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MISSOURI BOTANICAL GARDEN BULLETIN

VOLUME XV

WITH 28 PLATES

1927

ST. LOUIS, MISSOURI

PUBLISHED MONTHLY EXCEPT JULY AND AUGUST,
BY THE BOARD OF TRUSTEES

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Missouri Botanical Garden Bulletin

Vol. XV JANUARY, 1927 No. 1

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TROPICAL STATION, MISSOURI BOTANICAL GARDEN, BALBOA, CANAL ZONE.
Views in the new area being cleared for reception of Powell orchid collection.

Missouri Botanical
Garden Bulletin

Vol. XV JANUARY, 1927 No. 1

THIRTY-EIGHTH ANNUAL REPORT OF THE DIRECTOR

Gentlemen:

I have the honor to submit herewith the thirty-eighth annual report of the Director.

The vital part which botanical gardens have had in the development of the social and civic life of communities is becoming more and more recognized. During the past few years various cities throughout the United States have in one way or another started movements which must ultimately result in increasing greatly the number of real botanical gardens in this country. City dwellers are beginning to feel the need of the happy influence of the peaceful beauty of a botanical garden, and as America grows older we may expect to find a public garden regarded as important an adjunct of a city as a public library.

Through the benefactions of Henry Shaw St. Louis is more fortunate in this respect than most other cities, in fact more fortunate than many of its citizens realize, for in no other city in the United States is there a garden of the scope of the Missouri Botanical Garden, to the support of which the citizens, in one way or another, are not forced to contribute. While it is a statement, frequently heard, that the Garden is better known outside of St. Louis than in the city, this is becoming less and less true. With the gradual development of features likely to appeal to the public—particularly the winter flower shows—an increase in attendance has been brought about which indicates a growing interest in the Garden of

the community at large. The fact that as many as 10,000 people may come to the Garden on a Sunday afternoon simply to enjoy the plants and flowers, whether indoors or out, and that no additional attraction such as moving pictures or a band is necessary to draw them, is a gratifying proof that the people of St. Louis are still susceptible to such quiet influences. Any community which has a botanical garden and is beginning to use it as the citizens of St. Louis are using theirs cannot but be superior to a group of citizens who are not thus sensible to the finer things of life. The following editorial from the "Post-Dispatch," written during the last chrysanthemum show, well expresses a feeling which must be more or less widespread:

TWO STEPS FROM THE WORLD.

They have stopped autumn in her flight and called her sweetheart and blandished the jade until she left behind her beauty like a cloak flung down. Some of them have spoken for the gold coined by maple leaves in August sunshine and scattered on woodland floors while they danced lightly to a careless death in the September twilight. Others have chosen scarlet to love, recapturing the flash of a tanager's wings beating southward with the perfumed wind of an' October morning. There are bolder ones, too, who searched the lovely spoils for a bit of purple that once was mist left at the door of a dying meadow by a brook so moved to mourn. The purple is a royal fancy now, a vestiture worn gracefully, alas, by only a few of its new owners. For they have rollicked at their pillaging, improvidently under the rain, and many are penitent in faded blue.

But however well they fared in the lightsome joust for colors, these rogues have put on the dignity of reformation. Tall and straight they stand like kings and queens at court. A fervent number have set aside the gaudy robes and pose angelically in white. They are all a pirate band made suddenly aghast by the lustiness of their youth, regenerate revelers seeking honors in a somber world, yet too proud to beg. Let the gladiola blush for a sigh, let roses droop and woo tributes with an amorous breath. There are violets to plead for pity at shrines in the forest and daisies to smile meekly at men beside the road. These nobler blossoms bow not their heads. They are chrysanthemums, and splendid with dreams of Oriental empires more

exotic than the orchid knows in its drowsy watch above the jungle.

Aloof from life and lonely for the friendship of living things, the chrysanthemums seem not to use their charms, lest an empress presume or a commoner walk too close. Pathetic poseurs! It is all to keep November away. In their fortress at Shaw's Garden they are gathered as for a coronation day—two steps from a frozen city. They are gracious to color-hungry hearts, vacant with a sense of verdure vanished and warm hues chilled. Generously they yield up the blood of tremulous petals to paint a picture that is gone from the sky. The greens and reds and purples and yellows which spring gave and summer wore and autumn philandered in are the heritages of chrysanthemums. They are not misers but lay upon the eyes such a feast of beauty that the flower house becomes a magic palace and visitors are princes at the portals.

It is called, quite unworthily, "the annual mum show." But these and all other words can be lost in the sweet, harmonious silence of chrysanthemums in bloom.

While the year 1925 was in some respects the most notable in the history of the Garden since its founding by Henry Shaw, the year 1926 will also be one to be remembered because of the distinct progress along certain lines which it has been possible to make. In the annual report of the Director for last year a full account was given of the acquisition of the Gray Summit Extension to the Garden, and some of the advantages of this addition were indicated. The completion of the range of greenhouses early in the year made it possible to remove from the city garden the orchid collection and, although these plants have been in their new environment less than six months, the improvement in growth is little short of phenomenal. Their removal from the influence of the poisonous gases of the city, together with the increase in the amount and efficiency of sunlight, and the use of rain water instead of the harder city water, have all combined to produce effects which were attempted in vain at the old location. Plants which bloomed seldom, if ever, in the city have produced an abundance of blossoms, and the increase in the growth and general health of the orchids is so great as to justify the belief that within a few years the Missouri Botan-

ical Garden can compete with the orchid world, not only in quantity and variety, but also in the quality of plants.

The completion of the survey of the Gray Summit Extension has made it possible to lay out a system of roads which will eventually permit the public to visit all parts of the tract, particularly the wild flower reservations and the arboretum. Additions of native plants and trees are constantly being made, and, while it will be many years before the trees are of any great size, by the time the main arteries of the road system are completed there will be enough of interest to more than justify a trip to the out-of-town Garden. Because of the large amount of gravel available on the property the new roads as at first constructed will be of this material. Concrete roads do not lend themselves to the type of landscaping one expects to find in a garden, and not only will gravel roads be more suitable but so much less expensive that probably twice as much roadway can be completed each year than if it were built of concrete. A complete outfit of road-building machinery, with a gravel conveyor, has been acquired, and as soon as the necessary clearing and grading has been done a start will be made upon the construction of roads, the completion of which will permit the public to visit parts of the grounds now inaccessible.

During the year advantage was taken of an opportunity to secure the strip of land extending along the south side of the Meramec River, exactly opposite to the Garden property. This land, comprising 323 acres, gives us control of both banks of the Meramec and, if for no other reason, its acquisition was well worth while because of the protection it affords to the main tract. The Garden now controls a tract of 1,600 acres at the Gray Summit Extension, which possesses the unique feature of the Meramec River flowing through it. In general the land on the south bank is well designed for farming purposes and will be so used, for the present at least. Parts of the property are wooded, and while, with the exception of the two chestnut trees noted in the November, 1926, number of the BULLETIN, there is nothing here which does not grow on the other side of the river, it was desirable to acquire this land before it had been appropriated for camp purposes,

a prospect which was imminent. A house is under construction on this land for the use of the man who will farm this property.

Mr. L. P. Jensen, formerly arboriculturist to the Garden, has been put in general charge of the entire Gray Summit Extension, with Mr. Kisseck as engineer, Mr. Miller in charge of orchids, and Mr. Goedeke as farmer.

Tropical Station in the Canal Zone.—During the month of February I made a trip to Panama and the West Indies, and while at Balboa Mr. C. W. Powell generously presented the Missouri Botanical Garden with his world-wide-known collection of orchids. In the BULLETIN for November, 1923, Mr. Powell's garden was described at length, and in the BULLETIN for September, 1926, are listed some of the acquisitions to our orchid collection made possible by this gift. It has long been recognized that Panama is one of the most favorable places in the world for the cultivation of tropical orchids, and since the Canal Zone government was willing to set aside a tract of jungle land to be devoted to an orchid garden, it was decided to establish there a tropical station of the Missouri Botanical Garden, and to place Mr. Powell in charge as manager. The new location is being cleared and as rapidly as possible will be placed in condition to receive the Powell collection which will be transferred early next spring. The establishment of this station will make it possible for the Garden to grow many things which no longer can be maintained in the United States, and it is also likely that orchids and other plants will from time to time be transferred to this station. That the gift of Mr. Powell's orchids, added to those which the Garden already possessed, has placed the Garden collection in the front rank of public orchid collections in the world is perhaps best demonstrated by a quotation from the August number of the "Orchid Review," published at Richmond, Surrey, England. After giving an account of Mr. Powell's garden and commenting on the action of the Missouri Botanical Garden in arranging to establish and maintain a station on the Canal Zone, the editor says:

> "The Missouri Botanical Garden is by far the largest in the United States and has been for a long time a

strong rival of the Royal Botanic Gardens, Kew, for the premier position in orchid botanical gardens. By this latest move of theirs they have put themselves in a position to claim it and to maintain it."

It would seem, now that the Missouri Botanical Garden really extends from Panama on the south to Gray Summit on the north, that it is entitled to the designation Missouri Botanical Gardens, a term not infrequently applied to it.

Construction and Repair Work.—Owing to the favorable season an unusual amount of repair work was attended to during the summer months. New copper gutters and downspouts were placed on the old residence and museum buildings and the slate roofs thoroughly repaired. The lightning rods on all the buildings have likewise been overhauled and where necessary new parts supplied. Some of the growing houses, as well as the houses formerly occupied by the orchids, and the experimental greenhouse have been repainted and reglazed. Over 8,000 lights of glass were removed, all iron work scraped and painted, and the glass replaced in new putty. The iron fence along Alfred and Magnolia Avenues was cleaned of rust and painted, the pergolas in the Italian and rose gardens and trellises in the iris garden and on the stone wall have received two coats of paint. Extensive repairs were made in the boiler house, including a new three-inch feed water line, tearing down and rebuilding the bridge walls under all boilers, installing eight new fire-door liners and encasing same with fire brick, besides a thorough overhauling of the vacuum pumps and supplying bushings, piston rods, valve springs, etc. The old ash hoist was replaced with a new one. Extra heating coils were installed under the benches in the growing houses, and a rearrangement of the heating pipes in some of the exhibition houses was taken care of. A part of one of the growing houses has been fitted up with special heating apparatus, together with enclosed cases for the propagation of orchids from seed. Altogether it can be stated that there has never been a year in which it has been possible to do as much painting and repairing as during the past one and that the general condition of structures in the Garden is more satisfactory than it has been for a long

time. Some fifty benches of concrete and wood have been permanently installed in various places in the Garden, thus providing a very welcome addition to the number of seats available for visitors.

Flower Shows.—All the special exhibits of flowering plants were held in the floral display house as usual, but the fall chrysanthemum show still remains the most popular of these. However, the attendance at the orchid show is gradually increasing and it bids fair within a few years to rival the chrysanthemums in popularity. On Sunday, January 27, 8,600 people visited the orchid show, a number greater than the entire attendance for January in either 1924 or 1925. An exhibit which attracted unusual attention was a demonstration of the growth of an orchid from the minute seed through successive stages to the blooming plant. This exhibit was transferred to the national orchid show held in Philadelphia in May, and the American Orchid Society awarded it a silver medal.

On May 22 and 23 the Garden Club of St. Louis held its annual amateur show in the floral display house. Owing to unfavorable weather conditions the display was not the equal of several previous exhibits, but the increasing number of outsiders who exhibited is encouraging, indicating that the interest among amateurs around St. Louis is growing.

The dahlia show had to be omitted in 1925 because of early frosts, but the favorable fall of 1926 enabled growers in this vicinity to stage what in many respects was the most satisfactory dahlia show ever held at the Garden. While the quantity of blossoms was not so great, the quality was particularly fine, and, given favorable weather conditions, there is no reason why St. Louis should not produce dahlias which can compete with any grown in this part of the country. During the year the Garden continued to grow, for test, dahlias sent in from different parts of the country. Most of these are new seedlings, and the blossoms are carefully graded for reporting to the American Dahlia Society, which awards a certificate of merit if the flowers score sufficiently high.

A bouquet of orchids was again presented to the Veiled Prophet's Queen, and this, with the bouquets of the four spe-

cial maids, was exhibited in an electrically refrigerated display case on the day following the ball. This case will be used for the exhibition of especially selected blossoms in the next orchid show and will likewise be available for a continuous display of wild flowers which will be brought in every week during the season from the Gray Summit Extension.

On November 12 Queen Marie of Roumania visited the Garden, having particularly requested to be shown the chrysanthemums, and a bouquet of orchids was presented to her at the dinner given in her honor that evening.

Distinguished Visitors.—In addition to the very large number of botanists and horticulturists from the United States who annually come to the Garden in order to consult with various members of the staff or use the library, herbarium or plant collections, there were an unusually large number of foreign visitors. This was due in part to the number of botanists from abroad attending the International Congress of Plant Sciences held at Ithaca in August. These included Dr. Hugo Weigold, Director of the Natural History Museum, Hannover, Germany; Dr. Otto Rahn, Experimental Station, Kiel, Germany; Professor Yoshiji Yoshii, Professor of Plant Physiology, Imperial University, Sendai, Japan; Dr. Robert Ballenegger, College of Horticulture, Buda Pesth, Hungary; Dr. Mitsuhri Ishikawa, Professor of Botany, Tokyo, Japan; Professor Borza, University of Cluj, Roumania; Mr. Goro Ida, of the Botanical Institute, Tokyo, Japan; Dr. Arthur W. Hill, Director of Royal Botanic Gardens, Kew, England; Mr. C. W. Powell, Missouri Botanical Garden Tropical Station, Balboa, C. Z.; Mr. Harold Sandon, Rothamsted Experiment Station, Harpenden, England; Professor and Mrs. N. Maximow, Botanical Garden, Leningrad, Russia; Honorable Tsuneo Matsudaira, Japanese Ambassador to the United States; and Professor Naohdi Yatsu, Imperial University, Tokyo, Japan.

School for Gardening.—At the end of the school year last June Miss Fern Goss, of El Paso, Texas, finished the prescribed three years' course and was awarded a certificate. There are in the school at the present time five students. Mr. Layton is continuing the work begun last year, and four

young men, Messrs. Embree, Gilmour, Rist, and Waldbart, have been admitted as first-year students. The morning work has been put on a more definite and comprehensive basis, and the reaction of the students to the change has been excellent.

Annual Bequests.—The only annual bequest provided for in the will of Mr. Shaw to be carried out during the year was the annual flower sermon which was preached at Christ Church Cathedral, on Sunday, May 11, by the Rev. Joseph Fort Newton, Rector of St. Paul's Church, Overbrook, Philadelphia, Pa.

ATTENDANCE FOR THE YEAR 1926

	Week-days	Sundays
January	7,140	16,313
February	11,174	12,781
March	3,952	4,279
April	6,006	8,614
May	13,976	20,012
June	12,133	15,640
July	17,121	10,199
August	11,273	21,136
September	12,506	8,878
October	11,713	11,344
November	15,956	23,073
December	5,367	5,629
	128,317	157,898
		128,317
Total		286,215

RESEARCH AND INSTRUCTION

In connection with the work of the graduate and research laboratory a number of projects have been under investigation during 1926. The problem of the nature of mosaic diseases continues to occupy attention, and the facts throwing light upon the behavior of the disease-inducing agency are being accumulated. Upon the basis of the recent evidence several oral reports have been made tending to indicate the extreme smallness of the agency concerned, and disagreeing entirely with the view that pathogenic organisms of the usual type have any relation to these types of diseases. Likewise, general studies on variegation, and the influence of conditions

upon variegation, are being pursued. Some attention is also being given to the special influence of ultra-violet light—using a Quartz mercury vapor lamp—upon the appearance of variegation, as well as on the general morphology and histology of the plants exposed.

Many other problems, relating especially to the physiological-chemical phases of the work, are under investigation. New apparatus and new equipment have been installed in the laboratories from time to time as needed, but the requirements for experimental work of this kind are so extensive that it is not practicable to meet them all in the present crowded quarters of the laboratory. A new building devoted primarily to the experimental work, as previously pointed out, would seem to be the only reasonable solution of the problem, if this line of investigation is to be continued at the Garden. In this connection attention should be drawn to the great strides which have been made in plant physiology and other lines of experimental botany in recent years. These strides, however, have necessitated an increasing and a more diverse use of chemical and physical equipment, with an ever-increasing need of space and the special conditions demanded for such work. Research of this type involves such substantial capital investments and elaborate apparatus, the lack of any of the necessary conditions limiting so definitely the nature of the problem of investigation, that it is a question just how far an institution like the Garden should engage in this field, particularly in view of the recent establishment of centers where practically every facility for physiological work exists or can be provided.

Published Articles.—During the past year five numbers of the Annals, a quarterly journal of scientific research, have appeared or are in press, these constituting Number 4 of Volume XII, and Numbers 1-4 of Volume XIII. The various articles are listed below:

Duggar, B. M., and Joanne K. Armstrong, "The Effect of Treating the Virus of Tobacco Mosaic with the Juices of Various Plants." Vol. XII, pp. 359-366. 1925.

Ranker, E. R., "Determination of Total Nitrogen in Plants

and Plant Solutions: A Comparison of Methods with Modifications." Vol. XII, pp. 367-380. 1925.

Tisdale, L. E., "Colloidal Sulphur: Preparation and Toxicity." Vol. XII, pp. 381-418. 1925.

Kobuski, Clarence E., "Revision of the Genus Priva." Vol. XIII, pp. 1-34. 1926.

Epling, Carl C., "Studies on South American Labiatae, II." Vol. XIII, pp. 35-70. 1926.

Grenzebach, Myrle E., "A Revision of the Genus Bouchea (Exclusive of Chascanum)." Vol. XIII, pp. 71-100. 1926.

Moore, George T., and Nellie Carter, "Further Studies on the Subterranean Algal Flora of the Missouri Botanical Garden." Vol. XIII, pp. 101-140. 1926.

Smith, Fanny Fern, "Pseudo-Fertility in Nicotiana." Vol. XIII, pp. 141-172. 1926.

Burt, E. A., "The Thelephoraceae of North America. XV." Vol. XIII, pp. 173-354. 1926.

Moore, George T., and R. V. L. La Garde, "The Identification of Pollen From So-called 'Hay Fever' Plants." Vol. XIII, in press.

Ranker, E. R., "Determination of Total Nitrogen, Nitrate-Nitrogen, and Total Nitrogen, Not Including Nitrate Nitrogen: Further Observations on a Modification of the Official Salicylic-thiosulphate Method." Vol. XIII, in press.

Smith, Fanny Fern, "Some Cytological and Physiological Studies of Mosaic Diseases and Leaf Variegations." Vol. XIII, in press.

Articles published by members of the staff and others connected with the research work of the Garden, appearing in journals not supported by the Garden, are as follows:

Couch, J. N., "Notes on the Genus Aphanomyces, with a Description of a New Semiparasitic Species." Journal of the Elisha Mitchell Scientific Society, Vol. XLI, pp. 213-227. 1926.

Couch, J. N., "Heterothallism in Dictyuchus, a Genus of Water Molds." Annals of Botany, Vol. XL, pp. 849-882. 1926.

Duggar, B. M., "The International Congress of Plant Sciences." New Phytologist, Vol. XXV, pp. 61-62. 1926.

Duggar, B. M., "How Plants Behave When Diseased." [In a series of radio talks on science from National Research Coun-

cil, Washington, D. C.]. Scientific Monthly, Vol. XXIII, pp. 177-180. 1926.

Greenman, J. M., "Senecio," in Standley's Trees and Shrubs of Mexico. Contributions from the United States National Herbarium, Vol. XXIII, part 5, pp. 1621-1636. 1926.

Ranker, Emery R., "Some Physiological Considerations of the 'Delicious' Apple with Special Reference to the Problem of Alternate Bearing." American Journal of Botany, Vol. XIII, pp. 406-426. 1926.

Scientific and Popular Lectures and Papers.—It is not easy to differentiate sharply between the scientific and popular lectures delivered during the year by members of the scientific and Garden staff, but the following list is suggestive of the activities with which the Garden has been associated:

Edgar Anderson, January 23, before the second-class scouts of St. Louis, "Winter Identification of Trees."

Fern Goss, March 9, before the Better Homes Group of the Monday Club, Webster Groves, "Garden Planning."

G. H. Pring, March 11, before the members of the Cemetery Officials' Association of St. Louis, "Landscape Gardening."

Hermann von Schrenk, March 18, before the Women's Round Table, "Conservation."

Edgar Anderson, March 23, before the members of the Garden Club of Springfield, Illinois, "Flower Forms and Their Meaning." The same lecture was given before the Nature Study Society of Webster Groves on April 2.

B. M. Duggar, April 6, before the Botanical Society of Washington, "Some Recent Studies on the Virus of Tobacco Mosaic."

George T. Moore, April 22, before the American Philosophical Society in Philadelphia, "An Accurate Identification of Wind-Borne Pollens for Diagnostic Tests in Hay-Fever."

B. M. Duggar, April 27, before the National Academy of Sciences, "The Colloidal Behavior of the Agency Inducing the Mosaic Disease of Plants."

George T. Moore, May 4, before the annual joint meeting of Phi Beta Kappa and Sigma Xi, at Washington University, "On Being Scientific."

B. M. Duggar, May 13, radio talk from Washington, D. C., "How Plants Behave When Diseased."

G. H. Pring, before the chautauqua meetings at Piasa, Illinois, August 16, "The Economic Products of Trees," and August 17, "Native Plants."

E. A. Burt, August 17, before the section of mycology of the International Congress of Plant Sciences, at Ithaca, New York, "Classification of the Species of Corticium by the Tissues of the Fructification."

B. M. Duggar, August 18, before the section of pathology of the International Congress of Plant Sciences, at Ithaca, New York, "The Nature of Mosaic Diseases."

B. M. Duggar, August 21, before the section of physiology of the International Congress of Plant Sciences, at Ithaca, New York. Round-table discussion on "The Physical Chemistry of Protoplasm."

Esther L. Larsen, September 13, before the students of the high school at Minot, North Dakota, "The Missouri Botanical Garden."

G. H. Pring, October 4, before the Monday Club at Edwardsville, Illinois, "Gardening."

George T. Moore, November 2, before the Webster Groves Garden Club, "Flowering Trees of This Locality."

Hermann von Schrenk, December 1, before the Wednesday Club, "Termites."

B. M. Duggar, December 30, before the Botanical Society of America, at Philadelphia, "Results of the International Congress of Plant Sciences."

G. H. Pring has given his lecture, "The Effect of Smoke upon Plants," before the following audiences: the Science Section of the Wednesday Club, February 24; the Lions Club, June 23; Men's Club of the Clifton Heights Presbyterian Church, October 12; Chamber of Commerce, October 27; Railroad Y. M. C. A., November 17; Rotary Club, December 16.

G. H. Pring has given his lecture, "Orchid Hunting in South America," before the following audiences: O'Fallon Park Protective Association, January 6; Good Fellowship Club of the Independent Evangelical Church, February 18; a similar lecture was given before the Men's Club of the First

German Presbyterian Church, May 11, and before the Lions Club, at Belleville, Illinois, December 9.

Other Outside Scientific Activities.—Each year the members of the scientific staff contribute a certain amount of time and effort, as may seem desirable or practicable, to work which bears some relation to the advancement of botanical science in general. Among such duties are work on committees and various plant science organizations, attendance upon scientific meetings and participation in these, as well as other responsibilities in representative societies or organizations. Among these activities are the following:

W. J. Bach, E. A. Burt, B. M. Duggar, J. M. Greenman, R. V. L. La Garde, George T. Moore, E. R. Ranker, and Fanny Fern Smith attended the International Congress of Plant Sciences at Cornell University, Ithaca, New York, August 16-23. Two members of the Garden staff took a prominent part in the organization of this Congress, B. M. Duggar being Chairman of the Executive Committee and General Secretary of the Congress, and George T. Moore serving as Treasurer.

The meeting of the American Association for the Advancement of Science and affiliated societies in Philadelphia, December 27-31, was attended by J. N. Couch, E. F. Davis, B. M. Duggar, and Fanny Fern Smith.

B. M. Duggar has also served as editor for physiology on Botanical Abstracts; as editor for botany on Chemical Abstracts; as a member of the Editorial Board, American Journal of Botany; as substitute member, Board of Fellowships in the Biological Sciences, National Research Council, Washington, D. C.; as Chairman, Division of Biology and Agriculture, National Research Council, until July 1; as Trustee of the Bermuda Biological Station; as Chairman for Section G, American Association for the Advancement of Science; and as Secretary of the Union of American Biological Societies.

J. M. Greenman has served as editor for taxonomy on Botanical Abstracts; as a member on the Nomenclature Committee, Botanical Society of America; and as President, Washington University Chapter of Sigma Xi.

Appointments.—The retirement of Dr. Burt as mycologist made necessary the filling of this position, and Dr. D. H. Linder was appointed. Later Dr. Linder had the opportunity of joining an expedition to Africa under the auspices of the Harvard School of Tropical Medicine and was granted leave of absence for a year. Dr. L. O. Overholts, professor of botany at Pennsylvania State College, on leave of absence from that institution, was appointed mycologist for the year 1926-27.

Mr. Alexander F. Bucholtz, B. S., Cornell University, was appointed research assistant to succeed Mrs. Elva P. Miller.

Graduates, Fellows, and Investigators.—The experimental and other aspects of research, as heretofore, have been conducted both by members of the scientific staff and by graduate students registered as candidates for degrees in the Henry Shaw School of Botany of Washington University, or other research assistants and visiting investigators.

Graduate Students.—The following graduate students have been in residence during the calendar year: Dorothy M. Anderson (Mrs. Edgar), formerly teaching fellow; Everett Fogg Davis, formerly instructor in Washington University; C. E. Kobuski; Elva Pumphrey Miller (Mrs. Harry M.), formerly research assistant; Emery R. Ranker, formerly Lackland research fellow; Fanny Fern Smith, formerly Lackland research fellow; Esther L. Larsen, formerly teaching fellow; J. Paul Reeves, formerly teaching fellow; D. C. Neal, formerly Lackland research fellow; T. Fukushi, professor of botany at the Agricultural College, Tottori, Japan; Martha L. Beardsley; Alexander F. Bucholtz, research assistant; Ethel T. Eltinge; Lawrence Edgar Evinger, laboratory assistant, B. S. in Ed., Indiana State Normal School; Catherine M. Lieneman; Thomas D. Mallery; Mildred E. Mathias; Ernest H. Runyon, instructor in botany, Washington University; Paul F. Shope; Robert E. Woodson, Jr.

Fellows.—For the academic year 1925-26 the holders of various fellowships are as follows:

Rufus J. Lackland Research Fellowships.—Clarence Emmeren Kobuski, B. S. Cornell University, M. S. Washington University, appointed third successive year; Robert Everard Woodson, Jr., A. B. Washington University.

University Fellows.—Thomas Dwight Mallery, A. B. Oregon Agricultural College; Mildred Esther Mathias, A. B. Washington University.

Jesse Barr Fellows.—Ethel Taber Eltinge, A. B. and M. A. Syracuse University; Esther Louise Larsen, A. B. University of Montana, M. S. Washington University.

Teaching Fellows.—Martha Lydia Beardsley, A. B. Washington University; Catherine Mary Lieneman, A. B. University of Nebraska; Paul Franklin Shope, B. S. Pennsylvania State College, M. S. University of Colorado.

Special Investigators.—John N. Couch, National Research Council Fellow in the Biological Sciences, A. B., A. M., Ph. D. University of North Carolina, assistant professor of botany, University of North Carolina, on leave; Kazno Gotoh, graduate College of Agriculture, Hokkaido Imperial University, Sapporo Japan, lecturer in botany, Hokkaido Imperial University, on leave.

Non-resident.—P. L. Gainey, associate professor of bacteriology, Kansas Agricultural College, Manhattan, Kansas; D. C. Neal, professor of plant pathology, Agricultural and Mechanical College, Mississippi, and pathologist to the Mississippi State Plant Board; L. E. Tisdale, laboratory, General Chemical Company, New York.

Degrees and Assignments.—At the annual commencement of Washington University, June 7, 1926, degrees were conferred upon students of the graduate laboratory at the Garden, as follows: Master of Science, Esther L. Larsen, teaching fellow (thesis topic, "A Revision of the Genus Townsendia"); Doctor of Philosophy, Emery R. Ranker, Lackland research fellow (thesis topic, "The Determination of Nitrogen in Biological Material"); and Fanny Fern Smith, Lackland research fellow (thesis topic, "Some Cytological and Physiological Studies of Mosaic Diseases and Leaf Variegations").

HERBARIUM

The year 1926 may be characterized as a signal year in the continued growth and further organization of the herbarium. The number of specimens acquired during the year is nearly double that of 1925, notwithstanding the fact that the total

has not been augmented by the acquisition of a single private collection of any considerable size. While attention has continued to center primarily on the flora of the southwestern part of the United States, yet the new material obtained belongs to many different natural groups of plants, represents the vegetation of widely remote regions, and increases substantially our representation of the world's flora.

It is important to record that one of the large herbarium rooms, housing approximately 300,000 specimens, has been completely equipped with new steel fire-proof herbarium cases of the most modern type of construction. These new cases replace old wooden cases which were no longer adequate to protect valuable specimens from increasing deposits of coal smoke and possible damage or complete loss by fire. The new installation also gives considerable increased case-capacity, and affords, temporarily at least, much-needed space for expansion of the herbarium.

New Accessions.—Some of the more noteworthy collections obtained during the year are the following: Dr. E. Anderson, 125 plants of Canada and the eastern United States; Arnold Arboretum of Harvard University, 1,600 plants of North America, collected by E. J. Palmer; Prof. L. H. Bailey, 21 plants of Venezuela; E. Bartholomew, 200 North American fungi; A. R. Bechtel, 23 Indiana fungi; Botanical Garden and Museum, Berlin, Germany, 250 plants of Bolivia, 250 plants of Chile, and 13 photographs and fragments of types; W. E. Broadway, 435 plants of Trinidad and Tobago; B. F. Bush, 50 plants of Missouri; Mrs. Agnes Chase, 504 plants of Brazil; Hon. Joseph R. Churchill, 405 plants of northeastern United States; J. F. Collins, 21 plants of Rhode Island; A. D. E. Elmer, 1,511 plants of Borneo, and 89 plants of the Philippine Islands; Dr. Carl C. Epling, 570 plants, chiefly from Idaho; J. M. Grant, 250 plants of Washington; A. A. Heller, 325 plants of California; Prof. L. F. Henderson, 368 plants of Oregon; Dr. William Herter, 180 plants of Uruguay; J. M. Holzinger, 50 North American mosses; Hungarian National Museum, 107 plants of Hungary; Iowa Agricultural College, by Prof. L. H. Pammel, 245 plants of Wisconsin, Minnesota, and Iowa; J. H. Kellogg, 158 plants of

Missouri; G. K. Merrill, 50 lichens; Mrs. Ynes Mexia, 279 plants of Mexico; Dr. Hj. Möller, 390 plants of Brazil; New York Botanical Garden, 23 plants of the West Indies; Rev. Hugh O'Neill, 268 plants of Florida, and 69 plants of Colombia, South America; Dr. L. O. Overholts, 89 fungi of Missouri and Illinois; Dr. E. B. Payson, 497 plants of Wyoming; Philadelphia Academy of Natural Sciences, 363 plants of eastern United States; Dr. Morten P. Porsild, 230 plants of Greenland; C. W. Powell, 18 plants of Panama; Robert Ridgway, 60 plants of Illinois; N. B. Sanson, 107 plants of western Canada; F. C. Seymour, 100 plants of Hampden County, Massachusetts, and 100 plants of the Mexican Gulf States; U. S. Department of Agriculture, 114 grasses; U. S. National Museum, 28 plants of Tropical and South America; University of Cluj, by Prof. Al. Borza, 100 plants of Roumania; Université de Montréal, by Bro. Marie-Victorin, 415 plants of eastern Canada; University of Wisconsin, by Dr. J. J. Davis, 20 fungi of Wisconsin; Th. Oswald Weigel, 100 orchids of Papuasia, and 180 plants of Uruguay; Robert E. Woodson, Jr., 621 plants of Missouri, Nova Scotia, etc.; J. W. Wolfing, 1,092 algae of America, Europe, Japan, South Africa and Australia. Numerous smaller collections have been received from correspondents and friends of the Garden, which have been recorded in current numbers of the BULLETIN.

Mounting and Distribution.—Somewhat fewer specimens have been mounted during the year than in previous years. Although this work has been much interrupted, yet 8,420 specimens have been mounted and incorporated in the organized herbarium.

Field Work.—A limited amount of field work has been carried on during the past year, particularly in the St. Louis region. Special arrangement, whereby Mrs. Agnes Chase was commissioned to collect in Brazil certain groups of plants for the Missouri Botanical Garden, resulted in the acquisition of an interesting and valuable series of critically named Brazilian grasses.

Exchanges.—The number of exchanges is annually increasing; and many important series of herbarium specimens have been received during the fiscal year from institutions with

which the Garden has long maintained most cordial exchange relations. Owing to the unusual amount of labor involved incidental to the installation of new herbarium cases only a comparatively small number of duplicate herbarium specimens was distributed during the year.

Use of the Herbarium by Outside Botanists, and Loans.—Botanists from various parts of the country have visited the herbarium to consult particular groups of plants, as well as type material. Several loans have been made to scientific institutions in different parts of the United States for study by specialists who are occupied in monographic work. Likewise, loans have been made to the Garden for the benefit of members of the staff and advanced graduate students pursuing detailed investigations on special groups of plants. Such interchange of plant material greatly facilitates research in taxonomy and, provided proper care is exercised, materially enhances the scientific value of herbarium specimens.

Statistical Summary (For the year ending December 31, 1926).

Number of specimens received on new accessions:

By purchase ...	5,520	
By gift	2,658	
By exchange ...	4,244	
By field work...	605	
Total.....	13,027	valued at $1,302.70
Number of specimens mounted and incorporated.....	8,420	valued at $1,684.00
Number of specimens discarded from the herbarium.....	216	without value
Number of specimens in organized herbarium	929,591	valued at $147,829.50
Number of specimens in unorganized herbarium	90,626	valued at 7,719.26
Wood specimens, etc., supplementing the herbarium		valued at 280.00
Microscope slides, etc.....		valued at 410.00
Total valuation.....		$156,238.76

LIBRARY

During 1926 the library has made a steady growth. Due to the publication of the "Union List of Serials" (a list of all serial publications contained in American libraries), book dealers now have a record of the journals in the Garden library, and are offering to supply the numbers missing in our sets. The Garden has taken advantage of many of these opportunities and has been able to complete the files of some of the periodicals which have been needed in the library for some time. The checking of this list has taken considerable time of the library assistants, but it has already been found extremely useful in bibliographical work and in locating books which need to be borrowed from other libraries.

The shelf space in the library stacks has become entirely inadequate. Several years ago a corner in the basement, formerly used for storage purposes, was walled in, and in it was placed some of the books on plant physiology and agriculture. This room is now almost completely filled, and as there is no more available space in the building, the shelving of new books is becoming quite a problem.

New Accessions.—In addition to the purchase of the odd numbers of serials, already mentioned, some of the more noteworthy or valuable purchases during 1926 are the following: A new edition of Rand-McNally's "Atlas of the World"; Walcott's "North American Flowers," of which two volumes of plates with descriptions have been published in 1926; all the botanical numbers of "Bibliographica Genetica"; all the volumes of "Genetica," a serial now in its eighth volume; "Plant Physiology" and "Biological Abstracts," both of which are new serials begun in 1926; William Cobbett's "Woodlands"; Alexander's "Colloid Chemistry"; Bayliss's "Principles of General Physiology"; Diel's "Die Flora von Central China"; Jörgensen's "Microorganisms and Fermentation"; d'Herelle's "Bacteriophage"; Jepson's "Manual of Flowering Plants of California"; "Quarterly Review of Biology"; Saccardo's "Sylloge Fungorum," vol. 23; Rendle's "Classification of Flowering Plants," vol. 2; Thom and Church's "The Aspergilli"; Tipping's "English Gardens"; Wilson's "The Lilies of Eastern Asia"; Spoehr's "Photo-

synthesis''; Shelford's ''Guide to the Americas''; Shaw and Owens' ''The Smoke Problem of Great Cities''; Warming's ''Oecology of Plants,'' and Willis's ''Dictionary of Flowering Plants.''

In addition to the purchases many valuable books and articles are sent to the Garden as donations or in exchange for the Garden's reprints.

Garden Publications.—Four numbers of the Annals were issued in 1926—number 4 of vol. XII and numbers 1-3 of vol. XIII—and number 4 of vol. XIII is now in press. The three numbers of vol. XIII issued contain 354 pages, 2 text figures and 12 plates.

As conditions in Europe become more stabilized, more requests are being received from foreign institutions for the Annals as an exchange for their publications. Twenty-one new institutions were added to the Garden's exchange list in 1926. Of these four were from the United States, three from Russia, two from Germany, and one each from Czechoslovakia, Esthonia, Latvia, Poland, Dutch Guiana, Japan, Italy, Greece, China, Bulgaria, Federated Malay States, and Belgium. The library now receives over 1,500 serials on an exchange basis, some of which are in exchange for the BULLETIN.

The Annals and BULLETIN are also sold to subscribers. During 1926, $2,234.99 was received by the Garden from the sale of these two publications, together with reprints of Annals articles and Books of Views of the Garden.

Outside Visitors—Interest in and use of the library by the community is constantly growing. Many teachers, students, scout leaders, and nature lovers come to the Garden to obtain information on native plants. Wild-flower books and bulletins are in continuous demand, and the supply of Garden BULLETINS relating to native plants is almost exhausted.

In the December, 1926, issue of the BULLETIN mention was made of the number of scientific visitors using the Garden library. This has been more evident in 1926 than ever before. Scarcely a day passes but what a professor or student from one of the local universities or high schools visits the library to consult a book which he has seen reviewed in ''Biological

Abstracts'' or some other scientific journal. Many botanists from distant places visited the library in 1926 on their way to or from the International Congress of Plant Sciences and the annual meeting of the Botanical Society of America.

During 1926, 100 books were borrowed by 30 institutions on the inter-library loan plan.

Statistical.—There have been donated to the library or received in exchange during the year 461 books, valued at $1,031.41; and 1,972 pamphlets, valued at $444.83. Three hundred and forty-five volumes were bought at a cost of $2,020.03, and 135 pamphlets, at a cost of $83.39. One manuscript was donated to the library. The library now contains 42,251 books and 59,819 pamphlets, a total of 102,070. There are also 331 manuscripts valued at $1,614.80 and 933,800 index cards valued at $10,594.54. A total of 8,522 index cards have been added during the year, of which 906 were written by Garden employes, and 7,616 purchased at a cost of $138.98. Three hundred and seventy-four books were bound.

GEORGE T. MOORE,
Director.

STATISTICAL INFORMATION FOR DECEMBER, 1926

GARDEN ATTENDANCE:

Total number of visitors	10,996

PLANT ACCESSIONS:

Total number of plants and seed packets received as gifts	39

PLANT DISTRIBUTION:

Total number of plants distributed in exchange	19

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	82
Total number of books and pamphlets donated	231

HERBARIUM ACCESSIONS:

By Purchase—	
Anderson, Dr. and Mrs. Edgar—Canadian plants	100
Möller, Dr. Hj.—Plants of Brazil, collected by Dr. P. Dusen	390
By Gift—	
Anderson, Dr. Edgar—Plants of Michigan, Ohio, Illinois and Arkansas	10
Hume, H. Harold—Plants of Florida	2
Kellogg, John H.—Plants of Missouri	53
Kobuski, C. E.—*Jacobinia Ghiesbrechtiana* Benth. & Hook. f. from horticulture	2
Mathias, Miss Mildred, and Miss Ethel Eltinge—Plants of Missouri	12
Windler Wholesale Floral Company—*Helichrysum* sp. from South Africa	1
Woodson, Robert E., Jr.—Plants of eastern and central United States	620
By Field Work—	
Greenman, Dr. J. M.—Plants of Illinois	12
Overholts, Prof. L. O.—Plants of Missouri	18
Total	1,220

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and, while virtually a private garden, it was, except at certain stated times, always open to the public. By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the 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 of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises about 75 acres. There is now in process of development a tract of land of over 1500 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees, and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an aboretum as well as holding a certain area as a forest reservation, with the idea that possibly at some future time this may become the new botanical garden. About 12,000 species of plants are growing in the Garden.

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset; from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines. The Garden may also be reached by Bus Route No. 12, to which all other motorbus lines transfer.

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Missouri Botanical Garden Bulletin

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PLANTS THAT SHOOT

Many of the specimens in the Aroid House at the Missouri Botanical Garden could well bear the warning, "Do not annoy these plants; they might shoot you!" For it is literally true that many of them do shoot and as a result cause human suffering which is certainly intense though it may not be prolonged. It must be confessed that no ordinary ammunition is used, and that one is quite safe from bombardment unless the plant is handled very roughly. The ammunition consists of needle-shaped crystals of microscopic size, which are projected into the tongue by the hundreds of thousands if one nibbles a bit of the leaf. They make the tasting of the average aroid an experience to be long remembered but never knowingly repeated.

It is a favorite trick in country districts to feed the unwary stranger a slice from the bulb of our commonest North American aroid, the jack-in-the-pulpit or Indian turnip. The unfortunate victim, intrigued by the word "turnip", notices nothing wrong at the first nibble. The bulb is fresh and starchy, and tastes very much like a raw potato. Many find it so attractive as to take a second bite, but few have attempted the third. For at this point the "shooting" begins. The tongue suddenly feels uncomfortably rough and warm, the heat becomes more intense, and the stabs of pain are sharper and more numerous until the tongue and cheeks and throat feel as though they were being pierced by thousands of red-hot needles.

A thin section of the bulb, examined under the microscope,

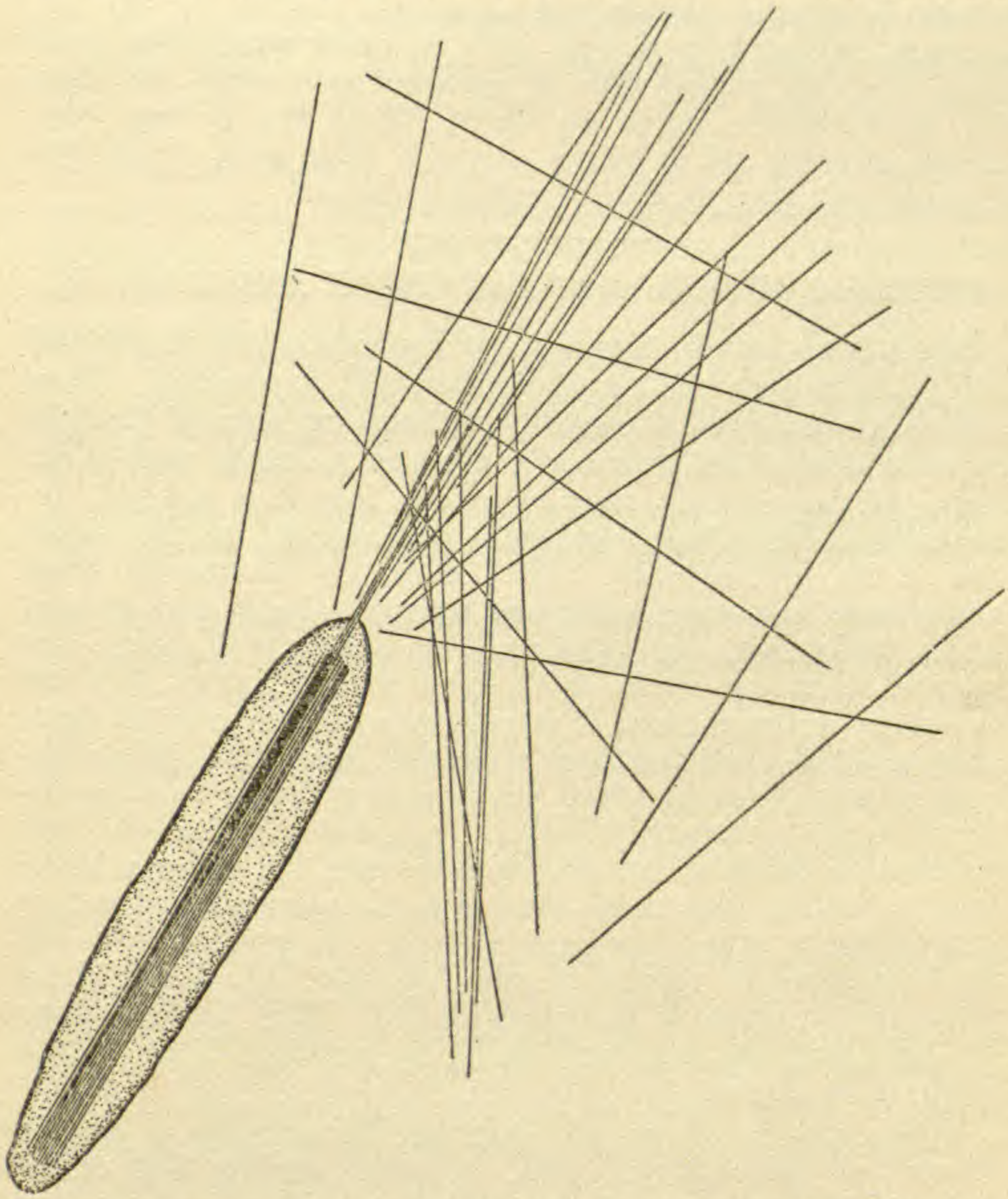
reveals the source of the pain. Bundles of long crystals are found distributed throughout the tissue, and it is these crystal needles, piercing the tongue and the cheek, which cause the burning sensation.

Chemical tests prove the crystals to be made of calcium oxalate, a substance very commonly found in plant tissues. It is quite bland as to flavor, for it is the form of the crystals, rather than their chemical composition, that makes them such an unpleasant mouthful. Many of the aroids which contain these crystals can therefore be made fit for human food if the crystals can be destroyed. The ease with which this can be done varies with different plants. In the case of the tropical taroes boiling is usually sufficient, while with our own jack-in-the-pulpit heat alone is not enough. One who would eat its bulb for the nourishment that it does admittedly contain, must treat it as the Indians did, grinding it into a pulp and then roasting or boiling the pulp thoroughly. Certain tropical species of the genus Alocasia are so acrid that the natives use them as food only under the threat of famine. So ugly are the crystals of some of the species of Alocasia that one may be "stung" by merely brushing against the plant in passing.

In certain plants of the Aroid family, these crystals do not lie passively in wait, but are actually discharged with considerable force. The crystals of *Xanthosoma Lindeni,* illustrated in the figure, are such a case. This plant, a small aroid with its green leaves attractively marked with silver, has nothing in its exterior appearance to suggest that it might prove unpleasant eating. Yet a single section of the leaf, when examined under the microscope, reveals numerous long spindle-shaped cells very different from the other cells of the leaf. They are filled with a mucilaginous substance and along the center of the cell lie the needle-shaped crystals of calcium oxalate in a neat bundle.

If water is applied and the behavior of the cell watched under the microscope the result is most surprising. The cell takes up the water rapidly and the resulting pressure forces out the crystals from one end. They pierce their way through,

one or two at a time, sometimes rushing out with such force as to make the whole cell rebound like a cannon that has



Cell *of Xanthosoma Lindeni*, in the act of discharging its crystals.

just been fired. Since the opening is small and the discharging of the needles is by no means continuous, the process

can be observed for some minutes. Now one or two needles will start out slowly, their movement barely visible; now the tension is released and they shoot out too rapidly for the eye to mark, followed by several more in quick succession; now there is a long period with no apparent movement and then the bombardment starts up anew. Thus the process continues until the cell is empty and the whole area about it is littered with tiny needles of calcium oxalate.

