normal growth of 30 feet in height and a spread of 30 feet in 40 years. The Maidenhair, on the other hand, grows twice that height in the same length of time.

The expressions, "suitable location", "when all requirements have been met," etc., have been used frequently. It is not easy to determine just what is lacking to produce a tree of giant size. For example, Redbud and Dog-

wood may persist as semi-shrubs on a dry glade while they grow to near saw-log size in the same length of time on deep alluvial soil along the river banks. On the other hand, both the American Holly and the Osage Orange usually look much better and grow much more symmetrical as garden subjects than they do in their native habitats. The Holly may grow larger in the southern swamps, while the Osage Orange will be far larger when planted on the lawn. The maturity of a tree depends upon many factors. Trees are constantly developing youthful cells in the cambium, so they do not suffer from old age but should live indefinitely. They do mature, however, and then begin to decline, largely because the soil in which they are growing has neither the fertility nor the moisture to keep them alive. The maximum size that a tree can attain depends, therefore, not upon inherent characteristics as much as it does on the excellence of the soil and the water supply. At the same time we can predict the life expectancy of most trees, because experience has shown that there are relatively few kinds of soil which will continue to support a tree for an indefinite period. In practice, this means simply that to succeed, a tree should be grown in the very best soil available. It may not live for three centuries, but at least it will flourish so long as that soil will support it.

AUGUST P. BEILMANN.

WINTER COURSE IN GARDENING FOR AMATEURS

A course in flower and vegetable gardening for amateurs, calculated to give the students as much practical work as possible, will start in February, 1945. The classes will be held in the experimental greenhouses, Tuesdays, 10:00 to 12:00 a. m. The course will be in charge of Dr. Fairburn.

REGISTRATION: It is desirable that registration be made by letter, with check enclosed payable to the Missouri Botanical Garden, as soon after January 1 as possible. Tickets will be distributed at the experimental greenhouses on day of first lecture.

FEE: The registration fee is $15.00 per student, and tickets are not transferable.

OUTLINE OF GARDENING COURSE

February 6–May 1—

Selection and general care of house plants.
Methods of forcing bulbs into flower during winter.
Preparation of fertile garden soil.
Soil testing.
How to improve soils by the use of fertilizers.

Planning, planting and general care of the family vegetable garden. Varieties to grow in Missouri.
Practical plant propagation; seed sowing and cuttings.
Potting rooted cuttings and seedlings.
Identification and control of common garden insects and diseases.
Landscaping the home grounds.
Preparation and care of lawns.
Garden work demonstrated.

NOTES

The November number of *Home Gardening* (5[4]:15-19) contains an article entitled "House Plants—When the Heat's Turned On," by Dr. David C. Fairburn, Horticulturist to the Garden.

Mr. George H. Pring, Superintendent of the Garden, spoke to the Alpha Chi Sigma Fraternity, November 13, and before a business and professional women's group, November 20, on "The Development of the Orchid from Seed to Flower." On November 21, he gave an illustrated lecture before the Men's Club of Peters Memorial Presbyterian Church, on "Collecting Para Rubber."

The fourth and final number of Vol. XXXI of the ANNALS OF THE MISSOURI BOTANICAL GARDEN was issued in November with the following ccntents: "Maíz reventador," "Cytological Observations on *Tripsacum dactyloides*," "Homologies of the Ear and Tassel in *Zea Mays*," "Two Collections of Prehistoric Corn Tassels from Southern Utah," and "The Sources of Effective Germ-plasm in Hybrid Maize," by Edgar Anderson; "Notes on Some North American Asclepiads," by Robert E. Woodson, Jr.; and "The Liliaceous Genus Polygonatum in North America," by Ruth Peck Ownbey.

Recent visitors to the Garden include: Mr. E. J. Alexander, Assistant Curator, New York Botanical Garden; Mr. Raymond Baker, Manager Breeding Department, Pioneer Hi-Bred Corn Company, Johnston, Iowa; Dr. William L. Brown, Geneticist, Rogers Brothers Seed Company, Olivia, Minn.; Dr. Alexander F. Bucholtz, Bacteriologist, Pabst Brewing Company, Peoria, Ill.; Dr. George B. Happ, Professor of Biology, Principia College, Elsah, Ill.; Lt. (j.g.) Wayne Lenz, of the U. S. Navy; Mrs. Jan Jansen of Sault Ste. Marie, Mich.; Lt. R. L. Steere, formerly botany major at the University of Michigan, Ann Arbor.

STATISTICAL INFORMATION FOR NOVEMBER, 1944

GARDEN ATTENDANCE:

Total number of visitors	25,510

PLANT ACCESSIONS:

Total number of plants and seed-packets received as gifts	114

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	38
Total number of books and pamphlets donated	159

HERBARIUM ACCESSIONS:

By Purchase—	
Barkley, Fred—Plants of Alaska	270
Barkley, Fred—Plants of Mexico	85
Fisher, George L.—Plants of Mexico	168
By Exchange—	
University of Texas—Plants of Texas	200
By Transfer—	
Cutak, Ladislaus—Plants of Horticulture	2
Pring, George H.—Plant of Horticulture	1
Total	726

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Figures in *italics* refer to page numbers of plates and cuts.

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