PRUNING OF ORNAMENTAL TREES AND SHRUBS

There is no branch of garden work which is less understood and yet more generally practiced than that of pruning. Trees and shrubs are pruned annually without any general thought in view except that pruning is essential to their well-being. This practice not only may sometimes lead to a gradual destruction of the plant, but, more particularly, to the entire loss of its individuality. The charm of ornamental trees and shrubs is largely dependent upon the habit and growth of the individual, and pruning is unnecessary if species are selected which are suited to the particular situation they are to occupy in the garden. Young trees and shrubs which have been planted close together to secure immediate effects become overcrowded in a few years, and pruning is often resorted to as a remedy, whereas a gradual thinning out and removal of plants is the proper procedure. It is essential to have a definite idea as to what is to be accomplished before attempting to prune any tree or shrub. No general rules can be formulated in regard to pruning, and only brief directions can be given in a limited article. More harm is done by indiscriminate pruning than by no pruning, hence do not prune if in doubt.

When woody plants are dug in the nursery a certain amount of fibrous roots is lost. A severe cutting back of the top and thinning out of the branches is then necessary in order to prevent the growth of foliage until enough roots have formed to supply sufficient moisture for the plant. Incidentally, the shaping of the plant may begin at this time,

by starting a leader in trees and by an uneven trimming of the tops of shrubs.

PRUNING OF TREES

Trees situated in mass plantations generally need very little pruning except the removal of dead limbs and crossed branches. The formation of bad crotches, due to development of two leaders, should be prevented by checking the growth of one. Side branches should also be shortened in some cases, for if too long they are in danger of being broken by wind and ice. In pruning trees on the lawn those branches under which persons walk or sit or those that obstruct a view should be removed. This pruning should be done gradually, however, particularly on small trees, for the removal of all the lower branches at one time would induce too heavy a growth at the top for the trunk to support in high winds. It is better to remove some of the lower branches in summer and shorten those which are to be cut later. In this way a large part of the strength of the tree goes to the top without increasing the size of the lower branches which are to be removed in a year or two. Trees growing on the borders of mass plantations or where they serve as a screen for unsightly objects or terminate a vista should be allowed to have their branches meet the ground. Trees which have become too large for a situation must necessarily be pruned, sometimes severely, and it often becomes a question whether it would not be better to remove such a tree and replace it by a smaller or slower-growing species.

It sometimes becomes necessary to remove large limbs which have been broken by wind or ice. To prevent splitting in such cases, a cut should first be made on the lower side of the limb a few inches from the stem of the tree, extending about half way through the limb. Then, by cutting at the proper place from above, the limb will break off, leaving a short stump which is afterward removed.

Unavoidable pruning of large trees necessitating the removal of heavy limbs should be entrusted to men who possess the essential knowledge and tools. This work always

entails a certain amount of danger, not only to the inexperienced pruner, but to passers-by, other trees, and adjoining property. Two men at least are needed, one to do the actual work in the tree, the other to direct the work from below and to pass up the required tools to the pruner. If ornamental trees are in a healthy condition they should need but little pruning aside from the removal of dead and diseased limbs, suckers, and other undesirable wood. This should be done systematically, however, without resorting to a heavy annual mutilation. Pollarding or severe heading-back of trees should be avoided, as it gives them an unnaturally bushy appearance.

The pruning of street and roadside trees does not differ materially from that of other trees except that they must have the lower branches removed gradually to prevent interference with traffic. All cuts should be made parallel to, and as close as possible to, the limb or trunk from which the branch is being removed. Under no circumstances must a stub be left, no matter how short, as it generally rots, leaving a hole in the center of the tree which may not heal. Stubs are always a menace to the life of the tree, because they form a most convenient and accessible point of entry into the wood for boring insects and fungus diseases. In some cases insects and diseases weaken the tree to such an extent that it is unable to resist the pressure of a heavy storm or a covering of sleet.

Conifers usually do not require much pruning. The removal of the lower branches greatly impairs the beauty of such trees, and every effort should be made to preserve their naturalness. Some conifers may be improved in appearance by cutting back the terminal branches, and thin plants can be made denser by this method. However, only part of the previous year's growth should be removed for this purpose, and sometimes the pinching out of the terminal bud, before growth starts in the spring, will be sufficient. Except for formal effects and for the shaping of young plants shearing should be avoided, the desired result being obtained without changing the individual character of the plant. By select-

ing species or varieties of evergreens, the natural growth of which is adapted to the particular site, pruning may be greatly reduced or entirely avoided.

Time for pruning of trees.—Large branches are best removed during winter, because pruning during the growing season lessens the leaf surface of the tree, thereby checking the growth. Dead branches may be cut out at any time. Small branches may be removed either in winter or any time during the growing season after the maturity of the leaves. Trees that are subject to bleeding in late winter or early spring should be pruned during the summer and autumn. Among such trees are maples (Acer), birches (Betula), mulberries (Morus), and the Japanese walnut (*Juglans Sieboldiana*). Pruning should never be practiced in extremely cold weather, because then the wood cracks easily and bad wounds may occur.

Dressing the wound.—All wounds made by pruning should receive a protective dressing to prevent the entry of water, insects, or fungi. This dressing should be applied as soon as possible after the cutting of the limb, making sure that the cut has been properly made and that the surface of the wound is clean cut, with no rough places which might tend to prevent the cambium from healing over. For small wounds the only treatment needed is a coat of waterproof shellac over the surface. Larger wounds should first be given a dressing of shellac, enough being applied to cover the cambium and part of the wood, thus preventing the sensitive cambium from drying out. The center of the wound should then be covered with a coat of paint, coal-tar, or creosote. Coal-tar or creosote are excellent dressings for wounds, but they sometimes burn the live cells at the edge of the cut, and should not be applied unless they can be kept from coming in contact with the cambium. Heavy lead paint makes a good dressing for wounds, and there are also a number of special dressings on the market which may be used to advantage. All wounds should be observed frequently and the dressing renewed if necessary.

PRUNING OF SHRUBS

In shrubs, as well as trees, the individuality or natural habit should be preserved except in formal plantations. Hence a uniform trimming down of tops and sides, as generally practiced, should be avoided. As a rule, the shrubs which bloom in spring and early summer should be pruned shortly after the fading of the flowers, because the flower buds are produced on the wood of last year and pruning in winter would greatly reduce the number of flowers. Shrubs blooming in summer or in autumn produce flower buds on the wood of the current season, and should be pruned while dormant in winter. Even with these, unless fewer and larger flowers are desired it is better to restrict pruning to the removal of unsightly flower clusters and to that which is necessary to keep them in good health and within bounds. Shrubs grown for the color effect of their twigs, which depends on the production of new wood, should either be cut to the ground every two or three years or a few of the branches be cut to the ground each year. The latter is preferred, because it keeps the shrubs in better condition, the top being maintained in vigor all the time. Among such shrubs are the golden, green, and red-twigged willow (Salix), the yellow, green, and red-branched dogwood (Cornus), and kerria (*Kerria japonica*).

The following list includes most of the shrubs generally grown in this section of the country which should be pruned in winter:

Amorpha canescens (lead-plant),
Amorpha fruticosa,
Improved by cutting back.

Baccharis halimifolia (groundsel-bush),
Remove old clusters in late winter or early spring.

Buddleia sp. (butterfly-bush),
Generally killed to the ground in winter; cut to or near the ground.

Ceanothus americanus (Jersey-tea),
Needs no special pruning.

Hamamelis virginiana (common witch-hazel),
Needs no special pruning.

Hibiscus syriacus (shrub althea),
If grown as a specimen on the lawn or trained in the form of a small tree, thin out weak branches and cut the remaining branches back one-half. This will reduce the number of flowers and increase their size.

Hydrangea arborescens (smooth hydrangea),
Hydrangea arborescens var. *grandiflora* (snowhill hydrangea),
Hydrangea paniculata (panicled hydrangea),
Hydrangea paniculata var. *grandiflora* (Peegee hydrangea),
Hydrangea radiata (silver-leaf hydrangea),
For fewer but very large panicles of flowers prune same as for Hibiscus. Generally benefited by annual cutting back.

Hypericum, woody species (St. John's-wort),
Require no special pruning.

Lonicera japonica var. *Halliana* (Hall's Japanese honeysuckle),
Lonicera sempervirens (trumpet honeysuckle),
No special pruning needed.

Lycium chinense (Chinese matrimony-vine),
Lycium halimifolium (common matrimony-vine),
L. chinense sometimes freezes back in winter; when this occurs cut back to live wood or to the ground.

Sambucus canadensis (common elder),
Prune to secure compact form, by pruning back too vigorous-growing branches.

Sorbaria sorbifolia (Ural false spiraea),
Prune same as for Spiraea.

Spiraea alba (meadow spiraea),
Spiraea Billardii (Billard's spiraea),
Spiraea Bumalda var. "Anthony Waterer" (Anthony Waterer spiraea),
Spiraea Douglasii (Douglas' spiraea),
Spiraea tomentosa (hardhack) and other late-blooming species,
Practice gradual renewal; thin out crowding stems and cut out unsightly fruit panicles.

Syringa japonica (Japanese tree lilac),
Requires no special pruning.

Most shrubs other than those above mentioned produce flowers on the previous year's wood, and, as stated above, should be pruned immediately after blooming.

The above directions apply particularly to shrubs grown chiefly for the effect of the flowers. Generally, however, a year-round effect is desired, and in such cases pruning should be practiced only for the purpose of securing the most pleasing and natural results. It should be resorted to only in order to keep the shrubs within bounds, removing some branches to prevent crowding and cutting back those which have become too long and straggling. This is particularly essential in certain species of mock-orange (Philadelphus) and golden-bell (Forsythia). The lilacs (Syringa) should not have all the suckers cut out at one time, since it makes the plant look bare at the bottom and also because some of the strongest branches will eventually be needed to take the place of old or dead ones. Some shrubs may be benefited by having their old flower clusters removed, syringas, lilacs, and some weigelias being examples. The practice of topping shrubs and cutting the lower branches away from the ground is bad, and should be discouraged. The latter is done, perhaps, more to accommodate the man who cuts the lawn than for any other reason.

Hedges may be either informal or formal. Informal hedges require just sufficient pruning to keep them shapely. Formal hedges should be trimmed as often as necessary during the growing season, but the practice should be discontinued late in August to give the wood a chance to ripen before winter, thereby preventing winter injury to the wood. Hedges of privet (*Ligustrum ovalifolium*) which have been injured by frost in winter should be cut down to the ground as should also hedges which have become bare at the base. This should be done before growth starts in the spring.

Pruning Tools.—The essential tools for pruning consist of pruning saw, pruning shears, and a curved-blade pruning knife. These tools should at all times be very sharp so as to make smooth, clean cuts, which will heal quickly. For extensive work, pole shears, rope, ladders, etc., will be required.

If trees and shrubs are kept in a healthy growing condition and proper care is given to cultivation, feeding, watering, and spraying, much less pruning will be required.

If trees and shrubs are naturally adapted to the soil and climatic conditions of the region in which they are growing less pruning will be needed.

If trees and shrubs are selected with a view to fitting a definite space or producing a certain effect much pruning will be avoided. Do not practice pruning if thinning out of plants will accomplish the desired result.

Leave no stubs, however short. Make clean smooth cuts and protect wounds with proper dressing until healed.

Do not forget that considerable judgment and knowledge of the purpose for which pruning is done is essential, and unless there is a clear picture in mind of the purpose to be accomplished do not prune.

NOTES

Dr. B. M. Duggar, Physiologist to the Garden, attended the meeting of the Board of Fellowships in the Biological Sciences, National Research Council, Washington, February 4-5.

Mr. Emmet J. Layton, second-year student in the School for Gardening, received a reward for his design of a small estate, in the Intercollegiate Competition in Landscape Architecture.

Mr. G. H. Pring, Horticulturist to the Garden, has been appointed a member of the committee on installation of the Eighth National Flower Show to be held in Detroit, March 12-20.

Mr. L. P. Jensen, Arboriculturist to the Garden, in charge of Gray Summit Extension, has been appointed chairman of the committee of horticulture of the American Institute of Park Executives for 1927.

Dr. B. M. Duggar, Physiologist to the Garden, spoke before the seminar of the department of botany, University of Cincinnati, on "Some Experimental Aspects of the Mosaic Disease Problem."

Dr. Hermann von Schrenk, Pathologist to the Garden, spoke before the Home Garden Club of Webster Groves, February 2, on "Trees of the Pacific Coast," and before the Kirkwood Garden Club, February 14, on "Trees."

Mr. L. P. Jensen, Arboriculturist to the Garden, in charge of Gray Summit Extension, is the author of an article in the February number of the "Gardener's Chronicle of America," on "Fascinating Old Books on Gardening"; and of one in the January-February issue of "Parks and Recreation" on "Useful and Interesting Publications."

In a communication recently received from Professor Borza, of Cluj, Roumania, who visited the Garden last October, he states: "Last month I gave a public lecture, with pictures, about your very fine and rich Botanical Garden to the Botanical Club of Cluj. The 30th of January I will speak about the same subject to the Society of American Naturalists at Bucharest."

The Washington University Chapter of Sigma Xi met at the Garden, January 13, and a brief talk on "Some Aspects of the Graduate Work in the Shaw School of Botany, with a Demonstration and Discussion of Certain Topics in Plant Physiology, Mycology, and Genetics," was given by members of the Garden staff and graduate students.

Among the recent visitors to the Garden were Dr. George J. Peirce, Head of the Department of Botany, Stanford University; Mr. D. D. Wood, Conservator of Forests for the government of British North Borneo, with headquarters at Sandakan; Mr. G. L. Wittroch, Instructor in Botany, Grinnell College, Grinnell, Iowa; Mr. W. W. Ashe, Secretary of the National Forest Reserve Committee, Washington, D. C.; Professor B. C. Tharp, Professor of Botany, University of Texas, Austin, Texas; and Dr. John B. May, Assistant Ornithologist, Department of Conservation and Natural Resources, State of Massachusetts.

The following lectures have been given recently by Mr. G. H. Pring, Horticulturist to the Garden: January 5, illustrated talk on "Smoke" before the St. Louis Association

of Gardeners; "Collecting Orchids in the Andes Mountains," January 13, before the Elks Club of Belleville, Illinois; January 14, before the Narcissus Club at its meeting in the lecture room at the Missouri Botanical Garden; February 2, at Michigan Agricultural College, East Lansing, Michigan; February 8, before the Principia School, St. Louis; February 10, "Smoke," before the Disabled American Veterans, at their Club, 3737 West Pine Blvd.

STATISTICAL INFORMATION FOR JANUARY, 1927

GARDEN ATTENDANCE:	
Total number of visitors	9,396
PLANT ACCESSIONS:	
Total number of plants and seed packets received as gifts	11
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	33
Total number of books and pamphlets donated	76
HERBARIUM ACCESSIONS:	
By Gift—	
Bechtel, A. R.—Fungi of Indiana	8
Hesler, L. R.—Fungi of Tennessee	33
Kellogg, J. H.—Mosses, hepatics, and lichens of Missouri	14
Litton, Alice W.—Collection of ferns	24
Matthews, E. O.—Fungi of Arizona	13
Ruth, Albert—*Mozinna sessiliflora* (Hook.) Small from Texas	1
Teas, Edward—Plants of Texas	3
Woodson, Robert E., Jr.—*Polytrichum ohioense* from Missouri	1
By Exchange—	
Institut Botanique de l'Universitè Masaryk de Brno, Moravia—"Flora exsiccata Reipublicae Bohemicae Slovenicae," Cent. I and II, Nos. 1-200	200
Royal Botanic Gardens, Kew, England—Photographs of type specimens	6
University of California—Plants of California	125

By Purchase—

Broadway, W. E.—Wood specimens of plants of Trinidad	59
Dutton, D. Lewis—Plants of Connecticut	100
Grant, J. M.—Fungi of America, Europe, Japan, etc.	700
Wilson, Percy—Fungi of the eastern United States	1,000
Total	2,287

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and, while virtually a private garden, it was, except at certain stated times, always open to the public. By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the 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 of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises about 75 acres. There is now in process of development a tract of land of over 1500 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees, and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a forest reservation, with the idea that possibly at some future time this may become the new botanical garden. About 12,000 species of plants are growing in the Garden.

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset; from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines. The Garden may also be reached by Bus Route No. 12, to which all other motorbus lines transfer.

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Missouri Botanical Garden Bulletin

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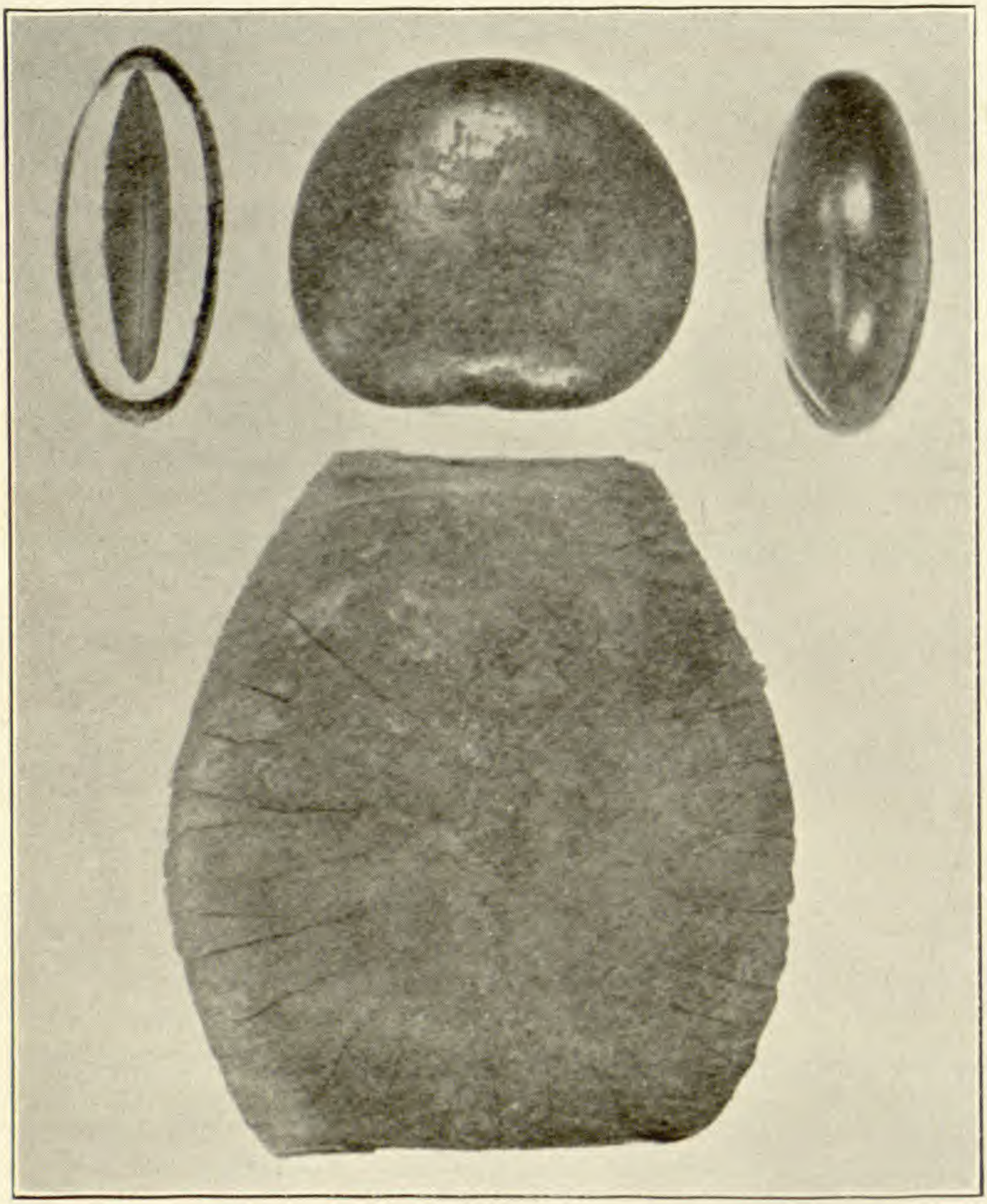


SNUFF-BOX BEAN (LENS PHASEOLOIDES)
(From Safford's "Useful Plants of Guam")

Missouri Botanical
Garden Bulletin

Vol. XV MARCH, 1927 No. 3

SNUFF-BOX BEANS AND THE DISCOVERY OF THE GULF STREAM

The study of plants sometimes leads to unexpected discoveries. Though it might be too much to claim that it was the study of an apple which led Newton to the Law of Gravitation, it is actually true that certain floating seeds first caused men to suspect the existence of the Gulf Stream. *Lens phaseoloides* Stickman, the so-called snuff-box sea bean, is only one of several tropical plants whose buoyant seeds are carried about by ocean currents. As early as 1693 we find one James Wallace giving an account of them in his description of the Orkney Islands. "Cast up on the Shoar there are very oft those pretty Nutts, of which they use to make snuff boxes."

Samples of the seeds were sent to Dr. Hans Sloane, and he recognized them as the seed of plants which he had seen growing very commonly along the coast of Jamaica. Why they should be so often found in the Orkneys and along the Irish coast seemed, he said, "very hard to determine." His only suggestion was that by the current which was already known to exist between Florida and the West Indies, they might perhaps be carried all the way across the ocean. "It is easy," he said, "to conceive that, growing in the woods of Jamaica they may find their way into the sea. It is likewise easy to believe, that being got to sea, and floating in it in the neighborhood of that island, they may be carried from thence by the wind and current, which is forced through the gulf of Florida. But how they should come the rest of the way, I cannot tell, unless it be thought reasonable that by

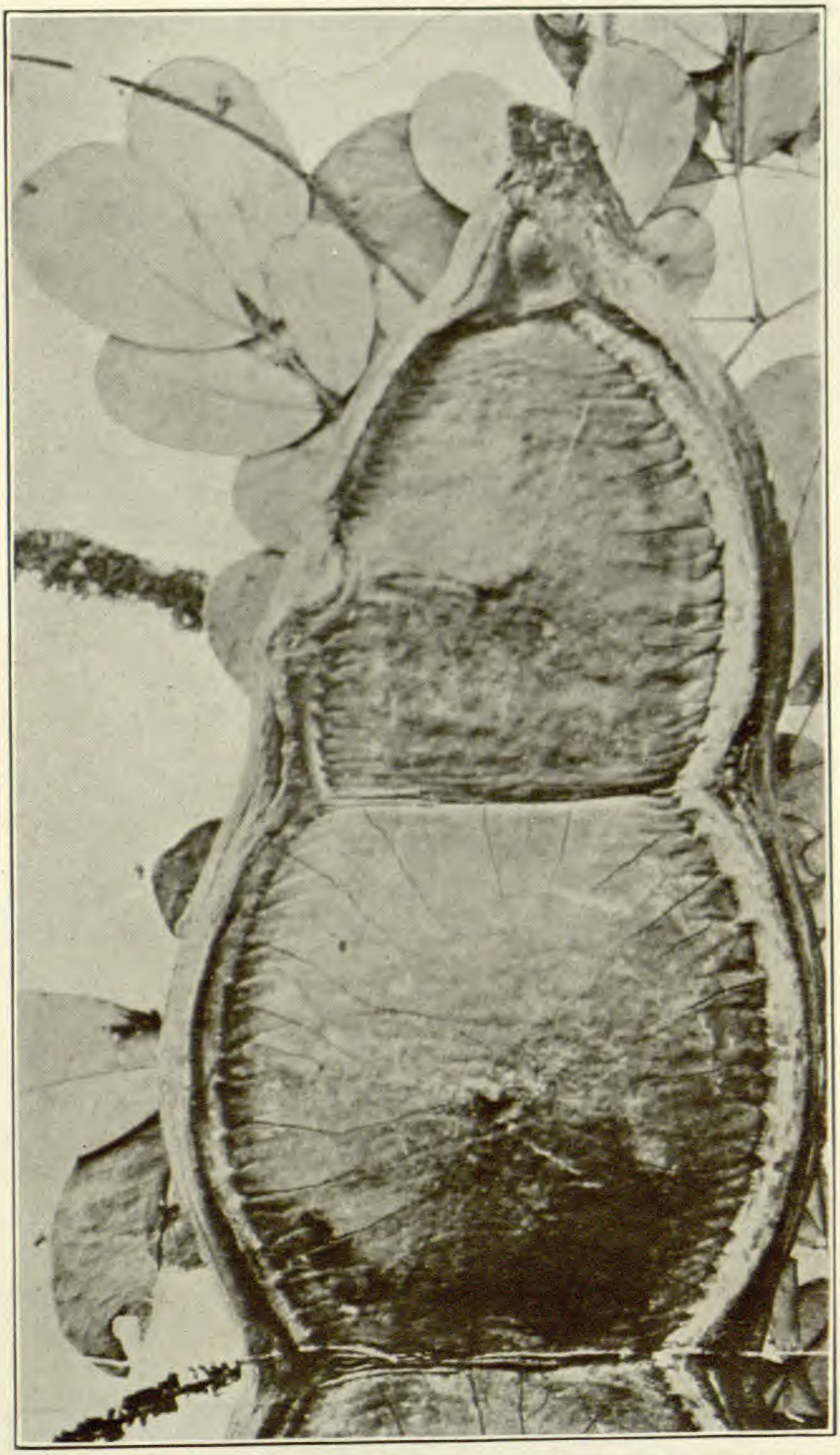
means of the westerly wind, the beans being brought north by the current from the gulf, they may be supposed by this means at last to arrive in Scotland. If there be such a current," he concluded, we can conceive how "the winds and current brought from America those several things towards the Azores, which are recorded by Fernand. Columb. in the life of his father Christopher, to be the reasons which moved the said Christopher Columbus to attempt the discovery of the West Indies."

It might then be argued that the study of these beans is not only responsible for the discovery of the Gulf Current but of America as well, since they very probably must have been among the objects brought to the attention of Columbus. They are very commonly found on the Azores to-day though the species has never established itself there. Darwin collected them there in considerable quantities and sent them to Kew where they germinated readily after their long journeyings.

THE DISCOVERY OF THE SOUTHERN YELLOW WOOD

Among our most interesting native trees is the southern yellow wood (*Cladrastis lutea* (Mich. f.) Koch). The Garden is the fortunate possessor of several specimens, and one of these, a particular favorite of Mr. Shaw's, was described in the Garden BULLETIN for February, 1923. The species was discovered by André Michaux and later described for the first time by his son, Francois André Michaux. The tree has such interesting qualities and the details of the discovery are so precisely and so quaintly described in the journals of the two men that an exact account may be of general interest.

On the first of March, 1796, André Michaux, travelling on horseback, arrived at Fort Blount in northern Tennessee. This fort, erected shortly before to protect the settlers against



SEED-POD AND BRANCH OF LENS PHASEOLOIDES
(From Safford's "Useful Plants of Guam")

FRANCOIS ANDRE MICHAUX
(Oil portrait painted for Mr. Shaw at the Missouri Botanical Garden)

the Cherokee Indians, was situated on the north bank of the Cumberland River near the present town of Gainesboro. For the second of March we find the following entry in his journal: "The 2nd remained over in order to pull young shoots of a new Sophora I had remarked in the vicinity of Flynn's Creek about 12 miles from the fort. Snow covered the ground and I was unable to get any young shoots but Captain Williams the young officer stationed in the fort, cut down some trees and I found some good sorts. I also pulled up some roots of those trees to replant them in my garden in Carolina."

Six years later, in 1802, young Francois André was travelling through the same general region. His father had died, the victim of tropical fever, on the island of Madagascar, and he was continuing his father's work in this country. At Nashville, Tennessee, we find him writing as follows in his "Travels to the Westward of the Allegany Mountains":

"We found particularly in these forests, a tree which, by the shape of its fruits and the disposition of its leaves, appears to have great affinity with the *sophora japonica*, the wood of which is used by the Chinese for dyeing yellow. My father, who discovered this tree in 1796, thought that it might be employed for the same use, and become an important object of traffic for the country. He imparted his conjectures to Mr. Blount, then governor of this state, and his letter was inserted in the Gazette at Knoxville on the 15th of March, 1796. Several persons in the country having a great desire to know whether it were possible to fix the beautiful yellow which the wood of this tree communicated to the water by the simple cold infusion, I profited by my stay at Nasheville to send twenty pounds of it to New York, the half of which was remitted to Dr. Mitchell, professor of chemistry, and the other addressed to Paris, to the Board of Agriculture attached to the Minister of the Interior, in order to verify the degree of utility that might be derived from it. The epoch of my stay at Nasheville being that when the seeds of this tree were ripe, I gathered a small quantity of them, which I brought over with me, and which have all come up.

Several of the plants are at the present moment ten or fifteen inches high. It is very probable that this tree may be reared in France, and that it will endure the cold of our winters."

TWO BOTANISTS OF FRONTIER DAYS

The last one hundred years have seen the complete reversal of the position of St. Louis in regard to botanical exploration. It is now one of the scientific centers of the world, from which are organized expeditions to visit the remote corners of the earth. Within the last ten years two such expeditions have been sent out by the Missouri Botanical Garden, one to South America in search of orchids, another to study the flora of Central America. A century ago, on the other hand, St. Louis was itself a part of that wilderness to which came distinguished botanical travellers of the educated world.

Of the several scientists who visited the territory between the Mississippi and the Atlantic, the most outstanding from a botanical point of view were André Michaux and his son, Francois André Michaux. These two Frenchmen were among the best-trained botanists of their day, and they travelled and collected more extensively in this country than any other scientists of their time. Officially commissioned by France, they had at their command resources denied to many another early scientific visitor, and their social prominence and official connections brought them into contact with the leading Americans of the day. Both were interested in the economic aspects of botany, the younger Michaux particularly so, and both were responsible for the introduction of American trees into Europe on a scale never before attempted.

André Michaux was born near Versailles, France, in 1746, the son of a middle-class farmer who died when the boy was in his early teens. The young man took over his father's work, married well, and was apparently settled for life. But when his young wife died in giving birth to a son, he was led to seek distraction in more adventurous fields. Encouraged

by a local horticulturist, he decided to prepare himself for the career of a plant explorer and set energetically to work, studying natural history and languages. Fortunately for Botany he made the acquaintance of Bernard de Jussieu, one of the greatest botanists of the time, who happened to be just then in charge of the royal gardens at the near-by Trianon. Michaux studied under him at Paris and later accompanied the great Lamarck on a collecting trip to the mountains of Auvergne.

In 1782 he set out on his first expedition, making a three-year's visit to Persia and the region between India and the Caspian Sea. In spite of adventures which read like those of Sinbad the Sailor, he not only came back alive but brought with him a large collection of seeds and a valuable herbarium. He had intended to return to Persia for even more ambitious exploration, but the French government, with the purpose of introducing into France such American trees as might be useful to the royal navy, sent him to this country instead. He arrived in New York in 1785, bringing with him a French gardener and his young son, Francois André, then a boy of 15.

For nearly two years, New York City was used as a base from which to make short collecting trips into neighboring regions. The journals which cover his activities during these years have been lost, but the following extracts from Washington's diary show that Michaux visited at Mt. Vernon and that he sent Washington specimens from time to time:

"Monday, June 19, 1786.

A Monsr. André Michaux, a Botanist sent by the Court of France to America (after having been only 6 weeks returned from India) came in a little before dinner with letters of introduction and recommendation from the Duke de Lauzen and Marqs. de la Fayette to me—he dined and returned afterwards to Alexandria, on his way to New York, from whence he had come; and where he was about to establish a Botanical Garden.

"Thursday, June 29.

Planted in one row between the Cheroke Plumb and the

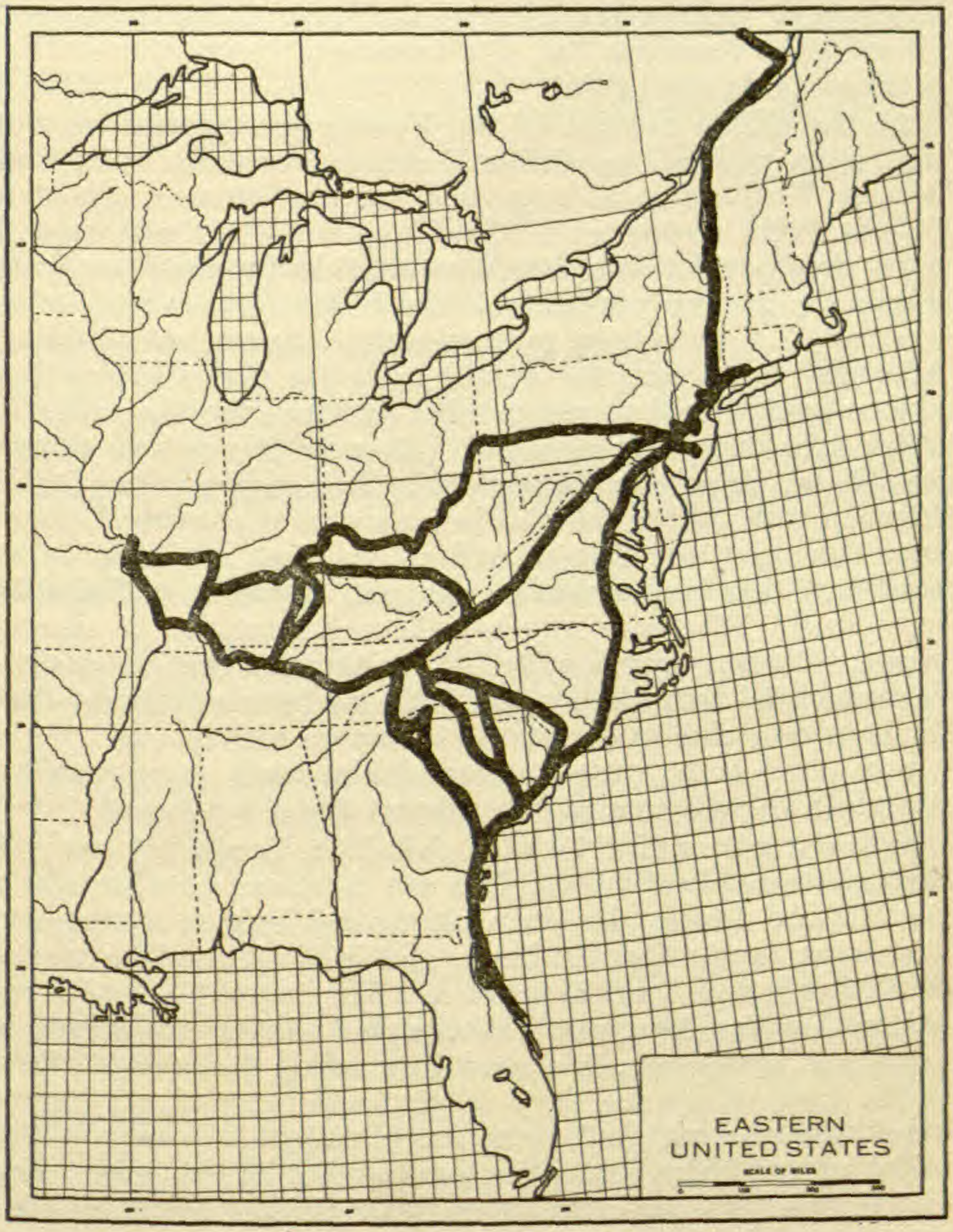
honey locust, back of the No. — Garden adjoining the green House (where the Spanish Chestnuts had been placed and were rotten) 25 of the Paliurus, very good to make hedges and inclosures for fields—Also in the sections between the Work House and Salt House, adjoining the Pride of China plants, and between the rows in which the Carolina laurel seeds have been sowed, 46 of the Pistacia nut in 3 rows—And in the places where the Hemlock Pines had been planted and were dead, Et. & Wt. of the Garden gates, the seeds of the Piramidical Cyprus 75 in number—all of which with others were presented to me by Mr. Michaux, Botanist, to his Most Christian Majesty.

"July 1st.

Plant 4 of the Ramnus tree (an evergreen) one on each side of the Garden gates—a peg with 2 notches drove down by them (Pegs No. 1 being by the Pyramidical Cyprus)—also planted 24 of the Philirea latifolio—(an evergreen shrub) in the shrubberies by Pegs No. 3—and 48 of the Cytire —a tree produced in a cold climate of quick growth, by pegs No. —. All these plants were given to me by Mr. Michaux."

In 1787 he moved his base of operations to Charleston, South Carolina, establishing there a botanical garden in which he kept plants and seeds under the best possible conditions until they could be sent to Europe. Though the old place has changed hands many times since his day and the house has fallen in ruins, many of the trees planted by Michaux were still standing, until very recently at least. These included a number of American trees not native to the immediate district and several foreign species. Conspicuous among these latter was the beautiful *Albizzia Julibrissin* Durazzini, or "pink acacia" which, succeeding well when introduced by Michaux, has been very commonly planted through the south. It is often seen there to-day in parks and dooryards and has become naturalized in several localities.

For the remaining nine years of his stay, Michaux travelled very extensively, returning from time to time to his garden at Charleston. As shown in the accompanying map he ranged very widely, from central Florida to the Hudson's



MAP OF EASTERN UNITED STATES, SHOWING THE MAIN ROUTES TAKEN BY THE ELDER MICHAUX

Bay country and from the Atlantic coast to the banks of the Mississippi. Altogether he travelled over 3,000 miles and visited some localities (as, for instance, the southern Alleghenies) again and again.

As the official servant of the French government he was sent upon political as well as botanical errands. His first trip to Kentucky was organized by the French minister, Genet. "The discontent of the Western settlers with regard to the free navigation of the Mississippi had reached an acute stage; the French minister to the United States had come armed with instructions to secure the cooperation of trans-Allegheny Americans for a raid upon the Spanish territory of Louisiana, aimed to recover that province for the power to which it had formerly belonged." Because he was "an ardent republican, already in the pay of the French government, and friendly with influential men in government circles, Michaux seemed a most desirable as well as the most available agent possible. One characteristic was not, however, sufficiently considered. Whatever may have been his interest in the intrigue, whatever accounts thereof are through caution or prudence omitted from the journal * * , one fact is evident—that Michaux was chiefly devoted to the cause of science; * * * * a rare plant or new tree interested him much more than an American general or a plot to subvert Spanish tyranny."

It is not known that he ever visited St. Louis, but some of the specimens described by him are listed as growing along the Missouri River. He did visit the old French settlements near what is now East St. Louis, and in his journal he speaks of St. Louis as a flourishing town. This journal, recently reprinted by the American Philosophical Society, to whom it was given by his son, is a most interesting document. "Michaux wrote it by the light of his lonely campfires, during brief moments snatched from short hours of repose, in the midst of hardships and often surrounded by dangers. The character of the man appears in this record of his daily life; the journal is something more than a mere diary of travel and botanical discovery. The information which it contains in regard to various plants first detected by Michaux is valu-

able even now, and his remarks upon the condition of the remote settlements which he visited in the course of his wanderings are interesting and often amusing. They record the impressions of a man of unusual intelligence—a traveller in many lands, who has learned by long practice to use his eyes to good advantage and to write down only what they saw."

In his journal he notes with meticulous care the names of those with whom he lodged or visited. Among others we find short mention of one middle-westerner who was later to become president of the United States. "June 15th came to the house of a resident near Cumber land River, Mr. Jackson; soil fertile. Oaks Quercus prinus; Quercus rubra; Quercus glandibu magnis; capsula includentibus, called the Overcup White Oak." This species (usually called Bur Oak) was later described by him as *Quercus macrocarpa,* and is here mentioned for the first time in his notes.

Of particular interest are the notes of his trip from Vincennes, across the Illinois prairies, to the banks of the Mississippi.

"Sunday 23rd of August 1795 started from Post Vincennes situated on the Wabash River for the Illinois on the Mississippi. We journeyed six miles and camped on the bank of a little river. I had no other company than a Savage and his wife. I had hired the savage for ten dollars and promised him two dollars more to induce him to carry all my baggage on his horse. The 24th we made about 25 miles; the savage was ill and was obliged to stop more than three hours before sunset. The 25th crossed several Prairies. Observed a new species of Gerardia. The 26th the provision of meat was consumed. The savage stopped very early, finding a favorable spot for hunting. Rain fell about three o'clock in the afternoon. An hour after camping the savage came back laden with a bear cub and with the two hams of another and much older one. We boiled the kettle twice and had enough to satisfy us. We roasted what remained. The 27th the savage killed two stags. We halted very early to dry the skins and to eat, for the savage and his wife ate five meals a day. The 28th of August, 1795. Just as I was eager to see game the

first and 2nd day, so was I afraid to see it then owing to the waste of time. I was all the more anxious to proceed that it rained every day. I had already been obliged once to dry at a fire my baggage that had been wet through especially four books of Botany and minerology I had with me, as I had been unwilling to expose them to the hazards of the river and had sent by way of the Mississippi two trunks containing gray paper, powder, lead, alum, boxes for collecting insects, and all the articles required for making collections of plants, animals, insects, and minerals.

"Sunday 30th of August arrived at the village of Kaskaskia situated two miles from the Mississippi river and half a mile from the Kaskaskia River. It is inhabited by former Frenchmen under the American Government. The number of families is about forty-five. It is agreeably situated but the number of inhabitants has decreased; nothing is to be seen but houses in ruins and abandoned because the French of the Illinois country, having always been brought up in and accustomed to the fur trade with the savages, have become the laziest and most ignorant of men. They live and the majority of them are clothed, in the manner of the savages. They wear no breeches but pass between their thighs a piece of cloth of about one-third of an ell in length, which is kept in place before and behind by a belt above the hips.

"The 31st of August herborized."

While Michaux was in this country great changes had been taking place in France, and during the last seven years of his stay he received no funds from the home government. When at length his own personal resources were exhausted, it became necessary for him to return home, and he accordingly sailed for France in 1796. One of his biographers has told us how he very nearly lost his life by shipwreck:

"The passage had not been unpropitious; but on the 18th of September, when in sight of the shores of Holland, a dreadful tempest arose, the sails were rent, the masts broken, and the vessel struck and split against the rocks. Such was the state of exhaustion and fatigue to which all the sailors and passengers were reduced, that the greater number would have

been lost, but for the assistance that was rendered by the inhabitants of Egmond, a little neighboring village. Michaux was lashed to one of the yards, and he was senseless when carried on shore; he did not recover till some hours after, when he found himself extended before a fire, with more than fifty persons standing around him. His first idea, when his recollections returned, was to inquire for his collections. He was informed that the packages which contained his own effects had been lying on deck, whence they were washed by the violence of the waves, but that those chests which had been lodged in the hold had been taken out safely. This intelligence consoled him. Notwithstanding the wretched state of his health Michaux was compelled to remain six weeks at Egmond, and to work day and night. His plants having got wetted by the salt water, he was obliged to immerse them all in fresh water and one after another, to dry them between new papers."

At Paris he prepared for the press his book on American oaks, "Histoire des Chenes de l'Amerique" and tried in vain to interest the government in further American exploration. They sent him, instead, on an expedition to the southern hemisphere, and he died of fever on the island of Madagascar, in November, 1802.

By his steadfast perseverance in the face of all sorts of obstacles; storm, shipwreck, hostile savages, political revolution, public indifference, we are strongly reminded of the words of Saint Paul: "Thrice I suffered shipwreck, a night and a day I have been in the deep; in journeyings often, in perils of waters, in perils of robbers, in perils by mine own countrymen, in perils by the heathen, in perils in the wilderness, in perils in the sea. In weariness and painfulness, in watchings often, in hunger and thirst, in fastings often." One of our leading American botanists has summarized his work as follows: "Not one among the self-sacrificing explorers and collectors of the plants of this continent better deserves the gratitude and appreciation of the world of science. No one of them has ever seen more clearly, or has endured more willingly the perils and hardships of the frontier and the wil-

derness. His eye always detected the rarest and most interesting plants—the ambition and long the despair of the plant-hunters who have now for a century been following in his footsteps.''

Fortunate is the father who has a son to carry on his work after him. Francois André Michaux had worked with his father in this country, remaining at the Charleston garden when his father undertook his longer expeditions, accompanying him on shorter trips to Florida and to the mountains of the Carolinas. He was sent back to France to finish his education and arrived at the outbreak of the revolution, with which, as an ardent republican, he was in hearty sympathy.

After his father's death he came back to America to forward such plants as still remained in the French nurseries and to sell the land. With these affairs attended to, he set out on a collecting trip to Kentucky and Tennessee. His journal of that trip realistically pictures the difficulties of middle-western travel in the early years of the nineteenth century. In June, 1802, we find him writing from Dover, Pennsylvania: ''The stage stopped at the house of one M. Logan, who keeps a miserable inn fifteen miles from York. Inns are very numerous in the United States, and especially in the little towns; yet almost everywhere they are very bad. There are always several beds in the rooms where you sleep; seldom do you meet with clean sheets. Fortunate is the traveller who arrives on the day they happen to be changed.'' A few days later we find him making the following shrewd observation: ''The *magnolia acuminata* is very common in the environs; it is known in the country by the name of cucumber tree. The inhabitants of the remote parts of Pennsylvania, Virginia, and even the western countries, pick the cones when green to infuse in whisky to which it gives a pleasant bitter. This is very much esteemed as a preventative against fevers; but I have my doubts whether it would be so generally used if it had the same qualities when mixed with water.''

Over much of the distance he had to furnish his own transportation, going by foot or on horseback or by canoe.

His journal of the trip from Wheeling, West Virginia, to Marietta, Ohio, is particularly interesting. The following account follows the original but has been very much abridged:

On the 18th of July we purchased a canoe, twenty-four feet long, eighteen inches wide, and about as many in depth. These canoes are always made with a single trunk of a tree, the pine and tulip tree are preferred for that purpose, the wood being very soft. These canoes are too narrow to use well with oars, and in shallow water are generally forced along either with a paddle or staff. We left Wheeling about five and made twelve miles that evening. We were exceedingly fatigued, not so much by continually paddling as by remaining constantly seated with our legs extended. Our canoe being very narrow at bottom, obliged us to keep that position; the least motion would have exposed us to being overset. Custom made these inconveniences disappear, however, and we attained the art of travelling comfortably.

We met a *settler*, an inhabitant of Wheeling, who accompanied us down the Ohio for two days. Alone in a canoe, he was going to survey the borders of the Missouri for a hundred and fifty miles beyond its *embrochure*. The excellent quality of land that is reckoned to be more fertile there than that on the borders of the Ohio, and which the Spanish government at that time ordered to be distributed gratis, the quantity of beavers, elks, and more especially bisons, were the motives that induced him to emigrate. His costume, like that of all the American sportsmen, consisted of a waistcoat with sleeves, a pair of pantaloons, and a large red and yellow worsted sash. A carabine, a tomahawk, two beaver snares, and a large knife suspended at his side, completed his dress. A rug constituted the whole of his luggage. Every evening he encamped on the banks of the river. Whenever he conceived the place favorable for the chace, he remained in the woods for several days together. Such were the first inhabitants of Kentucky and Tennessee of whom there are now but very few remaining.

Returning to France in 1803, Michaux bent his energies to hasten the publication of his father's works, the mono-

graph on oaks before mentioned, and the "Flora Boreali-Americana". This latter was the first flora of North America and was finished under the supervision of the French botanist, Claude Richard.

Three years later Michaux returned again to America, this time to import American trees on a large scale and to study the uses and value of their timbers. Visiting dock-yards and factories, he "ascertained the sources of the different barks employed in tanning, inquiring into the quality and price of the various woods used for fuel, and formed a complete collection of polished specimens of the species employed in cabinet work or otherwise." His travels, while not as extensive as those of his father, took him from the rivers of Maine to the Gulf states and as far west as Lake Ontario and Lake Erie. It was on his return from these latter regions that he had the honor of being Fulton's first passenger on his trial trip from Albany. The friendship thus formed continued through life, and Michaux was responsible for having a bust of Fulton placed in the galleries of the Louvre.

After three years in this country, Michaux returned again to France and shortly afterward brought out his "Histoire des Arbres Forestiers de l'Amerique du Nord," which was later published in an English edition as the "North American Sylva." It was an epoch-making book. Michaux himself, in a letter to the president of the American Philosophical Society, pointed out the distinctive characteristics of his own work: "The science of botany was the principal object of my father's explorations in North America, and the Flora Boreali Americana was the result of those explorations. As for me, I took another view of the vegetable kingdom, whilst in your country—a view more limited and less scientific, it is true, but, perhaps more generally profitable to the farmer and landholder, as well as to that class of society so numerous in the northern states of the Union, who employ wood in so many different ways."

A few quotations will serve to show the sort of information which, collected laboriously bit by bit, was here brought together for each species. In discussing the common bear

oak or scrub oak of New England (*Quercus ilicifolia* Wang.), he says: "As the Bear Oak grows on the most sterile soils, and resists the most intense cold and the most impetuous winds, perhaps it might serve to shelter the infancy of other more valuable trees in such exposures. The want of some such protection is the greatest obstacle to the success of plantations on the downs, as I was told near the Hague upon the coast of Holland. Proprietors of large estates might find this species convenient for copses. They would offer nourishment to the game during several months in the year, and would allow the sportsman a fair aim at the birds as they rose upon the wing."

The description of the black or sweet birch (*Betula lenta* L.) is followed by these typical comments: "The wood of the black birch when freshly cut is of a rosy hue which deepens by exposure to the light. Its grain is fine and close, whence it is susceptible of a brilliant polish; it possesses also a considerable share of strength. The union of these properties renders it superior to the other species of American Birch. Tables and bedsteads of this wood, when carefully preserved, acquire with time the appearance of Mahogany, hence it is employed in Boston for the frames of arm chairs and sofas. Coachmakers also use it for the frames of their panels."

For the remainder of his life Michaux lived quietly in France, experimenting with his beloved trees on his own estate and on those of others. At his Paris home, on the Place Saint Michel, he delighted to receive visiting Americans, particularly those who could give him news of the developing Ohio Valley, down which he had travelled by canoe in his young manhood and whose great industrial future he had predicted.

One American botanist who visited him there has described him as escorting his guests before breakfast through the fruit and vegetable market which was then held in the Place Saint Michel and pointing out the rarest and most unusual fruits and vegetables. In person, we are told he was "tall, strongly built, but not corpulent. His complexion

was fair, he was slightly pock-marked and possessed prominent features. His light blue eyes had a peculiar expression which startled me at first. His countenance was stern and cold on first approach; but it smoothed off and brightened gradually as he spoke and became more familiar; his utterance, in the beginning somewhat slow and cautious, became rapid and impressive, and his conversation gay and even humorous. All his manners were quite simple and unaffected; frank and lively—they were altogether those of an open-hearted country gentleman."

He died suddenly, on the 23rd of October, 1855, at the age of 85. He had busied himself the whole day, directing the planting of some American trees. Going to bed in apparent health, he had a sudden stroke of apoplexy in the middle of the night and died almost immediately. After his death it was found that he had bequeathed 14,000 dollars to the American Philosophical Society and 8,000 dollars to the Society of Agriculture and Arts of Boston, for the promotion of what had been his life-long interest, the propagation of useful forest trees.

NOTES

Dr. B. M. Duggar, Physiologist to the Garden, lectured before the Washington University Association, March 1, on "The Significance of Certain Ultra-Microscopic Virus Studies in Relation to the Origin of Life."

The March number of the Bulletin of the American Iris Society contains an article by Dr. Edgar Anderson, Geneticist to the Garden, on "*Iris Versicolor* in Northern Ontario."

Mr. George H. Pring, Horticulturist to the Garden, spoke on March 9 over Radio Station NBA from Balboa, C. Z., discussing the orchid collection at the Missouri Botanical Garden and its relation to the tropical station at Balboa.

Mr. Paul A. Kohl, Floriculturist to the Garden, spoke before the Carondelet Improvement Association, March 8, on "Plants, Shrubbery, Trees, Care of Yards, etc."; and before

the Garden Club of St. Louis, March 15, on "Plant Propagation."

Mr. George H. Pring, Horticulturist to the Garden, left for the Missouri Botanical Garden Tropical Station, at Balboa, Canal Zone, on February 18, with the intention of making a trip into the Chiriqui Province of Panama to collect orchids.

Recent visitors to the Garden include Dr. Winifred J. Robinson, Dean of the Woman's College of Delaware, Newark, Delaware; Mr. E. Mortensen, of Uvalde, Texas, who is connected with the Australian Prickly Pear Commission; and Professor D. C. Neal, Professor of Plant Pathology, Mississippi Agricultural College.

The following talks have been given recently by Dr. George T. Moore, Director of the Garden: March 16, before the science section of the Wednesday Club, "Some of the Experimental Work Conducted at the Missouri Botanical Garden"; March 24, before the Women's Round Table Club, at the Coronado Hotel, "Sensations in Plants"; March 31, before the Garden Department of the Springfield Art Association, Springfield, Illinois, "The Evolution of Gardens."

The fourth number of Volume XIII of the Annals of the Missouri Botanical Garden has recently been issued with the following contents:

"The Identification of Pollen from So-Called 'Hay-fever' Plants." George T. Moore and Roland V. L. La Garde.

"Determination of Total Nitrogen, Nitrate Nitrogen, and Total Nitrogen not Including Nitrate-Nitrogen: Further Observations on a Modification of the Official Salicylic-Thiosulphate Method." Emery R. Ranker.

"Some Cytological and Physiological Studies of Mosaic Diseases and Leaf Variegations." Fanny Fern Smith.

STATISTICAL INFORMATION FOR FEBRUARY, 1927

GARDEN ATTENDANCE:

Total number of visitors 21,472

PLANT ACCESSIONS:

Total number of plants and seed packets received as gifts 158

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	106
Total number of books and pamphlets donated	227

HERBARIUM ACCESSIONS:

By Gift—

Chrysler, Prof. M. A.—*Microcycas calocoma* A. DC. from Cuba	3
Dixon, Royal A.—*Pyrus arbutifolia* (L.) L. f. from Florida	1
Ledman, O. S.—*Ephedra trifurca* Torr. from Arizona..	1
Wagner, D. D.—Fungi of New York.....	35
Woodson, Robert E., Jr.—Plants of eastern United States, collected chiefly by R. E. Woodson, Jr., Mildred Mathias, Doris Bausch, and Martha Beardsley	623

By Exchange—

Botanical Museum, Stockholm, by Prof. G. Samuelsson—Plants of Sweden.....	200
Epling, Dr. C. C.—Plants of Idaho	261
Epling, Dr. C. C.—Plants of Mexico	54

By Purchase—

Merrill, G. K.—"Lichenes Exsiccati" Fascicle V, Nos. 101-125, inclusive	25
Seymour, Frank C.—Flora of Hampden County, Massachusetts, Fascicle V, Nos. 516-615, inclusive.....	100

By Field Work—

Chase, Mrs. Agnes—Grasses of Brazil.....	350
Total	1,653

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and, while virtually a private garden, it was, except at certain stated times, always open to the public. By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the 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 of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises about 75 acres. There is now in process of development a tract of land of over 1,500 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a forest reservation, with the idea that possibly at some future time this may become the new botanical garden. About 12,000 species of plants are growing in the Garden.

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day and Christmas—week days from 8:00 a. m. until one-half hour after sunset; Sundays from December to April, 1:00 p. m. until sunset; from April to December, 2:00 p. m. until sunset.

The main entrance to the Garden is located at Tower Grove avenue and Flora boulevard, on the Vandeventer avenue car line. Transfer south from all intersecting lines. The Garden may also be reached by Bus Route No. 12, to which all other motorbus lines transfer.

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Missouri Botanical
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TAGS AS GUIDES IN THE DESERT HOUSE

It is an almost daily occurrence for a visitor to the Garden to say, on leaving, that a new world has been opened up to him during his short stay. Many make the additional comment that had they been less ignorant about the plants on display, their visit would have been still more enjoyable. It is with the needs of such people in mind that a new way of showing people through the Garden is being tried out in the desert house. Some forty or fifty plants have been labelled with linen baggage tags, written with India ink. These are designed to take the place of a guide, supposedly more versed in natural history than yourself, who is showing you through the Garden and calling your attention to certain interesting points.

These tags are not to be thought of as ordinary labels; far from it. Labels are usually dull, at best they are dry and formal; while the tags attempt to reproduce the sprightly tone of natural conversation. Written as they are on a temporary tag, they may say things in a way that would not be fitting for a formal, printed label. They may even crack a joke or make a pun. Then, too, their statements will be short and couched in as few words as possible. If he who runs may not be able to read them, at least he who walks may do so.

The desert house, in which these friendly tags have been installed, is a fairly successful attempt to represent desert plants in something like the natural conditions under which they grow. Few of the great deserts of the world are the

barren, desolate wastes of our imagination. By far the greater portion of them are, like our own Arizona deserts, more or less clothed with natural vegetation. More than one visitor has commented on the garden-like effect of natural desert scenery. "Try as you will to get rid of it, the garden idea sticks in your mind," writes one visitor to Arizona, "and the more you see of these deserts, the more fixed does it become. Many times your progress will lead you to a five- or ten-acre tract of desert botanical garden, whereon you will find that Nature had joyously thrown together a fine sample lot of all the species that have been used in planting operations for twenty miles around. When we begin to analyze the component parts of the desert, we immediately notice that it is made like an old-fashioned museum. Each object is an individual specimen, standing on its own solitary pedestal. Each is a perfect botanical specimen, growing in its own invisible tub, standing alone, and quite untrammelled by its neighbors. Out of a million desert plants nearly everyone has its own circumpolar area of smooth bare earth. Elsewhere we have been accustomed to seeing bushes massed together with little individuality; and the independent specimens of the desert are far more interesting. They compel interest in a way that massed bushes never can, no matter what they are. Out here every traveler becomes a botanist, because the facilities are matchless and the temptation is irresistible. The reason for the zones of bare ground between the bushes is easily recognized; there is not enough water to support a shrub growth that is continuous. The desert rain is sufficient only for one bush every five or ten feet; not to be wondered at in a region where the average able-bodied man consumes two gallons or more of drinking water daily."

If portions of a desert often look like a botanical garden, is it too much to claim that a part of the Missouri Botanical Garden resembles a real desert? The essentially natural aspect of the planting in the desert house becomes even more remarkable when we consider that the plants have been brought, not from any one region, but from all the great

deserts of the world. Some, like the prickly pears, are from our own western deserts, and some, the stapelias, for instance, are from South Africa. Others are from northern Africa, Asia Minor, and Australia. That they fit so naturally together is due to the fact that most desert plants have many features in common, while some of them are almost identical in general aspect. Of the latter, the most striking examples are certain plants belonging to the genera Euphorbia, Cactus, and Stapelia. Each of these groups of plants has produced leafless desert forms with thick, accordion-plaited trunks and few branches, but the three groups are not at all closely related. The euphorbias are spurges, like our Christmas poinsettias; and the stapelias are members of the milkweed family. That three separate plant families, each in a different desert region (the euphorbias in North Africa, the stapelias in South Africa, and the cacti in America), should have developed forms so strikingly similar is one of the most interesting facts that we discover when we study desert plants. The friendly tags accordingly call attention to it by such remarks as the following:

BIRDS OF A FEATHER FLOCK TOGETHER

This plant is not a cactus, but a kind of milkweed. It is found in deserts, because like the cactus it is adapted for that kind of life.

Aside from these three groups of plants which are so strikingly similar, there is a general similarity among most succulent desert plants. When we come to study them we find them adapted for desert life in two general ways. First, they are fitted for water-storage; second, they are well protected by various kinds of spines and thorny outgrowths. Water storage is effected by some sort of a reservoir and by various devices for reducing evaporation, such as a waxy coating over the skin, accordion plaits which shrink together during dry weather and reduce the amount of surface exposed to the desert air, etc. The following are some of the tags which call attention to these phenomena:

WHAT CHANCE HAS A BARREL OF WATER IN A HOT DESERT?

A good chance if it is protected like this one:
from the sun.....by a thick, waxy skin,
from thirsty animals.....by spines and prickers.

A NEW USE FOR ACCORDION PLAITS

When the desert is long on heat and short on water, the plant shrinks, bringing the plaits closer together and reducing the amount of exposed surface.

Some desert plants store water at the base of the trunk. A yucca of this sort, with greatly enlarged base, bears the following tag:

A PLANT WITH A CISTERN IN THE BASEMENT

The enlarged base of this Yucca stores water over dry periods.

A few desert plants store water in such quantities that they become an important source of supply for desert travelers. In many the juice is bitter, but in the barrel cacti the flavor is not unpleasant. A traveler on our western deserts has given the following description of the process by which water is extracted:

"With his machete—which is really an Iowa corn cutter of Mexican antecedents and Connecticut manufacture—he deftly cuts off the upper story of a fine specimen that stood beside the trail. He then began to attack the central surface of the decapitated cactus with a smooth stick of pale verde. White bits of cactus meat began to fly like sparks from an anvil, and presently a cavity began to form. In this the meat was pounded to a pulpy mass, and in it water began to appear, when he proceeded to squeeze the pulp between his hands and throw it away. By alternate squeezings and poundings about three pints of white water soon was accumulated; and we were invited to step up and drink out of our hands, as do lost men on the desert. The water was surprisingly cool, a trifle sweet, and in flavor like the finest kind of raw turnip." Several of the barrel cacti bear tags calling

attention to their water-yielding properties. One, for instance, reads as follows:

A PLANT THAT DESERVES A LIFE SAVING MEDAL

The juicy center yields a quantity of very fair drinking water. It has saved the lives of many travelers in American deserts.

Phrasing these tags has been a much more difficult proposition than many people might realize. The difficulty lies in the fact that scientists themselves are not agreed as to how desert plants developed the features we have been considering: thick, waxy skins, protective thorns, water reservoirs, etc. Whether they were developed in response to the desert environment; whether plants with features of this sort, having originated elsewhere, spread to the deserts and found there a favorable home; or whether we must rely upon some other explanation, are questions that must be left to the future. Of only one thing are we certain; we find desert plants adapted to desert life. The tags have had to be so worded that they call attention to the adaptation without making any implication as to its explanation.

One other point has been called to the visitor's attention by the tags. Like all public places, the Garden is the prey of thoughtless people who cause really serious damage without benefiting themselves in any way. The smooth, waxy skin of many of the desert plants has proved an irresistible temptation to people of this sort, and some plants have been marred and even killed by being used as slates on which to carve initials, names, and addresses.

Two of the tags make an attempt to stay the hands of these scripto-maniacs. A battle-scarred cactus near the front entrance, a veteran of many attacks, bears the label:

A POOR WAY OF THANKING MR. SHAW

Vandalism costs the Garden hundreds of dollars each year.

At the other end of the house a group of mutilated prickly pears is labelled as follows:

THESE PLANTS COULD LIVE IN THE DEATH VALLEY WITHOUT PROTECTION

City vandals are slowly KILLING them.

WALNUTS

No native tree is being more generally esteemed at the present time than the black walnut. Its wood is in demand for furniture and finishing, and walnut burls are so valuable that they are sold by the pound. Modern methods of extraction have made black walnut meats a national commodity, and the nuts are now being bought and sold by the carload; while walnut trees as memorials have appealed to the popular fancy, and since the war thousands of them have been set out along memorial highways. With such popular appreciation of the tree it is gratifying to find it unusually well represented at the Garden's extension at Gray Summit. The very large specimens which we are told were at one time on the property have disappeared, but there still remains a great number of trees, ranging in size from small saplings to trees two and three feet in diameter. These are growing in the valleys and hillsides and along fence-rows and roadways.

The black walnut belongs to the genus Juglans, the name itself (meaning Jove's nut) testifying to the esteem in which the group was held in ancient as well as in modern times. There are in the genus about twelve recognized species, of which six are indigenous to the United States. Two of these, the black walnut and the butternut, are native to the region about St. Louis. Both of them are trees which prefer fertile, well-drained soil and were naturally destroyed in large numbers when the best land was cleared for cultivation. Moreover, since the black walnut has been particularly sought after for its timber large specimens are now practically unknown in this vicinity. Younger trees are fairly common in the region about the city and in many cases have been extensively planted along roadsides. Butternuts are much more scarce; there are a few trees at Meramec Highlands and in the vicinity of Barret Station, and both species are found growing together along the narrows of the Big River, south of Eureka.

THE BLACK WALNUT

Juglans nigra L.

The black walnut is widely distributed in eastern North America from western Massachusetts to Minnesota, southward to Florida and the valley of the San Antonio River in Texas. There are particularly fine stands along the Wichita River in Oklahoma and on the head-waters of the Arkansas River. The technical description of the tree is as follows:

Symmetric in form, with spreading branches, attaining a height of 90 to 150 feet and a trunk diameter of from 4 to 6 feet, rarely larger. Leaves alternate, compound, with 13-23 leaflets. Leaflets 3 to 4 inches long, acute at the apex and oblique at the base, serrate, nearly sessile. Flowers monoecious, appearing when the leaves are about half developed; staminate ones arranged in long unbranched catkins, pistillate ones in two- to five-flowered spikes. Fruit a round nut covered with a sticky husk with a pungent odor. Shell thick, dark, and sculptured. Nut edible, oily and sweet. Wood very dark brown in the heartwood, durable, taking a good polish.

Because the wood is easily worked with tools and does not warp nor swell badly when wet, it has been much sought after. For one particular purpose, the making of gunstocks, it stands supreme. Black walnut and the nearly similar European walnut are almost exclusively used for this purpose, and though the war departments of Great Britain and of the United States have searched the world over, no satisfactory substitute has been found. No other wood has just the right combination of characters. In the first place, since it does not warp and swell when wet, the action of the gunlock is not interfered with; it takes a sharp edge which fits snugly against the metal parts of the mechanism; and furthermore, its dark color and beautiful grain produce an attractive implement which appeals to the soldier's orderly soul. Another war-time use of the walnut, which caused government agents to scout the country for timber, was for airplane propellers.

The same qualities which made walnut the best of woods

for gunstocks have led to its use in furniture, particularly since the development of special processes for making thin veneer. Cherry, mahogany, and walnut are the only woods which are well suited to the rotary or semi-rotary processes in which the logs, after a preliminary soaking in hot water, are revolved past a sharp blade, which cuts off the wood in thin sheets. One unusual feature of the walnut is that the best wood for producing figured effects comes from the stumps, and these, when large, sell for a high price.

Like its close relative, the Persian or English walnut, the black walnut is valued for its nuts as well as for its timber. They are produced bountifully in most seasons, but with a shell so hard that their use has been very much restricted. Until recently the only way of obtaining the kernel has been to crack the nuts by hand, a slow and laborious process, as any country boy or girl can tell you. Of late years prepared nutmeats have become increasingly common, and St. Louisans should be proud of the fact that it is an invention of one of their fellow-citizens which has very largely made this possible. In 1922 Mr. R. E. Woodson, of St. Louis, perfected the first successful machine for cracking black walnuts, and with improvements since made by himself and his associates, it has revolutionized the use of this nut. A factory in Memphis, Tennessee, equipped with these machines, is now handling over fifty carloads of black walnuts a year. Black walnut-growing for the nuts is still in the experimental stage, however, and the Department of Agriculture makes the following recommendations:

"1. Fertile, tillable farm land having established value for other agricultural crops, should not now be planted to black walnut trees if the planter is dependent upon the land for a paying income.

"2. Until more rapid-growing strains are developed than are now available for timber purposes, or until better nut-bearing varieties appear and establish their value, planting of black walnut should be restricted to fertile land otherwise unused.

"3. There is enough unused but fertile land well suited

to walnut planting available on steep hillsides, along ditches, on stream banks, by roadways, in private lanes and drives, fence corners, parks, dooryards, and other places within the range of the species to afford abundant opportunity for rapid and normal expansion of the black-walnut industry at inappreciable cost. Development along these lines should add very greatly to the total agricultural wealth and welfare of the entire country.

"4. Great and worthy public service may be rendered by planting black-walnut trees in such places. This is a matter of sufficient importance to engage the earnest attention of educators generally. School teachers over the entire country can do a great deal by encouraging children to plant useful tree seeds wherever there are idle areas of fertile land.

"5. Wherever it is desired to stimulate nut production, young, thrifty black walnut trees of from 15 to 50 feet in height may quickly be converted into bearing trees by cutting back the tops and grafting over with scions of promising varieties now available and awaiting such test. This procedure will add greatly to the interest in nut culture on the part of the average farmer, to his general knowledge of horticulture, and, inevitably, although perhaps gradually, to his material wealth."

Eventually it is to be expected that the nuts will be produced on as stable a basis as pecans or almonds are at present. Undoubtedly the next fifty years will see increasing interest in the production of better named-varieties of black walnuts; varieties with larger meats, thinner shells, and a more delicate flavor. A number of varieties are already on the market, and an orchard of these kinds is being established at the Garden's new extension at Gray Summit. Hybrids between different species of walnuts are quite common, and it is within the range of possibility that varieties produced by this method may some day be extensively grown in the Middle West.

As an ornamental tree the black walnut has many qualities to recommend it, but is nevertheless not without faults. It has the annoying habit of losing its leaves very early in the fall, and its insect or fungous enemies, while causing no

extensive damage, make the trees too unsightly for a small city lot. For large country estates or for planting along country roadsides, however, the tree is ideal and is being very largely used at the present time.

Its merit as an ornamental tree has been recognized in Europe as well as in America, and it has been very extensively planted there. It was introduced very early, just when we do not know, but it was recorded as growing in England in the garden of the botanist Tradescant as early as 1656. It has done well in that country when planted on fertile soil and specimens ninety to one hundred feet high are not uncommon on old estates.

The seedlings develop a distinct tap root very early in life, and the species is therefore difficult to transplant in any but the very young stages. For this reason the nuts are very often planted directly where the trees are desired. In other cases the nuts are stratified over the winter in sand, planted out in the nursery the next spring, and the young trees moved a year or two later.

THE BUTTERNUT

(*Juglans cinerea* L.)

The butternut is quite similar to the black walnut, but can be easily separated by a number of characters. The bark is much lighter and the lenticels, or breathing pores, which are conspicuous on the young branches, are longer and not as rough. The nut is longer and more deeply furrowed. Perhaps the easiest way to distinguish the two is by the leaf scar which is large and easily studied in both species. That of the black walnut has a distinct notch in the upper margin so that it is roughly heart-shaped. The scar of the butternut is straight across the top, giving it a triangular or irregularly circular outline (see fig. 1). The technical description of the tree is as follows:

Tree broadly spreading, 30 to 50, occasionally up to 90, feet in height. Diameter 1 to 4 feet. Trunk short, crown broad and rather open. Leaves alternate, compound, 15-28 inches long with 7 to 17 leaflets. Leaflets 3-5 inches long,

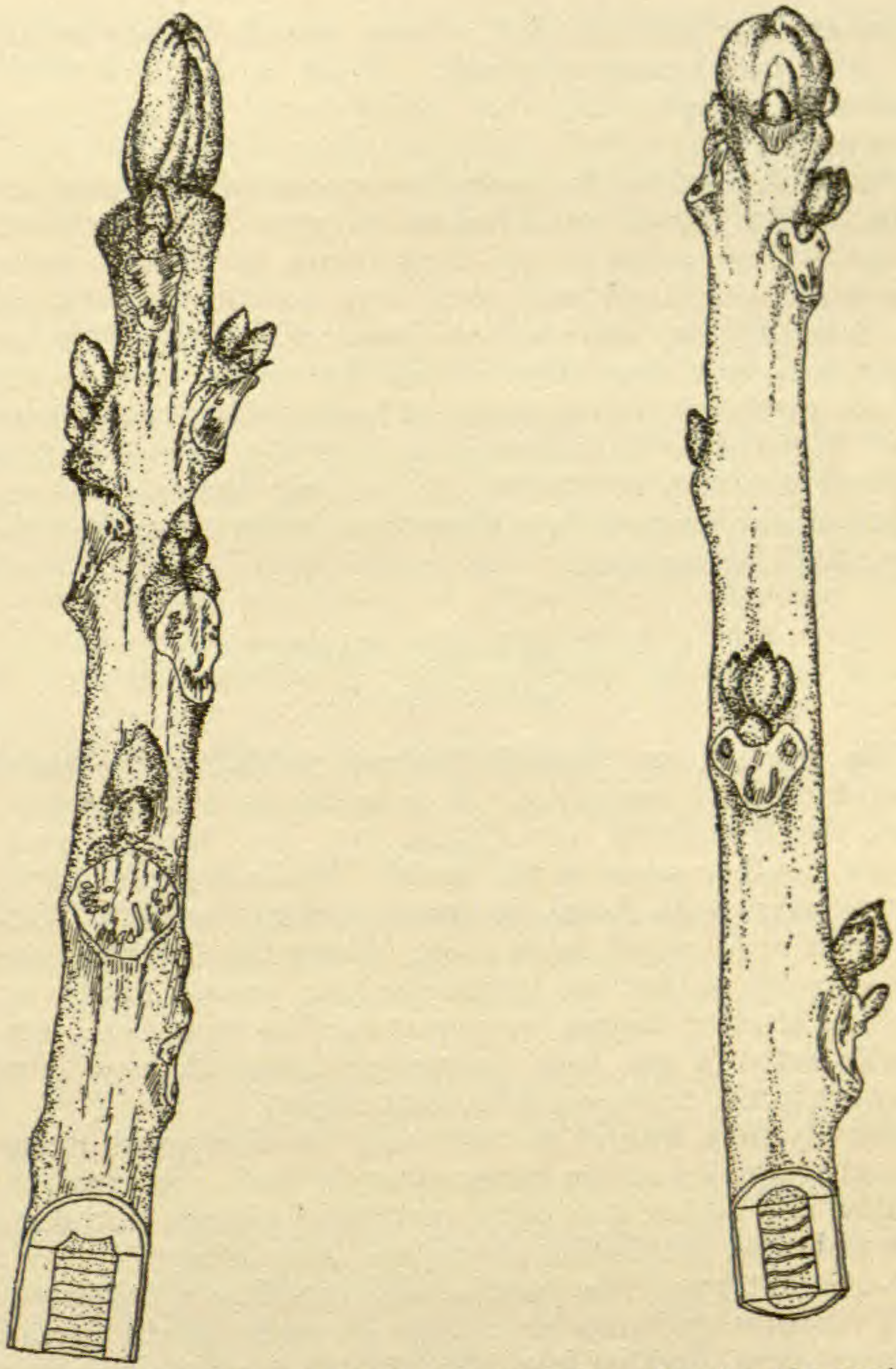

Fig. 1. Butternut and black walnut twigs, showing the various characters by which the two species may be separated, i. e., by the shape of the leaf scar, the buds, etc.

acute at apex and rounded at base, serrate, sessile or nearly so. Petioles clammy-pubescent. Fruit an ellipsoid nut covered with a fleshy and very sticky husk, borne in racemes of 2 or 3.

The timber of the butternut is very similar to that of the black walnut, but is much lighter in color. For this reason it is very often known by the trade name of "white walnut." The husks and inner bark were very commonly employed in the early days of this country for producing a yellow-brown dye. This was very largely used for men's work trousers, which were at that time made at home. Until well after the Civil War these "butternut jeans," as they were called, were a common article of clothing in country districts and many a prominent present-day Missourian wore them for everyday use in his boyhood.

THE ENGLISH WALNUT

Juglans regis L.

The Persian or English walnut produces the common walnut meat of commerce. It is native to southeastern Europe, the Himalayas, and China, but has been extensively grown in other parts of the world. While scarcely hardy in the vicinity of St. Louis, it grows well in southern England and even as far north as Sweden. Along the Atlantic coast in this country, occasional specimens have proved hardy as far north as Boston, though they are quite the exception. On the Pacific coast it has been extensively planted, and most of the nuts in the trade are from that region.

The English walnut is very easy to distinguish from all the other species of the genus when in leaf. The leaflets are smaller and entire, and quite glabrous (without pubescence). The technical description of the tree is as follows:

A round-topped tree occasionally reaching a height of 100 feet. Leaves glabrous or nearly so, dark green above and lighter below, divided into 5-9 leaflets (occasionally as many as 13). Leaflets entire or with the margin slightly waved. Male catkins short and densely flowered. Female flowers at

the end of young shoots. Fruit leathery, aromatic, inclosing an edible nut.

The timber is very much like that of the black walnut and has been used for the same purposes. Before the introduction of mahogany it was the best cabinet wood in Europe, and most of the better furniture was made of it. Like the black walnut in this country it has been very largely used for gunstocks. Loudon records that during the Napoleonic wars more than 12,000 trees were used annually for this purpose in France alone. The good qualities of the wood were very early appreciated. In 1664 Evelyn wrote of it as follows in his famous "Sylva": "Thus Burgundy abound with them * * * * Whenever they fell a tree (which is only the old and decay'd) they always plant a young one near him; and in several places 'twixt Hanw and Francfort in Germany, no young farmer watsoever is permitted to marry a wife till he brings proof that he hath planted, and is a father of such a stated number of Wall-nut-trees, as the law is inviolably observed to this day for the extraordinary benefit which this tree affords the inhabitants."

NOTES

Dr. Ford A. Carpenter, meteorologist and aeronaut, of Los Angeles, California, visited the Garden, April 4.

Mr. Alexander F. Bucholtz, Research Assistant, has been elected a member of the Deutsche Botanische Gesellschaft.

Mr. Paul A. Kohl, Floriculturist to the Garden, spoke before the Alton Woman's Council, April 8, on "Plant Propagation."

Mr. John Noyes, Landscape Designer to the Garden, has returned from a two-months trip to Europe, where he visited most of the important gardens.

The following students in the Henry Shaw School of Botany have been elected to the society of Sigma Xi: Esther L. Larsen, T. D. Mallery, Mildred E. Mathias, and Kazuo Gotoh.

Dr. George T. Moore, Director of the Garden, spoke before the St. Louis chapter of Phi Sigma, April 6, on "Some Plant Reactions," and before the Guild of the Church of the Messiah, April 10, on "The Plant Commonwealth."

Mr. George H. Pring, Horticulturist to the Garden, has returned from a trip to Panama where he spent a month in the Chiriqui region collecting orchids. In all he collected about 2000 plants, six cases of which were shipped to the Garden and the remainder left for the Tropical Garden, at Balboa, Canal Zone.

Under the auspices of Gamma Sigma Delta and Sigma Xi, Dr. B. M. Duggar, Physiologist to the Garden, gave two public lectures at the University of Missouri, April 7, on the following topics: "Methods of Fundamental Research in Certain Virus Diseases," and "The Significance of Some Ultra-Microscopic Studies in Relation to the Nature and Origin of Life."

STATISTICAL INFORMATION FOR MARCH, 1927

GARDEN ATTENDANCE:	
Total number of visitors	32,466
PLANT ACCESSIONS:	
Total number of plants and seed packets received as gifts	300
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	33
Total number of books and pamphlets donated	368
HERBARIUM ACCESSIONS:	
By Gift—	
Broadway, W. E.—Carpological specimens from Trinidad	12
Epling, Dr. Carl C.—Fruiting specimens of cultivated plants	3
Kellogg, John H.—Plants of Missouri	7
Kobuski, C. E.—Mosses of Jefferson County, Missouri	3
Larsen, Miss Esther L.—Plants of Missouri	4
Mathias, Miss Mildred—Plants of St. Louis County, Missouri	4
Routh, Miss—*Stellaria media* (L.) Cyrill. from Indiana	1

By Exchange—
Botanical Museum, Stockholm, by Prof. G. Samuelsson —Plants of Sweden..... 200

By Purchase—
Botanical Garden and Museum, Berlin-Dahlem—Plants of Bolivia 150
Heller, A. A.—Plants of United States..... 400
Holzinger, John M.—Musci acrocarpi Boreali-Americani et Europaei, Fasc. XXV, Nos. 601-625, inclusive... 25

By Field Work—
Overholts, Dr. L. O.—Plants of Missouri..... 13

Total 822

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and, while virtually a private garden, it was, except at certain stated times, always open to the public. By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the 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 of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises about 75 acres. There is now in process of development a tract of land of over 1,500 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a forest reservation, with the idea that possibly at some future time this may become the new botanical garden. About 12,000 species of plants are growing in the Garden.

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day and Christmas—week days from 8:00 a. m. until one-half hour after sunset; Sundays from December to April, 1:00 p. m. until sunset; from April to December, 2:00 p. m. until sunset.

The main entrance to the Garden is located at Tower Grove avenue and Flora boulevard, on the Vandeventer avenue car line. Transfer south from all intersecting lines. The Garden may also be reached by Bus Route No. 12, to which all other motorbus lines transfer.

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OF THE MISSOURI BOTANICAL GARDEN

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Pathologist

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D. MILLER,
Orchids

R. E. KISSECK,
Engineer

TROPICAL GARDEN, BALBOA, CANAL ZONE

C. W. POWELL,
Manager

Missouri Botanical Garden Bulletin

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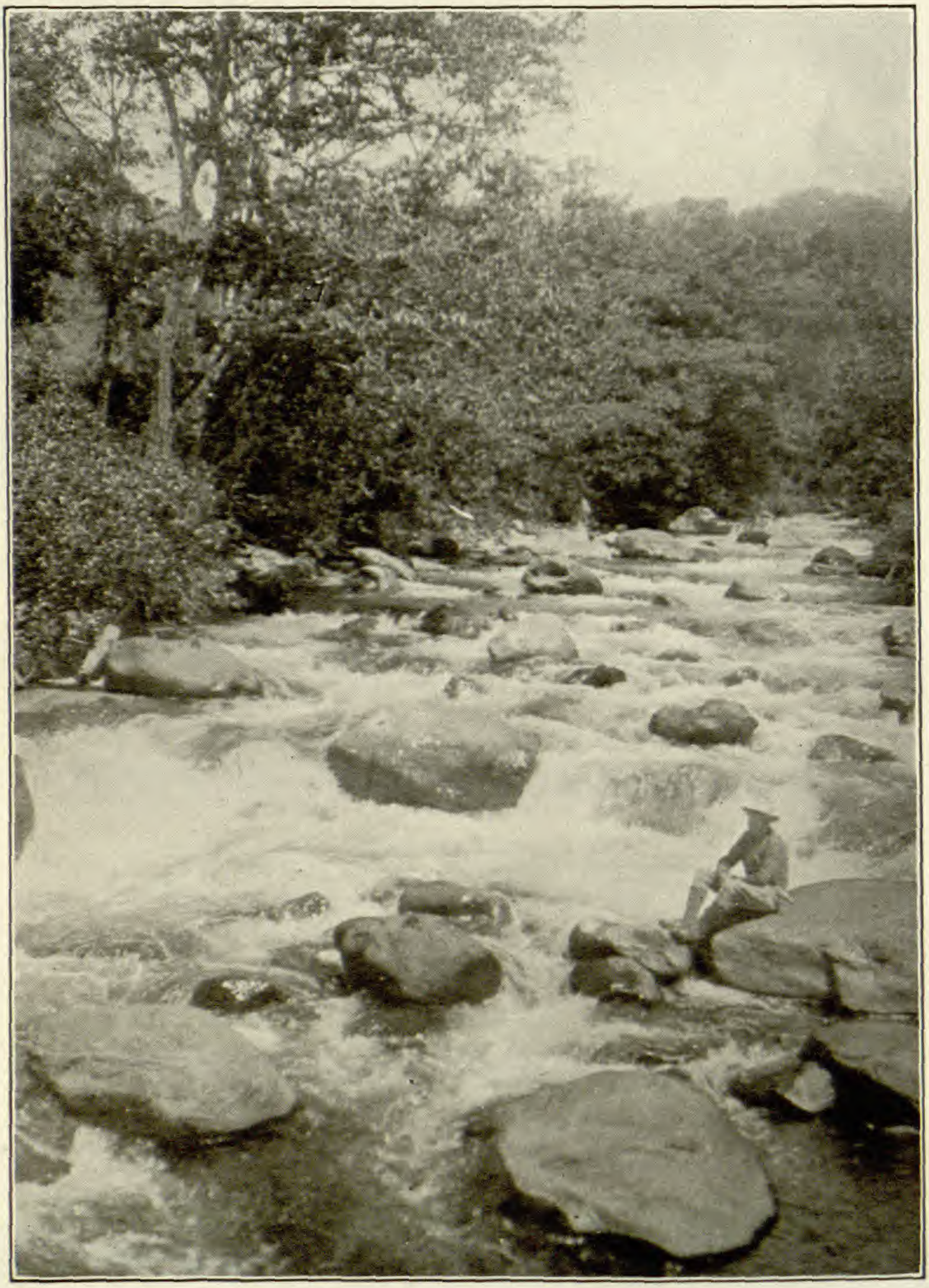

RIO CALDERA AT LINO, A MECCA FOR PLEUROTHALLIS.

Missouri Botanical
Garden Bulletin

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COLLECTING ORCHIDS IN THE CHIRIQUI, PANAMA

The following report of Mr. G. H. Pring, Horticulturist to the Garden, was submitted shortly after his return from Panama. Because of the wide interest concerning the new tropical station of the Garden and the methods employed for securing orchids from the jungle, it is herewith printed practically as written:

"I left New York for Panama on February 23, stopping for a day at Port au Prince, Haiti, where the experimental station was visited and also one of the largest sugar plantations. I arrived at Cristobal, March 3, and at noon of the same day, Mr. C. W. Powell, Manager of the Tropical Station of the Missouri Botanical Station, met me at Balboa.

"The object of this visit was to inspect the new tropical station of the Missouri Botanical Garden and to discuss its development with Mr. Powell. I was very much impressed with the location and with the work accomplished so far. Within a few months the ground had been converted from a jungle into the first stages of an attractive garden. The walks have been lined out, an avenue of palms has been planted, and several interesting economic plants, such as the mangosteen, the chaulmoogra-oil tree, alligator pear, mangoes, and citrus fruits, have been established. Arrangements have been made with some of the experimental stations to furnish eighty species of palms which will be planted on the hillsides. These will form the basis of a comprehensive collection of palms from all parts of the world. To bring the orchids into view 30 stages were built in tiers, with cheese-cloth shade over the

top. Because of lack of shade in the Garden at the present time there is also being built a lath house 40 feet long by 15 feet wide, under which to grow the shade-loving orchids of the higher altitude. The orchids collected in the vicinity of Panama City, which grow at an altitude of from sea-level to 1000 feet, are being established on the existing trees, to conform to their natural habit. These grow in more open situations and delight in sunshine, *Encyclia atropurpurea,* 'Santa Manos,' *Epidendrum imatophyllum, Oncidium ampliatum,* 'Yellow Butterfly,' and *Brassavola grandiflora,* 'Queen of the Night,' being some such examples.

"Arrangements were made with Mr. Zetek for a visit to the Barro-Colorado Island Laboratory for the Institute of Research in Tropical America. I left Balboa at 7 A. M. for Frijoles where we boarded a launch which took us across Gatun Lake to the scientist's paradise. The island was formed during the flooding of the land which formed Gatun Lake. Here one may penetrate the typical tropical jungle with its original vegetation combined with the indigenous fauna. The island comprises about 3600 acres, through which trails have been cut to make access easy for study of the animal and plant life. A visit to the island should not be overlooked by any lover of real jungle life, even the howling of monkeys being heard from the interior. In the afternoon a trip was made with Dr. Chapman, of the American Museum of Natural History, for the purpose of laying snares for such animals as oscelots, wild pigs, pumas, etc. At a selected tree where the animals come to feed upon the fruit which drops to the ground, there was placed a specially made camera and equipment. The narrow trail was blocked with a very small thin cord, about a foot from the ground. This in turn was attached to the shutter of the camera and likewise to an electric battery and flashlight. At night the animal, in walking to its feeding place, comes in contact with the string across the trail, this releasing the shutter of the camera and making a connection between the battery and flashlight which causes an explosion. Some of the photographs taken the previous night were shown me—one of an oscelot looking directly into

the camera, another of a wild pig with its two young, the mother holding in her mouth the banana which had been used for bait. During the trip over the various trails orchids were very scarce, but I did succeed in getting a massive dove orchid (*Peristeria elata*).

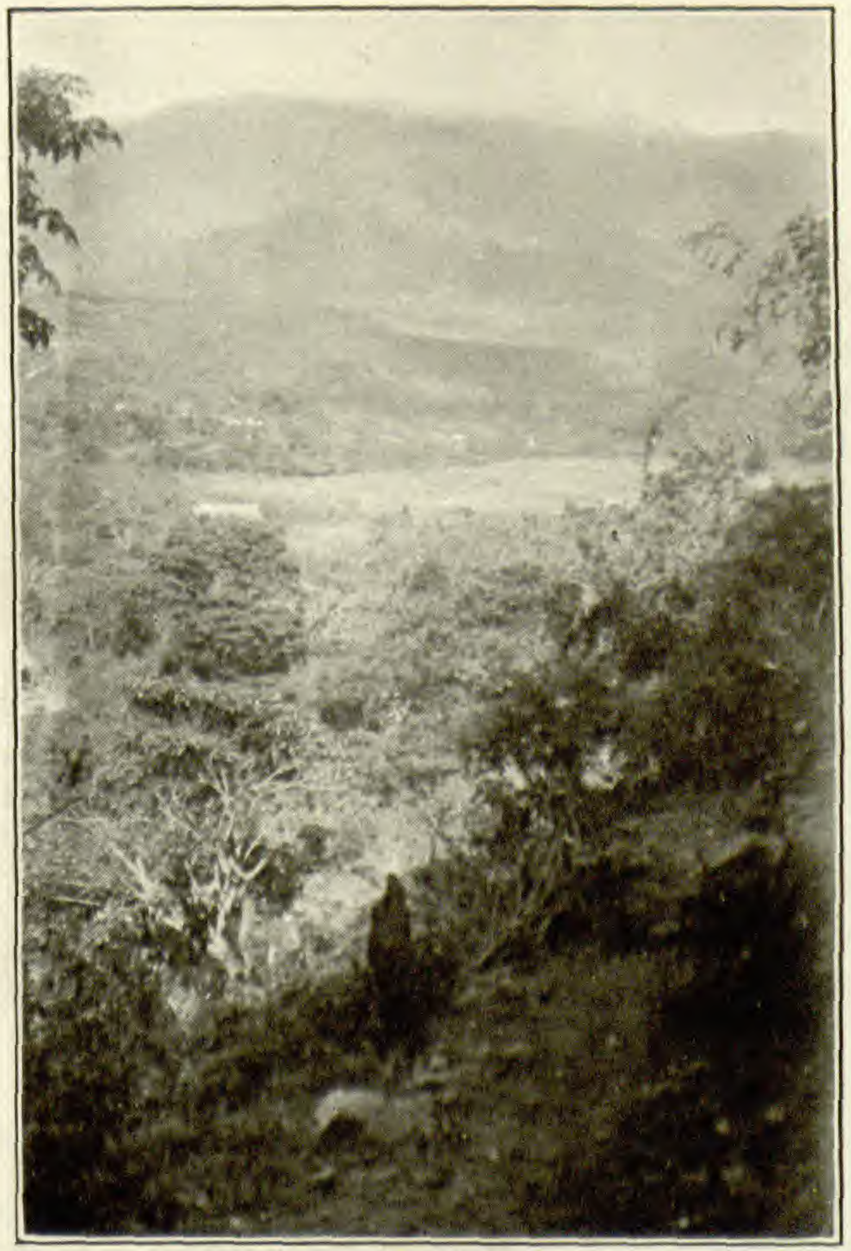
"My next trip was to collect dove orchids. Christopher Cheeseman, who had been in Mr. Powell's employ for eleven years and likewise is a plant collector, acted as guide on this trip. He informed me that it would be necessary to take a 25-mile trip to LaCumbre to get these orchids, since the original area around Panama had become depleted due to the natives bringing the plants in to Balboa and Panama to be sold. Accordingly we made our way into the jungles, but the day's work resulted in only twelve plants. Unlike many tropical orchids, the dove orchid is purely terrestrial in habit and grows in the typical red clay soil among low bushes which provide only partial shade. The fallen leaves furnish a mulch in which the lateral roots ramify, the brace roots penetrating into the red subsoil. The pseudo-bulbs are kept in plump condition during the dry season by the moisture-laden atmosphere of the nights. Most orchid growers look upon the dry season as a definite period during which the plants do not receive moisture, but this is a mistake. For example, in Balboa, the moisture at night is so heavy as to give the impression that it has rained, and it is only because of the tropical dews that many orchids are able to survive the so-called 'dry season.' However, between the hours of eleven A. M. and three P. M. the sun is very penetrating, and heavy watering of the plants at the tropical station is required.

"Arrangements had been made for a month's collecting trip into the Chiriqui region of Panama to supplement the orchid collection at the Balboa Station. Mr. A. A. Hunter, who has always been with Mr. Powell on his collecting trips, accompanied me, and Mr. Powell remained in Balboa to receive the shipments. Passage was booked on a cattle boat to leave Balboa on March 14, at midnight. The necessary equipment, such as riding outfit and the much-needed machete, was to be purchased in Panama. Since the boat was anchored

two miles out in Panama Bay, we had to be rowed from shore in a 'panga.' The oarsman recognized Hunter, and after asking for Powell inquired 'Parasita, senor, in Chiriqui?' He then kept up a continual conversation, most of which was informing us that he spoke very 'grammatica.' I must say that this was influenced by libations of rum which he had apparently consumed before starting.

"Upon embarking on the 'Vapor David, (pronounced Dahveed) we discovered that 120 passengers were on board, with sleeping accommodations for 30, and we congratulated ourselves on having booked a berth a week ahead. The staterooms were provided with four bunks, and on the wall was a notice requesting that passengers remove their shoes before going to bed. Our stateroom companions were an American doctor, who preferred to carry his own water in a canteen, and an American engineer whose legs were about two feet longer than the berth he was supposed to occupy. The doctor preferred to sleep out on deck and had provided himself with a deck chair for that purpose. Before retiring we found a young American girl with no place to sleep, so the doctor gave up his chair and with Hunter's and my blanket she was made comfortable for her night on deck, with other passengers of all classes and colors. There was only sufficient room in our cabin for one person to dress at a time, so the next morning we gave the doctor first turn. Preparing to wash he discovered that the basin had no plug, so the boy brought a piece of paper. Then we found there was no water. This was brought and likewise one towel. After some remonstrance we each received a towel. By this time the doctor had completed his ablutions and pulled out the paper plug, the water immediately running all over the stateroom floor. We then requisitioned a pan which one person balanced while another washed. It was rather interesting to observe the people on the outside of our cabin who felt the need of a morning bath. They would get a glassful of drinking water from the container, carry it to the side of the deck, pour it over the head with one hand and wash the face with the other. It was only after the return trip that we realized how fortunate we were in not having cattle with us on this boat.

PERISTERIA ELATA, GROWING IN NATURAL HABITAT AT LA CUMBRE, NEAR PANAMA CITY.



SHOWING VALLEY OF BOUQUETE WITH CONTINENTAL DIVIDE IN THE DISTANCE.

TREE FERNS EAST OF BOUQUETE. IMMEDIATELY BEHIND THEM, UPON A MOISTURE-LADEN ROCKY RIDGE, PHRAGMOPEDILUM LONGIFOLIUM WAS COLLECTED.

EAST OF BOUQUETE, AT 5000 FEET ALTITUDE, SHOWING GUIDE HOLDING BRANCH WITH FLOWERING SPECIMEN OF TRICHOPILIA SUAVIS.

"We arrived at the mouth of the Rio David after a thirty-four-hour voyage and were obliged to wait five hours off one of the many islands until the tide let us pass the reef. During the delay the captain permitted us to do a little botanizing on an island about a mile away, but our search was rewarded with only one specimen of Catasetum. After crossing the bar we entered the mouth of the Rio David, the banks of which are covered with a growth of mangrove, and arrived at Port Pedregal, at five o'clock, March 16. Here we caught the 'motor', a cross between a street car and an automobile, which brought us to David, a town of 10,000 people, about four miles from Pedregal. We stayed the night in comfortable quarters at the Hotel Lombardy, and the next morning caught the so-called 'motor' up to Bouquete. This meant a thirty-mile trip, passing from an elevation of 500 feet to 3800 feet. At Bouquete we made our base of operations and were fortunate in being able to stay with an American, Mr. J. Wright. The town has a population of about 300 people, and is situated in a valley almost surrounded by the Continental Divide, with the Vulcan towering 11,800 feet within a 2½-hours ride. This territory is rapidly developing into a coffee-growing center. The climate is very delightful, a maximum of 75° F. during the day and a minimum of 55° F. at night. A peculiarity of the weather of this valley is the so-called 'bajo-rico,' which means 'rich below', but the term is applied to the periodical mist which is precipitated in the valley. It is caused by the trade winds from the Atlantic striking the mountain tops after passing over the valley. A sort of vacuum is thus produced, drawing the clouds into the valley where they are precipitated in a very fine mist. Undoubtedly this moisture-laden atmosphere is a great factor in the productiveness of the valley and particularly in its effect upon epiphytic growths, such as orchids.

"Arrangements were made with Mr. Wright to furnish horses for three weeks, during which time the entire territory within a radius of twenty miles was thoroughly covered. One way to collect orchids is to make one's self comfortable in the village and hire 'mozos' (laborers) to collect the so-called 'parasitas.' In most cases this method is very unsat-

isfactory unless one wants one or two varieties in quantity, such as cattleyas in the Colombian region. To obtain varied genera and new species it is necessary to climb the 'barrancas', ford streams, cut one's way through the jungle, or in other words, hunt for the coveted orchid, and it is truly a hunt. They do not grow except in more or less inaccessible places, and it ofttimes takes the expert eye to observe them. The first two or three days one must adjust himself to looking up in the trees for material. However, Hunter's sharp eyes detected almost everything within range. The day's program would consist of arising at six o'clock, rubbing the skin with a repellent against ticks and red bugs, and starting at eight o'clock on horseback with a reliable guide. Reaching a prospective orchid region, the horses are tied along the trail, and we enter the jungle to collect.

"Orchids are obtained simply by climbing the trees, if the trees are small. The Indian is a good climber, but the mozo prefers to keep one foot on the ground. Climbing the tall trees is practically an impossibility, since in most cases the trunks are perpendicular, the lowest branch being 40 or 50 feet from the ground. When the orchids grow upon the trunks of such trees they are removed by cutting a forked-top sapling long enough to reach the plants and with this fork their tenacious hold upon the bough is gradually loosened. The roots in some cases are three and four feet long, and great dexterity is required to fasten the plant between the forked top of the sapling and to dislodge it without causing injury. During this operation the clouds of dust, granulated bark, and moss which rain down from above almost blind the collector. When the plants are within reach the indispensable machete is used to detach them from the bark. It is useless to try to collect orchids without a machete, for not only is it needed to remove the plants from the trees but it must be used constantly for opening up trails and for cutting the impenetrable tangle of vines. After collecting the orchids, they are placed in bags which are carried on the back to where the horses are tied, and at the end of the day one returns to the base of supplies with from one to four well-filled bags—or sometimes with nothing at all.

SHOWING METHOD OF USING CUT SAPLING TO REMOVE EPIPHYTES FROM TREES. ON THE LLANOS, SOUTH OF BOUQUETE.

FLOWERING EPIDENDRUM RADICANS GROWING ON BOULDERS, ON TRAIL UP TO PALO ALTO.

HUNTER AND INDIAN GUIDE, EMILIANO, CROSSING RIO CALDERA, AT ALTO CHICARO, THE BRIDGE BEING A MASSIVE TREE COVERED WITH EPIPHYTES.

MR. PRING, HOLDING LARGE SPECIMEN OF LYCASTE MACROPHYLLA COLLECTED ALONGSIDE RIO CALDERA NEAR ALTO CHICARO.

"One can usually judge by the type of vegetation whether or not the orchid will be found. Tropical orchids usually grow in groups, depending upon the peculiarities of a given region. A most important factor is the presence of moss upon the bark of the trees, for if there were no indication of moss or lichens we rarely found any epiphytic growth. The shallow ravines bordering the Llanos (flat, lava-strewn areas where only stunted trees grow) produced quantities of Hexisia. These were in full bloom at the time, their reddish flowers making the plants easy to find. Along the Caldera River where the 'bajo-rico' does not penetrate but the moisture is supplied at nights by the mist from the river we collected Brassia, Maxillaria, Epidendrum, Stanhopea, and Brassavola. The pseudo-bulbs showed slight shriveling, indicating, of course, a dry region. Contrasted with this are the moist valleys which contain such genera as Pleurothallis, Trichopilia, Ornithidium, Epidendrum, Odontoglossum, Warscewiczella, Lycaste, etc. The first week we were particularly fortunate in collecting 75 plants of *Odontoglossum Powellii*, which is extremely local.

"Probably one of the hardest plants to collect is the 'chinela' (*Phragmopedilum caudatum* var. *Warscewiczii*). Mr. Powell, on his various trips to this region, had never seen it growing. In fact, before I left Panama, he informed me that the 'mozos' had collected a few small plants for him, informing him of their finding them in 'muck land', but this did not seem probable as it is reported as an epiphyte. He advised us to see the same native so as to try to obtain specimens. We found the native, but he told us that there were no more plants in that region. We had previously collected the *Phragmopedilum longifolium* which was found growing on a rock associated with a brackish soil, but we were much more interested in finding the epiphytic species. After many disappointments we were rewarded during our visit to Palo Alto, where we met a Mr. A. Guterriez who owns a coffee 'finca' (plantation). Upon asking him for information on the chinela, he replied: 'Haven't seen a plant in years.' However, he said that there were lots of 'parasitas', which, by the way, means not only orchids but anything and everything that

grows upon a tree. So he very kindly furnished us with another guide who took us over to a tract where most of the trees had been cut down in preparation for a coffee plantation. As Hunter was not feeling well, we left him as comfortable as we could, and with two guides started to walk and crawl over the fallen timber in search of orchids. It was interesting to note that after felling the trees the orchids were burned by exposure to the full sun within three or four days, although when growing up in the trees one imagines that they receive sunshine most of the day. This is a mistaken idea, however, for upon close observation it can be seen that when the sun is directly overhead the topmost branches of the trees give considerable shade to the orchids below, especially those attached to the moss-laden bark of the trunk. I am speaking, of course, of this particular locality, 5,000 feet altitude with moisture-laden atmosphere, not the region at sea-level, where the plants receive considerably more sunshine with intense heat. In the morning before eleven and in the afternoon after three are the only times that the plants receive full sunshine.

"After collecting in this clearing for some time my disappointment was becoming more and more acute at not finding the chinela. Suddenly I observed what I thought to be a Maxillaria, belonging in the Equitant group. I climbed the tree and came down with the plant in my mouth. Upon reaching the ground I examined the plant and found I had secured the coveted chinela. In my excitement I forgot my guide and rushed back to Hunter, exclaiming 'I've found it, I've found it.' Hunter immediately lost sight of his weakened condition and joined me in a feverish hunt for more plants. A thorough combing of all the fallen trees rewarded us with thirty good specimens. Such a clearing is undoubtedly the orchid collector's paradise, since we gathered in this location six sacks of various genera, which was as much as we had collected the whole previous week.

"Up to this time we had not found any Mormodes, so we traveled west of Bouquete along the Caldera River where Hunter had found them on previous trips. The usual disappointments were experienced, and we were just about to

ORNITHIDIUM GROWING UPON A TREE IN THE JUNGLE. ON THE TRAIL TO CALDERA.

CATASETUM GROWING UPON A ROCK IN FULL SUNSHINE. LLANOS AT CALDERA.

BRASSAVOLA LINEATA (RAT-TAIL ORCHID) GROWING ON UNDER SIDE OF A BRANCH. ON THE TRAIL TO THE VULCAN.

HUNTER REMOVING SPECIMEN PLANT OF ODONTOGLOSSUM POWELLII WITH HIS MACHETE. AT THE VULCAN.

retrace our steps when we discovered a large half-rotten tree. Hunter remarked, "Here's where we'll find them if we are in luck.' The tree was fully exposed to the sun; the bark half decomposed but still attached to the tree, and a half-dozen Mormodes plants rewarded us. This genus is found nowhere except on dead trees. While removing several of the plants a large sheet of bark was loosened, under which were numerous seedling orchids about the size of an ordinary small pea. The larger ones showed their first leaf which was penetrating the decomposed bark. It was evident that the seeds were blown under this rotten bark where they were kept moist and shaded during the early stages of growth. During their development they root on to the hard wood, also the interior of the bark which securely fastens them, and ultimately penetrate the bark where they develop pseudobulbs. We also found several specimens around an old saw mill.

"We were now ready to look for the swan orchid, Cycnoches, and the monk's-hood orchid, Catasetum. Mr. Laws, an American merchant, whom we met, informed us that these grew on the Llanos at Caldera, and he arranged to supply us with a guide to take us there. The following day at seven o'clock we were ready to start, taking also our own guide, who said that he had made the trip before. Our promised guide who lived in that region was evidently celebrating, for he was not on hand, so we left under the guidance of our own man, carrying with us a letter of introduction to a reliable native, Martez Gonzales, who Laws said would take care of us. He advised us to take some food in case of emergency, and we were able to purchase from a Chinaman sardines, Libby's 'bully beef," some native bread, and for a luxury, biscuits imported from England.

"We ascended from Bouquete, 3400 feet, almost immediately up to 5500 feet, then we gradually descended to the village of Caldera, an altitude of 1000 feet. It was interesting as we rode down to observe the various orchid zones. At 5000 feet the Trichopilias were in full bloom and were at first discovered by their unusual fragrance. At 4000 feet Ornithidiums and Brassavolas were dominant. At 3000 feet the

spider orchid, Brassia, Bulbophyllum, Pleurothallis, and Stelis were growing. At 2000 down to 1000 feet the Schomburgkia and Epidendrum of the pseudobulbous type, until the Llanos of Caldera were reached, where Catasetums and the swan orchid (Cycnoches) are indigenous. Passing over the Continental Divide (5000 feet) we could see Caldera in the distance, but in the drop to Caldera one had to penetrate some very narrow trails, and after riding 4½ hours we found that we had missed the trail. Finally, about three hours later, we arrived at the home of Gonzales, to whom we presented our letter of introduction and were welcomed to truly native life. The family consisted of Grandma, who 'didn't know how old she was because the padre lost the book,' Mr. Gonzales and his young wife and two children, none of whom possessed shoes or stockings. We were ready for lunch, so Grandma placed a table under one of the large fig trees. As soon as we began on our provisions we were joined by four half-starved dogs, a half dozen pigs, and about thirty chickens, all of which were running between our legs and under the table, having a battle royal as to which was to have the crumbs. During this time Grandma, in a squatting position in front of the fire, had made us some hot coffee. This was prepared by roasting the beans over the fire until they were charred, and then adding water, and boiling. The drink was as black as your hat and tasted like charcoal.

"Feeling somewhat refreshed we inquired the distance to Caldera and were told it was about 1½-hour's ride. So we again mounted our horses for the village, which proved to consist of a dozen native huts and very few orchids. Since the best region for collecting was evidently back in the region of Gonzales' home, we turned about, arriving at the hut at seven o'clock. We had spent twelve hours in the saddle and had practically no orchids. Grandma evidently anticipated our return, for she had prepared a boiled chicken (a great delicacy), so during the meal there were bones much to the delight of the fighting dogs, pigs, and chickens. At eight o'clock we were ready to retire. Grandma took us in the house, which was built of palm leaves, cane, and mud—one room only with a dirt floor, two doors, no windows. The

beds consisted of an L-shaped box built along one side and the end of the room, devoid of bed-clothes. This affair took care of Grandma, our guide, and Mr. Hunter. My eye caught sight of a native folding-bed, made of canvas stretched between two sawbucks, which when opened up was four feet from the ground, and this I appropriated. The family sat down on the doorstep, evidently waiting for us to go to bed, so after removing our shoes and puttees we opened up our blankets and crawled in. Gonzales evidently went out to secure his bed for in a short time we heard it being dragged to our bed-chamber. This proved to be of cowhide, and after a little trouble it was pulled through the narrow doorway and spread on the floor between Hunter and myself. Mother, father, and two children, after securely closing the two doors, retired to the cowhide for rest. The air soon became rather close and then strange noises came to my ears which sounded like something flying, and about that time a large cock-roach landed on my nose. In my excitement my bed almost collapsed.

"Next morning we all got up in the darkness at 4 o'clock. At breakfast, as we were discussing the hunt for the swan orchid (Cycnoches), Catasetums were observed in quantities within easy reach, growing on the small trees, fence-posts, and rocks. After breakfast Hunter's sharp eyes noticed a plant stuck in the tree just outside the house and asked me if that was not the plant I was looking for. Grandma noticed my interest and assured us that there were plenty of them growing all around, which, by the way, is the customary reply when you are looking for any orchid. Nevertheless, we informed Grandma that it was the wrong kind that was so abundant all about us and explained what we were after. She evidently was very observant because she knew at once what we were talking about and was aware of the botanical difference between the Catasetum and Cycnoches. The pseudo-bulbs of the Catasetum possess spines at the apex formed by the veins of the deciduous leaves, whereas the Cycnoches with their cylindrical pseudo-bulbs do not have spines. About this time Gonzales appeared and suggested that we follow him to where the swan orchid grew. A two-hour hunt netted

us about five plants, although the Catasetums were plentiful. Upon our returning to the house Grandma was evidently disgusted with the results and ordered out the wife and children to scatter over the Llanos in different directions. Within an hour they were coming in from all sides with one or two plants apiece, Grandma in the distance holding up a superb specimen with pseudo-bulbs fourteen inches long. In all, we secured twelve excellent plants of Cycnoches. The return trip, due to the fact that Gonzales put us on the right trail, was made in 4½ hours. We appreciated the hospitality of these native people, which, under the conditions at their disposal, could not have been much more generous.

"Our next objective was the southwest side of the Vulcan (the extinct volcano of Chiriqui). We were fortunate in securing an introduction to Mr. T. B. Moeniche, who proved to be much interested in plant life and told us of many orchids growing in that section. His own collection established in the jungle adjacent to his residence was well worth studying. He owns and operates the best coffee finca in the Bouquete region. Everything from the planting and cultivating to the finished product is handled in the most up-to-date fashion. We arrived at the height of the coffee season, when the pickers were bringing in one ton of coffee beans a day for cleaning. Mr. Moeniche showed me several new varieties of coffee obtained by selection, one, which he intends for future development, being of a more dwarfed pendant habit and proliferous seeder. Seeds of this form were given me for the St. Louis Garden. In discussing the collecting of orchids in this area he suggested several trips which would necessitate a guide and he offered us his own Indian guide, Emiliano. However, Emiliano was not at hand at this time due to the fact that he was tracking three boys who had been lost for several days. We accordingly returned to Bouquete, Mr. Moeniche promising to send word to us when Emiliano returned. Three days later a messenger on horseback was sent to notify us to come up the following morning, and on our arrival Emiliano awaited us. He was very much excited because he had found the trail of the lost boys. This trail was turned over to other guides, and he returned to rest. The boys were fourteen, ten,

and seven years old, and they had been lost in the jungle for six days, the entire population in the meanwhile searching for them. Two days later, while returning over the trail on which the boys had been lost, the advance guides caught up with us, and a much-excited conversation took place. When translated, we learned that the boys had been found twenty miles away, the three huddled together and unconsciously moving their machetes as if still cutting their way through the jungle. When finally brought back on the backs of the guides the younger boy temporarily revived to tell that they had had nothing to eat but palm stems. It was questionable whether the older boys would survive. Emiliano, the previous day, had showed us where they had missed their trail, but to our untrained eyes the jungle at this point was nothing but an impenetrable thicket of ferns and we could not even distinguish a trail.

"Our two-day collecting trip was very successful, especially with regard to Lycastes, Acinetas and a few undetermined genera and species. We were also rewarded with a second batch of chinelas collected in a clearing at Alto Chicaro. One of the interesting parts of the trail penetrated an old clearing which had been abandoned. Emiliano, with Indian-like agility, started to run along the felled trees like a squirrel. Hunter and I, however, had on boots, and since the barkless trunks resembled greased poles, we made slow progress. The entire area was completely covered with vines and undergrowth, concealing the distance from tree to ground. Suddenly, Hunter lost his balance and dropped out of sight. Upon my asking him if he was all right, he replied, 'Yes, but it was a long drop, about fifteen feet.' Emiliano, on his bare feet, came tripping back to help Hunter up on the tree, and we again proceeded. After I too had slipped and fallen, Emiliano decided that we had better travel on the ground, so he rapidly began cutting a path under the trees while Hunter was extricating me from the vines. It was marvelous how this Indian could tunnel his way through the fallen timbers without losing his way, finally coming to the exterior, with the Caldera River 1000 feet below. We returned to Moeniche's place entirely satisfied with our two-day's collection. We were

wet to the skin and found the large open fireplace with a blazing fire very welcome. After a most delightful dinner the evening was spent discussing the orchids of that region with which Mr. Moeniche was quite familiar. He believes that there are still many new things to be collected.

"We now made our way back to Bouquete, feeling that we had covered this region fairly well, and packed our plants for shipment to Panama. With our longest trip still ahead of us, to the other side of the extinct volcano called the 'Vulcan', we left Bouquete immediately by the 'motor' for David. This return trip was interesting because the entire thirty miles is by gravity. We were fortunate in arriving at David, on the day the train left for Concepcion, twenty-five miles away. Here we passed the night and arranged for horses to take us the following morning to the Vulcan region. Up to this time I had been in perfect health and at the station that afternoon weighed 150 pounds, but four days later on the same scales I had dropped to 140 pounds, the result of a mild attack of dysentery. The trip to the Vulcan was through rich zones of orchids at an altitude of 4000 feet. With difficulty we secured a massive specimen of Pescatorea in full bloom, but as we were coming back the same way we left it alongside the trail, only to find on returning that it had been seriously damaged by the sun—a striking illustration of the fact that in nature these plants are not exposed to the sun during the hottest part of the day. We reached the Vulcan region after an 8½-hour ride, having risen from an elevation of 800 feet (Concepcion) to 5800 feet. This is a particularly rich region for *Trichopilia suavis,* and within two days we shipped several hundred plants back to Concepcion by mule-pack train. Returning to Concepcion the following morning we found our plants in the safe keeping of Sam, the Chinaman, who volunteered 'Plants velly good.' Securing cases from him the orchids were packed and with the help of a boy and a handcar we got them to the station in time to be booked through. In all, we had collected about 126 species of plants embracing 58 genera, and there are still 12 kinds of plants unidentified.

"Our forced return from this region, due to my condition, was unfortunate, as an army plane was to have been sent from

the Canal Zone to David a week later to take us back and we would have been spared the return trip. That night at David the landlady very sympathetically said 'Meestah Huntah, we are full tonight.' We told her that we would gladly sleep on the floor in the hall, but finally we were able to get a room with four other men. The following morning we left Pedregal on the cattle boat, and it was well named. In preparation for loading the animal's head is tied by a stout rope between its horns, a derrick is switched around hooked on to the rope, the half-wild animal is raised off its feet, when immediately it becomes as docile as a lamb. It is dropped down in the hold of the boat where, with its fellows, two rows with heads toward the water are formed, all securely fastened by the heads so that they cannot move. A hundred and fifty cattle were packed on the lower deck. Eighty heads of hogs were then run in on the same deck. These were permitted to find their own space between the legs of the cattle. With 300 chickens and a cargo of freight, not to mention the passengers, 'The David' left Pedregal for Balboa. I was informed by a Panamanian friend that the boat was called 'Noah's ark.' "

NOTES

The "Scientific American" for May, 1927, contains an article by Dr. George T. Moore, Director of the Garden, on "Smoke".

Dr. B. M. Duggar, Physiologist to the Garden, was one of the two botanists elected to membership in the National Academy of Sciences, at its annual meeting, at Washington, D. C.

The annual flower sermon, provided for in Henry Shaw's will to "commemorate the Goodness of God as revealed in flowers," was preached on May 15, at Christ Church Cathedral, by the Rev. Frank Du Moulin, D. D., of Philadelphia.

Dr. J. M. Greenman, Curator of the Herbarium, attended the annual meeting of the Illinois Academy of Science, at Joliet, April 29, and presented a paper on "Early Botanical Collections in Illinois."

At the bicentenary celebration of the American Philoso-

phical Society, at Philadelphia, Dr. George T. Moore, Director of the Garden, gave an illustrated talk, April 29, on "The New Tropical Station of the Missouri Botanical Garden, at Balboa, Canal Zone."

Mr. Paul A. Kohl, Floriculturist to the Garden, spoke before the Matrons' Literary Club of Madison, at Edwardsville, Illinois, May 14, on "Iris and Roses."

Dr. Hermann von Schrenk, Pathologist to the Garden, gave a talk on "Gardens" before the Garden Club of East Orange, New Jersey, on April 27.

Recent visitors to the Garden include Mr. E. J. Palmer, of the Arnold Arboretum; Professor L. H. Bailey and Miss Ethel Bailey, of Ithaca, New York; Mr. Ralph W. Shreve, of Farmington, Arkansas, a member of the American Iris Society; Dr. George R. Hill, Director of the Department of Agricultural Research, American Smelting and Refining Co., Salt Lake City, Utah; and Mr. John Monteith, Jr., associate pathologist, forage-crop diseases, United States Department of Agriculture.

The following talks have been given recently by Mr. George H. Pring, Horticulturist to the Garden: "Effect of Smoke upon Plants," May 2, before the Parkview Improvement Association; "Collecting Orchids in the Chiriqui Region of Panama," May 3, before the Men's Club of the Clifton Heights Presbyterian Church, May 5, before the St. Louis Architects' Club, and May 11, before the Women's Club, of Belleville, Illinois.

STATISTICAL INFORMATION FOR APRIL, 1927.

GARDEN ATTENDANCE:	
Total number of visitors	25,572
PLANT ACCESSIONS:	
Total number of plants and seed packets received as gifts	1569
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	42
Total number of books and pamphlets donated	129
HERBARIUM ACCESSIONS:	
By Gift—	
Churchill, Hon. Joseph R.—Plants of United States	217
Epling, Dr. Carl C.—Cultivated plant	1
Kellogg, John H.—Plants of Gray Summit, Missouri	10
Larsen, Miss Esther L.—Plants of Missouri	2
Mathias, Miss Mildred—Plants of Missouri	20
Overholts, Dr. L. O.—Plants of Missouri	3
By Exchange—	
Drushel, Prof. J. A.—Plants of Massachusetts, New York, Texas, and Washington	8
Iowa State College, by Prof. L. H. Pammel—Plants of the United States	221
Payson, Dr. Edwin B.—Senecios of Wyoming	10
U. S. National Museum—Miscellaneous duplicate herbarium specimens	102
By Purchase—	
Herter, Dr. Guillermo—Plants of Uruguay	330
Total	924

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and, while virtually a private garden, it was, except at certain stated times, always open to the public. By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the 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 of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises about 75 acres. There is now in process of development a tract of land of over 1,500 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a forest reservation, with the idea that possibly at some future time this may become the new botanical garden. About 12,000 species of plants are growing in the Garden.

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day and Christmas—week days from 8:00 a. m. until one-half hour after sunset; Sundays from December to April, 1:00 p. m. until sunset; from April to December, 2:00 p. m. until sunset.

The main entrance to the Garden is located at Tower Grove avenue and Flora boulevard, on the Vandeventer avenue car line. Transfer south from all intersecting lines. The Garden may also be reached by Bus Route No. 12, to which all other motorbus lines transfer.

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TROPICAL GARDEN, BALBOA, CANAL ZONE

C. W. POWELL,
Manager

Missouri Botanical Garden Bulletin

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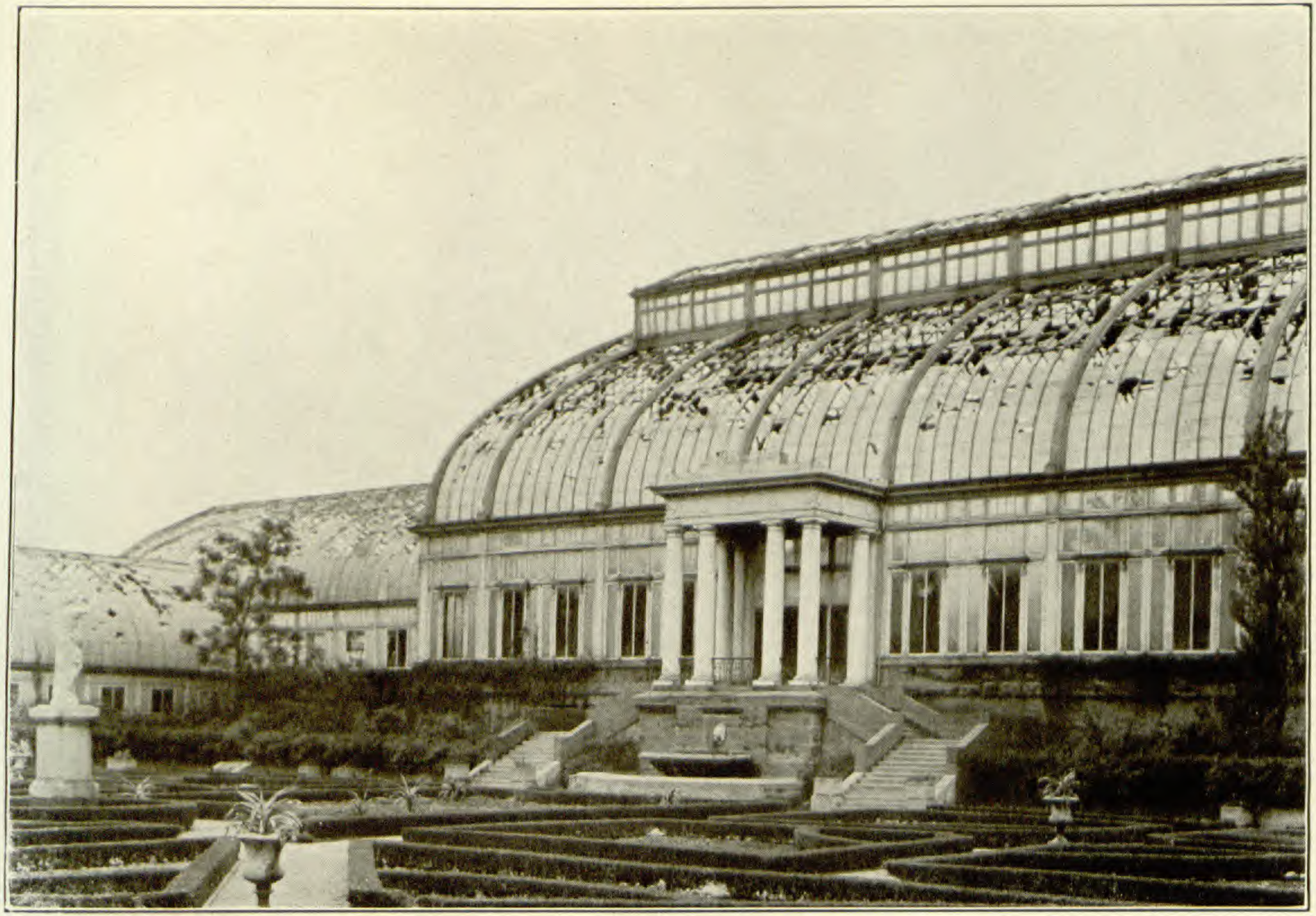

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THE HAILSTORM OF MAY 28, 1927

No storm in the history of the Garden, not even the cyclone of May 27, 1896, did so much damage to the greenhouse and tropical plants as the hailstorm on Saturday, May 28, at 3:00 P. M. Most of the destruction from the cyclone was on the outside and consisted of uprooting and breaking branches of trees and shrubs, and very little damage was done to buildings and greenhouses within the Garden. The outdoor destruction by the present storm was negligible, only a few walks being washed out and a few trees, principally the flowering branches of the tulip trees, being broken. The lawns showed thousands of holes, some of them four inches deep, caused by the force of the hailstones. A wind storm during the early part of the month did more outdoor damage than the hailstorm, either disfiguring or permanently destroying about two hundred trees varying in size from saplings to some of the largest specimens in the Garden. A notable loss was to the large Scotch elm, at the northwest corner of the old Shaw residence, of which one of the main terminal branches over a foot in diameter was broken off. This tree was the most perfectly shaped specimen of its kind in the Garden. The soft-wooded trees, such as maple, poplar, and sycamore, suffered the most damage.

The hailstorm, which lasted but fifteen minutes, gave no warning, the gardeners not having sufficient time to even close the ventilators on the greenhouses. The writer, who had just passed through the floral display house where the fuchsia exhibit had that afternoon been opened to the public, entered the tunnel under the fern house, and started up the

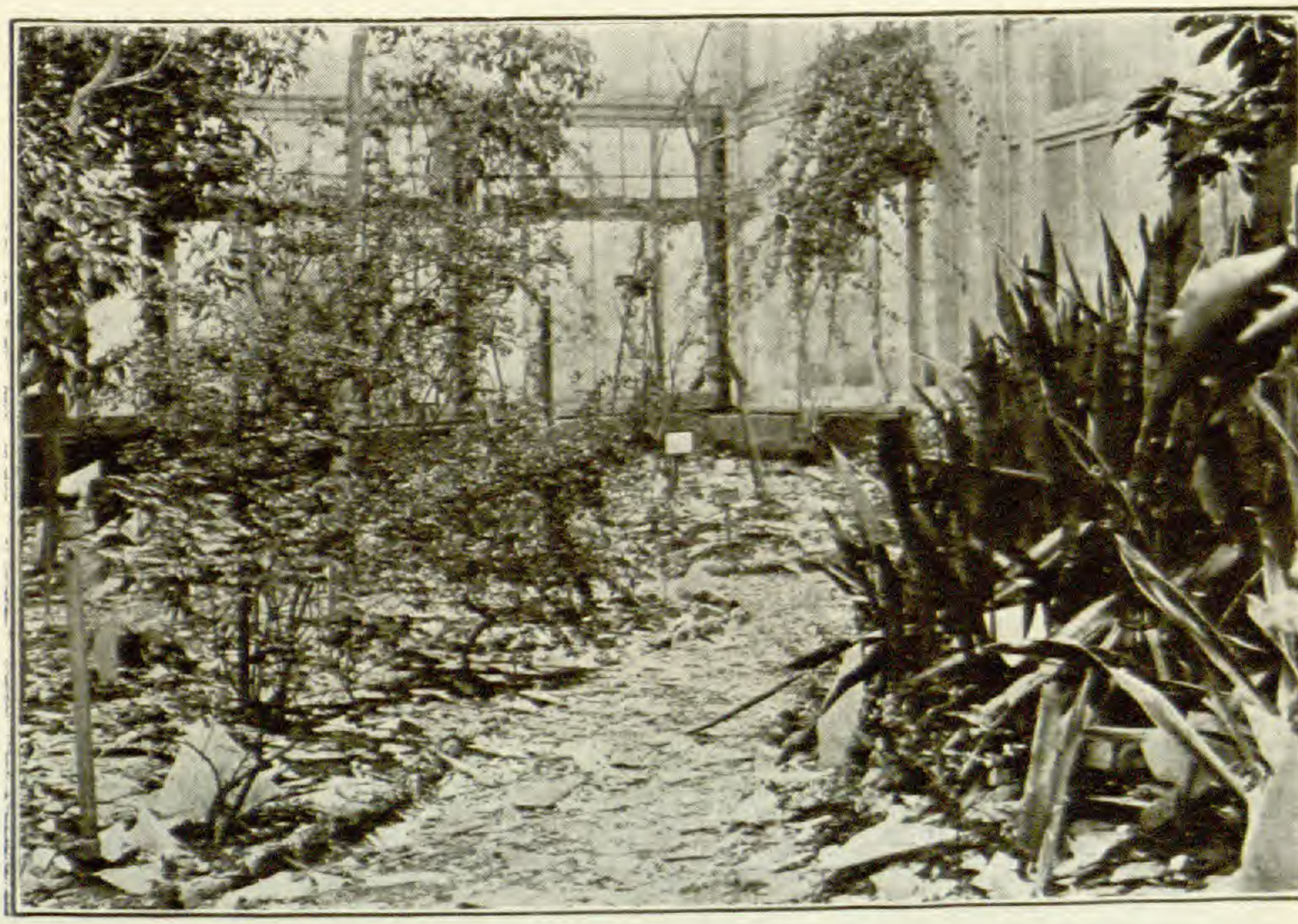
steps of the cycad house. Upon entering the tunnel no sign of a storm was visible except the clouding of the sky, but when starting up the cycad house steps leading to the fern house the barrage started. He immediately ran back to the tunnel and standing in the doorway watched the glass roof give way under the pelting hail, cutting leaves and decapitating plants in its downward path. The noise was deafening. Within fifteen minutes practically all the glass on the roof was destroyed except the first three rows of curved glass at the side. Half of the broken glass was left on the sash bars, temporarily held by the putty, the pointed triangular ends hanging loosely and making it impossible to enter the houses in safety. A hurried trip to the outside disclosed twenty visitors in the west and east vestibules of the palm house. Fortunately no visitors were hurt which under the circumstances was rather remarkable. Had the storm occurred a week earlier during the spring show of the Garden Club of St. Louis, the houses would have been crowded and many people would certainly have been injured.

All greenhouses were closed immediately after the storm and locked from the outside. Falling glass continued to rain down for several days, making it unsafe to enter the larger houses. The hailstones, ranging in size from a small pebble to a large ball and weighing from a few ounces to over a pound, had come down perfectly straight, and, since there was no wind, none of the glass on the sides of the houses was broken.

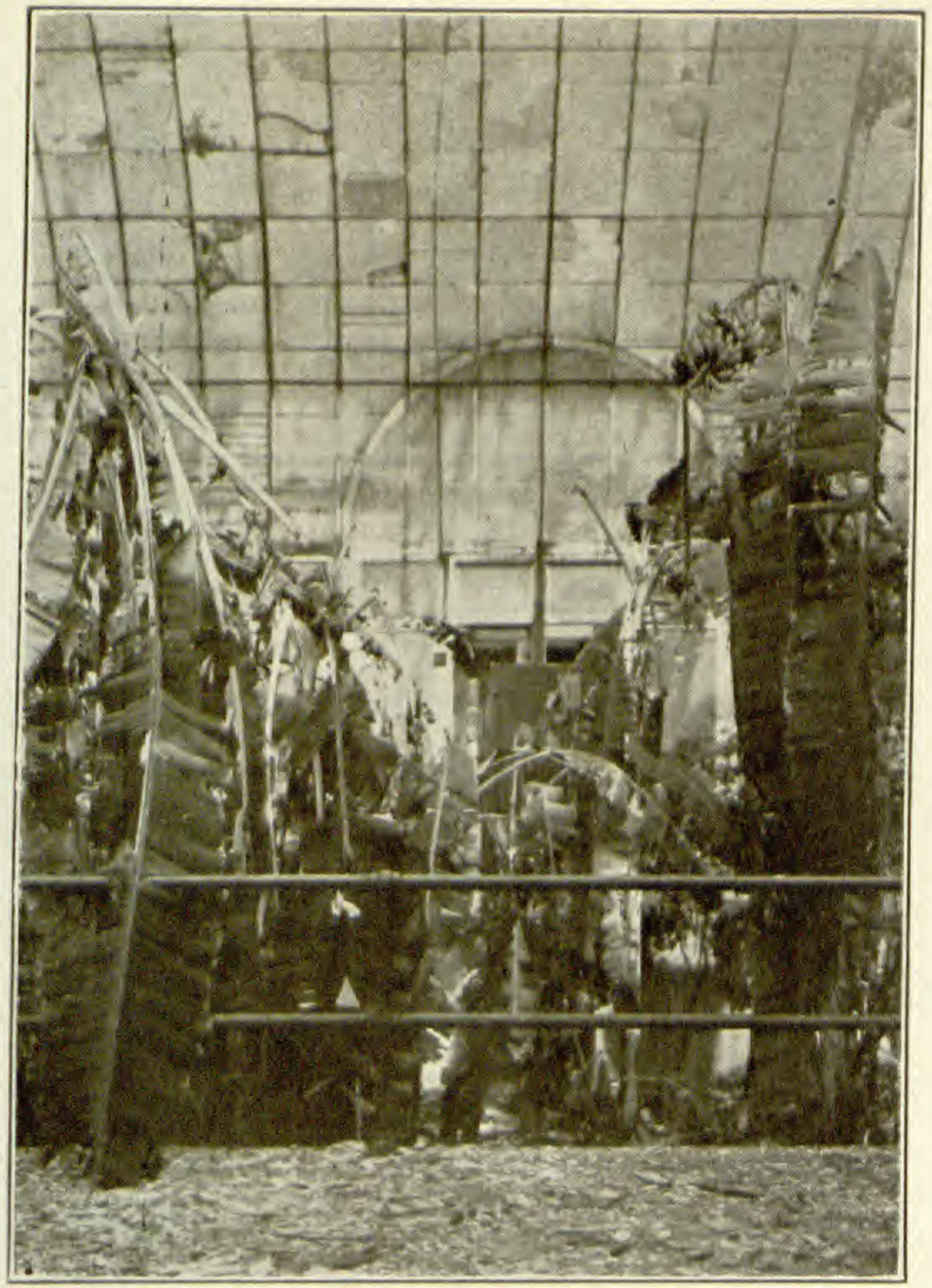
All available men on duty at the time were concentrated on reglazing the small seedling orchid house to prevent a sudden lowering of temperature. The hail had broken through the glass roof and the glass frames below, breaking ten flasks containing seedlings. The following day, Sunday, all employes were at work removing the broken glass from the small houses. The men worked from the roof with poles, punching in the broken glass, to be later picked up by hand. This latter task will not be completed for over a month.

Palm House.—There is not a single specimen in the palm house that entirely escaped damage. Several of the date palms have lost as many as fifteen leaves each, severed as

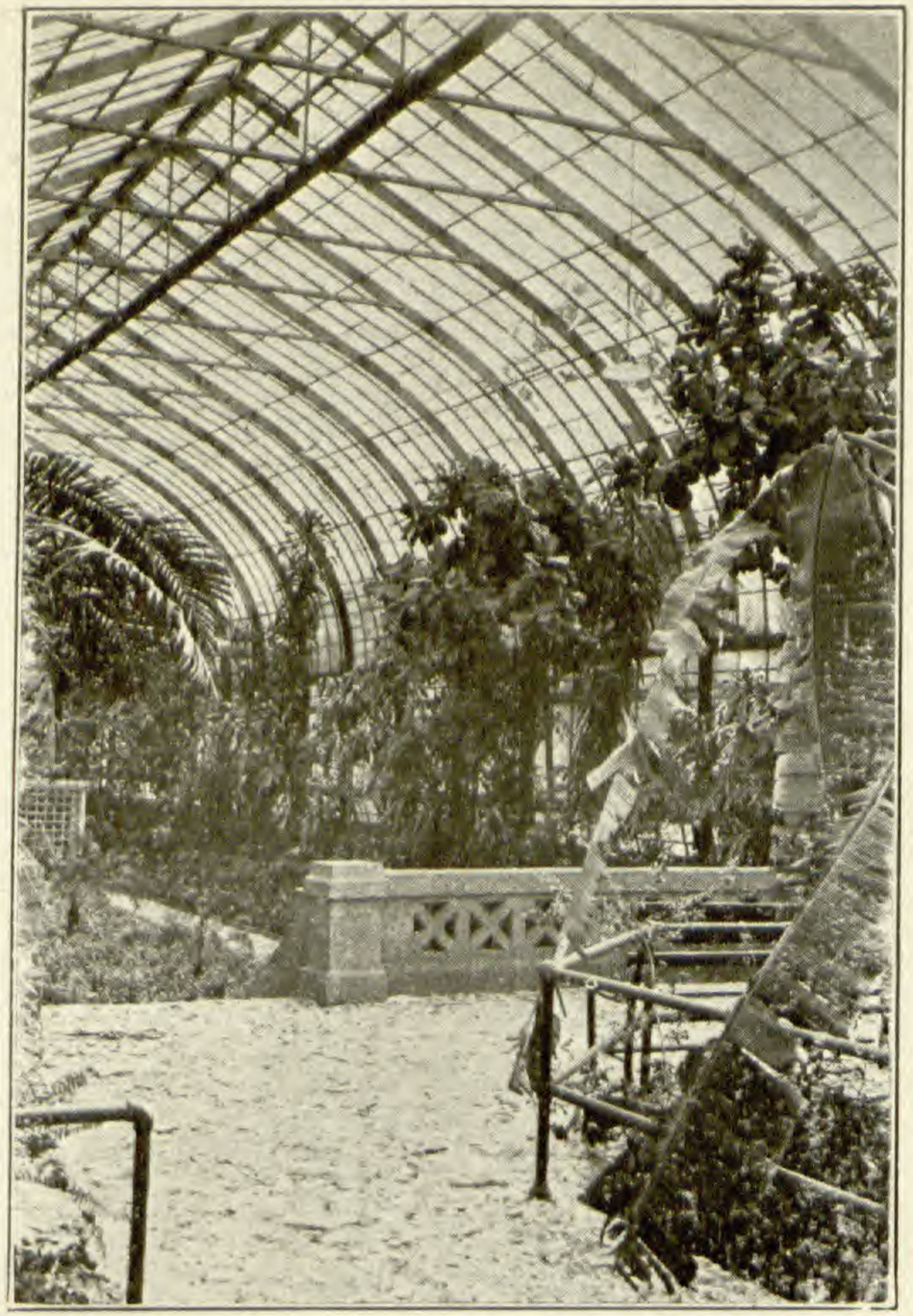
INTERIOR OF AROID HOUSE



INTERIOR OF ECONOMIC HOUSE



BANANA DOME IN FLORAL DISPLAY HOUSE



FLORAL DISPLAY HOUSE FROM BANANA DOME

cleanly as if cut with a knife. Even the sabal palms, with their massive fan-shaped leaves supported by petioles several inches in diameter, did not withstand the impact of falling glass, and one specimen was entirely denuded of foliage. The oil palms which were raised from seed at the Garden in 1912 and possessed leaves upwards of fifteen feet in length were seriously disfigured, one specimen losing ten leaves. The tall-growing *Cocos plumosa,* with pendant leaves some twenty feet long, was completely defoliated, only the main trunk with its terminal shoot being left. The small royal palm, growing on the west side of the exit, was entirely cut through six feet from the ground. All the clumps of *Chrysalidocarpus lutescens* have lost most of their leaves. Our only specimen of *Jubaea spectabilis,* despite being shielded by a large date palm, has lost four out of eight leaves. The large specimen wax palm has lost four of its six massive glaucous leaves. The four large clumps of the rattan palm were almost defoliated. The armor palm, despite its protection of rigid spines, succumbed to the cutting edges of the glass. The soft-stemmed devil's tongue, of which twenty plants were raised in 1914 and planted out for development, have all been cut through at the leaf stem. The large tubers, however, should produce new growth next year. Our only specimen of *Cocoloba grandiflora,* possessing three large peltate leaves three feet across, was practically ruined. However, although the condition of this house appears hopeless at present, very few terminal shoots have been destroyed and with careful attention the plants should outgrow their mutilated appearance within three years.

Fern House.—It is sufficient to say that the loss in the fern house will necessitate entire replanting. The following genera have been denuded of leaves: Asplenium, Aspidium, Polypodium, Dicksonia, Cibotium, Davallia, Pteris, Nephrodium, Alsophila, and Nephrolepis.

Cycad House.—Fortunately most of the plants in the cycad house had finished their new growth and the leaves had developed the characteristic pendant appearance. The upper leaves were broken but the lower whorls were sufficiently protected to escape. After the removal of broken glass and

leaves the damage, from the visitor's standpoint, will not be so evident. The new growth next spring will cover to a considerable extent this year's damage, particularly since the leaves are cut off annually. All the ground planting, however, was destroyed. The genera showing the most damage are Dioon and Cycas, while the leathery-leaved genera, such as Zamia, Ceratozamia and Encephalartos, escaped.

Succulent House.—In the succulent house the true cactus plants possessing numerous rigid whorls of spines, such as the hedge-hog cactus, the organ-pipe cactus, Cereus, etc., were injured but little, due to their protective armor. The grafted cacti, displayed in the vestibule, especially Rhipsalis, Epiphyllum, etc., were practically destroyed. The fleshy succulents, such as the Euphorbias, Crassulas, etc., were badly mutilated. The Agaves, with their flat-spreading whorls of leaves, made a catch-all for falling glass which will show many scars in addition to the initials cut by visitors.

Economic House.—Generally speaking, the plants in the economic house did not suffer to any great extent. The trees showing most injury were tapioca, milk bush, Singapore cedar, coffee, Bauhinia, avocado pear, mango, Ficus, beefwood chicle, and bowstring hemp. All the plants will require careful pruning to bring them back into shape for new-growth development, since many branches were broken or split.

Linnean House.—The plants in the Linnean house showed the least damage. After pruning the broken branches and removing the glass from the beds and walks the injury was not very noticeable. The plants most affected were the camellias, of which many split lateral branches had to be removed. This greenhouse is now open to visitors.

Floral Display House.—The fuchsia exhibition, which had just been opened to the public in the floral display house, was totally destroyed. The large banana trees, with their extremely succulent stems and leaves, readily succumbed and presented a doleful appearance. The young tender Kentia palms used as decorative plants in connection with the various flower shows throughout the winter and summer were considerably damaged. The border planting which formed

INTERIOR OF PALM HOUSE

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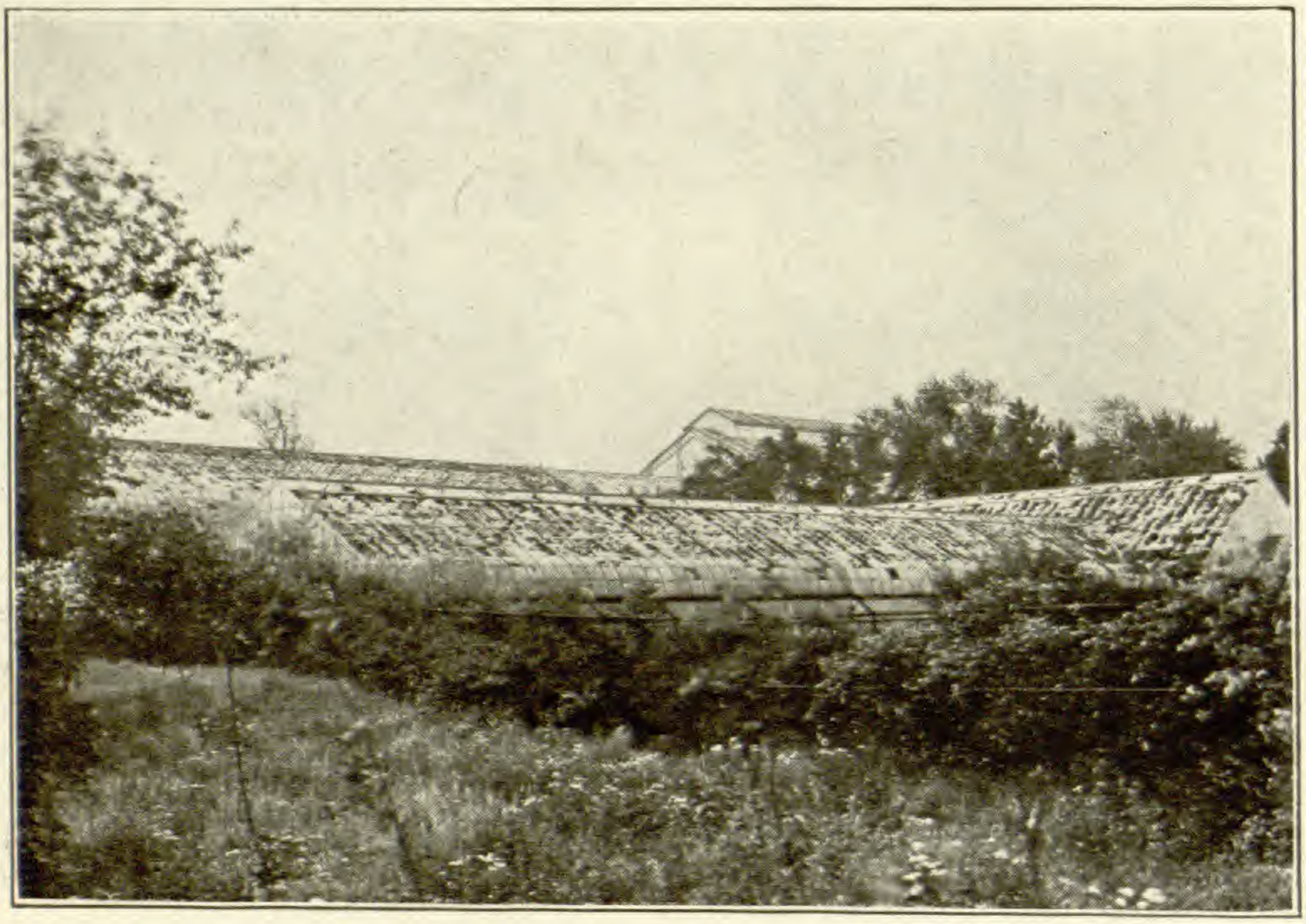
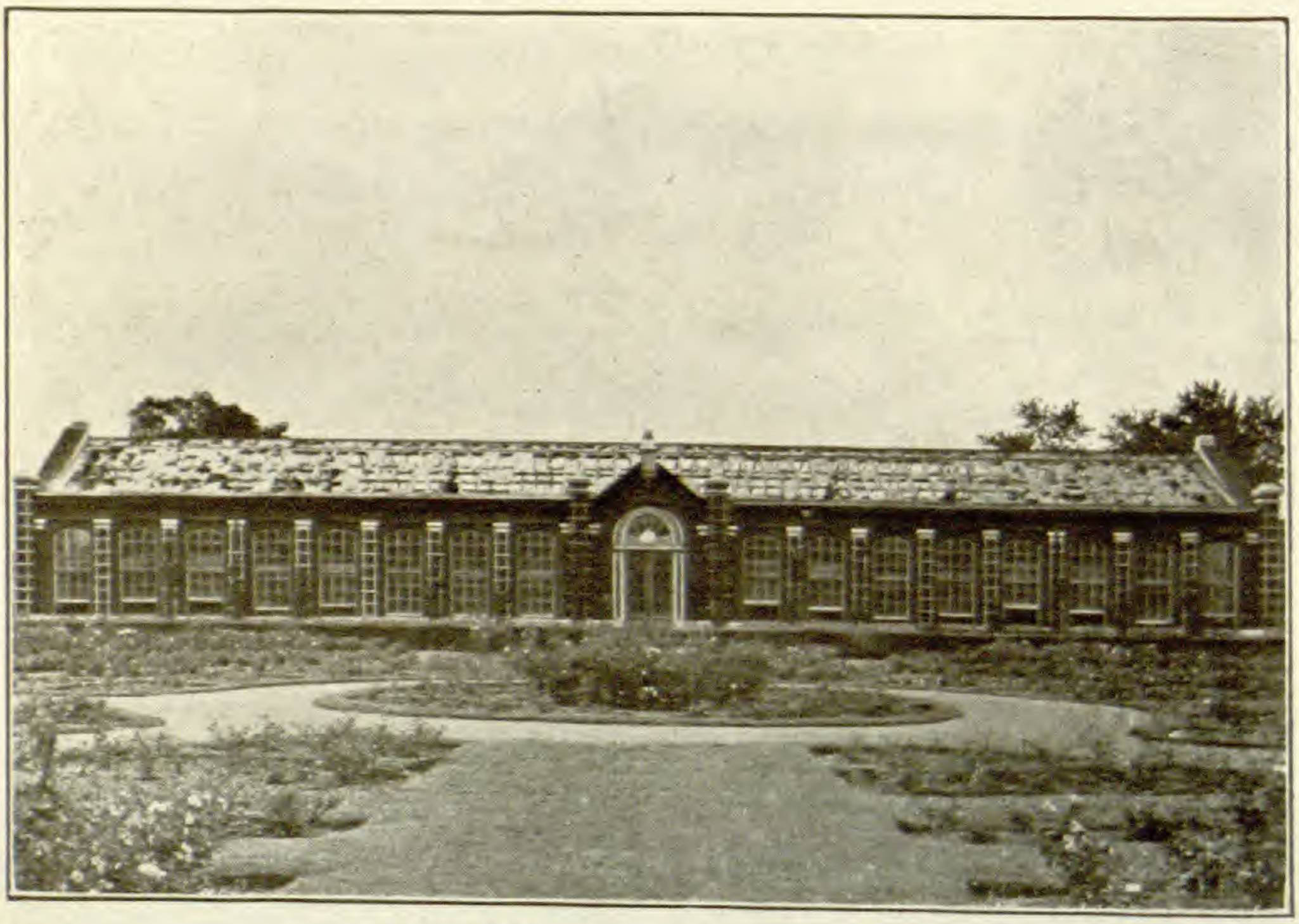


PROPAGATING HOUSES



EXTERIOR OF LINNEAN HOUSE

a green screen around the interior of the house was but slightly injured.

Aroid House.—Like the fern house, the injury in the aroid house will necessitate entire replanting. The plants in most cases were cut to pieces, especially those belonging to such genera as Philodendron, Dieffenbachia, Anthurium, and Schismatoglottis. One large specimen, *Philodendron Meliononi,* which had been in the Garden collection since 1912 and had about eighteen leaves, was completely defoliated. The two specimen plants of *Strelitzia Reginae* are now represented only by their bare stems. The Marantas and Calatheas were likewise destroyed. The sudden drop in temperature was also a factor in the injury to these plants.

Citrus House.—Most of the plants in the citrus house will require pruning and heading back to shape up the specimens while awaiting new growth. Generally speaking, the plants here have not suffered to any great extent.

Bromeliad House.—The epiphytes in the bromeliad house caught much falling glass. After the glass had been removed from the rosette-like growths most of the colored and variegated leaves were found to be injured. However, next year's growth which develops from the base will permit the removal of this year's disfigured leaves. Most of the rarer varieties have been placed under a lath house to prevent sunburn.

Forced Fruit House.—The grape vines and nectarine and peach trees, though well filled with fruit, were not injured to any extent by falling glass. However, the sudden change in temperature caused the dropping of the green peaches and nectarines. The birds were highly delighted to find grapes at their disposal so early in the season.

Propagating House.—Fortunately over half of the bedding plants had already been set outside and, while those remaining in the house were injured, the damage was practically no more than a pinching back to produce lateral growth. The chrysanthemums, especially the single-stemmed varieties, had some of the terminal growths broken. The bush plants will not suffer to any great extent, since their major growth is

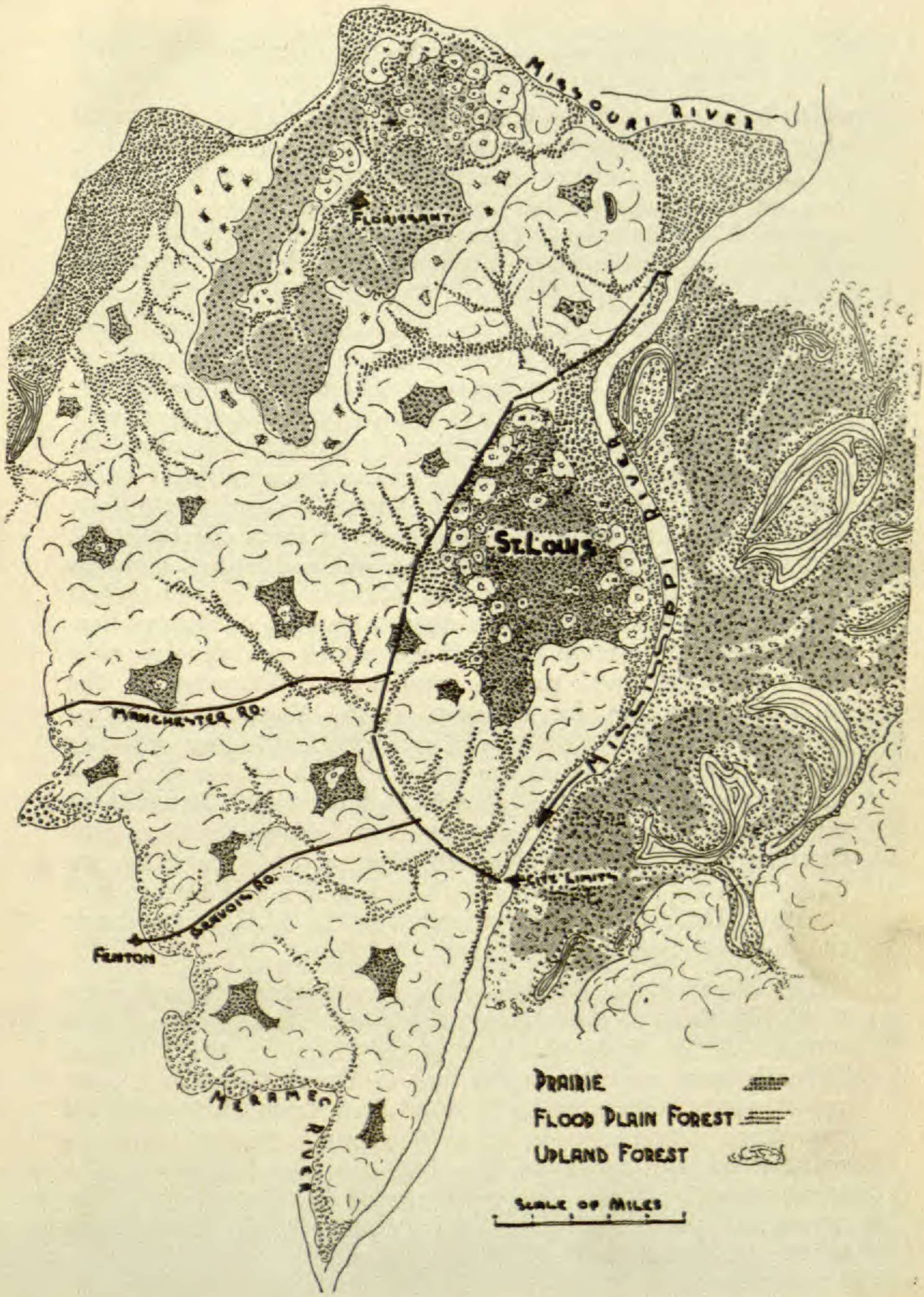
made outside after planting in nursery rows. The water-lilies received their share of cut leaves, the Victorias especially, but the damage is only temporary. All lilies have since been planted in the outside pools. The medicinal plants which were being grown for the new garden received many cuts and bruises, but no loss of species has been noticed.

Storage Lean-to.—All the palms stored in the lean-to house for the winter had fortunately been removed to the English garden early in the week. Not one leaf from the entire collection showed the slightest injury by hail, despite the fact that they received the full force of the storm, plainly indicating that all the damage to plants in the greenhouses was from falling glass.

In addition to the damage to the contents of the greenhouses indicated above, about 20,000 lights of glass will have to be replaced. Advantage will be taken of the opportunity to repaint, replace old mullions, and make similar repairs. Some fundamental changes will likewise be made in the roof which will reduce maintenance expenses in the future, and certain long-contemplated improvements in the arrangement of the planting in various houses will likewise be made at this time. Were it not for the heavy expense involved, the storm might not be regarded as a complete disaster, since it is believed that when everything is finished the range of houses with their contents will be more satisfactory and useful than ever before. Fortunately the large and valuable collection of orchids was moved to Gray Summit last summer, and no loss was sustained on these plants.

THE LANDSCAPE OF ST. LOUIS IN 1727

Two hundred years ago the St. Louis area was a part of an unbroken wilderness. The River des Peres, a limpid stream, flowed through a thick forest of elm and sycamore. A park-like oak forest grew on the bluffs above the Mississippi, and much of to-day's business district was an open prairie through which herds of buffalo came down to the river to drink. It is a fascinating task to piece together the bits of evidence

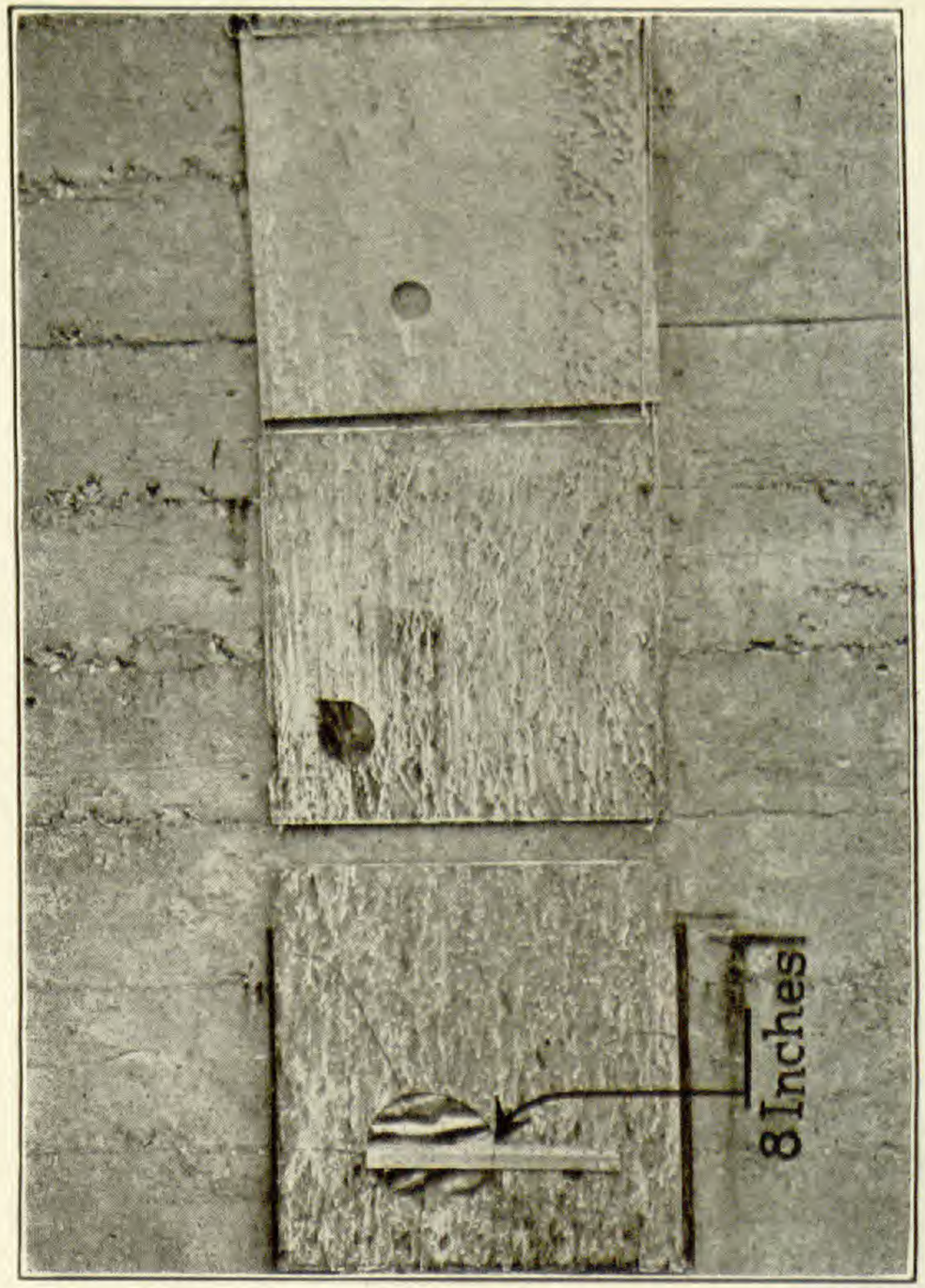

Missouri River
Florissant
St. Louis
Mississippi
Manchester Rd.
City Limits
Gravois Rd.
Fenton
Meramec River
Prairie
Flood Plain Forest
Upland Forest
Scale of Miles

which have survived the last two centuries and to determine what must have been the aspect of the country at that time. Two hundred years have indeed seen great changes. Prairie fires are no longer set by the Indians to flush the game in the fall; the forests have been cut, the land tilled, and over a million people live where there was then but an occasional Indian.

It may seem surprising that at this late day we could have any certain proof as to what areas about the city were originally forest and what were prairie. There are, however, several lines of evidence, and they support each other so consistently that their clues may be pieced together with some degree of confidence. There are of course the reports of early visitors to the region, and several of these are quite complete. Some of the most exact data are gleaned from old law-suits over land titles, in which numerous old residents testify as to the nature of the territory. In addition to these historical records, there are the even less disputable ones of Nature herself. There are certain types of soil which can develop only under long-continued prairie conditions. Wherever in the St. Louis area (as, for instance, at the Missouri Botanical Garden) we find these kinds of soil existing to-day, we may state with confidence that the area had been a natural prairie for some years before the advent of civilization. From these several sources, we find that there were originally three outstanding types of vegetation in this region. To these we have given the names Flood-Plain Forest, Upland Forest, and Prairie. Their original distribution in the St. Louis areas is shown on the accompanying map.

The Flood-Plain Forests.—The river-bottom forests were much like those of the present day except that the trees were larger. A few isolated areas of this type in the Missouri River bottom, near the north end of Creve Coeur Lake, remain even to-day practically unaltered from their original condition. Prominent in these flood-plain forests were the cottonwood, the sycamore, the bur oak, the hackberry, the honey locust, and the elm. Forests of this nature lined the rivers and creeks and extended over much of the flood plains of the Mississippi and Missouri Rivers.

INTERIOR OF LINNEAN HOUSE



HOLES IN GLASS MADE BY SINGLE HAILSTONES

The Upland Forests.—The vegetation of the uplands was quite different from that which we know to-day, even in uncultivated spots. Prairie fires set by the Indians kept down the underbrush and helped in maintaining the areas of prairie which were scattered through the forests. The forests themselves were consequently much more open than those we know to-day, the early travelers referring again and again to their park-like nature. Take, for instance, Henry Schoolcraft's account of his walk from the Le May ferry on the Meramec River to the town of Carondelet:

> "July 27th (1818). We were again on our path at an early hour, and soon passed out of the fertile and heavily timbered valley of the Meramec. There now commenced a gentle ridge running parallel to the Mississippi River for twelve miles. In this distance there was not a single house, nor any trace that man had bestowed any permanent labor. It was sparsely covered with oaks, standing at long distances apart, with the intervening spaces profusely covered with prairie-grass and flowers. We frequently saw deer bounding before us; and the views, in which we sometimes caught glimpses of the river, were of a highly sylvan character. But the heat of the day was intense, and we sweltered beneath it. About half-way we encountered a standing spring in a sort of open cavern at the foot of a hill and stooped down and drank. We then went on, still 'faint and wearily' to the old French village of Carondelet, which bears the sobriquet of 'Vide-pouche' (empty sack). It contains about sixty wooden buildings, arranged mostly in a single street. Here we took breakfast."

The Prairies.—Between the prairies and the forests there was no sharp line of demarcation. Patches of grassland occurred throughout the forests, and isolated trees or groups of trees were a common feature of the prairies. When St. Louis was first settled there was a thick growth of woodland extending up from the river to about the site of Broadway. Back of that, except along the water-courses, were extensive prairies, reaching at least as far west as Kingshighway. During the Spanish administration, much of this land was held as "common fields" by the villagers of the little settlement. They tilled the open ground and let the rest remain as it was —a wild tangle of hazel bushes, wild plum thickets, and blackberry bushes.

One of the most complete descriptions is given by Brackenridge, who visited St. Louis in 1811:

> "On ascending the second bank which is about forty feet above the level of the plain we have the town below us and a view of the Mississippi in each direction, and of the fine country through which it passes. * * * Looking to the west, a most charming country spreads itself before us. It is neither very level nor hilly, but of an agreeable waving surface, and rising for several miles with an ascent almost imperceptible. Except a small belt to the north there are no trees, the rest is covered with shrubby oak, intermixt with hazels, and a few trifling thickets of thorns, crab apple, or plum trees. * * * A number of fine springs take their rise here, and contribute to the uneven appearance. The greater part fall to the S. W. and aid in forming a beautiful rivulet, [the present Mill Creek sewer!] which a short distance below the town gives itself to the river. I have often delighted in my solitary walks, to trace this rivulet to its sources. Three miles from the town but within view amongst a few tall oaks, it arises in four or five silver fountains within short distances of each other, presenting a picture to the fancy of the poet or the pencil of the painter. I have fancied myself for a moment on classic ground and beheld the Naiads pouring the stream from their urns."

The land now occupied by the Missouri Botanical Garden was originally a part of these prairies. Mr. Shaw has described its appearance at his first visit to it as follows:

> "When the writer first visited these grounds in 1820, they were called 'La Prairie de la Barriére à Denoyer' from Louis Denoyer who formerly lived at, and kept, the gate of the fence (barrière), by which the commons of the old village of St. Louis were surrounded. For a short distance of nearly two miles from where Tower Grove Park is now laid out * * *, no trees were growing except two or three venerable cottonwoods (*Populus canadensis*) on the watercourse running to Rock Spring and thence to Chouteau's Millpond, and a clump of hazel bushes on the rising ground, where the grove of the Garden now exists. The prairie was grown over with a tall natural grass, Andropogon, prairie grass, with an occasional patch of the wild strawberry (*Fragaria Virginiana*)."

By 1836 the prairies outside the town had practically disappeared, as we learn from Flagg's "Far West," page 162:

> "The face of the country is neither uniform nor broken, but undulates almost imperceptibly away, clothed in a dense

forest of black-jack oak, interspersed with thickets of the wild-plum, the crab-apple, and the hazel. Thirty years ago this broad plain was a treeless, shrubless waste without a solitary farmhouse to break the monotony. But the annual fires were stopped; a young forest sprang into existence; and delightful villas and country seats are now gleaming from the dark foliage in all directions. * * * The woods abound with game of every species: the rabbit, quail, prairie-hen, wild-turkey, and the deer; while the lakes, which flash from every dell and dingle, are swarmed with fish."

While scattered prairies occurred throughout the forest, at only two other points were they so large and numerous as to call forth special comment from early visitors. These two regions were the Florissant Valley and the American Bottoms. The charms of Florissant (originally known as Ferdinand) were sung by every traveller. Major Stoddard described its appearance in 1804 as follows:

"About fourteen miles to the north west of St. Louis is the small village of Ferdinand. It contains about sixty houses; most of them are situated on a rising ground, at the foot of which is a considerable stream of pure water, and on the opposite side is one of the most fertile and valuable prairies in the country. The inhabitants of this village are also Creoles and Canadians. The inhabitants of all the compact villages are of this description: But the extensive settlements about the country have been made by the English Americans; these form about three-fifths of the populations, and perhaps more. * * * The prairie in the vicinity of St. Ferdinand is about twelf miles long and two miles broad. It extends nearly parallel to the Missouri River and from one to two miles from it. The plantations on each side of this prairie are so laid out as to embrace suitable portions of it, as also the necessary woodlands. Considerable settlements are formed along the borders of it."

Even more glowing were the terms in which early travellers described those lands on the Illinois side of the Mississippi Flood Plain which are still known as the American Bottoms. The following account from Flagg's "Far West" has been somewhat abridged:

"Descending, I was upon the AMERICAN BOTTOM. This name was a distinction given when it constituted the extreme limit in this direction of the Northwestern Territory. Extending northward from the Kaskaskia river

to the confluence of the Mississippi and the Missouri, embracing three hundred thousand acres of land, of fertility unrivaled, it presents, perhaps second only to the Delta of Egypt, the most remarkable tract of country known. Its breadth varies from three miles to seven. Upon one side it is bounded by a heavy strip of forest a mile or two deep, skirting the Mississippi, and upon the other by an extended range of bluffs. The area between the timber-belt and the bluffs is comprised in one extended meadow, heaving in alternate waves like the ocean after a storm, and interspersed with island groves, sloughs, bayous, lagoons, and shallow lakes. The poisonous night-dews caused by these marshes, and the miasm of their decomposing and putrefying vegetation, occasion the far-dreaded 'fever and ague' not unfrequently terminating in consumption.

"As I journeyed leisurely onward over this celebrated tract, extensive and beautiful, the prairie was carpeted with the luxuriant richness of the golden rod and all the gaudy varieties of asters and the crimson-died leaves of the dwarf-sumac. Here and there stood out in loneliness upon the extended plain, one of those mysterious tombs of a departed race of mound builders."

FLORAL CLOCKS

Any one who has lived in a small town will remember the interest displayed by the community when some local gardener brought a "tropical night-blooming cereus" into flower. Friends were called in when the buds began to open, and an eager circle watched for an hour as the large waxen petals slowly unfurled. Among the hundreds who must have been present on such occasions, it is doubtful if more than one or two realized the every-day nature of the phenomenon. A night-blooming flower, or even one in which the petals open so quickly that the movements are perceptible to the eye, is not so great a rarity as the general public would believe. One of our commonest American plants, the evening primrose, *Oenothera biennis,* is quite as remarkable in this respect as the night-blooming cereus. Shortly after sunset its large yellow petals begin to unroll, almost imperceptibly at first, then gathering speed as the petals lose their hold on each other. Like the night-blooming cereus, the evening primrose

remains in flower during the night and closes the next morning.

He who has failed to notice the strict hours kept by this commonplace weed should not feel discouraged. He is in good company, for the great Linnaeus, father of modern Botany, was well along in his scientific career before a chance occurrence brought the phenomenon to his attention. He was at that time particularly interested in a legume from southern France, *Lotus ornithopodioides*. When it bloomed for the first time in the botanical garden at Upsala, he was so interested that he came back to the garden in the evening to look at the flowers. Strangely enough they had disappeared and he could not even find a trace of the bud. What was his surprise the next morning to find the plant again bearing two blossoms! He thereupon watched it carefully and found that the flowers closed at nightfall and that the leaves on the same stalk folded up like an umbrella and hid the bud. Thoroughly interested in the subject, he watched other flowers in the greenhouses and garden plots and found that many of them had definite times for opening and closing. There were, in fact, so many and they were so diverse in the hours they kept that he tried making up a collection of flowers, from whose opening and closing it would be possible to tell the time. The species used in this "floral clock" are listed below:

FLORAL CLOCK

3-5 A. M.

Vegetable-oyster (*Tragopogon pratensis*)

4-5 A. M.

Chicory (*Cichorium Intybus*)

Fall-dandelion (*Leontodon tuberosum*)

Andromeda (*Pieris hieracioides*)

5 A. M.

Common day-lily (*Hemerocallis fulva*)

Iceland poppy (*Papaver nudicaule*)

Common sow-thistle (*Sonchus oleraceus*)

5-6 A. M.

Crepis alpina

Rhagadiolus edulis

Dandelion (*Taraxacum officinale*)

6 A. M.

Hawkweed (*Hieracium umbellatum*)

Cats-ear (*Hypochaeris maculata*)

6-7 A. M.

Alyssum (*Alyssum utriculatum*)

Crepis rubra

Hawkweed (*Hieracium murorum*)

Hawkweed
(Hieracium Pilosella)
Field sow-thistle
(Sonchus arvensis)

7 A. M.

Anthericum ramosum
Pot-marigold
(Calendula pluvialis)
Garden lettuce *(Lactuca sativa)*
Dandelion *(Leontodon hastile)*
White water-lily
(Nymphaea alba)
Sow-thistle
(Sonchus lapponicus)

7-8 A. M.

Bearded fig-marigold
(Mesembryanthemum barbatum)
Mesembryanthemum linguaeforme

8 A. M.

Common pimpernel
(Anagallis arvensis)
Proliferous pink
(Dianthus prolifer)
Hawkweed
(Hieracium auricula)

8-10 A. M.

*Dandelion
(Taraxacum officinale)

9 A. M.

Pot-marigold
(Calendula arvensis)
Hawkweed
(Hieracium chondrilloides)

9-10 A. M.

Sandwort *(Arenaria rubra)*
Fig-marigold
(Mesembryanthemum crystallinum)
*Vegetable-oyster
(Tragopogon pratensis)

10 A. M.

*Chicory *(Cichorium Intybus)*
*Garden lettuce *(Lactuca sativa)*
**Rhagadiolus edulis*
*Field sow-thistle
(Sonchus arvensis)

10-11 A. M.

Fig-marigold
(Mesembryanthemum nodiflorum)

11 A. M.

**Crepis alpina*
*Common sow-thistle
(Sonchus oleraceus)

12 at noon

*Pot-marigold
(Calendula arvensis)
*Sow-thistle
(Conchus lapponicus)

1 P. M.

*Proliferous pink
(Dianthus prolifer)
*Hawkweed
(Hieracium chondrilloides)

1-2 P. M.

**Crepis rubra*

2 P. M.

*Hawkweed
(Hieracium auricula)
*Hawkweed
(Hieracium murorum)
*Bearded fig-marigold
(Mesembryanthemum barbatum)

2-3 P. M.

*Sandwort *(Arenaria rubra)*

2-4 P. M.

*Fig-marigold
(Mesembryanthemum crystallinum)

3 P. M.

*Dandelion *(Leontodon hastile)*
*Fig-marigold
(Mesembryanthemum nodiflorum)

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* The asterisk preceding the plant name denotes that the flowers close at the time indicated; those without an asterisk open at the time indicated.

*Fig-marigold
(Mesembryanthemum linguacforme)

3-4 P. M.

**Anthericum ramosum*
*Pot-marigold
(Calendula pluvialis)
*Hawkweed
(Hieracium Pilosella)

4 P. M.

**Alyssum utriculatum*

4-5 P. M.

*Cats-ear
(Hypochaeris maculata)

5 P. M.

*Hawkweed
(Hieracium umbellatum)
*Marvel of Peru
(Nyctago hortensis)
*White water-lily
(Nymphaea alba)

6 P. M.

Cranesbill *(Geranium triste)*

7 P. M.

*Iceland poppy
(Papaver nudicaule)

7-8 P. M.

*Common day-lily
(Hemerocallis fulva)

9-10 P. M.

Cactus grandiflorus
Night campion
(Silene noctiflora)

Midnight

**Cactus grandiflorus*

While this table is approximately correct, subsequent study has shown that a number of factors need to be taken into account if a reliable floral clock is to be constructed. Since the opening and closing of flowers is affected by many conditions, of which light and temperature are the most important, the time of sunrise and sunset need to be considered. In more southern latitudes where the sun rises later and sets earlier in the summer time than it does in Linnaeus' home in Sweden, many of the flowers on his list will open one or two hours later and close anywhere from one to six hours later than in his table. Since sunrise varies with the time of year that also must be taken into account. Investigation has shown that in the same species, blooming from March until May, flowers will open an hour earlier in May than in March. Another disturbing factor is the weather, for floral clocks, like sun-dials, are of no value on rainy days. The flowers of many of the plants in the table will close an hour or so before the approach of a thunderstorm ("weather plants").

Among the most accurate floral clocks ever constructed was that exhibited by Dr. Burgerstein of Vienna. It was based on the accurate investigations of Fritsch and von Kerner, made over a period of several years. During the Vienna Anniversary Exhibition of 1898 it worked well on clear and

dry days. The plants used by Dr. Burgerstein are listed below; as in the previous table an asterisk denotes that the flowers of the plant in question close at the time indicated, while those without an asterisk open at that time.

4-6 A. M.

Cucurbita Pepo
Papaver Rhoeas
Tragopogon pratensis

5-7 A. M.

Ampelopsis hederacea
Anthericium ramosum
Cichorium Intybus
Convolvulus Sepium
Erythraea centaurium
Helianthemum vulgare
Hieracium murorum
Lactuca sativa
Lapsana communis
Solanum tuberosum
Sonchus arvensis

6-8 A. M.

Convolvulus arvensis
Crepis barbata
Hieracium Pilosella
Lactuca perennis
Linum usitatissimum
Tussilago Farfara
**Lychnis vespertina*
**Oenothera biennis*

7-9 A. M.

Anagallis arvensis
Bellis perennis
Calendula officinalis
Campanula Trachelium
Caltha palustris
Cardamine pratensis
Crocus vernis
Galanthus nivalis
Leontodon Taraxacum
Oxalis Acetosella
**Nicotiana affinis*

8-10 A. M.

**Datura Stramonium*

9-11 A. M.

Adonis vernalis
Mesembryanthemum crystallinum
Ornithogalum umbellatum
Oxalis stricta
Veronica arvensis
Veronica Chamaedrys

11 A. M.-1 P. M.

**Lapsana communis*
**Sonchus arvensis*

12-2 P. M.

**Erythraea Centaurium*
**Lactuca sativa*
**Mirabilis Jalapa*

2-4 P. M.

**Cucurbita Pepo*
**Hieracium murorum*
**Tragopogon pratensis*

3-5 P. M.

**Anthericum ramosum*
**Lactuca perennis*
**Leontodon Taraxacum*
**Linum usitatissimum*
**Oxalis stricta*
**Solanum tuberosum*
**Tussilago Farfara*
**Verbascum Thapsus*

4-6 P. M.

**Anagallis arvensis*
**Convolvulus arvensis*

5-7 P. M.

Datura Stramonium
Mirabilis Jalapa
Nicotiana affinis
Oenothera biennis
**Adonis vernalis*

**Bellis perennis*
**Calendula officinalis*
**Cichorium Intybus*
**Convolvulus Sepium*
**Crepis barbata*
**Crocus vernus*
**Galanthus nivalis*
**Helianthemum vulgare*
**Mesembryanthemum crystallinum*
**Ornithogalum umbellatum*
**Papaver Rhoeas*
**Veronica arvensis*

6-8 P. M.

Lychnis vespertina
**Ampelopsis hederacea*
**Campanula Trachelium*
**Cardamine pratensis*
**Oxalis Acetosella*

8-10 P. M.

Ipomoea purpurea
Cereus grandiflorus
Cereus nycticalus
**Caltha palustris*
**Veronica Chamaedrys*

NOTES

Professor Delzie Demaree, professor of botany, University of Arkansas, visited the Garden Herbarium recently.

The members of the St. Louis Association of Gardeners were guests of the Garden, at the Gray Summit Extension, at their meeting, June 5.

Dr. George T. Moore, Director of the Garden, addressed the graduating class of the St. Louis Country Day School, at its commencement, June 9, on "The Evidence of Experience."

The March-April issue of "Parks and Recreation" contains two articles by Mr. L. P. Jensen, Arboriculturist to the Garden: one on "A Retrospective View on Parks," and one on "More State Parks for Missouri."

The first number of Volume XIV of the Annals of the Missouri Botanical Garden has been recently issued. It contains a paper by Esther L. Larsen on "A Revision of the Genus Townsendia," and one by Carl C. Epling on "Studies on South American Labiatæ. III. Synopsis of the Genus Satureia."

Word has been received at the Garden of the death of Dr. Edwin B. Payson, at Denver, Colorado, on May 15. Dr. Payson was formerly a teaching fellow at the Garden, and received his doctor's degree from Washington University in 1921. At the time of his death he was professor of botany at the University of Wyoming.

At the commencement of Washington University, June 7, degrees were conferred upon members of the graduate laboratory at the Garden as follows: Doctor of Philosophy, P. L. Gainey, Clarence

E. Kobuski, and David Carleton Neal; Master of Science, Martha L. Beardsley, Catherine M. Lieneman, Mildred E. Mathias, and Robert E. Woodson.

The St. Louis Florists met at the Gray Summit Extension, June 9, about 400 members and guests being present. Miss Elinor Alberts, Orchid Specialist to the Garden, spoke on "Growing Orchids from Seeds," demonstrating with plants in various stages, from material in flasks to flowering plants. Mr. G. H. Pring, Horticulturist to the Garden, discussed the new range of greenhouses, and Mr. William Langan, Engineer to the Garden, the heating system at Gray Summit.

Dr. C. C. Epling, formerly Rufus J. Lackland Research Fellow at the Garden, receiving his degree of doctor of philosophy from Washington University in 1924, visited the Garden recently. Dr. Epling has been granted a leave of absence from the University of California, Southern Branch, at Los Angeles, where he is instructor in botany, and has accepted a fellowship from the National Research Council to study abroad. He and Mrs. Epling will spend the coming scholastic year in botanical research in taxonomy at English and continental herbaria.

STATISTICAL INFORMATION FOR MAY, 1927.

GARDEN ATTENDANCE:

Total number of visitors	25,249

PLANT ACCESSIONS:

Total number of plants and seed packets received in exchange	999

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	148
Total number of books and pamphlets donated	594

HERBARIUM ACCESSIONS:

By Gift—

Bebb, Robert—Plants of Colorado	41
Beinke, Mrs. Amos A.—Plants of Missouri	2
Bettis, Mrs. James R.—Plant of Horticulture	1
Elrod, Mrs. W. D—*Pentstemon gracilis* Nutt. from Oklahoma	1
Eltinge, Miss Ethel—Fungi of Missouri	3
Grossart, Fred G.—*Calopogon pulchellus* (Sw.) R. Br. from Missouri	1
Hume, H. Harold—Plants of Florida	4
Kellogg, John H.—Plants of Missouri	20
Kobuski, Clarence E.—Fungi of Missouri	3
Larsen, Miss Esther L.—Plant of Missouri	1
Ledman, O. S.—Plants of Missouri	3
Mathias, Miss Mildred—Missouri fungi	29
St. John, Dr. Harold—*Senecio Hookeri* Torr. and Gray from Idaho	1
Wagner, D. D.—New York fungi	5
Woodson, Robert E., Jr.—Plants of Tennessee, Alabama, and Mississippi	103

By Exchange—

Epling, Dr. Carl C.—*Senecio Roldana* DC. from Mexico	1
Field Museum of Natural History—Senecios from Peru	2

By Purchase—

Arnold Arboretum of Harvard University—Plants of North America collected by Ernest J. Palmer	1,677

By Field Work—

Greenman, Dr. J. M.—Plants of Madison, Iron, and St. Francois Counties, Mo	274
Overholts, Dr. L. O.—Missouri fungi	55
Total	2,227

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and, while virtually a private garden, it was, except at certain stated times, always open to the public. By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the 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 of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises about 75 acres. There is now in process of development a tract of land of over 1,500 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a forest reservation, with the idea that possibly at some future time this may become the new botanical garden. About 12,000 species of plants are growing in the Garden.

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day and Christmas—week days from 8:00 a. m. until one-half hour after sunset; Sundays from December to April, 1:00 p. m. until sunset; from April to December, 2:00 p. m. until sunset.

The main entrance to the Garden is located at Tower Grove avenue and Flora boulevard, on the Vandeventer avenue car line. Transfer south from all intersecting lines. The Garden may also be reached by Bus Route No. 12, to which all other motorbus lines transfer.

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TROPICAL GARDEN, BALBOA, CANAL ZONE

C. W. POWELL,
Manager

Missouri Botanical Garden Bulletin

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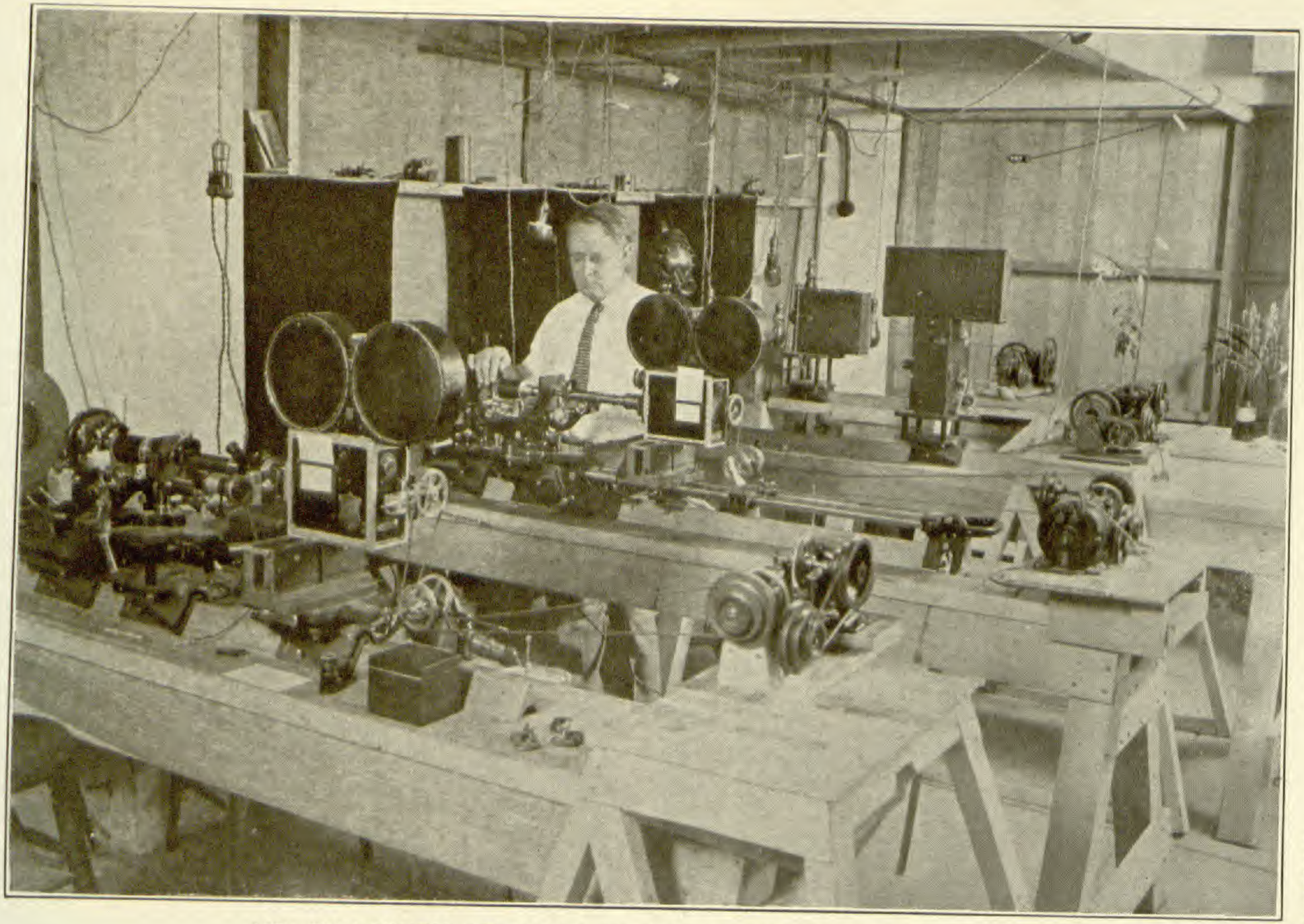

MR. PILLSBURY AT WORK IN THE MOVING-PICTURE STUDIO.

Missouri Botanical
Garden Bulletin

Vol. XV SEPTEMBER, 1927 No. 7

MOTION PICTURES OF PLANT LIFE.

Through the generosity of a few friends of the Missouri Botanical Garden it has been possible to engage the services of Mr. A. C. Pillsbury for a part of the present year to make moving pictures of plants, both macroscopic and microscopic. Mr. Pillsbury is widely known through his lectures and is recognized as the most expert producer of films of plant life in this country, if not in the world. As the official photographer of Yosemite National Park, he had opportunity to observe the wild flowers of that region, and after years of study and experience has perfected unique methods of recording the life history of plants. By means of a clock-work mechanism and other ingenious devices of his own invention, Mr. Pillsbury is not only able to secure records of the movement of parts of flowers, leaves, etc., which have never before been visualized, but his success in obtaining pictures of what goes on in the cell of the plant as seen under the microscope has never been equalled. It is this phase of the work in which the Garden is most interested, for it seems probable, by taking a series of pictures extending over a day or a week and then running them before the eye in a few minutes that activities of the cell will become visible which direct observation through the microscope has not revealed. Through the success that Mr. Pillsbury and others have had with films of this kind, it should not be long until every biological laboratory will come to regard a moving picture outfit as essential as the microscope. So far as is known the Missouri Botanical Garden is the first botanical garden to undertake this sort of an investigation.

The wealth of growing material at the Garden will make it possible to obtain moving pictures of many plants not hitherto followed through their development, the budding and blooming orchids of various species affording an unusual opportunity in this direction.

A special studio, including developing and printing rooms, has been fitted up for Mr. Pillsbury, and four movie cameras are now installed, two for microscopic and two for macroscopic work. Because of the great value of such films in teaching, it is expected that later certain subjects showing the hidden activities of plants will be made available for classes in botany in schools and colleges.

THE MEDICINAL PLANT GARDEN

Aims and Purposes.—Although thousands of synthetic medicaments have been prepared for the relief or cure of the bodily ills of mankind, many of these have failed to replace the crude products derived from the vegetable kingdom. Indeed it is doubtful whether synthetic drugs will ever take the place of such drugs as cinchona bark, opium, nux vomica, belladonna, digitalis, and many others that are daily dispensed by the professional pharmacist. Man has from remotest periods employed various barks, roots, and other parts of potent and non-potent plants and probably will always resort to their use in the treatment of his bodily ills. Bastedo has aptly stated that "Medicine it sometimes cures, often relieves and always consoles." This seems to be especially true of the employment of the many quaint and mysterious drugs used from time to time by mankind. Today the word "drug" includes all substances utilized in the treatment of disease, whether derived from the vegetable, animal, or mineral kingdoms, but the origin of the word, from "drugan," "to dry," indicates that earlier it was restricted to dried plants.

Medicines, like other things, pass through certain specific cycles. For instance, years ago, with the introduction of the coal tar synthetics, a wave of utilization of this much-varied compound swept over the entire world. More recently we

have been passing through a cycle of glandular therapy. The pendulum now appears to be swinging back to a position formerly occupied, the employment of the crude vegetable drug or its products.

The Value of a Medicinal Plant Garden.—During the course of the last decade or two some 30 or more medicinal plant gardens have been established as adjuncts to colleges of pharmacy throughout America, and with the tendency to a greater utilization of our vegetable *Materia Medica* a medicinal plant garden assumes a far greater sphere of usefulness than is generally recognized.

The medicinal plant garden at the Missouri Botanical Garden, developed as a cooperative project between the Garden and the St. Louis College of Pharmacy under the personal supervision of the professor of *Materia Medica* at the latter institution, will aid both institutions in many ways. First, it will appeal to the curiosity of the public, since it affords an opportunity to see growing those drug plants which find their way into the prescriptions written by the physician and compounded by the pharmacist. To the student a garden of this type offers unusual facilities for becoming better acquainted with the living plants which furnish drugs from all four corners of the globe. When properly labeled with scientific and common name, natural habitat, part used in medicine, and general medicinal action, a medicinal garden becomes a living museum for the student of plant sciences as well as the public at large. To the research worker in plant physiology or pharmaco-chemistry a medicinal plant garden is invaluable, for here the investigator can secure fresh and authentic materials with which to work and concerning which much valuable data is available.

During the past decade colloidal chemistry, dealing for the most part with "state of matter" as compared to "kind of matter," has opened avenues of approach to many intricate problems concerning which in the past hypotheses only were possible. This fact, together with a possible return to the utilization of crude vegetable drugs or their products, makes it most necessary that the plant physiologist, the pharmacognosist, the pharmacologist, and others interested have access

to the plant as a whole or to the fresh plant product elaborated within its myriads of microscopic laboratories.

Man first used the fresh herb for the relief of his bodily ills. Since fresh materials were only to be secured during the growing season, and with the additional idea of eliminating the variable factor of moisture content, the custom of drying the plants came into use. Little or no attention was paid to the possibility of producing undesirable changes in the drug by this process. However, from our knowledge of changes that occur through the heating of a substance it is not unreasonable to suppose that results of a detrimental character, in so far as medicinal virtues are concerned, may possibly take place through the drying of a plant.

Our knowledge concerning the "state of matter" within a living cell is altogether too meager. Observations through the microscope of material which has been subjected to the crude and harsh methods of killing, fixing and staining tells but little, and the examination of living mounts is equally unsatisfactory. From the little that has been learned from motion photography of the living cell under the microscope we are forced to the conclusion that methods of examination in the past have been very faulty, giving us a grossly distorted picture of that which actually takes place. And this only concerns the visible picture. Even to a greater extent it is likely that the chemical composition may change. Are the so-called active constituents of plants, extracted by acids, alkalis, immiscible solvents, etc., the same as the crude drug, in terms of therapeutic action? Does morphine represent the action of opium? Does atropine, which the textbooks wrongly state as the active constituent of the deadly nightshade, represent the therapeutic action of this herb? Recent investigations tend to show that atropine does not exist as such in belladonna, but is formed from its stereoisomer, hyoscyamine, during the course of extraction with acids, alkalis, immiscible solvents, etc. Thus in our eagerness to secure these "active constituents" in a purified form, we may have possibly overlooked certain important facts concerning the therapeutic action of the fresh drug as a whole, just as we have eliminated from table salt, cereals, etc., substances which are now found to be important and should be retained.

The research worker needs to secure more data on drug absorption, drug adsorption, the nature of the state of matter within healthy and diseased tissues, and many other fundamental problems for the solution of which material can only be obtained from the authenticated plant grown in the medicinal garden.

Botanical Studies.—Much of the crude vegetable drug material found on the market is imported from other countries, and in many cases has proved to be of uncertain or unknown origin. Owing to the difficulty of securing authentic plants or first-hand information as to their origin a number of taxonomic problems still remain to be solved. An excellent example of this condition is that of the botanical origin of the plants yielding chaulmoogra oil. (See September, 1921, number of the BULLETIN.) A medicinal garden in which seed may be sown and the plant followed through to maturity is absolutely essential for the proper determination of many drug plants. In addition, the plant breeder is offered opportunities of vast practical importance in bringing about selections and crosses that will result in increasing the active constituent. To the pharmacognosist, in his work of detecting substitutions and adulterations, a medicinal plant garden aids in an invaluable manner in the supplying of fresh authentic materials for comparison.

Origin, Nature, and Physiological Function of Plant Products.—To the investigator the origin and function of the many products elaborated by plants offer a vast field for research. Since 1817, when Serturner isolated morphine from opium there have been isolated, purified, and identified hundreds of similar compounds. Little attention has been paid, however, to the origin, nature, and physiological function of these active constituents within the plant itself. To cite but a single example of the value of a medicinal garden in investigations of this kind: In the past the time of the year in which distillations of various vegetable oils have been made was for the most part decided empirically. Very few volatile oil-bearing plants have been subjected to a careful microscopic, microchemical, and periodical distillation test yet this is most necessary in order to obtain information calculated to

give the largest and most satisfactory yield. Should the plant be grown in low wet ground or on sunny or shaded hillsides to obtain the best results and when is the best time for distillation in order to secure the most active volatile oil? Many glucosides, tannins, resins, balsams, etc., furnish similar problems and the most satisfactory way in which to obtain much of this information is from material or plants from the medicinal garden.

Certain medicinal plants grow wild in various parts of the country. Foxglove has been found in great abundance in the northwest states bordering on the Pacific Ocean. Missouri abounds in a plentiful supply of Echinacea or purple coneflower which has come into considerable prominence as a valuable remedy in the treatment of blood poisoning. Here again a medicinal plant garden can serve in supplying valuable information concerning the cultural requirements of many of our drug plants.

As An Aid to the Professional Pharmacist.—According to speakers at the convention of the American Pharmaceutical Association recently held in St. Louis, the profession of pharmacy is rapidly undergoing a marked transformation. In former years, the apothecary, with his large stock of herbs and decoctions, occupied a most necessary and important place between the patient and the physician. Lately, however, hundreds of side lines have become a part of the drug store, until the prescription case has in some instances been almost obliterated. Today one begins to note the return of the strictly professional store, especially in the larger cities where it is frequently located in close proximity to the grouped offices of physicians. Eventually we may expect two types of drug stores, one doing what may be called a general merchandising business, and the other, purely professional. This increase in the number of professional stores will place greater demands upon the pharmacist by the physician, particularly if there is a greater utilization of fresh and authentic plant materials. Even now, the physician, in many cases, prescribes "fresh" digitalis in the treatment of cardiac disorders, and as various investigations now under way are extended and the advantage of fresh drugs is dem-

onstrated the demand for such products is sure to increase. The medicinal garden is an important adjunct in such investigations.

For Purposes of Pharmacognostical Instruction.—According to present plans, the students of the St. Louis College of Pharmacy will make frequent trips to the Garden for the purpose of making careful and detailed studies of the various drug plants under cultivation. The students will be required to collect different roots, leaves, herbs, flowers, fruits, seeds, and to subject same to proper methods of drying, preservation, etc. These materials will then be examined in the pharmacognosy laboratory and compared with the commercial drug article found on the market. Through this unique opportunity the students will become better acquainted, not only with the drug itself, but also with the living plant that yields the particular drug. The drug materials secured from this garden will also be utilized in the courses of the pharmaceutical curriculum dealing with *Materia Medica,* manufacturing pharmacy, and drug analysis.

Development of Garden.—The present garden occupies the site formerly devoted to wild flowers, directly west of the Italian Garden. This was made possible through the acquisition of the large tract at Gray Summit where there already existed one of the largest and most representative collections of wild flowers in this part of the country. Additions are being made to the native flora, which eventually will include all of the wild plants that can be grown successfully in this region.

The work of constructing a medicinal plant garden was considerably delayed this year on account of the continuous and excessive spring rains, and the hail storm of May 28 also interfered with its completion. Consequently the present garden represents only a part of what is hoped will develop in future years. The location is ideal, offering a great variety of growing conditions. Three small lakes and a creek form a part of the design, thus affording facilities for the cultivation of aquatic medicinal plants. One section of the plot very closely represents natural woodland, and here are grown the shade-loving plants, e. g., bloodroot, mandrake, American

sanicle root, various types of snakeroots, wild ginger, ginseng, golden-seal, etc. A considerable portion of the garden has full sunlight, in both low and hillside areas, while other sections of similar locations are exposed to partial shade. It is essential to have various types of growing conditions in order to ascertain the best possible location not only for culture, but also from the standpoint of the yield of the active constituents. Thus, mints will be grown in the wet lowlands surrounding the lakes and will also be placed under cultivation on the hillsides. Much of the existing information as to the proper location for these plants is based upon theory. In former years it was thought that mints thrived best in moist lowlands, but investigations have shown that plants grown on hillsides yield not only a greater percentage of oil, but the active constituents are increased as well. Contrary to the practice in most botanical gardens, it has not been deemed advisable here to group the plants according to family or pharmacological classification. A plant can best be grown under natural conditions, a fact which artificial systems of classification fail to recognize.

During the past spring and summer many medicinal plants have been brought in from the 1,600-acre extension at Gray Summit. The work is to be continued until the city garden includes all of the medicinal plants which grow about St. Louis.

Among the medicinal plants collected or noted at Gray Summit the following may be cited at this time:

1. *Podophyllum peltatum* (mandrake).
2. *Sanguinaria canadensis* (bloodroot).
3. *Sanicula canadensis* (American sanicle root).
4. *Aristolochia Serpentaria* (Virginia snakeroot).
5. *Menispermum canadense* (Canada moonseed).
6. *Dioscorea villosa* (wild yam).
7. *Apocynum cannabinum* (Canadian hemp).
8. *Asclepias tuberosa* (pleurisy root).
9. *Eupatorium purpureum* (Joe-Pye weed).
10. *Eupatorium perfoliatum* (boneset).
11. *Hydrangea arborescens* (wild hydrangea).
12. Species of Trillium (Beth root).
13. *Brauneria angustifolia* (Echinacea).
14. *Arisaema triphyllum* (Jack-in-the-pulpit).
15. *Arisaema Dracontium* (green dragon).

16. *Geranium maculatum* (spotted cranesbill).
17. *Cornus florida* (flowering dogwood).
18. *Asarum canadense* (wild ginger).
19. *Actaea alba* (white snakeroot).
20. *Pedicularis canadensis* (lousewort).
21. *Dicentra Cucullaria* (Dutchman's breeches).
22. *Dicentra canadensis* (squirrel corn).
23. *Ulmus fulva* (slippery elm).
24. *Ruellia ciliosa* (adulterant of spigelia or pink root).
25. *Lobelia inflata* (Indian tobacco).
26. *Phytolacca decandra* (pokeweed).
27. *Hedeoma pulegioides* (pennyroyal).
28. *Marrubium vulgare* (horehound).
29. *Chenopodium ambrosioides* var. *anthelminticum* (American wormseed).
30. *Humulus Lupulus* (hops).
31. *Hamamelis virginiana* (witchhazel).
32. *Melilotus officinalis* (yellow sweet clover).
33. *Nepeta Cataria* (catmint).
34. *Cypripedium pubescens* (lady-slipper root).
35. Species of Delphinium (larkspur).
36. *Veronica virginica* (Culver's root).
37. *Arctium minus* (burdock root).
38. *Ceanothus americanus* (New Jersey tea).
39. *Sambucus canadensis* (elder flower).
40. *Senecio aureus* (life-root plant).
41. *Solanum carolinense* (horse-nettle berries).
42. *Taraxacum officinale* (dandelion).
43. *Trifolium pratense* (red clover).
44. *Trifolium repens* (white clover).
45. *Verbascum Thapsus* (mullein).
46. *Viburnum prunifolium* (black haw).
47. *Datura Stramonium* (jimson weed).
48. *Monarda fistulosa* (wild bergamot).
49. *Rhus glabra* (Sumac).
50. *Cichorium Intybus* (chicory).
51. *Juglans nigra* (black walnut).
52. Rumex (curled dock).
53. *Erigeron canadensis* (fleabane).
54. *Parthenium repens* (feverfew).

Type of Out-of-Door Plant Label.—The selection of a proper label for use out of doors is a difficult matter, since it must be legible at all times, contain necessary information, and not be unduly affected by the weather. The type of label utilized in the medicinal garden consists of a green pyralin card lettered with black water-proof India ink, over which is placed one or more coats of a special varnish. These cards

measuring 1x2 inches and 3x4 inches are mounted in metal frames, supported on rods 24 inches in length. The smaller labels state the scientific and common names only. The larger ones designate the scientific and common names, habitat, part used in medicine, and the general medicinal action. Thus far experience has shown that these labels will meet all requirements, since those placed out during the early summer have not faded or curled, and after a light sponging present the same fresh appearance as when placed in the garden.

In addition to the pyralin label a metal-strip label is also employed for catalogue purposes, on which is stated the scientific name and catalogue number. These are fastened at both ends by a copper wire to a looped rod 24 inches in length. These remain in the garden throughout the entire year, but the card labels are brought in at the close of the season for a good scrubbing and possibly a new coat of varnish.

The list of plants now incorporated in the medicinal garden will appear in the October number of the BULLETIN.

FIFTH ANNUAL PLANT SCIENCE SEMINAR

Held at the Missouri Botanical Garden, August 16-19, 1927

The Plant Science Seminar, composed of botanists, pharmacognosists, plant physiologists, chemists and pharmacologists, met at the Missouri Botanical Garden, August 16-19. The first three days were spent at the Garden in St. Louis, and the last day was devoted to a field trip at Gray Summit. On the latter occasion, Mr. G. H. Pring, Horticulturist to the Garden, discussed the orchid collection, after which groups of the visitors were conducted through the orchid houses and to the wild flower area.

The complete program of the Seminar was as follows:

Tuesday afternoon, August 16.

Address of Welcome, "The Activities of the Missouri Botanical Garden"—Dr. George T. Moore, Director.

Wednesday morning, August 17.

"A Report on the Histological Nomenclature of U. S. P. X."—Professors E. L. Newcomb, Albert Schneider, E. H. Wirth, H. W. Youngken and E. N. Gathercoal.

Wednesday afternoon, August 17.

"The Pharmacognosy of the New German Pharmacopoeia in Comparison with U. S. P. X."—Professor E. H. Wirth.

"Some Medical Aspects of Pharmacognosy."—Professor Seward Owen.

"Some Investigations of Hay Fever Pollen."—Dr. R. V. L. LaGarde.

"A Recent Substitute for Viburnum prunifolium."—Dr. H. W. Youngken.

"Drug Plants of Arkansas."—Dr. E. J. Petry.

"A Report on the Survey of Our Native Drug Resources."—Dr. W. W. Stockberger.

Wednesday evening, August 17.

"Cocoa Production."—Mr. L. J. Schwarz.

Thursday morning, August 18.

"Microchemistry and the Polarizing Microscope in Qualitative Analysis."—Dr. George L. Keenan.

"Some Recent Evidence of the Kinship between Plants and Animals."—Dr. Albert Schneider.

"Abbreviations in the Pharmacopoeia and National Formulary."—Dr. C. C. Plitt.

Thursday afternoon, August 18.

"Dr. A. Tschirch, Dean of Pharmacognosists."—Professor E. Fullerton Cook.

"The Teaching of Pharmacognosy."—A Round Table—Professor Anton Hogstad.

On Thursday evening the Plant Science Seminar met jointly with the Naturalists' Club and the Kellogg Wild Flower Society of St. Louis at a picnic lunch, after which they were shown motion pictures of plant life by Mr. A. C. Pillsbury.

NOTES.

Mr. George H. Pring, Horticulturist to the Garden, spoke before the Rotary Club at Edwardsville, Illinois, August 4, on "Collecting Orchids in Panama."

Dr. Edgar Anderson, Geneticist to the Garden, spent the month of June collecting plants in Pennsylvania, New York, and Ontario, Canada. In July and August he visited England where he consulted the herbaria of the Linnean Society and of the British Museum.

Dr. George T. Moore, Director of the Garden, will speak before the first national fuels meeting, arranged for Ameri-

can engineers interested in the use and conservation of fuels, October 13, on "The Measurement of Atmospheric Pollution, Visible and Invisible."

Mr. George H. Pring, Horticulturist to the Garden, was on the programme of the chautauqua at Piasa, Illinois, July 26-27, when he was scheduled to deliver an address on "Collecting Orchids in the Andes Mountains," to make a talk on wild flowers, and to conduct a field trip.

Among those visiting the Garden during the summer months were: Dr. George R. Hill, Jr., formerly research assistant at the Garden, now botanist for the American Smelting and Refining Co., Salt Lake City; Professor R. A. Studhalter, professor of biology, Texas Technological College, Lubbock, Texas; Dr. H. M. Jennison, professor of botany, University of Tennessee; Mr. Dow V. Baxter, of the office of forest pathology, Washington, D. C.; and Miss Hanna Giersbach, of the Boyce Thompson Institute for Plant Research, Yonkers, N. Y.

STATISTICAL INFORMATION FOR JUNE-AUGUST, 1927

GARDEN ATTENDANCE:

Total number of visitors in June 26,081
Total number of visitors in July 26,631
Total number of visitors in August 31,208

PLANT ACCESSIONS:

Total number of plants received as gifts in June..... 123
Total number of plants and seed packets received as gifts in July 184
Total number of plants and seed packets received as gifts in August..... 99

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought in June... 22
Total number of books and pamphlets donated in June.. 909
Total number of books bought in July..... 14
Total number of books and pamphlets donated in July... 819
Total number of books and pamphlets bought in August 4
Total number of books and pamphlets donated in August 118

HERBARIUM ACCESSIONS:

JUNE

By Gift—

Bettis, Mrs. James R.—Plant from horticulture..... 1
Drushel, Professor J. A.—*Drosera rotundifolia* Linn. and *Senecio aureus* Linn. var. *gracilis* (Pursh) Britt. from Ohio 2
Emerson, Miss Iva—*Sisyrinchium* sp. from South Dakota 1
Hume, H. Harold—Plants from Florida..... 10
Kellogg, John H.—Plants of Missouri..... 9
Mathias, Miss Mildred—*Pastinaca sativa* Linn. from Missouri 1
Mathias, Miss Mildred—Mosses from Illinois..... 3
Stark Bros.—Plant of horticulture..... 1

By Exchange—

Epling, Dr. Carl C.—Plants of northern Idaho..... 5
Field Museum of Natural History—*Senecio* sp. from Peru 1
Iowa State College, by Professor L. H. Pammel—Plants of Oregon, collected by Kirk Whited..... 267
O'Neill, O. S. B., Rev. Hugh—Plants of Florida..... 237
U. S. National Museum—Mosses of Mexico..... 144
U. S. National Museum—Miscellaneous herbarium duplicates, mostly flowering plants..... 288

By Purchase—

Harvard College Library—Photograph of *Ruellia erecta*..	1
Merrill, G. K.—Lichenes exsiccati, Fasc. VI. Nos. 120-150	25
Möller, Dr. Hjalmar—Plants of Brazil, collected by Dr. P. Dusén	136
Porsild, Dr. Morten P.—Plants of Greenland	110
Stevens, Professor F. L.—Fungi of Central and South America, Hawaii, etc.	740
Total	1,982

JULY

By Gift—

Allen, Professor C. E.—*Pellionia Daveauana* N. E. Brown from horticulture	1
Ashe, W. W.—Plants of south Atlantic states	5
Bucholtz, A. F.—Plants of Illinois	4
Gurney, James—*Viburnum* sp. from horticulture	1
Keller, J. R.—*Koelreuteria paniculata* Laxm. from Salt Lake City, Utah	1
Kellogg, John H.—Plants of Dent County, Mo.	12
Mathias, Miss Mildred—*Cogswellia daucifolia* (Nutt.) Jones, from Oklahoma	1
California Academy of Science, by Miss Alice Eastwood —*Senecio Douglasii* DC., from Arizona	1

By Exchange—

United States National Museum—Miscellaneous duplicate ferns	60
University of Montreal, by Brother M. Victorin—Plants of Quebec, Canada	338
Total	424

AUGUST

By Gift—

Meyer, G. F.—*Hymenocallis occidentalis* (LeConte) Kth. from Illinois	1
Seropyan, Mrs. Milton—*Salix pentandra* from horticulture	1

By Exchange—

New York Botanical Garden—South American Cactaceæ..	133

By Purchase—

Sydow, H.—"Fungi exotici exsiccati," Fasc. XII-XV, Nos. 551-750, inclusive	200
Total	335

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and, while virtually a private garden, it was, except at certain stated times, always open to the public. By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the 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 of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises about 75 acres. There is now in process of development a tract of land of over 1,500 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a forest reservation, with the idea that possibly at some future time this may become the new botanical garden. About 12,000 species of plants are growing in the Garden.

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day and Christmas—week days from 8:00 a. m. until one-half hour after sunset; Sundays from December to April, 1:00 p. m. until sunset; from April to December, 2:00 p. m. until sunset.

The main entrance to the Garden is located at Tower Grove avenue and Flora place, on the Vandeventer avenue car line. Transfer south from all intersecting lines. The Garden may also be reached by Bus Route No. 12, to which all other motorbus lines transfer.

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TROPICAL GARDEN, BALBOA, CANAL ZONE

Manager

Missouri Botanical Garden Bulletin

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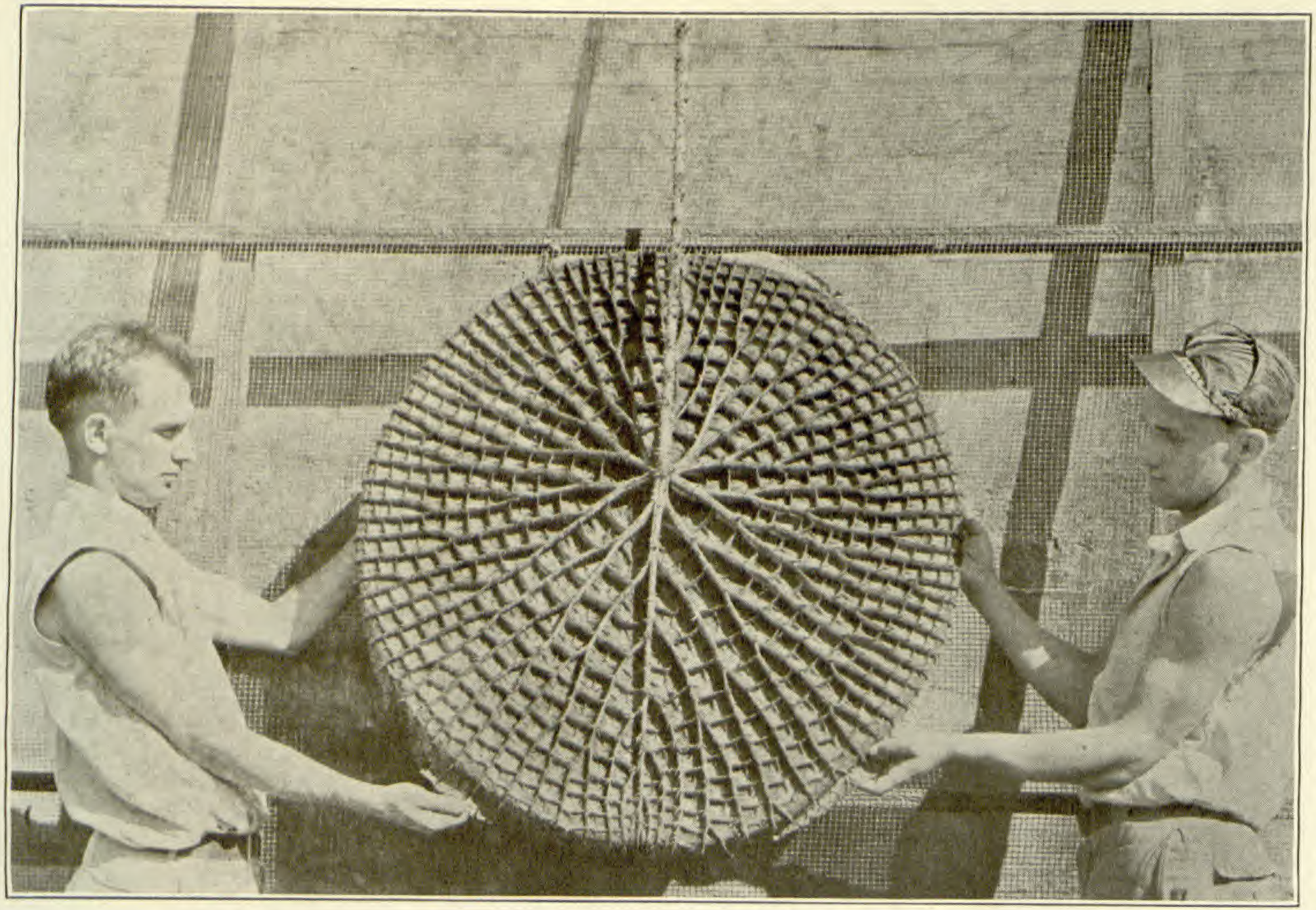


UNDER SURFACE OF AMAZON WATER-LILY LEAF.

Missouri Botanical Garden Bulletin

Vol. XV OCTOBER, 1927 No. 8

AMAZON WATER-LILIES AS ENGINEERS

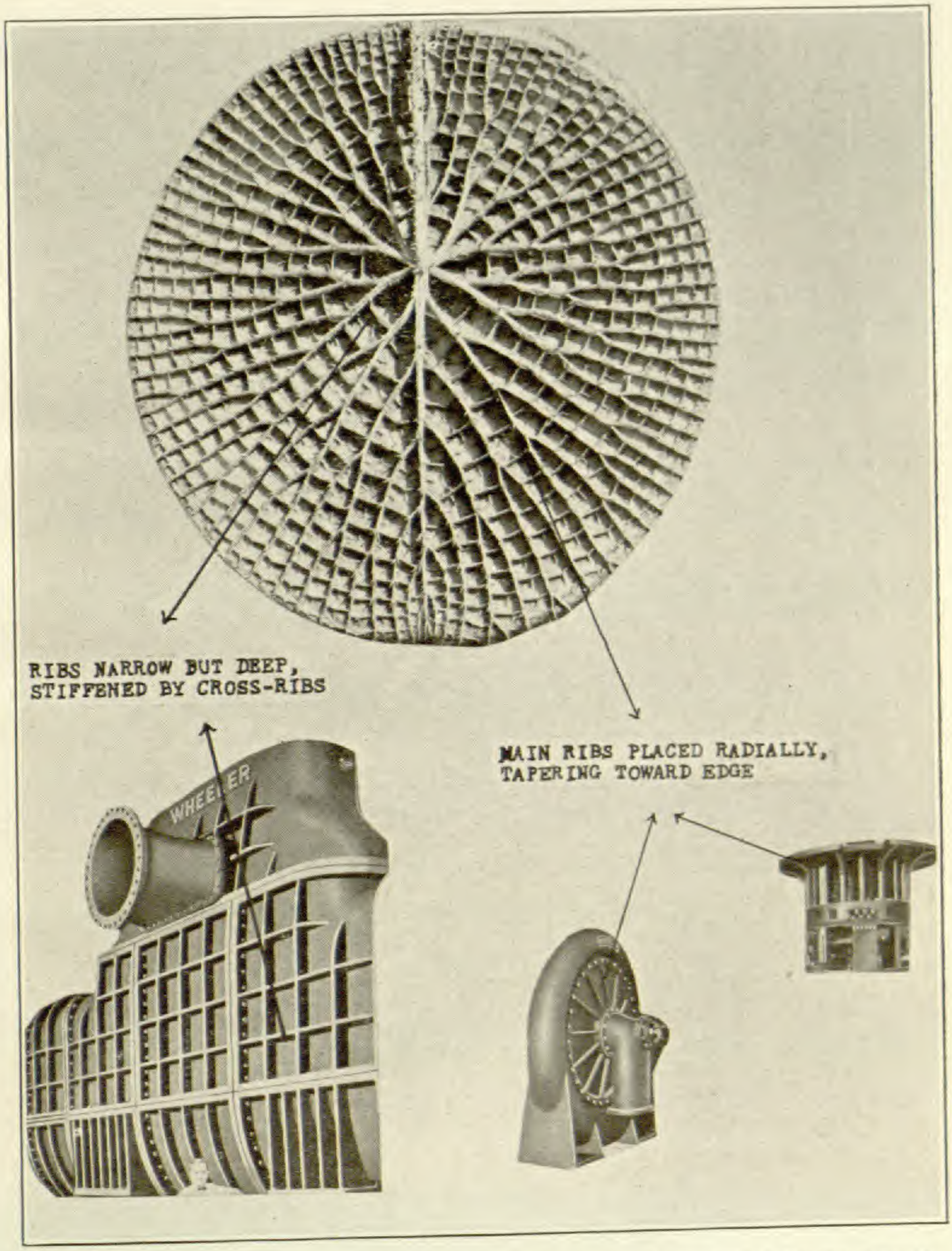
It is unfortunate that one of the Garden's commonest exhibits has to be grown in such a way that its most interesting features are hidden from the public. Among the thousands who every summer stop to admire the huge leaves of the giant water-lilies of the Amazon (*Victoria regia* Lindl. and *Victoria Cruziana* d'Orb.) only a very few discover that the under surface is strikingly different in appearance from the smooth, green upper surface and even more interesting. This unfamiliar view of a familiar object is shown in plates 19 and 20, and demonstrates the mechanism that enables the great leaves, which often reach five feet in diameter, to remain smooth and unruffled throughout the season. The entire under surface is spanned by a framework of narrow ribs, attached at the stem and gradually tapering toward the edge of the leaf. They are deep but narrow, at their largest ends being about two inches deep and less than half an inch wide. Joining them is a network of web-like side veins, unique from the standpoint of plant anatomy, for though they are scarcely as wide as a sheet of paper they are nearly as deep as the main ribs which they knit together. Their general position is shown in plates 19 and 20, and one or two, designated by arrows, are shown in closer view in plate 21. The thorns which occur on the under surface are another detail of construction well shown in this latter picture. Though they have a soft and harmless appearance they are actually so

sharp and so close-set as to make it impossible to handle the leaf without some sort of protection.

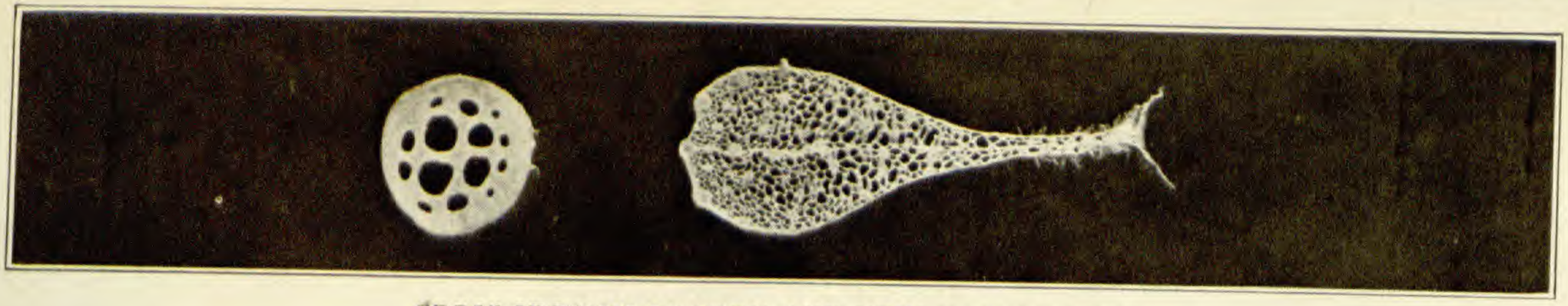
That the veins do form an efficient support has been demonstrated again and again. By adding a light lattice work to distribute the weight it is possible for a grown man to stand on one of the larger leaves. By actual test it has been shown that a single leaf can bear upward of 300 pounds of sand before collapsing. Believing that a leaf which could support such a weight was a success from a purely mechanical point of view, one was submitted to an expert at Washington University for his opinion. He pronounced the design an excellent one and made the further admission that he could not suggest an improvement in any important detail. Therefore when the statement is made that were a mechanical engineer to design a stiffening and supporting system for the leaf he would practically duplicate the actual pattern developed by Nature herself, it is not meant simply in the form of a general analogy. Rather is it true that in detail after detail the recommendations of the engineer, arrived at through his theoretical knowledge of the laws of mechanics, parallel the solution already worked out by the plant itself.

Wherever an engineer is confronted with the problem of stiffening a circular flat plate, supported near the center, his design will look very much like the one developed by the water-lily of the Amazon. It so happens that this particular problem is not a common one in machine design; but similar problems, involving the same general principles, are constantly coming up. One cannot turn the pages of a machinery catalogue or walk through a factory without finding numerous examples which in one detail or another show the same construction as the water-lily leaf.

It has been said that the veins, and particularly the secondary ones, are remarkable by reason of their great depth in proportion to their width. The advantage of this unusual shape is clear when one studies the laws of mechanics which deal with the stiffness of supporting beams. Experts in mechanics, studying the underlying mathematics of the problem, have determined that the end-to-end stiffness of a supporting beam is proportional to its width and to the cube of its depth



SHOWING CONSTRUCTION DETAILS IN COMMON BETWEEN WATER-LILY LEAF AND MACHINERY.



CROSS-SECTION OF STEM AND VEIN OF LILY LEAF.

CLOSE-UP OF UNDER SURFACE SHOWING VEINS AND THORNS. ARROWS POINT TO CROSS-VEINS.

($R=k\ w\ d^3$). In other words, a beam 3 inches deep is 27 times as rigid under end-to-end pressure as is one only 1 inch deep; while one 3 inches wide would be only 3 times as rigid as one 1 inch wide. For this reason the supporting ribs of flat plates are commonly made much deeper than wide. In developing its peculiar veins the plant has done only what an engineer would have advised it to do. There is one danger in making supporting ribs so narrow: that they will buckle under side pressure. This can be overcome, however, by a supporting system of cross-ribs, and here again the plant has copied the machine designer, or perhaps we should say that the machine designer has copied the plants, since Victoria lilies must have floated on the Amazon long before man made his first rude machines.

One feature of the Victoria leaves, and one rather commonly met with through the plant world, is also a common feature in machine design. That is the manner in which the supporting ribs, large and heavy where they are attached to the stem, gradually taper toward the edge as the strain becomes less and less. The problem of the plant has been essentially that of the engineer: to produce the maximum amount of strength with the minimum amount of material. Both have saved material by tapering off the ribs toward the edge of the supported plate or leaf.

The interior construction of the ribs shows another way in which the lily has held to this same principle of economy in construction. From the standpoint of pure mechanics, a hollow tube is much stronger than would be a solid column made from the same amount of material. Study of the ribs in cross-section shows that they are practically hollow tubes —a mere shell of hard tissue filled with a light, spongy mass of cells (pl. 21, fig. 1).

Only in its spiny surface does the construction of the water lily depart radically from that of similar machines. There it does so for the reason that the plant has a problem peculiar to itself, that of defense. If man-made machines were subject to attacks from browsing animals, then we might expect them, too, to bear a surface armour of sharp spines.

So much for the facts in the case. It can be stated flatly

and without fear of contradiction that these leaves are admirably constructed, and all that we have learned about the laws of mechanics, about stresses and loads, would not enable us to improve upon their design. As to the interpretation of the facts it is another matter altogether. How such leaves have originated, we do not know. In discussing what processes have brought them to perfection we fall into the habit of saying, "The plant strengthened this vein" or, "Nature designed this leaf," as though it had been actually a conscious and intelligent process. What we do know about plants and animals makes us believe that such is not the real explanation, but that these leaves are as they are through the working out of the laws of Nature. What those laws are and how they operate we can as yet only dimly suspect. We talk about the "Survival of those fittest to survive" and of the effects of "Use and Disuse," but we are not able to say anything very definite as to how these principles may or may not have operated. Here, as everywhere, what we have learned so far carries us only a little way. Further than that we cannot go as yet, but must frankly say, "We do not know."

THE MEDICINAL PLANT GARDEN

(Continued from September Bulletin)

United States Pharmacopoeia, Tenth Decennial Revision

1. *Aconitum Napellus* (monkshood)
2. *Aloe Perryi* (aloe—Succulent House)
3. *Aloe vera* (aloe—Succulent House)
4. *Aloe ferox* (aloe—Succulent House)
5. *Althaea officinalis* (marsh-mallow)
6. *Zea Mays* (corn)
7. *Dryopteris Filix-mas* (male fern)
8. *Citrus Aurantium* var. *sinensis* (Tropical Fruit House)
9. *Toluifera Pereirae* (balsam of Peru—Economic House)
10. *Atropa Belladonna* (deadly nightshade)
11. *Cannabis sativa* (Indian hemp)
12. *Cinnamomum Camphora* (camphor—Economic House)
13. *Capsicum frutescens* (Cayenne pepper)
14. *Elettaria Cardamomum* (cardamon—Economic House)
15. *Carum Carvi* (Caraway)
16. *Rhamnus Purshiana* (cascara sagrada)
17. *Cimicifuga racemosa* (black cohosh)
18. Sp. of Cinchona (seedlings of *C. officinalis*, the original species under cultivation)

19. *Citrullus Colocynthis* (bitter apple)
20. *Digitalis purpurea* (foxglove)
21. *Ecballium Elaterium* (squirting cucumber)
22. *Claviceps purpurea* (ergot of rye)
23. *Gentiana lutea* (gentian root)
24. *Glycyrrhiza glabra* var. *typica* (licorice)
25. *Glycyrrhiza glabra* var. *glandulifera* (licorice)
26. *Gossypium herbaceum* or other species (cotton)
27. *Punica Granatum* (pomegranate—Economic House)
28. *Hydrastis canadensis* (golden seal)
29. *Hyoscyamus niger* (henbane)
30. *Citrus Medica* var. *Limomum* (lemon—Tropical Fruit House)
31. *Linum usitatissimum* (flax)
32. *Lobelia inflata* (Indian tobacco)
33. *Mentha piperita* (peppermint)
34. *Mentha spicata* (spearmint)
35. *Strychnos Nux-vomica* (Quaker button—seedlings under cultivation)
36. *Papaver somniferum* (opium poppy)
37. *Papaver somniferum* var. *album* (white opium poppy)
38. *Cucurbita Pepo* (pumpkin)
39. *Podophyllum peltatum* (mandrake)
40. *Prunus serotina* (wild cherry)
41. *Rheum officinale* and other species of Rheum (Chinese rhubarb)
42. *Rheum palmatum* (Chinese rhubarb)
43. *Rhus glabra* (sumac)
44. *Rosa gallica* (rose)
45. Sp. of Salix (source of salicin)
46. Sp. of Populus (source of salicin)
47. *Urginea maritima* (sea onion—in Peat House)
48. *Polygala Senega* (Seneca snakeroot)
49. *Aristolochia Serpentaria* (Virginia snakeroot)
50. *Aristolochia reticulata* (Texas snakeroot)
51. *Brassica nigra* (black mustard)
52. *Brassica juncea* (black mustard)
53. *Datura Stramonium* (jimson weed)
54. *Liquidambar styraciflua* (American storax)
55. *Toluifera Balsamum* (balsam of tolu—Economic House)
56. *Ulmus fulva* (slippery elm)
57. *Valeriana officinalis* (valerian)
58. *Zingiber officinalis* (ginger—Economic House)

National Formulary, Fifth Edition

1. *Adonis vernalis* (pheasant's eye)
2. *Aletris farinosa* (star grass)
3. *Althaea officinalis* (marsh-mallow)
4. *Angelica Archangelica* (angelica)
5. *Pimpinella Anisum* (anise)
6. *Apium graveolens* (celery)

7. *Apocynum cannabinum* (Indian hemp)
8. *Aralia racemosa* (American spikenard)
9. *Arnica montana* (arnica)
10. *Asarum canadense* (wild ginger)
11. *Asclepias tuberosa* (pleurisy root)
12. *Avena sativa* (oats)
13. *Baptisia tinctoria* (wild indigo)
14. Sp. of Berberis (barberry)
15. *Bryonia alba* (bryony)
16. *Bryonia dioica* (bryony)
17. *Selenicereus grandiflorus* (night-blooming cereus — Succulent House)
18. *Calendula officinalis* (marigold)
19. *Castanea dentata* (chestnut)
20. *Nepeta Cataria* (catmint)
21. *Caulophyllum thalictroides* (blue cohosh)
22. *Chionanthus virginica* (fringe tree)
23. *Coffea arabica* (coffee—Economic House)
24. *Conium maculatum* (poison hemlock)
25. *Convallaria majalis* (lily-of-the-valley)
26. *Coptis trifolia* (gold-thread)
27. *Coriandrum sativum* (coriander)
28. *Cornus florida* (flowering dogwood)
29. *Dicentra canadensis* (squirrel corn)
30. *Dicentra Cucullaria* (Dutchman's breeches)
31. *Cypripedium pubescens* and other species of Cypripedium (lady-slipper)
32. *Delphinium Ajacis* (larkspur)
33. *Dioscorea villosa* (wild yam)
34. *Drosera rotundifolia* and other species of Drosera (sundew)
35. *Solanum Dulcamara* (bittersweet)
36. *Brauneria angustifolia* (purple cone-flower)
37. *Euonymus atropurpurea* (wahoo)
38. *Eupatorium perfoliatum* (boneset)
39. *Tussilago Farfara* (coltsfoot)
40. *Ficus Carica* (fig—Tropical Fruit House)
41. *Foeniculum vulgare* (fennel)
42. *Rhamnus Frangula* (buckthorn)
43. *Galega officinalis* (European goat's rue)
44. *Gelsemium sempervirens* (yellow jessamine)
45. *Geranium maculatum* (crane's-bill)
46. *Gossypium herbaceum* and other species of Gossypium (cotton)
47. *Grindelia squarrosa* (grindelia)
48. *Hamamelis virginiana* (witch-hazel)
49. *Humulus Lupulus* (hops)
50. *Hydrangea arborescens* (seven-barks)
51. *Inula Helenium* (elecampane)
52. *Iris florentina* (orris root)
53. *Iris germanica* (orris root)

54. *Iris pallida* (orris root)
55. *Iris versicolor* (blue flag)
56. *Juglans cinerea* (butternut)
57. *Juniperus communis* (juniper)
58. *Arctium Lappa* (burdock)
59. *Arctium minus* (burdock)
60. *Veronica virginica* (Culver's root)
61. *Malva rotundifolia* (mallow)
62. *Malva sylvestris* (mallow)
63. *Pistacia Lentiscus* (mastic—Economic House)
64. *Matricaria Chamomilla* (German chamomile)
65. *Melilotus officinalis* (yellow sweet clover)
66. *Daphne Mezereum* (mezereon—Economic House)
67. *Mitchella repens* (partridge berry)
68. *Myrica cerifera* (wax myrtle bark)
69. *Myrica carolinensis* (wax myrtle bark)
70. *Passiflora incarnata* (passion-flower)
71. *Phytolacca decandra* (poke)
72. *Piper nigrum* (black pepper—Economic House)
73. *Populus balsamifera* and other sp. of Populus (Balm of Gilead)
74. *Quercus alba* (white oak)
75. *Rhamnus cathartica* (buckthorn)
76. *Rubus idaeus* (raspberry)
77. *Rubus strigosus* (raspberry)
78. *Rumex crispus* (curled dock)
79. *Rumex obtusifolius* (curled dock)
80. *Serenoa serrulata* (saw palmetto—Palm House)
81. *Sambucus canadensis* (elder)
82. *Sanguinaria canadensis* (bloodroot)
83. *Sassafras variifolium* (sassafras)
84. *Cytisus scoparius* (broom)
85. *Scutellaria lateriflora* (skullcap)
86. *Senecio aureus* (life root)
87. *Solanum carolinense* (horse-nettle)
88. *Tamarindus indica* (tamarind—Economic House)
89. *Taraxacum Leontodon* (dandelion)
90. *Thymus vulgaris* (thyme)
91. *Trifolium pratense* (red clover)
92. *Trillium erectum* and other species of Trillium (Beth root)
93. *Agropyron repens* (couch grass)
94. *Vanilla planifolia* (vanilla—Bromeliad House)
95. *Verbascum phlomoides* (mullein)
96. *Verbascum thapsiforme* (mullein)
97. *Verbascum Thapsus* (mullein)
98. *Viburnum Opulus* (cramp bark)
99. *Viburnum prunifolium* (black haw)
100. *Zanthoxylum americanum* (northern prickly ash)
101. *Zanthoxylum clava-Herculis* (southern prickly ash)
102. *Zea Mays* (corn)

Non-official list

1. *Abrus precatorius* (Jequirty)
2. *Acacia arabica* (gum arabic—Peat House)
3. *Achillea Millefolium* (yarrow)
4. *Achillea Ptarmica* (sneezeweed)
5. *Acorus Calamus* (sweet flag)
6. *Actaea alba* (white snakeroot)
7. *Actaea rubra* (red snakeroot)
8. *Adiantum pedatum* (maidenhair fern)
9. *Agave americana* (century plant—Cactus House)
10. *Agrimonia parviflora* (agrimony)
11. *Allium stellatum* (garlic)
12. *Amomum Cardamon* (round cardamon—Economic House)
13. *Anchusa capensis* (alkanet)
14. *Anchusa officinalis* (alkanet)
15. *Anethum graveolens* (dill)
16. *Anthemis arvensis* (corn chamomile)
17. *Anthemis Cotula* (dog fennel)
18. *Anthemis nobilis* (garden chamomile)
19. *Anthemis tinctoria* (yellow chamomile)
20. *Antiaris toxicaria* (upas tree—Economic House)
21. *Apocynum androsaemifolium* (spreading dog-bane)
22. *Aralia nudicaulis* (American sarsaparilla)
23. *Aralia spinosa* (Hercules' club)
24. *Argemone mexicana* (Mexican poppy)
25. *Arisaema Dracontium* (green dragon)
26. *Arisaema triphyllum* (Jack-in-the-pulpit)
27. *Artemisia Absinthium* (wormwood)
28. *Artemisia annua* (annual wormwood)
29. *Artemisia frigida* (pasture sage brush)
30. *Artemisia vulgaris* (common mugwort)
31. *Asclepias incarnata* (swamp milkweed)
32. *Asclepias phytolaccoides* (poke milkweed)
33. *Asparagus officinalis* (asparagus)
34. *Baptisia australis* var. *sulphurea* (false indigo)
35. *Benzoin aestivale* (spice bush)
36. *Bifora radians*
37. *Borago officinalis* (borage)
38. *Brassica Napus* (rape seed)
39. *Carduus Marianus* (milk thistle)
40. *Carica Papaya* (papaw—Economic House)
41. *Carthamus tinctorius* (American saffron)
42. *Cassia marilandica* (American senna)
43. *Celastrus scandens* (waxwork)
44. *Chelidonium majus* (celandine)
45. *Chelone glabra* (balmony)
46. *Chenopodium ambrosioides anthelminticum* (American wormseed)
47. *Chrysanthemum cinerariaefolium* (insect flowers)

48. *Chrysanthemum leucanthemum* (ox-eye daisy)
49. *Cichorium Intybus* (chicory)
50. *Cicuta maculata* (water hemlock)
51. *Cocculus laurifolius* (Economic House)
52. *Cocos nucifera* (cocoanut—Palm House)
53. *Coix Lacryma-Jobi* (Job's tears)
54. *Collinsonia canadensis* (stone root)
55. *Commelina communis* (hay-flower)
56. *Cuminum Cyminum* (cumin)
57. *Cunila origanoides* (dittany)
58. *Cynoglossum officinale* (hound's tongue)
59. *Cyperus Papyrus* (Egyptian paper plant)
60. *Datura arborea* (angel's trumpet)
61. *Datura fastuosa*
62. *Datura inoxia*
63. *Datura Metel* (entire-leaved thorn-apple)
64. *Datura meteloides*
65. *Datura Tatula* (purple thorn-apple)
66. *Delphinium Consolida* (larkspur)
67. *Delphinium Staphisagria* (stavesacre)
68. *Dictamnus albus* (burning bush)
69. *Digitalis ambigua* (foxglove)
70. *Digitalis lanata* (foxglove)
71. *Digitalis lutea* (foxglove)
72. *Digitalis sibirica* (Siberian foxglove)
73. *Diospyros virginiana* (persimmon)
74. *Eschscholtzia californica* (California poppy)
75. *Eupatorium purpureum* (boneset)
76. *Eupatorium urticaefolium* (white snakeroot)
77. *Euphorbia corollata* (flowering spurge)
78. *Euphorbia splendens* (Christ's thorns)
79. *Fumaria officinalis* (fumitory)
80. *Gillenia stipulata* (American or false ipecac)
81. *Helianthus annuus* (sunflower)
82. *Heuchera americana* (alum root)
83. *Hevea brasiliensis* (rubber tree—Economic House)
84. *Hyoscyamus albus* (henbane)
85. *Hyoscyamus pictus* (henbane)
86. *Hypericum cistifolium* (round-podded St. John's-wort)
87. *Hypericum perforatum* (common St. John's-wort)
88. *Hyssopus officinalis* (garden hyssop)
89. *Isatis tinctoria* (dyer's wood)
91. *Laurus nobilis* (sweet bay—Economic House)
92. *Lavandula Spica* (lavender)
93. *Lavandula vera* (lavender)
94. *Levisticum officinale* (lovage)
95. *Liatris scariosa* (button snakeroot)
96. *Linum Lewisii* (flax)
97. *Lithospermum canescens* (hoary puccoon)

98. *Lobelia cardinalis* (cardinal flower)
99. *Lobelia syphilitica* (great lobelia)
100. *Lobelia spicata* (pale spiked lobelia)
101. *Manihot utilissima* (Economic House)
102. *Marrubium vulgare* (hoarhound)
103. *Martynia louisiana* (devil's claw)
104. *Matricaria inodora* (scentless chamomile)
105. *Melilotus officinalis* (white sweet clover)
106. *Melissa officinalis* (lemon balm)
107. *Menispermum canadense* (Canada moonseed)
108. *Mentha arvensis* (corn mint)
109. *Mentha arvensis* var. *piperascens* (Japanese mint)
110. *Monarda didyma* (Oswego tea)
111. *Monarda fistulosa* (wild bergamot)
112. *Monarda punctata* (horse-mint)
113. *Nicandra Physalodes* (apple of Peru)
114. *Nicotiana Tabacum* (tobacco)
115. *Nigella damascena* (love-in-a-mist)
116. *Nopalea coccinellifera* (Cactus House)
117. *Ocimum Basilicum* (sweet basil)
118. *Osmorhiza longistylis* (sweet cicely)
119. *Osmunda Claytoniana* (adulterant of aspidium)
120. *Panax quinquefolium* (ginseng)
121. *Parthenium repens* (feverfew)
122. *Pedicularis canadensis* (lousewort)
123. *Perilla frutescens* (beef-steak plant)
124. *Petroselinum hortense* (parsley)
125. *Phoenix dactylifera* (date palm—Palm House)
126. *Phytolacca dioica* (poke)
127. *Plantago psyllium* (fleawort)
128. *Podophyllum emodi* (Indian mandrake)
129. *Polemonium reptans* (Jacob's ladder)
130. *Polygonatum commutatum* (great Solomon's seal)
131. *Polygonum virginianum* (smartweed)
131. *Polypodium vulgare* (polypody)
132. *Potentilla canadensis* (five fingers)
133. *Prunus Laurocerasus* (cherry laurel—Peat House)
134. *Ricinus communis* (castor-oil bean)
135. *Rubia tinctorum* (madder)
136. *Ruellia ciliosa* (adulterant of spigelia)
137. *Ruellia strepens* (smooth ruellia)
138. *Ruta graveolens* (garden rue)
139. *Salvia austriaca*
140. *Salvia Horminum*
141. *Salvia officinalis* (garden sage)
142. *Salvia Sclarea* (clary)
143. *Sanicula canadensis* (sanicle)
144. *Sanicula marilandica* (sanicle)
145. *Saponaria officinalis* (bouncing Bet)

146. *Satureja hortensis* (savory)
147. *Scrophularia marilandica* (figwort)
148. *Senecio vulgaris* (common groundsel)
149. *Sesamum indicum* (benne—Economic House)
150. *Sinapis alba* (white mustard)
151. *Smilacina racemosa* (false Solomon's seal)
152. *Symphytum officinale* (comfrey)
153. *Tanacetum vulgare* (tansy)
154. *Thalictrum dioicum* (early meadow rue)
155. *Trigonella Foenum-Graecum* (fenugreek)
156. *Verbascum Blattaria* (moth mullein)
157. *Verbena hastata* (blue vervain)
158. *Viburnum Lentago* (nanny-berry)

Acknowledgments for seeds and plant materials received for the medicinal garden during 1926-27 are due the following:

Dr. W. W. Stockberger, Bureau of Plant Industry, Washington, D. C.

Dean E. R. Serles, Division of Pharmacy, South Dakota State College, Brookings, South Dakota.

Dr. Wm. O. Richtmann, Department of Pharmacy, University of Wisconsin, Madison, Wisconsin.

Dr. G. A. Russell, care Vick Chemical Company, Greensboro, North Carolina.

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Dr. Arno Viehoever, Philadelphia College of Pharmacy & Science, Philadelphia, Pa.

DAMAGE TO THE GARDEN BY THE CYCLONE OF SEPTEMBER 29

No year in the history of the Garden has seen so much damage both to buildings and plants as that of 1927. With the hailstorm of May 28, it was thought that the climax of disasters had been reached, and it was little suspected that a few months later a cyclone would visit St. Louis. The Garden, however, was unusually fortunate in being just on the edge of the cyclone area. The path of the storm started within one block of the western boundary of the Garden, several factories on Vandeventer Avenue being badly dam-

aged. From here it continued north on Kingshighway to Manchester, then northeast, crossing Forest Park Boulevard and Lindell Boulevard, north on Sarah almost to St. Louis Avenue, east to Grand, then north to the river.

The greenhouses withstood the pressure of the high wind remarkably well, and not a single pane of glass was broken in the large conservatories. All the conservatories had just been repaired from the damage of the hailstorm of May 28, using a new type of glazing with bronze clips to hold each pane in place. Under the old type of glazing the vacuum-like pressure caused by the wind in the interior of the Palm House would probably have blown out as many as 500 panes of glass and carried them as far as the main gate. The only damage to the Garden buildings was to the Linnean House, where all the copper guttering on the south side, with the attached boards, was torn off and carried over the ridge of the roof into the nursery. This caused the breaking of twenty panes of glass on the south span of the house.

The greatest damage done was to the specimen trees in various parts of the Garden. Two hundred and six trees, varying from 4 to 18 inches in diameter, were either ruined or injured. Unlike in previous storms the hardwood trees suffered to the same degree as the soft-wooded species. The greatest havoc was wrought west of the Economic Garden and around the Grove, and west and east of the large conservatories, where the trees were either upheaved or the terminal branches twisted. One of the greatest disasters was the decapitation of the specimen maidenhair tree east of the Fern House. This tree best illustrated the unusual habit of grafting by inarching (see December, 1923, number of the BULLETIN). The large Scotch elm west of the old residence (described in the June, 1924, number of the BULLETIN), damaged during early May, is now completely ruined by the loss of its remaining terminal branch and several lateral branches. Our largest horse-chestnut, west of the Grove, was likewise decapitated. The trunk of the largest persimmon in the Garden, which had dominated the north entrance to the Grove, was twisted off about 12 feet from the ground. This tree was struck by lightning during 1908, at which time it was split

from its terminal branch down to the ground, opening up a fissure 10 inches wide at the base. It was again struck in 1922. However, its destruction cannot be laid to a weakened condition caused by previous storms, because the heartwood was in perfect condition at the broken area. One of the large specimen bald cypresses, west of the power plant, was completely twisted off a few feet from the ground. The greatest amount of injury was naturally among the soft maples, sycamores, and ailanthus. The latter, due to their root formation, were in most cases blown down and uprooted.

Following is a list of the kind of trees and the number of specimens injured:

Soft maple	10	Oak	2
Elm	2	Plum	2
Ailanthus	8	Sassafras	2
Tulip tree	3	Ash	5
Gingko	3	Hackberry	3
Persimmon	3	Hawthorn	5
Sycamore	11	*Evonymus Bungeana*	5
Populus	7	Willow	6
Osage-orange	4	Catalpa	4
Magnolia glauca	2	Buckeye	2
Sumac	7	Alder	1
Cherry	2		
Black locust	2	Total	101

The following were destroyed:

Soft maple	19	Sycamore	1
Elm	2	Mulberry	5
Ailanthus	6	Osage-orange	3
Gingko	1	*Magnolia glauca*	3
Persimmon	5	Honey locust	2
Oak	1	Sumac	7
Populus	9	Cherry	3
Plum	1	Paulownia	1
Paper mulberry	1	Coffee bean	3
Cypress	1	Black locust	3
Papaw	3	Apple	2
Evonymus Bungeana	11	Box elder	2
Catalpa	4	Willow	1
Buckeye	2	Sweet gum	1
Plum	1		
Hawthorn	1	Total	105

THE FOURTH ANNUAL DAHLIA SHOW

The fourth Annual Dahlia Show was held in the Floral Display House on October 1-2. Though the weather had been anything but favorable, both amateur and commercial sections were well represented. Judges for the amateurs section were: W. A. Bangs, Springfield, Mo.; L. B. Dover, Clayton, Mo.; and August Koch, Supt. Garfield Park Greenhouses, Chicago, Ill. Judges for the commercial section were: E. H. Johanning, Webster Groves, Mo.; Edw. F. Nolte, Webster Groves, Mo.; and F. M. Davis, Wellston Station. Mo.

The bronze medal of the American Dahlia Society for the most meritorious exhibit in the amateur section was awarded to Edw. F. Nolte of Webster Groves for his exhibit of a collection of five varieties. The Society's silver medal for the most meritorious exhibit in the commercial section was awarded to the Highland Gardens for their exhibit of a similar collection. Ribbon prizes were awarded in the other classes as follows:

SECTION A—AMATEUR

Class No. 1 (Specimen Cactus)—1st, 2nd and 3rd: Richard Kramske, Route 9, Jefferson Barracks, Mo.

Class No. 2 (Hybrid Cactus)—1st, H. R. Hartman, 5206 Louisiana Ave., St. Louis; 2nd, E. F. Nolte, 667 W. Lockwood Ave., Webster Groves, Mo.; 3rd, H. R. Hartman and H. J. Wichman, 11 Sarah St., Webster Groves, Mo.

Class No. 4 (Decorative)—1st, Florence Kelley, Iuka, Ill.; 2nd, H. J. Wichman; 3rd, E. F. Nolte.

Class No. 6 (Peony)—1st, Richard Kramske; 2nd, E. F. Nolte; 3rd, G. A. Smith, 5466 Plover Ave., St. Louis.

Class No. 7 (Pompon)—1st, E. H. Johanning, Webster Groves, Mo.; 2nd, Dr. W. R. Hewitt, 7116 Lanham St., St. Louis; 3rd, no award.

Class No. 8 (Seedling)—1st, Richard Kramske; 2nd, J. L. Ramsey, 1516 Locust, Eldorado, Ill.; 3rd, Dr. W. R. Hewitt.

Class No. 10 (Show)—1st, E. F. Nolte; 2nd, Richard Kramske; 3rd, Dr. W. R. Hewitt.

Class No. 11 (Collection of ten varieties)—1st, E. H. Johanning; 2nd, E. F. Nolte; 3rd, Dr. W. R. Hewitt.

Class No. 12 (Collection of five varieties)—1st, E. F. Nolte (also bronze medal); 2nd, Richard Kramske; 3rd, F. J. Eilers.

Class No. 13 (Case of ten blooms)—1st, E. H. Johanning; 2nd, Dr. W. R. Hewitt; 3rd, no award.

Class No. 14 (Vase of five blooms)—1st, E. H. Johanning; 2nd, Florence Kelley; 3rd, Dr. W. R. Hewitt.

Class No. 15 (Most artistic vase)—1st, Richard Kramske; 2nd, Florence Kelley; 3rd, Dr. W. R. Hewitt.

Class No. 16 (Davis cup for collection of six varieties)—1st and 2nd, E. F. Nolte; 3rd, no award.

SECTION B—COMMERCIAL

Class 1 (Specimen Cactus)—1st, Highland Gardens, Bangs Bros., 2021 North Fort Ave., Springfield, Mo.; 2nd, J. W. Bibb, 5534 Cabanne, St. Louis; 3rd, L. B. Dover, Route 1, Box 940, Clayton, Mo.

Class 2 (Hybrid Cactus)—1st, L. B. Dover; 2nd, Highland Gardens; 3rd, J. W. Bibb.

Class 4 (Decorative)—1st, Highland Gardens; 2nd, J. W. Bibb; 3rd, F. R. Holaway, Springfield, Mo.

Class 6 (Peony)—1st, J. W. Bibb; 2nd, Highland Gardens; 3rd, J. W. Bibb.

Class 7 (Pompon)—1st, J. W. Bibb.

Class 8 (Seedling)—1st, J. W. Bibb; 2nd and 3rd, L. B. Dover.

Class 10 (Show)—1st, Highland Gardens; 2nd, J. W. Bibb; 3rd, Highland Gardens.

Class 11 (Collection of ten varieties)—1st, L. B. Dover.

Class 12 (Collection of five varieties)—1st, Highland Gardens (also silver medal).

Class 13 (Best display)—1st, Highland Gardens; 2nd, J. W. Bibb.

Class 14 (Most artistic vase)—1st and 2nd, J. W. Bibb; 3rd, L. B. Dover.

GENERAL SEMINARS, SHAW SCHOOL OF BOTANY

SEPTEMBER 30

Topic by Dr. Clifford H. Farr.—THE PROCEEDINGS OF THE FIRST INTERNATIONAL CONGRESS OF SOIL SCIENCE, HELD IN WASHINGTON, D. C., JUNE 13-22, 1927

OCTOBER 7

Topic by E. H. Runyon.—PECTIC SUBSTANCES AND PECTIC ENZYMES

I. Pectic substances

A. Chemistry and nomenclature. Pectic substances are carbohydrate derivatives, closely allied to the polysaccharides. Protopectins, the insoluble mother substances, are thought to be complex Ca-Mg salts containing arabinose, galactose, methoxy, and 4(?) galacturonic acid groupings. Some of the products of hydrolysis of the protopectins are: *pectins*, which are water-soluble, neutral substances, and *pectic* acids, which are *gelatinous*

B. Occurrence. Associated with cellulose, and in fruit juices. Metabolic changes. During ripening of fruits, and senescence.

C. Function. Importance. (1) To the plant: a building material, water adsorbant, factor in susceptibility to disease, in

abscission and senescence; (2) Economically: setting of jellies, retting of flax and other fibers, keeping qualities of vegetables and fruits, mealiness, etc.

II. Pectic enzymes

A. Classification. *Protopectinase* hydrolyzes protopectins to pectins. *Pectase* hydrolyzes pectins to pectic acid, methyl alcohol, and acetone. *Pectinase* hydrolyzes pectins and pectic acids to galactose, arabinose, galacturonic acid

B. Occurrence

C. Importance

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OCTOBER 14

Topic by A. F. Bucholtz.—THE STUDY OF THE ORIGIN OF CULTIVATED PLANTS WITH THE PURPOSE OF DETERMINING THEIR VARIABILITY

I. Introduction

The present status of the study of distribution and breeding of cultivated plants. The work of the Russian school of applied botany—the Institute of Applied Botany and Plant Breeding at Leningrad

II. Methods suggested by N. Vavilov

A. The law of homologous series of variation

Species and genera more or less closely related to each other are characterized by similar series of variations with such a regularity that, knowing a succession of varieties in one genus and species, one can forecast the existence of similar forms and even similar genotypical differences in other genera and species. The true Linnean species are definite systems of forms and not casual collections of separate varieties

B. The study of the centers of origin of cultivated plants with the purpose of utilizing the potential sources of varietal

wealth for the introduction of new varieties and experimental phylogenetics

III. "Studies of Origin of Cultivated Plants" by N. Vavilov

A. Methods suggested

1. The differentiation of a given plant into Linnean species and genetical groups by the aid of morphology, taxonomy, hybridization, cytology, reaction to parasites, etc.
2. The determination of the areas of those species in the past and present and the centers of concentration of their hereditary diversity in different regions and countries

B. Primary and secondary crops

Primary crops are ancient crops known only as cultivated plants

Secondary crops have originated from weeds admixed with primary crops

C. Centers of origin of wheat and rye

D. Common world centers of origin of cultivated plants

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OCTOBER 21

Topic by Mildred E. Mathias.—STUDIES ON UMBELLIFERAE

I. Morphological survey of the family with especial reference to fruit characters and their relation to a phylogenetic arrangement of the genera

II. The genus *Glehnia* Schmidt

A. Morphology of the genus

B. Relationships in the family

C. Geographical distribution

D. Taxonomy of the genus

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NOTES

Dr. Roland V. L. La Garde has been appointed Research Assistant on the staff of the Missouri Botanical Garden.

Dr. George T. Moore, Director of the Garden, spoke before the Collinsville Study Club, October 18, on "Sensations in Plants."

Clarence E. Kobuski, Ph.D. Washington University, 1927, has been appointed Assistant at the Arnold Arboretum of Harvard University.

Recent visitors to the Garden include Dr. J. N. Rose, of the United States National Museum, and Mr. P. G. Russell, of the Bureau of Plant Industry, Washington, D. C.

Dr. George T. Moore addressed the smoke-abatement session of the National Fuels Meeting, October 13, on "The Measurement of Atmospheric Smoke Pollution Visible and Invisible."

Dr. J. M. Greenman, Curator of the Herbarium, Missouri Botanical Garden, and Professor of Botany, Washington University, has been placed in charge of graduate work in the Henry Shaw School of Botany.

Mr. G. H. Pring, Horticulturist to the Garden, is giving a special gardening course of twelve lectures to the cemetery superintendent of St. Louis and the surrounding district. Twenty-two men have registered.

Ernest Shaw Reynolds, Ph.B., A.M., Brown University, 1907, and Ph.D. University of Illinois, 1909, has been ap-

pointed Professor of Plant Physiology in the Henry Shaw School of Botany of Washington University and Physiologist to the Missouri Botanical Garden.

David Linder, Ph.D. Harvard University, 1926, Instructor in Botany in Washington University and Mycologist to the Missouri Botanical Garden, after a year's leave of absence in Africa, has returned to this country and has taken up his work in Washington University and the Garden.

Dr. W. W. Lepeschkin, Professor and Dean of the department of Natural Sciences of the Russian People's University in Prague and member of the committee for teaching Russian students in Czechoslovakia, Visiting Professor of Plant Physiology in Washington University and Physiologist to the Missouri Botanical Garden, is giving a course of lectures at Washington University on the "Physiological Processes of Plants from a Physico-chemical Standpoint." Dr. Lepeschkin's lectures are being attended by members of the faculty and graduate students from several departments of the University.

Volume 14, Number 3, of the Annals of the Missouri Botanical Garden has been issued during the last month. The entire number, consisting of 148 pages with 6 plates, is devoted to a paper by Dr. E. B. Payson, formerly Teaching Fellow in the Henry Shaw School of Botany and, until his sudden death last spring, Professor of Botany at the University of Wyoming. Dr. Payson's paper is entitled "A Monograph of the Section Oreocarya of Cryptantha." As indicated in the title, it classifies and describes a closely related group of plants belonging to the Borage family. Native mainly to waste areas in arid regions of the west, they are as a group characterized by their lack of conspicuous differences between the several species. Dr. Payson's careful work, particularly in studying their seeds, or more correctly speaking their nutlets, has shown that precise differences do exist and has enabled him to describe and classify the 46 species in an orderly fashion.

Students pursuing graduate work in the Henry Shaw School of Botany, either in the laboratories at the Missouri

Botanical Garden or in Rebstock Hall at Washington University, during the current academic year are as follows:

Instructor.—Ernest Hocking Runyon, B.S. University of Chicago, 1925.

Assistants.—Martha Lydia Beardsley, A.B. Washington University, 1926, M.S. 1927; Catharine Mary Lieneman, A.B. University of Nebraska, 1925, M.S. Washington University, 1927; Paul Gerald Wible, A.B. University of Indiana, 1926.

Rufus J. Lackland Research Fellows.—Alexander F. Bucholtz, student at Dorpat University, Dorpat, Esthonia, 1920-23, B.S. Cornell University, 1926; Edgar Lawrence Evinger, B.S. Indiana State Normal School, 1926; Oliver Small Orton, B.S. University of Vermont, 1927.

Jessie R. Barr Fellows.—Ethel Taber Eltinge, A.B. Syracuse University, 1921, A.M., 1922; Esther Louise Larsen, A.B. University of Montana, 1925, M.S. Washington University, 1926; Mildred E. Mathias, A.B. Washington University, 1926, M.S., 1927.

Mr. Kazuo Gotoh, Lecturer of Botany, Hokkaido Imperial University, Sapporo, Japan, International Education Board Fellow; Mrs. Eva M. Fling Roush, A.B. University of West Virginia, 1911, A.M. 1920; Paul Franklin Shope (in absentia), Instructor of Botany, University of Colorado.

STATISTICAL INFORMATION FOR SEPTEMBER, 1927

GARDEN ATTENDANCE:

Total number of visitors.....22,997

PLANT ACCESSIONS:

Total number of plants and seed packets received as gifts 726

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought..... 27

Total number of books and pamphlets donated..... 33

HERBARIUM ACCESSIONS:

By Gift—

Anderson, Dr. Edgar S.—Plants of Ontario, Canada.... 56

Drushel, Prof. J. A.—Plants of New Jersey..... 118

Hume, H. Harold—Plants of Florida..... 4

Kellogg, John H.—Plants of Dent County, Missouri.... 2

Roush, Mrs. Eva M. Fling—Plants of Virginia and West Virginia 2

Woodson, Robert E., Jr.—Plants of eastern United States 206

By Purchase—

Davis, Miss Edna L.—Plants of North Carolina, South Carolina, and Georgia..... 1,634

Herter, Dr. Guillermo—Plants of Uruguay..... 106

Kramer, Dr. Joseph—Plants of Nebraska..... 205

Werderman, Dr. E.—Plantae Chilenses, Nos. 927-1150, incl. 224

By Exchange—

Botanical Museum, University of Cluj, by Professor Al. Borza—Plants of Roumania, Cent. VII, Nos. 601-700 100

U. S. Department of Agriculture, by Dr. C. L. Shear—"Exsiccatae citri cancris"..... 27

Total 2,684

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and, while virtually a private garden, it was, except at certain stated times, always open to the public. By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the 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 of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises about 75 acres. There is now in process of development a tract of land of over 1,500 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a forest reservation, with the idea that possibly at some future time this may become the new botanical garden. About 12,000 species of plants are growing in the Garden.

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day and Christmas—week days from 8:00 a. m. until one-half hour after sunset; Sundays from December to April, 1:00 p. m. until sunset; from April to December, 2:00 p. m. until sunset.

The main entrance to the Garden is located at Tower Grove avenue and Flora place, on the Vandeventer avenue car line. Transfer south from all intersecting lines. The Garden may also be reached by Bus Route No. 12, to which all other motorbus lines transfer.

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Manager

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. XV NOVEMBER, 1927 No. 9

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ST. LOUIS, MO.
1927

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OF THE MISSOURI BOTANICAL GARDEN

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Missouri Botanical Garden Bulletin

Vol. XV NOVEMBER, 1927 No. 9

THE EARLIEST ST. LOUISAN OF BOTANICAL NOTE

The wilderness which was the continent of North America presented itself as a challenge to the early botanists of Europe, and the challenge was met with a vigor which even today is marvelous. Emanating from the great Swedish botanist, Carolus Linnaeus, the great importance of extensive collections of specimens became recognized, and, inspired by his intensive travels and studies, many students embarked upon trips of exploration for plants.

Of the many botanists who visited and explored North America during the latter part of the eighteenth, and the early part of the nineteenth, centuries in particular, the names of Michaux, Nuttall, and Bradbury stand in sharp relief for the extent and productivity of their travels. Of the three, André Michaux is the most noted. He probably explored more of North America than any of the early botanists, and his explorations have perhaps not been equalled since. His travels extended from the Carolinas to Hudson's Bay and Lake Mistassini in southern Labrador, and hundreds of new plants were added to the knowledge of Science through his efforts. Thomas Nuttall is of almost equal fame, since he was one of the first Europeans to cross the continent, and his collections of western plants are among the very earliest. But his travelling companion, John Bradbury, is of particular interest to those St. Louisans who are concerned with Botany, because he was one of the earliest botanical explorers of the

Mississippi and Missouri valleys, and because, although an Englishman by birth, he became an American and a St. Louisan by adoption.

When Bradbury was sent to this country by the Liverpool Botanic Garden, it was intended that he should make New Orleans the center of his activities, but Thomas Jefferson recommended that St. Louis be chosen instead, because of the more varied topography in the upper reaches of the Mississippi valley, as well as the greater region accessible to travel through the proximity of the Missouri River.

Accordingly, Bradbury arrived in St. Louis, December 31, 1809, and made preparations for the reception of the specimens which he planned to accumulate the following spring and summer. During the season of 1810 he made frequent excursions into the "wilderness", but never went further than eighty or one hundred miles from the town. He visited the region about Ste. Genevieve, where he had the good fortune to make friends with a merchant of that town, one M. Longprè, who was of considerable assistance to him with his collecting. The lead mines of the district interested him particularly, and we learn from the account which he subsequently published that he visited the diggings at Mine La Motte, DesLoge, and Herculaneum.

During the autumn and winter of his first year in St. Louis, Bradbury became acquainted with several inhabitants of the town, and was told of the hilly region to the south, called the Ozarks, or, by the older French, "Aux-Arcs," and he laid plans to visit it during the spring of 1811. Those plans, however, were never fulfilled, for late in the winter a party of Canadians arrived whose plan it was to follow the route of Lewis and Clark to the Pacific coast. Bradbury became acquainted with those men and needed very little inducement to go with them instead of visiting the Ozarks. The following spring, accompanied by Thomas Nuttall, the party set out from St. Charles, near the confluence of the Missouri and the Mississippi, and followed the Missouri in canoes as far as the "Mandan Villages", an Indian community close to the present site of Bismarck, North Dakota. There Brad-

bury thought it best he should leave the expedition, and returned by the same route to St. Louis.

The fact that the two naturalists, Nuttall and Bradbury, both collected plants from the same new localities has caused considerable confusion. The collections of the two men, though often made at the same spot and on the same date, were enumerated and described independently; Nuttall's in his "Genera of North American Plants" (1817), and in Fraser's "Catalogue" (1813); Bradbury's by Pursh in the latter's "Flora Americæ Septentrionalis" (1814.) So it happened that in many cases the same species received two different names. For example, the plant described by Pursh as *Seseli divaricatum* and collected by Bradbury on the Missouri was earlier described by Nuttall as *Seseli lucidum* and based on a plant collected on the "Missouri." The same is true for *Selinum acaule* of Pursh and *Thapsia glomerata* of Nuttall, the plants from which each was described probably having been collected in the same locality.

Bradbury's experiences upon the expedition were numerous and varied. At Boone's Lick he met Daniel Boone, then an old man of over eighty years. Close to the present site of the city of St. Joseph, the party had an encounter with the Nodawessie Indians (for whom Nodaway County receives its name). A terrific storm overtook the party once, and we find in Bradbury's Journal evidence of the continual scrutiny and care of the botanist in the midst of bodily perils. "Such lightning and such thunder I never before had witnessed," he wrote. "We stopped and fastened our boats to some shrubs (*Amorpha fruticosa*) and prepared to save ourselves and our little barks if possible. Upon my recommendation, we left the trees which in a short time would furnish us little shelter, and might become an actual danger, and went into the open prairie where we lay down in our blankets. I put my plants under me."

The botanical activities of Bradbury in the territory of the hostile Sioux were a source of concern to the other explorers, and he was frequently accompanied by a friend who acted as a lookout, since his occupation kept him "for the most part in a stooping position." It does not seem, however, that he

had much to fear from the Indians. They at all times accorded him respectful interest, believing him to be the physician of the expedition since he was always occupied with his plants, and several times the native medicine men asked him to examine their stock of herbs, and occasionally furnished him with a new plant, for which he was grateful.

Several observations of more than ordinary interest are related in Bradbury's Journal, one of which concerns the naturalization of the European honey-bee in North America. "The honey bees have been introduced into this continent from Europe," he explained, "but at what time I have not been able to ascertain. Even if it be admitted that they were brought over soon after the first settlement took place, their increase appears astonishing, as bees are found in all parts of the United States; and since they have entered upon the fine countries of the Illinois and Upper Louisiana, their progress westward has been surprisingly rapid. It is generally known in Upper Louisiana that bees had not been found westward of the Mississippi prior to the year 1797. They relate in St. Louis that a French lady of that place having received a present of honey from Kaskaskias was much delighted with it, and being told that it was produced by a kind of fly, she sent a negro with a small box to Kaskaskias (60 miles) to get a pair of the flies, in order that she might obtain the breed. They are now found as high up the Missouri as the Maha nation, having moved westward to the distance of 600 miles in fourteen years. Bees have spread over this continent in a degree, and with a celerity so nearly corresponding to that of the Anglo-Americans that it has given rise to a belief, both amongst the Indians and the Whites, that bees are their precursors, and that to whatever part they go the white people will follow. I am of the opinion that they are right, as I think it as impossible to stop the progress of one as of the other."

Soon after arriving again in St. Louis, Bradbury prepared to return to England whence he had sent his plants before him, and left upon a Mississippi River barge for New Orleans, December 5, 1811. Just below New Madrid, upon the night of December 15, Bradbury witnessed a natural phenomenon

which has had few equals in violence in this country, and one which has been but poorly described at first hand. Bradbury's account is one of the most vivid:

"In the night, about ten o'clock, I was awakened by a most tremendous noise, accompanied by so violent an agitation of the boat that it appeared in danger of upsetting. Before I could quit the bed, or rather the skin, upon which I lay, the four men who slept in the other cabin rushed in, and cried out in the greatest terror, 'O mon Dieu! Monsieur Bradbury, qu'est ce qu'il y a?' I passed them with some difficulty, and ran to the door of the cabin, where I could distinctly see the river agitated as if by a storm; and although the noise was inconceivably loud and terrific, I could distinctly hear the crash of falling trees, and the screaming of wild fowl on the river.

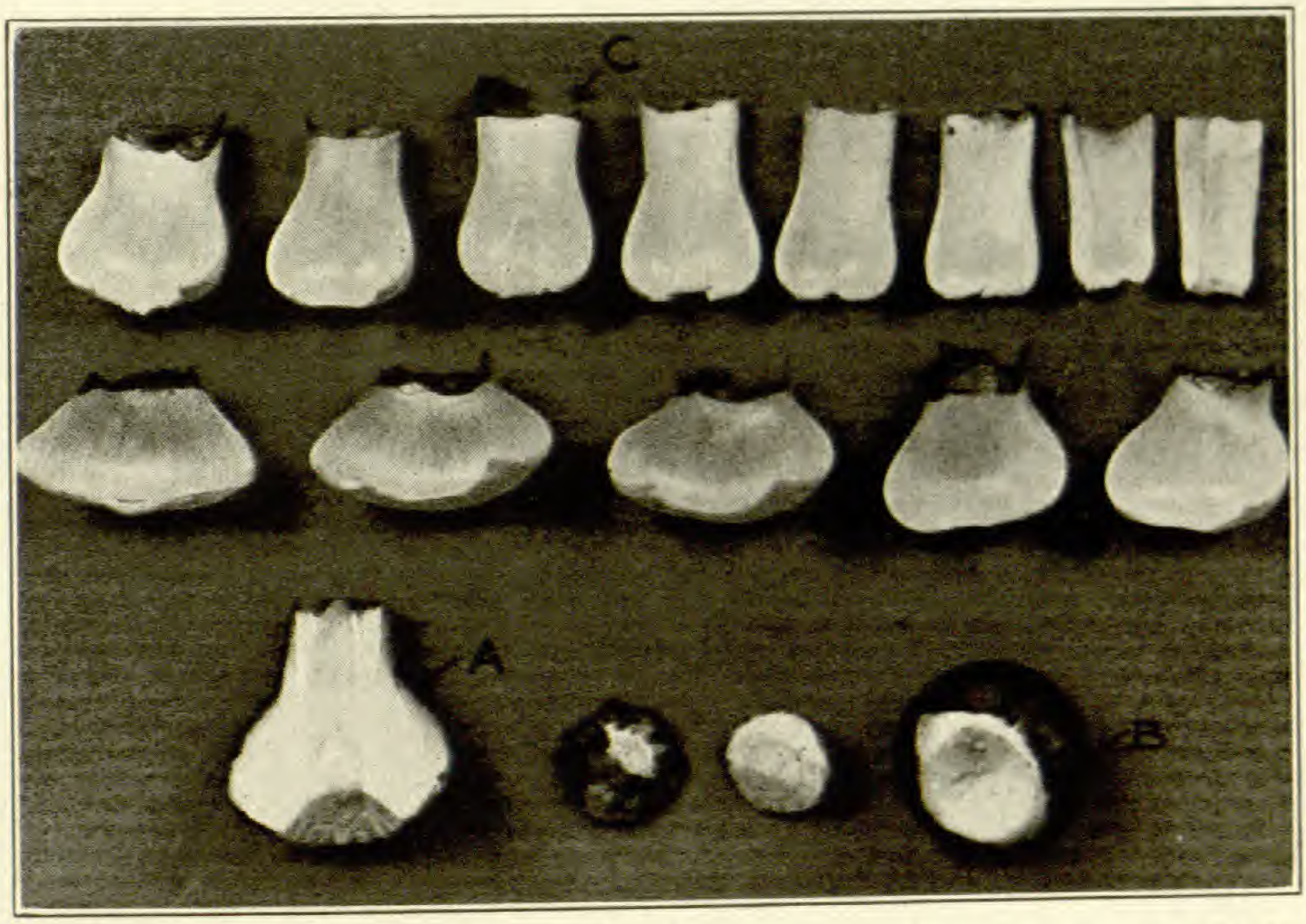
It was, in fact, the great New Madrid earthquake, the most violent and most widely distributed earthquake of which there is any human record in North America. The boat in which the party was resting was safely moored to a low bank, which probably saved their lives, for a high cliff on the opposite side of the river was falling into the water in such vast fragments as to nearly sink the craft by the swell occasioned. During the remaining hours of the night violent shocks occurred at intervals of from six to ten minutes, and in all twenty-seven shocks of great severity were counted. In the morning the river was covered with foam and drift timber and had risen considerably, but the boat was still miraculously safe. Even during the day, however, frequent shocks occurred. "The trees on both sides of the river were most violently agitated, and the banks in several places fell in, within our view, carrying with them innumerable trees, the crash of which falling into the river, mixed with the terrible sound attending the shock, and the screaming of the geese and other wild fowl, produced an idea that all nature was in a state of dissolution." Upon its arrival at the "Chickasaw Bluffs," the present site of Memphis, Tennessee, the party was informed that the wide plains upon which the town of New Madrid was situated had become an enormous lake, and that the inhabitants had all fled the region.

Upon his arrival in England from New Orleans, Bradbury found to his dismay that the plants which he had sent to Liverpool had been inspected by "a certain person named Pursh," who had studied them and had published what new ones there were. This breach of faith so filled Bradbury with indignation that he refused to have anything more to do with the specimens, and he soon left England permanently, returning to St. Louis, where he had formed numerous acquaintances and made friends with prominent families of the town. St. Louis became his home henceforth. Until recently it was not known how long Bradbury lived after his return, the only evidence that he was still alive in 1821 being the city directory of that year, which listed his name as one of the residents of the city. However, an examination of the newspaper files of that period revealed the following notice which appeared in the "Republican" under date of May 7, 1823.

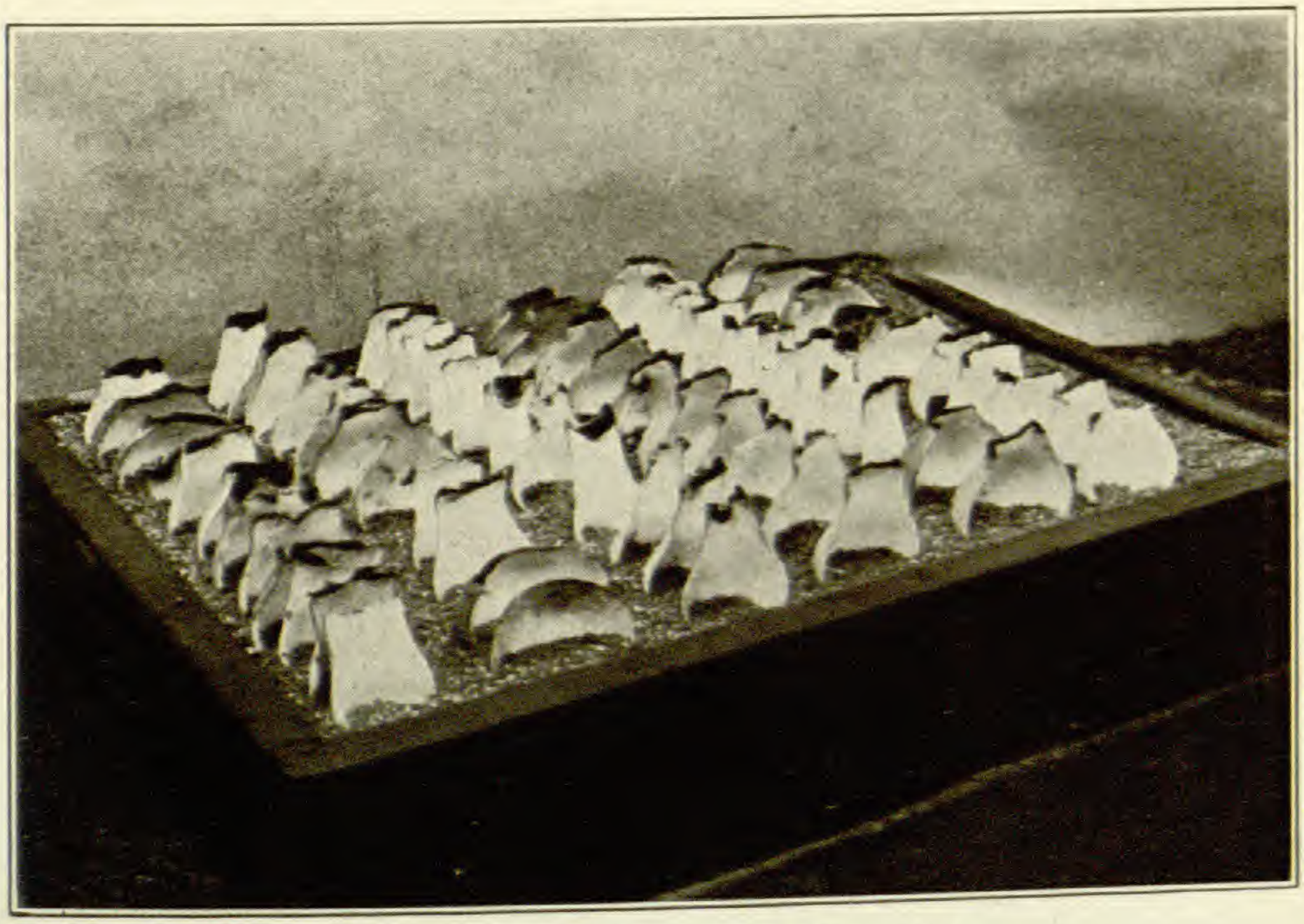
Died at Middletown, Ky., on the 16th of March last, after a short illness, Mr. John Bradbury. Mr. Bradbury is known to the scientific world as one among the first botanists and mineralogists. His knowledge in science generally was esteemed valuable. Never was there a better companion or more sincere friend.

PROPAGATING HIPPEASTRUMS.

In December, 1926, the Garden received a bulletin from the Laboratory of Plant-Physiological Research, Wageningen, Holland, by Ida Luyten, entitled "Vegetative Cultivation of Hippeastrum." This bulletin contained an interesting account of the results of experiments, commenced in November, 1922, on propagating hippeastrum bulbs vegetatively so that varieties could be kept true and easily produced in quantity. Some hippeastrums occasionally produce one or two offsets, but if this method of propagation were followed it would take years to secure a few dozen bulbs of the same variety. Since the hybrid hippeastrums set seed readily and are easily grown from seed, this has been the only method of producing them in quantity for commercial use. Consequently bulb firms, in their catalogues, list the hippeastrums, erroneously called amaryllis, as "hybrid amaryllis" which can be supplied in mixture only. Hitherto it has been impossible to offer in

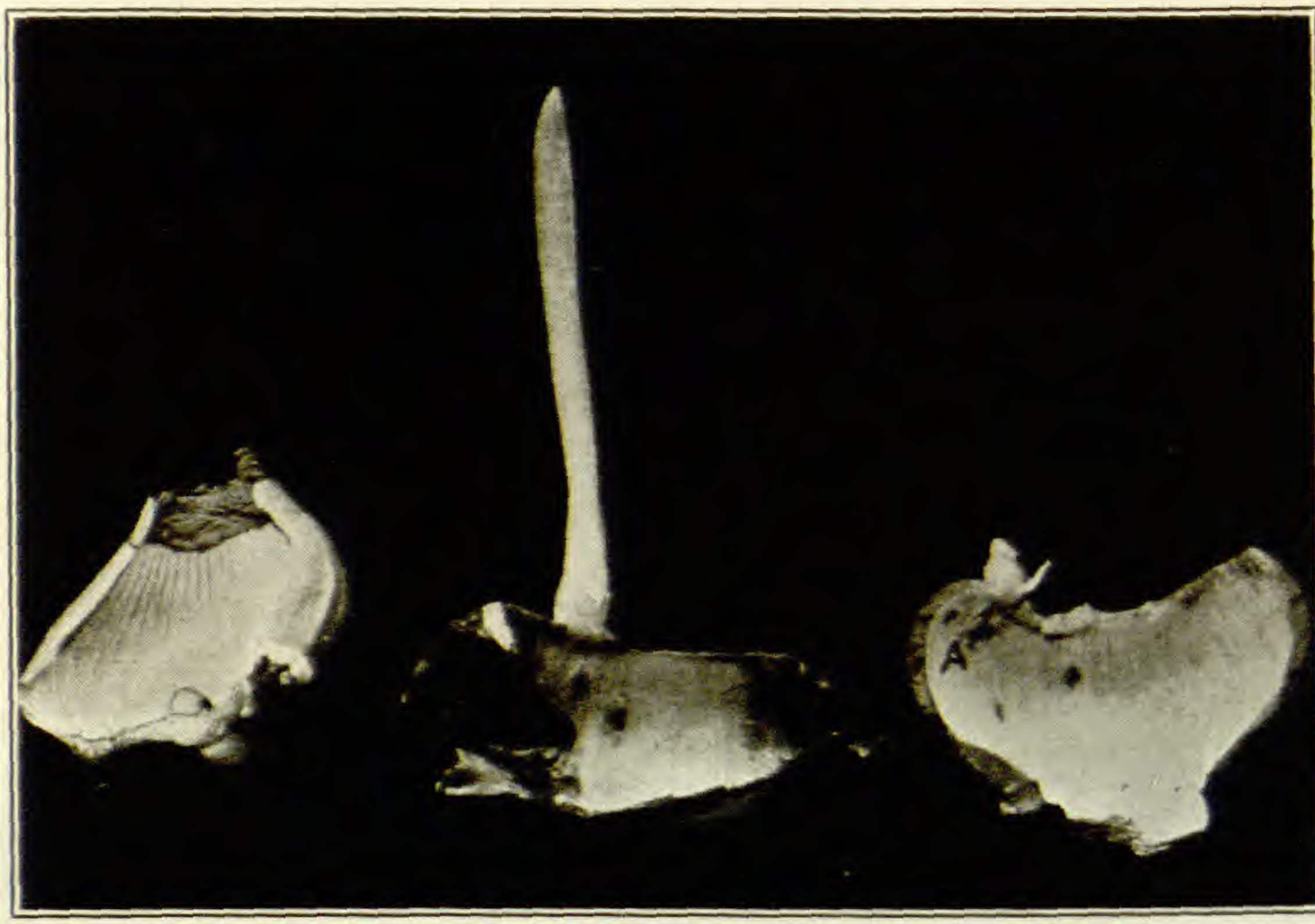


A, HALF BULB BEFORE REMOVING SCALES, B, BULB WITH DISK REMOVED, C, SCALES READY FOR INSERTING IN SAND.



SCALES SET IN A FLAT OF SAND.

RUDIMENTARY BULBS FORMING AT THE BASE OF SCALES.



CONCAVE SIDE OF SCALES SHOWING RUDIMENTARY BULBS. (A) BULB WITH A ROOT ATTACHED.

quantity any one variety of hippeastrum, but if the new method of propagation proves successful, there should be no reason why one should not be able to buy hippeastrums, just as hyacinths and tulips, according to name and be certain of getting the color desired.

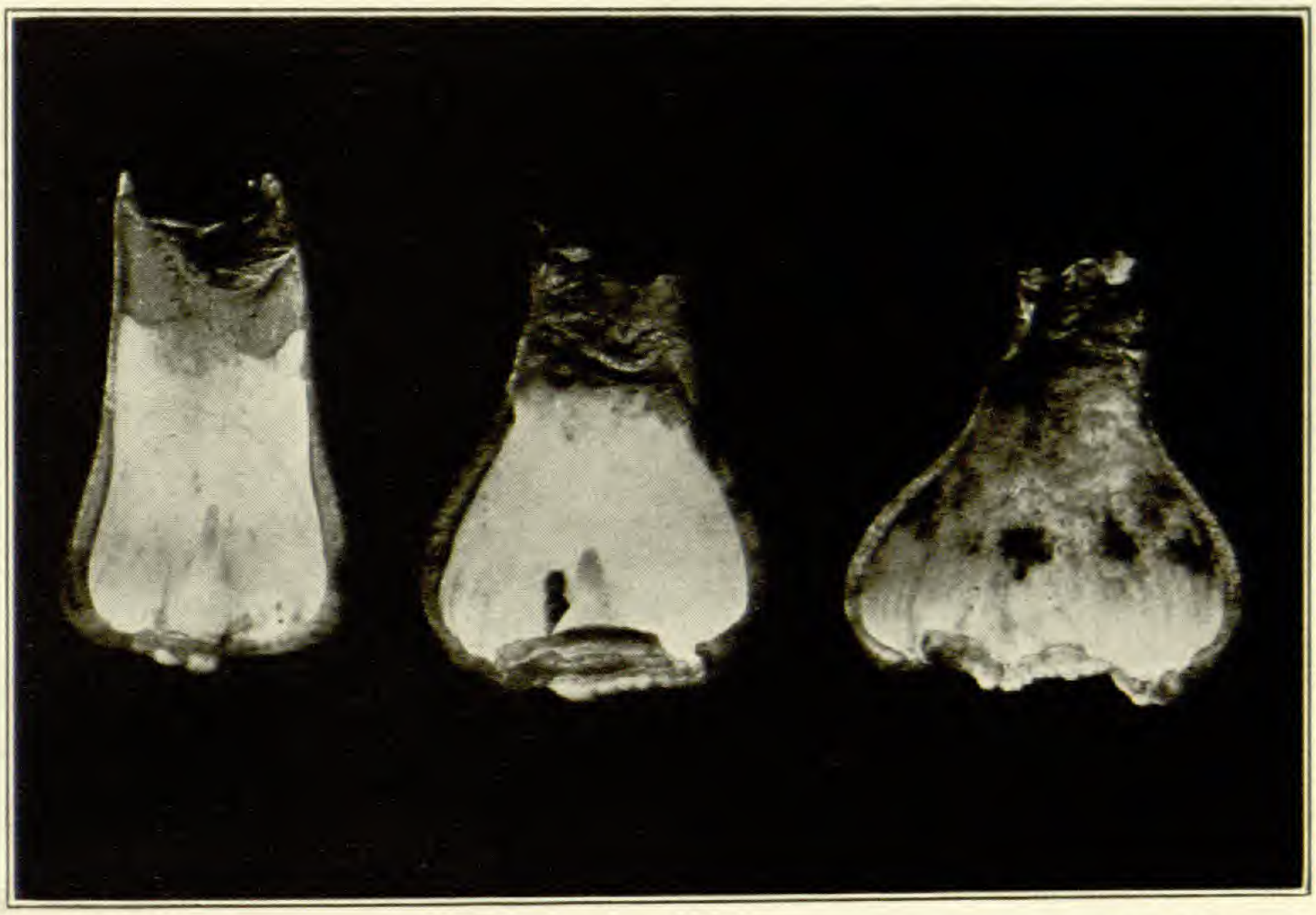
Having some dormant hippeastrum bulbs on hand last winter the Garden tried the experiment of propagating the bulbs from scales as was done in Holland. At the laboratory in Wageningen various combinations of soil, temperature, and light were tried and different ways of placing the scales on or in the soil. After the experiments were run for some time it developed that the scales placed at a temperature of 80 degrees Fahrenheit progressed more rapidly than those at 55 or 68 degrees; in fact 55 degrees caused some of the scales to rot. Accordingly a temperature of 80 degrees was maintained at the Garden for the scales.

On December 11, 1926, the experiment was started. Three bulbs were cut in half and on a line with the leaf blades (plate 22, fig. 1*A*.) The disk at the bottom was removed and the bulb scooped out about one inch deep, using an ordinary pocket knife. Starting from the center of the bulb the scales were removed, and if any failed to come off readily a little more of the base of the bulb to which they were attached was cut. The scales were then set about one-half inch deep in a flat of sand in an upright position (plate 22, fig. 2.) Three more bulbs were cut and the scales separated, but instead of placing the scales in sand a mixture of half sand and half chopped peat was used. The scales in this mixture decayed rapidly. Another bulb, instead of being halved, was cut in quarters, but these pieces were too small and did not produce bulblets. Some half scales and quarter scales of another bulb were placed on damp sphagnum, concave side up, but these did not produce new growth. From one year's experience it appears that the narrow leaf scales taken from the center of the bulb seldom produced bulblets and that standing the scales in sand gives the most satisfactory results. Plate 22, fig. 1*B* shows a bulb with the disk removed, *A*, a half bulb just before removing the scales, and *C*, all of the scales of the other half ready for inserting in the sand.

The scales were watered immediately after they were set in sand, and thereafter were sprayed about once a day, oftener on bright warm days. The flats were placed in a propagating case in full light, but not direct sunlight, where a constant temperature of 80 degrees was maintained. As protuberances began to form some of the scales were pushed out of the sand, but they were left in whichever position they assumed and more sand was dropped around their base. Plate 23 and fig. 1 of plate 24, show the rudimentary bulbs forming at the base of the scales. Some of the scales produced white swellings, these not always developing into bulbs. Plates 23, fig. 2*A*, shows a bulb with a root attached.

After the bulblets were large enough to handle, and even though they did not all have roots, they were potted into two-inch pots and replaced in the propagating case, the temperature later being lowered to 75 degrees and more air admitted. Plate 24, fig. 2, shows some of the bulblets ready for potting, and it will be noticed that a small portion of the scale is left with each bulb. The scales had bulblets in various stages of development, those large enough for potting being removed, the other scales being replaced in the sand until the bulblets were larger. A sandy soil was used for the initial potting. After the bulbs were rooted they were removed from the propagating case to the ordinary greenhouse but were kept in a flat with glass sides and top until the end of May. During the day the top glass was raised about two inches and shaded with paper when the sun was bright. The first bulblets were potted on January 28, 1927, or forty-eight days after the scales were placed in sand. The remaining ones were potted whenever they attained sufficient size. The experiment was stopped at the end of February. Plate 25, fig. 1, shows the bulbs ten months after the scales were placed in sand. Plate 25, fig. 2*A*, shows a bulb three months old grown from seed; *B*, a year-old bulb from seed, and C, one ten months old grown from a scale.

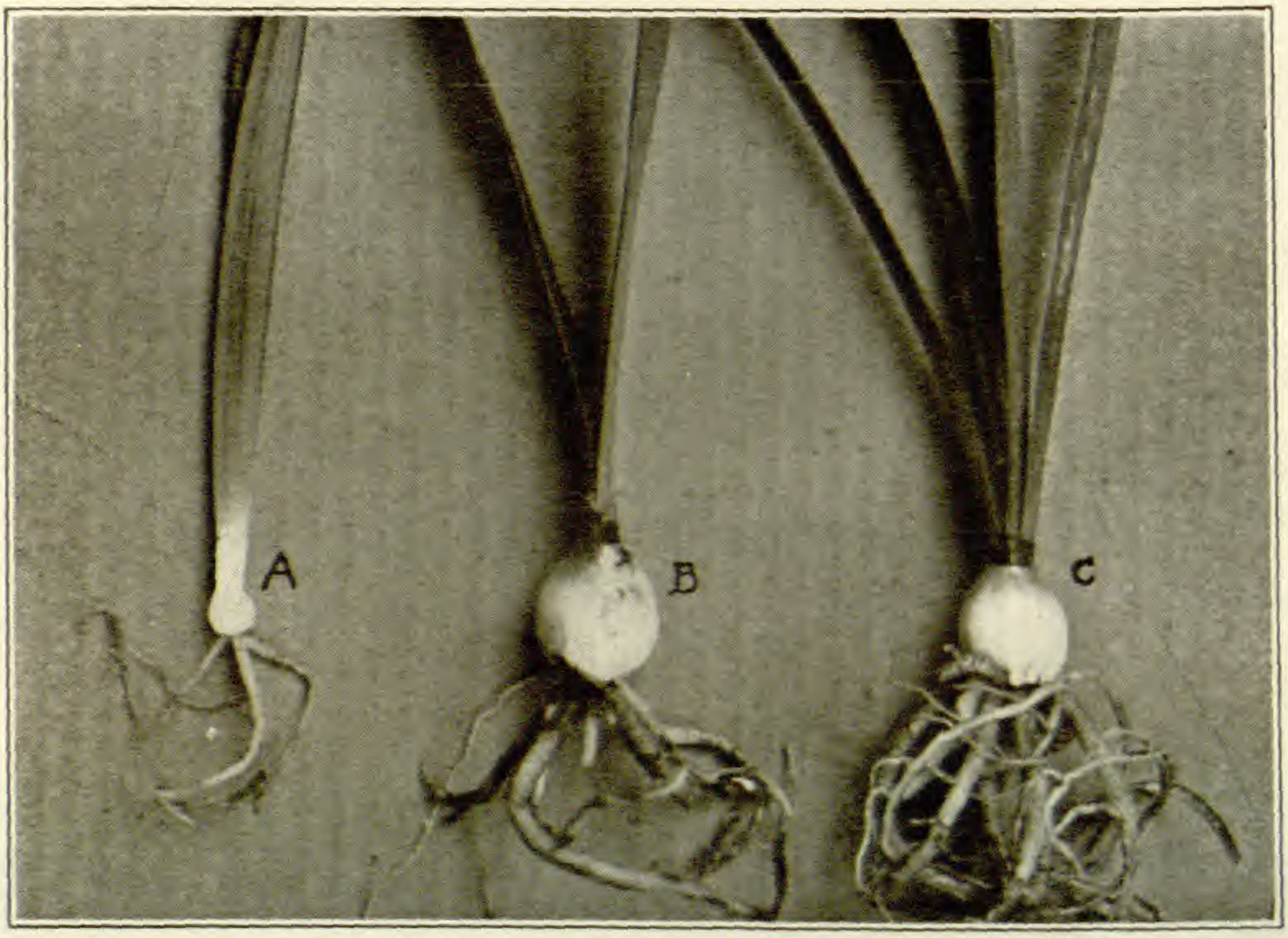
It remains to be determined whether the bulbs vegetatively produced will flower as freely as those grown from seed. There is no reason why they should not, because other bulbs, the hyacinth, for instance, are propagated vegetatively, but by a method best suited to them. Scooping hippeastrum bulbs



BULBLETS AND PROTUBERANCES FORMING AT THE BASE OF SCALES.

BULBLETS READY FOR POTTING.

HIPPEASTRUM BULBS GROWN FROM SCALES.



A, HIPPEASTRUM BULB THREE MONTHS OLD GROWN FROM SEED, B, YEAR-OLD BULB FROM SEED, C, ONE TEN MONTHS OLD GROWN FROM A SCALE.

is not successful, according to the bulletin referred to. As yet it can not be said just how long it will take for these bulbs to bloom and how many of them will flower in two, three, and four years. The experience of Miss Luyten, as stated in her report, has been that some of the bulbs bloomed two years after propagating and produced flowers that compared favorably with any grown from seed. Nearly half of her bulbs raised in a temperature of 80 degrees, in the propagating case, flowered three years later, some of them with two flower stalks.

Experiments at the Garden the first year showed that hippeastrums could be propagated from scales as was done in Holland. This success warrants an attempt to propagate from some of the best varieties of bulbs to increase the stock of the newer and better sorts.

ADDITIONAL TESTS WITH BENT GRASS

The large sod of Washington Bent grass illustrated in plate 26 was taken up from the experimental grass nursery and put on exhibition during the past month. It attracted much attention from visitors, and an account of it was published in one of the local newspapers under the title of "The World's Largest Sod."

The experimental work with bent grasses has been considerably increased during the past year. In June a planting by the "plug" method was tried out on a large scale. Small plugs of sod were planted in the existing lawn, after the undesirable annual grasses (chiefly crab grass) had germinated and were growing actively. The plugs were set a few inches apart over a considerable area, and practically no attention was given them, not even to water them systematically over dry periods. In August the test seemed a failure, for there was an almost perfect stand of the undesired crab grass. After the first frost, however, the bright green shoots of the bent grass were plainly in evidence, and at present it seems probable that the crab grass did not crowd out the bent grass but merely acted as a nurse crop during the summer.

The experimental grass plots in the nursery have been augmented this fall by two shipments from the United States Department of Agriculture, at Washington, D. C. The first, on

September 19, included sods of Highland Velvet Bent, Washington Bent, Virginia Bent, and Metropolitan Bent. Upon arrival these were immediately chopped and broadcasted upon prepared plots ten feet wide and one hundred feet long. At the present time these four plots are entirely covered by the grass, some of the shoots measuring six inches in length. On September 21 a second shipment arrived, including seeds from selected strains of Creeping Bent, Rhode Island Bent, South German Bent, Red Top, and Kentucky Blue grass. These were sown upon plots ten feet wide by one hundred feet long. A similar plot, planted last fall to seed of unselected German Bent, made a successful growth and has so far withstood the invasion of the annual grasses.

GENERAL SEMINARS, SHAW SCHOOL OF BOTANY

OCTOBER 28

Topic by ETHEL T. ELTINGE.—STRUCTURE AND PHYSIOLOGY OF STOMATA

I. Types of stomata present in different groups of plants
   A. Terrestrial plants
      1. Moss type—*Mnium, Funaria, Polystichum*
      2. Grass type—*Poa*
      3. Xerophytic type—*Ficus, Nerium*
   B. Aquatic plants—*Lemna, Alsophila*
II. Arrangement and distribution of stomata
III. Physiology of stomata
   A. Daily movement of stomata and their behavior during wilting
   B. Osmotic relations of the guard cells
   C. Starch and sugar content of the guard cells
   D. Effect of changes in acidity on the starch and sugar content of the guard cells
   E. Probable cause of the change in acidity in the guard cells

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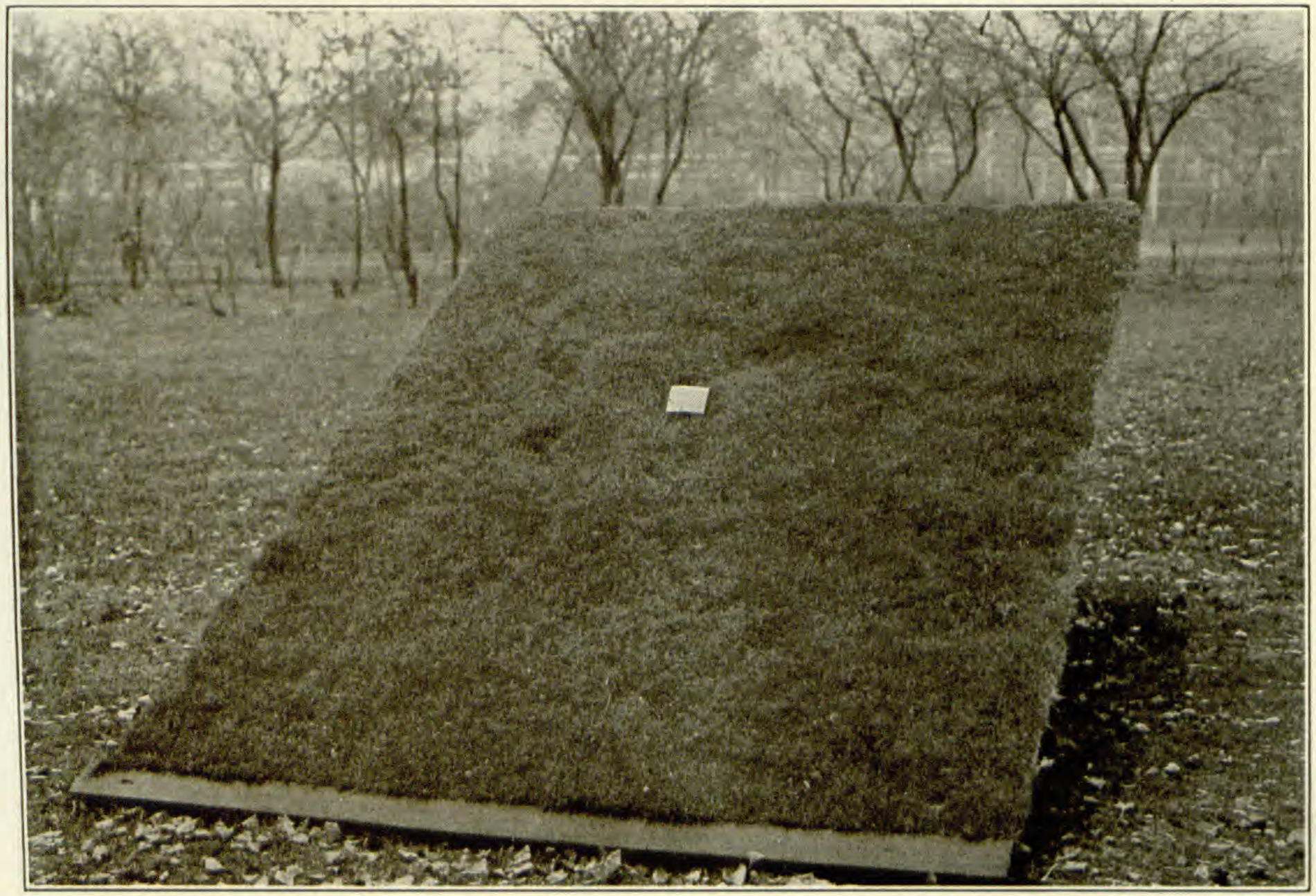
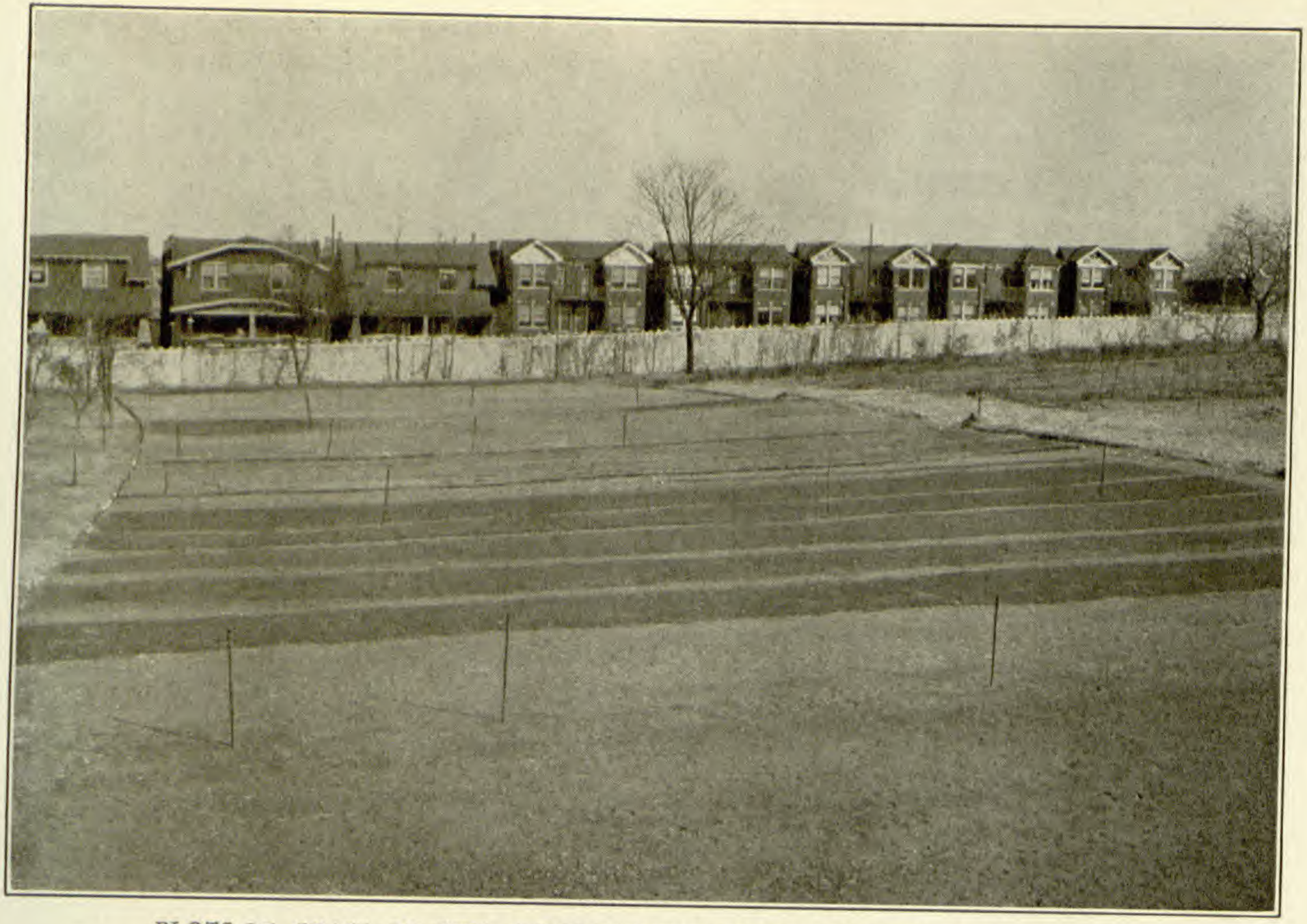


LARGE SOD OF WASHINGTON BENT GRASS FROM THE EXPERIMENTAL GRASS NURSERY.



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NOVEMBER 4

Topic by CATHARINE LIENEMAN.—FACTORS INVOLVED IN THE PRODUCTION OF THE FRUITING STAGE OF FUNGI

I. Introduction
II. Factors involved
  A. Light
  B. Moisture relations
  C. Aeration
  D. Temperature
  E. Nutrition—Quality—Quantity
  F. Reaction of the substratum

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of Pyronema confluens Tul. (P. omphaloides (Bull.) Fuckel). Ann. Bot. 40:245-272. 1926.

NOVEMBER 11

Topic by OLIVER ORTON.—BIOLOGICAL EFFECTS OF POLARIZED LIGHT

I. Introduction
   A. Nature of polarized light
   B. Historical statement
II. Work done on the effects of polarized light, and criticisms
   A. On enzymes in vitro
   B. On lower organisms, as yeasts, bacteria, etc.
   C. On higher plants
   D. On animals
III. Present status of the subject

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NOVEMBER 18

Topic by PAUL G. WIBLE—HERITABLE CHLOROPHYLL-DEFICIENCIES IN MAIZE

I. Chlorophyll inheritance in maize
II. Lindstrom's method of investigation
III. Types of chlorophyll-deficiencies in maize
  A. Albino seedling
  B. Yellow seedling
  C. Xantha seedling
  D. Pale green seedling
  E. Virescent white seedling
  F. Virescent 1, 2, 3, 4, 5 seedlings
  G. Golden type
  H. Japonica striped leaves
  I. Iojap striped leaves
  J. Green striped leaves
  K. Fine striped leaves
  L. Fine streaked leaves
  M. Lineate leaves
  N. Zebra striped leaves
  O. Blotch leaves
  P. Spotted leaves
  Q. Polkadot leaves
  R. White sheath
IV. Frequency of appearance of chlorophyll-deficiencies
V. Maternal inheritance of chlorophyll in maize
VI. Cytology of chlorophyll-types of maize
VII. Two outstanding facts in heritable variations

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NOTES

Dr. W. W. Lepeschkin, Visiting Physiologist at the Garden, spoke before the Washington University Association, November 21, on "Physico-Chemical Causes of Death."

Mr. G. H. Pring, Horticulturist to the Garden, gave an illustrated lecture before the botany section of the Webster Groves Nature Study Society, November 21, on "Collecting Orchids in South America."

Dr. Edgar Anderson, Geneticist to the Garden, spoke at the annual dinner of the Peoria Garden Club, Peoria, Illinois, October 25, on "Flower Families"; and before the Botany Club of Soldan High School, November 4, on "Blue Flags."

This year's chrysanthemum show introduced several novel features. Although the rich colors were well represented,

pastel shades predominated, and the umbrella-shaped specimen pieces were made a central part of the design in each panel.

Due to the unusually warm weather many plants remained in bloom at the Garden until killed by the recent frosts. At the present time, one shrub, the witch hazel, is still in flower outdoors. It has the curious habit of blooming in late autumn and early winter after its leaves have fallen.

STATISTICAL INFORMATION FOR OCTOBER, 1927

GARDEN ATTENDANCE:

Total number of visitors.....20,416

PLANT ACCESSIONS:

Total number of plants and seed packets received as gifts 479

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought..... 72

Total number of books and pamphlets donated..... 101

HERBARIUM ACCESSIONS:

By Gift—

Anderson, Dr. Edgar S.—Plants of England..... 33

Bechtel, A. R.—Fungi of Indiana..... 9

Florists Publishing Company—*Polygonum cuspidatum* Sieb. & Zucc. from horticulture..... 1

Gilbert, Frank A.—Fungi of Colorado..... 2

Hake, Professor H. G.—Cultivated specimen of *Aster tartarica* L. f..... 1

Hume, H. Harold—Plants of Florida..... 15

Kellogg, John H.—Plants of Missouri..... 3

Letcher, Houston—*Flaveria trinervia* (Spreng.) Mohr, from Arizona..... 2

Short, Miss Etta—Plants of horticulture..... 2

By Purchase—

Broadway, W. E.—Plants of Trinidad and Tobago..... 20

Larsen, Miss Esther Louise—Plants of Montana and North Dakota 576

Mathias, Miss Mildred—Plants, chiefly from Vermont..... 296

Total 960

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and, while virtually a private garden, it was, except at certain stated times, always open to the public. By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the 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 of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises about 75 acres. There is now in process of development a tract of land of over 1,500 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a forest reservation, with the idea that possibly at some future time this may become the new botanical garden. About 12,000 species of plants are growing in the Garden.

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day and Christmas—week days from 8:00 a. m. until one-half hour after sunset; Sundays from December to April, 1:00 p. m. until sunset; from April to December, 2:00 p. m. until sunset.

The main entrance to the Garden is located at Tower Grove avenue and Flora place, on the Vandeventer avenue car line. Transfer south from all intersecting lines. The Garden may also be reached by Bus Route No. 12, to which all other motorbus lines transfer.

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Manager

Missouri Botanical Garden Bulletin

Vol. XV DECEMBER, 1927 No. 10

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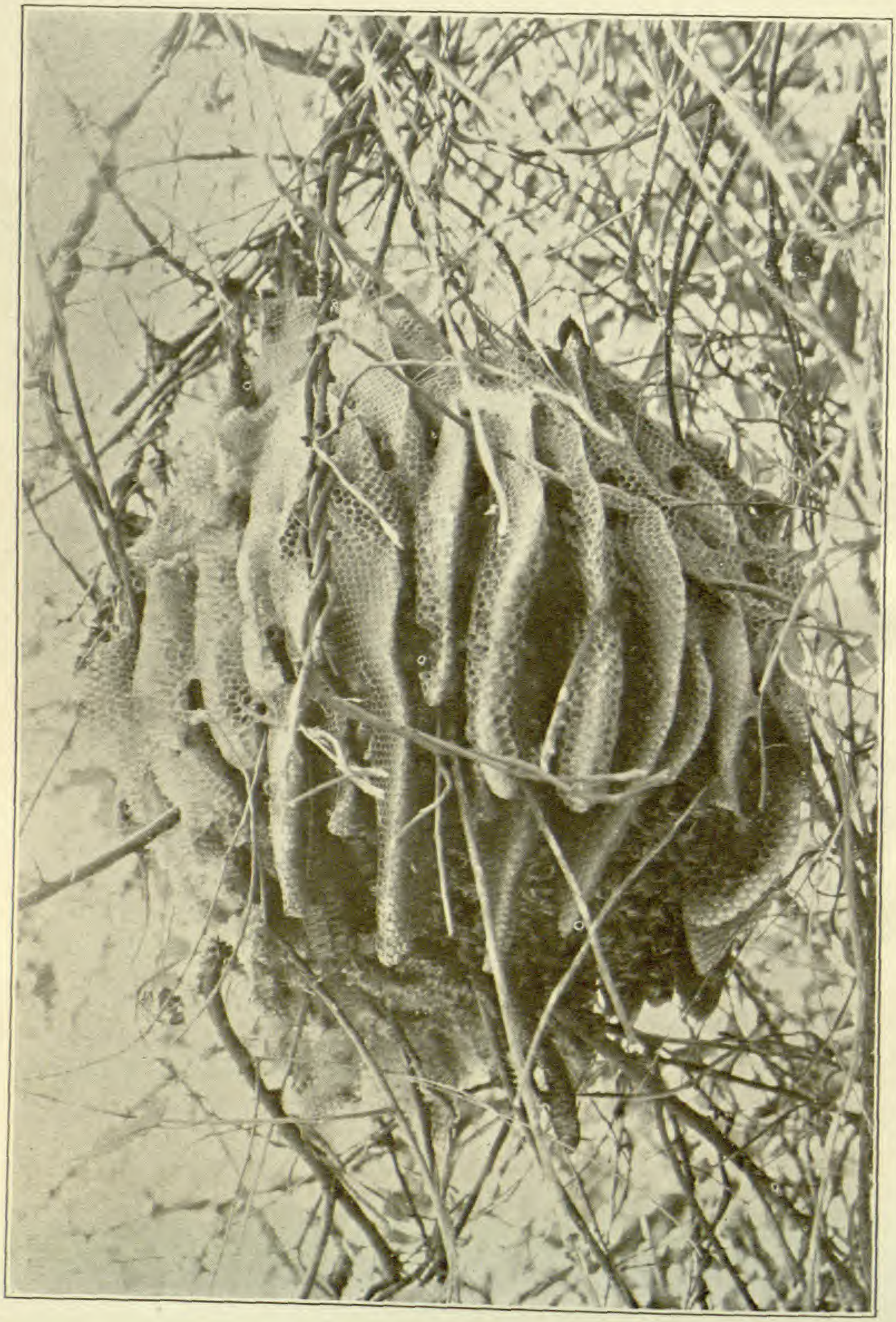

AN UNUSUAL BEES' NEST.

Missouri Botanical Garden Bulletin

Vol. XV DECEMBER, 1927 No. 10

AN UNUSUAL BEES' NEST

It is a common occurrence for a swarm of bees to escape from their owners and run wild. Such swarms usually locate in a hollow tree or a similarly protected place. Instances have been reported where they built between the studding in a house, and in one case the family living in the house were able to gather, year after year, the honey that had been stored in their walls.

During the past summer an even more unusual nest was made at the Garden. Early last June a small swarm from one of the Garden hives, housed on an upper porch of the old Shaw residence, lit in a tangle of wisteria vines on a small mulberry tree near by. Other work was pressing at the time, and the swarm was allowed to remain. To everyone's surprise it set to work without further exploration and built its nest with no other protection than the thick tangle of leaves above it. In spite of a wet summer and several encounters with marauding boys, the nest developed steadily throughout the season, until it presented the unusual aspect shown in plate 28, a great globe of intersecting combs, about three feet in diameter.

When the leaves fell and left the colony without even that rude canopy, it was expected that the bees would soon die off, but they have lingered on, weathering the recent cold weather, and every warm day sees them flying about, apparently as busy as ever.

CONSTANTINE RAFINESQUE

Surely the most unique, the most fantastic, the most peculiarly gifted man who has ever entered the annals of American Science was Constantine Samuel Rafinesque-Schmaltz. His ancestry and early training were as exotic as his life, for he was born in a suburb of Constantinople of a French father and a Greco-German mother. His boyhood was spent first in Marseilles, France, and after the revolution, in Leghorn, Italy.

Of the man himself, no better description has been left us than that made by Audubon, who described him under the title of "An Eccentric Naturalist", in his "Ornithological Biography." Audubon's account, somewhat abridged, reads as follows: " 'What an odd looking fellow!' said I to myself, as while walking by the river, I observed a man landing from a boat, with what I thought a bundle of dried clover on his back; 'how the boatmen stare at him! sure he must be an original!' He ascended with a rapid step, and drawing a letter from his pocket, handed it to me without any remark. I broke the seal and read as follows: 'My dear AUDUBON, I send you an odd fish, which you may prove to be undescribed, and hope you will do so in your next letter. Believe me always your friend B.' With all the simplicity of a woodsman I asked the bearer where the odd fish was, when Rafinesque smiled, rubbed his hands, and with the greatest good humour said, 'I am that odd fish, I presume, Mr. AUDUBON.' I felt confounded and blushed, but contrived to stammer an apology.

"We soon reached the house, when I presented my learned guest to my family, and was ordering a servant to go to the boat for Rafinesque's luggage, when he told me he had none but what he brought on his back. He then loosened the pack of weeds which had first drawn my attention. The ladies were a little surprised, but I checked their critical glances for the moment. The naturalist pulled off his shoes, and while engaged in drawing his stockings, not up, but down, in order to cover the holes about the heels, told us in the gayest mood imaginable that he had walked a great distance, and had only taken a passage on board the *ark*, to be put on this shore, and that he was sorry his apparel had suffered so much from his late journey. Clean clothes were offered, but he would not

accept them, and it was with evident reluctance that he performed the lavations usual on such occasions before he sat down to dinner.

"At table, however, his agreeable conversation made us forget his singular appearance; and indeed, it was only as we strolled together in the garden that his attire struck me as exceedingly remarkable. A long loose coat of yellow nankeen, much the worse of the many rubs it had got in its time, and stained all over with the juice of plants, hung loosely about him like a sac. A waistcoat of the same, with enormous pockets, and buttoned up to the chin, reached below over a pair of tight pantaloons, the lower parts of which were buttoned down to the ankles. His beard was as long as I have known my own to be during some of my peregrinations, and his lank black hair hung loosely over his shoulders.

"He had come to visit me, he said, expressly for the purpose of seeing my drawings, having been told that my representations of birds were accompanied with those of shrubs and plants, and he was desirous of knowing whether I might chance to have in my collection any with which he was unacquainted. I observed some degree of impatience, and we returned to the house, where I opened my portfolios and laid them before him. He chanced to turn over the drawing of a plant quite new to him. After inspecting it closely, he shook his head, and told me no such plant existed in nature. I told my guest that the plant was common in the immediate neighborhood, and that I would shew it him on the morrow. 'And why to-morrow, Mr. AUDUBON? Let us go now.' We did so, and when I pointed to the plant I thought he had gone mad. He plucked the plants one after another, danced, hugged me in his arms, and exultingly told me that he had got not merely a new species, but a new genus. When we returned home, I shewed him to the apartment intended for him during his stay, and endeavoured to render him comfortable. We had all retired to rest. Every person I imagined was in deep slumber save myself, when of a sudden I heard a great uproar in the naturalist's room. I got up, reached the place in a few moments, and opened the door, when, to my astonishment, I saw my guest running about the room naked, holding the handle of my favorite violin, the body of which he had bat-

tered to pieces against the walls in attempting to kill the bats which had entered by the open window. He continued jumping and running round and round, until he was fairly exhausted, when he begged me to procure one of the animals for him, as he felt convinced they belonged to a 'new species'. I took up the bow of my demolished Cremona, and soon got specimens enough.

"He remained with us for three weeks, and collected multitudes of plants, shells, bats, and fishes. We were perfectly reconciled to his oddities, and finding him a most agreeable and intelligent companion, hoped that his sojourn might be of long duration. But one evening, when tea was prepared, and we expected him to join the family, he was nowhere to be found. His grasses and other valuables were all removed from his room. The night was spent in searching for him in the neighborhood. No eccentric naturalist could be discovered; nor was it until some weeks after that a letter from him, thanking us for our attention, assured me of his safety."

Amusing as is Audubon's account, he cannily refrained from describing the most amusing result of the visit, which has been described by David Starr Jordan. "Audubon was something of a wag withal, and some spirit of mischief led him to revenge the loss of his violin on the too ready credulity of his guest. He showed him gravely some ten grotesque drawings of impossible fishes which he had observed 'down the river', with notes on their habits, and a list of names by which they were known by the French and the English settlers. These Rafinesque duly copied and later published them as representatives of new genera, such as *Pogostoma, Litholepis,* and the like. These singular genera, so like and yet so unlike anything yet known, have been a standing puzzle to students of fishes. Many of the hard things that have been said of Rafinesque's work rest on these unlucky genera," and it was not until long afterwards that they were proved to be merely a practical joke.

Such was the nature of the first resident botanist in the Middle West and the first professor of natural science west of the Alleghanies. Educated in France and Italy, where he specialized in languages and in natural history, he came to this country in 1802 when a young man of twenty. Return-

ing again in 1815, he came to Lexington at the invitation of his well-to-do friend, Clifford, and in 1820 took up his duties as professor of natural history and modern languages at Transylvania University.

With a brilliant mind, an energy that has seldom been equaled, and a training better than most of his contemporaries, he found much to interest him in the rapidly developing Middle-West. He was a prolific writer, and his wide-ranging interests embraced all sorts of subjects, the medical botany of America, the oil of pumpkin seeds, new species of animals and of plants, fossil remains, Indian languages, fireproof buildings, to name only a few. Had he been provided with a congenial environment in which to work he might have become one of the great figures in American science. But his friend Clifford soon died, the university was undergoing unfortunate internal dissensions, his colleagues were classicists not interested in science and not capable of appreciating his abilities. He undertook to organize a botanical garden, but he was far ahead of his time. The scheme came to nothing, and he had to content himself with establishing representatives of the native flora on the estate of Col. David Meade.

Rafinesque's chief and basic sin might be expressed as his furious versatility. He pursued everything which attracted his fancy, and the subjects which attracted him were unfortunately legion. Criticism of his hasty work evidently aroused in him a hallucination of persecution which developed until it assumed the proportions of a mania. When his magazine "The Modern Minerva" was refused publication, he assumed that personal enemies had bribed the editor. He declared: "This may prove that even in free countries there are means to controll the press and crush knowledge. I could have started a law-suit; but it was in vain to struggle against bad faith and powerful foes. The main cause of persecution was that I knew more than they, and could not cringe. A flatterer and a sycophant would have done better."

In 1823, Rafinesque departed from Lexington without notifying the University authorities, and was gone several months. Upon his return, he found "how the president of the University had conducted himself" during his absence: "To evince his hatred against sciences and discoveries, he had

broken into my rooms, giving one to the students, and thrown all my effects, books and collections in a heap in the other. He had also deprived me of my position as librarian and my board in the college. I had to put up with all this to avoid a law suit. I took lodgings in town and carried there all my effects; thus leaving the College with curses on it and Holly; who were both reached by them soon after, since he died next year at sea of the yellow fever, caught at New Orleans, after having been driven from Lexington by public opinion; and the College has been burnt in 1828 with all its contents."

Rafinesque's curses were ill-deserved. After such a flagrant migrant had quit the College without a word, it is a wonder that the authorities granted the use even of one room for the storage of his effects, which in those classical surroundings must have appeared as worthless junk. President Holly, also, had proved himself a valued friend to the eccentric naturalist, who was always a welcome visitor at his home. We are told by a student at the University during the professorship of Rafinesque that "Mrs. Holly, the wife of the President, took a motherly supervision over this lone, friendless little creature, while at Transylvania University, and saw that he ate his dinner, that the mud from his various expeditions was removed from his garments, that his hair was combed and his face washed, as often as any or all of these particulars would be forgotten by the oblivious scientist."

Arriving in the East, Rafinesque brought to organization a scheme which he had had in mind since his residence at Lexington. This scheme he called "The Divitial Institution and Six Per-Cent Savings Bank." The basis of the organization was merely our modern system of coupon bonds, of which Rafinesque should be acknowledged the founder. The bank, peculiarly enough, was at the start a success, and lent money at six per-cent, paying a dividend of six per-cent to its stock-holders. Whether by risks, losses, or sudden calls, Rafinesque's bank proved to be unsafe, and all the stock-holders lost heavily by its bankruptcy. The organizer complained bitterly that he had been worsted by rivals, and the charge may have been true, since similar institutions founded upon like principles succeeded magnificently.

Forced to become a recluse, Rafinesque died in 1840 of

cancer of the stomach. A few friends who learned of his death arrived just in time to save the body from being sold to a medical college by a penurious landlord. So died, in obscure poverty, one of the most brilliant and gifted men America has ever seen. His last words were "Time renders justice to all." In his case nothing is harder to do, for the good is so interwoven with the bad, the sublime with the ridiculous. Always self-confident, his belief in himself became in later years almost a mania and strongly colors all that he wrote. Many of the ideas that so amused his contemporaries are commonplaces to-day. He was a firm believer in Evolution though he died before Darwin's "Origin of Species" was published.

Many genera and species, it is true, were proposed by Rafinesque. Many of the proposals have been denied validity, as perhaps they deserve to be, but even in the limited range of the seventh edition of Gray's "Manual of Botany", it is interesting to find twenty-four genera, thirty-two species, and one variety of Rafinesque's making. Perhaps more of his proposals were *bona fide*, and are unknown to-day because of the indifference with which the scientific world treated much of his work. This view is expressed by even so conservative a botanist as Asa Gray, who wrote, in part, after Rafinesque's death: "It is indeed a subject of regret, that the courtesy which prevails among the botanists of the present day (who are careful to adopt the names proposed by those who even suggest a new genus) was not more usual with us some twenty years ago. Many of Rafinesque's names should have been adopted; some as a matter of courtesy, and others in accordance with strict rule."

Fourteen years after his death Louis Agassiz wrote of him as follows: "Tracing his course as a naturalist during his residence in this country, it is plain that he alarmed those with whom he had intercourse, by his innovations, and that they preferred to lean upon the authority of the great naturalists of the age, then residing in Europe, who, however, knew little of the special natural history of this country, than to trust a somewhat hasty man who was living among them, and who had collected a vast amount of information from all parts of the States, upon a variety of objects then entirely

new to science. From what I can learn of Rafinesque, I am satisfied that he was a better man than he appeared. His misfortune was his prurient desire for novelties and his rashness in publishing them, and yet both in Europe and America he has anticipated most of his contemporaries in the discovery of new genera and species in those departments of science which he has cultivated most perseveringly, and it is but justice to restore them to him, whenever it can be done."

No better ending can be given to an appreciation of Rafinesque than to quote from an article which he himself wrote, shortly before his death, on the pleasures and hardships of botany:

"Such a life of travels and exertions has its pleasures and its pains, its sudden delights and deep joys mixt with dangers, trials, difficulties, and troubles. No one could better paint them than myself, who has experienced them all.

"Let the practical Botanist who wishes like myself to be a pioneer of science, be fully prepared to meet dangers of all sorts in the wild groves and mountains of America. The mere fatigue of a pedestrian journey is nothing compared to the gloom of solitary forests, when not a human being is met for many miles, when the food and collections must be carried in your pocket or knapsack from day to day; when the fare is not only scanty but sometimes worse; when you must live on corn bread and salt pork, be burnt and steamed by a hot sun at noon, or drenched by rain, even with an umbrella in hand, as I always had.

"Mosquitoes and flies often annoy you or suck your blood if you stop or leave a hurried step. Gnats dance before your eyes, insects creep on you and into your ears. Ants crawl on you whenever you rest on the ground, wasps will assail you like furies if you touch their nests. But ticks the worst of all are unavoidable whenever you go among bushes, and stick to you in crowds, filling your skin with pimples and sores. Spiders, gallineps, horse-flies and other obnoxious insects will often beset you, or sorely hurt you. Hateful snakes are met, and if poisonous are very dangerous, some do not warn you off like the Rattle-snakes.

"You meet rough or muddy roads to vex you, and blind paths to perplex you, rocks, mountains, and steep ascents.

You may often lose your way, and must always have a compass with you as I had. You may be lamed in climbing rocks for plants or break your limbs by a fall. You must cross and wade through brooks, creeks, rivers, and swamps. In deep fords or in swift streams you may lose your footing and be drowned. You may be overtaken by a storm, the trees fall around you, the thunder roars and strikes before you. The winds may annoy you, the fire of heaven or of men sets fire to the grass or forest, and you may be surrounded by it, unless you fly for your life.

"You may travel over a unhealthy region or in a sickly season, you may fall sick on the road and become helpless, unless you be very careful, abstemious and temperate.

"Such are some of the dangers and troubles of a botanical excursion in the mountains and forests of North America. The sedentary botanists or those who travel in carriages or by steamboats, know little of them; those who merely herborize near a city or town, do not appreciate the courage of those who brave such dangers to reap the botanical wealth of the land, nor sufficiently value the collections thus made.

"Yet although I have felt all those miseries, I have escaped some to which others are liable. I have never been compelled to sleep at night on the ground, but have always found a shelter. I have never been actually starved, nor assailed by snakes or wild beasts, nor robbed, nor drowned, nor suddenly unwell.

"I like the free range of the woods, and glades, I hate the sight of fences like the Indians!

"The pleasures of botanical exploration fully compensate for miseries and dangers, else no one would be a travelling Botanist, nor spend his time and money in vain. Many fair-days and fair-roads are met with, a clear sky or a bracing breeze inspires delight and ease, you breathe the pure air of the country. What delight to meet with a spring after a thirsty walk, or a bowl of cool milk out of the dairy! What sound sleep at night after a long day's walk, what soothing naps at noon under a shaded tree."

GENERAL SEMINARS, SHAW SCHOOL OF BOTANY

NOVEMBER 25

Topic by MARTHA L. BEARDSLEY.—FIXATION OF CHROMOSOMES

I. Standard methods of chromosome fixation
   A. Flemming's method
   B. Carnoy's method
   C. Bouin's method
   D. Belling's method
II. Morphological conceptions of chromosome structure
   A. Chromomere
   B. Single chromonema
   C. Double chromonema
III. Effect of various reagents on chromosomes
   A. On fixed material
      Sodium phosphate, acid sodium phosphate, sodium hydroxide, and pepsin hydrochloric acid
   B. On living material
      Acids, bases, salts, constituents of standard fixing solutions, and organic compounds

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DECEMBER 2

Topic by EVA M. FLING ROUSH.—MYXOMYCETES (MYCETOZOA)

I. Controversy over their place in nature
II. Terminology necessary for an understanding of the group
III. Classification of the orders according to life histories
   A. Acrasiales
   B. Labyrinthulales
   C. Myxogastrales
   D. Plasmodiophorales
IV. Myxogastrales
   A. Taxonomy based on minute morphological characters
   B. Geographical distribution and habitat

C. Experimental work
   1. Culture and germination of organism
   2. Feeding habits
   3. Response to various stimuli
D. Field collections and herbarium preparations

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DECEMBER 9

Topic by ESTHER L. LARSEN.—THE VEGETATION OF THE NORTH DAKOTA BAD LANDS

I. Topography of the region
II. Geology of the region
   A. Extinct fauna
   B. Extinct flora
III. Exploration
IV. Vegetation of the region

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DECEMBER 16

Topic by ANNA E. TENSFELD.—CELLULAR DEGENERATION AND REJUVENESCENCE

I. General discussion of vital activity, dormancy and degeneration
II. Comparison of rejuvenescence and senescence in plants, animals and man
III. Nuclear behavior during degeneration
IV. Other intracellular evidence of senescence, rejuvenation and death

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NOTES

Mr. G. H. Pring, Horticulturist to the Garden, attended the meeting of the executive committee of the National Flower Show, of which he is a member, at Louisville, December 7-9.

Mr. G. H. Pring has been reappointed by the Society of American Florists and Ornamental Horticulturists, to serve on the national committee on "School Gardens" for 1928.

The poinsettia show this year is much larger and finer than in previous years and occupies the entire Floral Display House. It was staged immediately following the chrysanthemum show and will remain until after the Holidays. The response of the public has been gratifying, all previous attendance records for this show having been broken. Over 4000 people visited the Garden on the first Sunday of the show.

Recent visitors to the Garden include Dr. B. M. Duggar, professor of physiological and applied botany, University of Wisconsin; Dr. E. D. Merrill, Dean of the College of Agriculture, University of California, Berkeley, and Director of the California Botanical Garden at Los Angeles, California; Professor George Meister, of the Institut für Landwirtschaft und landw. Versuchsstation, Saratow, U. S. S. R.; Dr. D. T. MacDougal, Director Laboratory for Plant Physiology, Carnegie Institution of Washington, Desert Laboratory, Tucson, Arizona; Dr. Yushun Kudo, professor of botany, Taiwan Imperial University, Taihoku (Taipeh), Japan.

STATISTICAL INFORMATION FOR NOVEMBER, 1927

GARDEN ATTENDANCE:

Total number of visitors.....50,241

PLANT ACCESSIONS:

Total number of plants and seed packets received as gifts and exchange..... 427

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought..... 93
Total number of books and pamphlets donated..... 526

HERBARIUM ACCESSIONS:

By Gift—

Bettis, Mrs. James R.—Specimen from Mississippi..... 1
Boyce, J. S.—Fungi of Oregon..... 5
Epling, Dr. Carl C.—Photographs of type specimens..... 3
Evinger, E. L.—Plants of Missouri..... 2
Harper, R. M.—Plants of Alabama..... 27
Kellogg, John H.—Plants of Missouri..... 221
Pring, George H.—Plants of horticulture..... 2
Ruedel, Franklin J.—Plant of horticulture..... 1
St. John, Dr. Harold—*Senecio flavovirens* Rydb. from Washington 1
Teas Wholesale Nursery Co.—*Pyrus arbutifolia* L.f. var. *macrophylla* Rehder, from Texas..... 1
von Schrenk, Dr. Hermann—Plants of Georgia..... 3

By Exchange—

Kirkwood, Professor J. E.—*Cicuta cinicola* Nels. from Montana 5

By Purchase—

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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 to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and, while virtually a private garden, it was, except at certain stated times, always open to the public. By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the 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 of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises about 75 acres. There is now in process of development a tract of land of over 1,500 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a forest reservation, with the idea that possibly at some future time this may become the new botanical garden. About 12,000 species of plants are growing in the Garden.

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day and Christmas—week days from 8:00 a. m. until one-half hour after sunset; Sundays from 10 a. m. until sunset.

The main entrance to the Garden is located at Tower Grove avenue and Flora place, on the Vandeventer avenue car line. Transfer south from all intersecting lines. The Garden may also be reached by Bus Route No. 12, to which all other motorbus lines transfer.

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