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Plant Idioblasts: Remarkable Examples of Cell Specialization

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(NOTE: *This paper, slightly abbreviated, is the address of the retiring president of the Botanical Society of America given at the annual banquet of the Society, held at Michigan State University on September 8, 1955. Dr. Foster's address was illustrated with a series of excellent slides of mixed botanical and psycho-entomological nature.)*

One of the privileges—and certainly one of the penalties—of having served as President of the Botanical Society is the delivery of a retiring address at the culmination of our annual meeting. In your present well-fed and relaxed state, some of you may be resigned to listening to a historical and soporific resumé of some specialized area of modern botanical research. A number of you perhaps may anticipate—probably with dismay—a much broader non-technical type of discourse intended to exhibit the retiring President's firm grasp of and keen insight into such imponderable topics as "The Place of Botany in the Education of Physical Scientists" or "Is Botany a Unified Science—and If Not, Why Not?" Still others in my audience may wistfully hope for the "light touch," a divertissement in the form of a botanical satire or even a loosely coherent series of repeatable "funny" anecdotes and stories. In the "Sword of Damocles" atmosphere in which I have lived during the past year, I assure you that I have indeed considered all of these possibilities—and several others too! When frustration and dismay were my bed-fellows, I even contemplated selecting a non-botanical topic such as "The History of Jurisprudence in Bulgaria." By adopting this form of "escape"—and with diligent application to the facts discussed in any good encyclopedia—one might produce a watertight little essay on an obscure subject and thus avoid the polemical review of his subject by his friends and colleagues following the address.

In a more relaxed frame of mind, I finally decided to discuss a rather unconventional aspect of plant histology which has always held a particular fascination for me. I propose this evening to talk about a variety of highly specialized cells which do not form coherent tissues but on the contrary occur as isolated elements in the tissue systems of plants. Julius Sachs in 1874 designated all such isolated and peculiar cells by the collective term "idioblast" which, in its literal etymology, means a "distinct" or "peculiar" germ or sprout. It must be emphasized that the term "idioblast" is one of convenience rather than of specific morphological or physiological connotation because this word, as used by Sachs and modern histologists, includes a bewildering array of cell types. More or less familiar examples of idioblasts are the "secretory cells" developed in parenchyma tissues, the remarkable cystolith-containing cells of the epidermis of *Fiscus* and *Urtica* and the often grotesque ramified sclereids found in the leaves of many plants. Unicellular trichomes are epidermal idioblasts and the guard cells of stomata might be regarded from an ontogenetic point of view as "paired" or "twin" idioblasts.

My own interest in this motley assemblage of idioblastic cells arose during my early years as a teacher of plant anatomy. It seemed to me then—as it does now—that any decision as to the suitable criteria to be used in classifying and discussing cell types and tissues in plants must consider the disturbing frequency of occurrence of idioblasts. To the formal descriptive anatomist, idioblasts prove inconvenient structures because they interrupt the homogeneous or "simple" morphological aspect of so many tissues. The problem becomes further complicated from both a morphological and a physiological point of view when one realizes that some cell types, e.g. non-articulated laticifers or "latex cells," occur *only* as idioblasts while other specialized elements, for example sclereids, may develop either as idioblasts, as clusters of cells or as components of homogeneous sclerenchyma tissue. From a morphological viewpoint De Bary (1884) took the position that "all tissue-elements, which correspond in definite similar properties, are termed collectively a sort of tissue, whether they be idioblasts, or are connected with like elements." On the physiological side, Haberlandt (1914) held a similar opinion and stated that "where all the idioblasts contained in a given tissue are similar in structure and subserve the same purpose, they may in a sense be regarded as components of a special 'diffuse tissue'." These viewpoints of De Bary and Haberlandt are reflected in Lundegardh's (1922) classification of idioblasts under the "Disperse Tissue Systems" of the plant.

Regardless of how one decides to assign idioblasts in a treatment of plant tissues, these remarkably individualized cells pose anew the mystery which still surrounds processes of specific cell differentiation in plants. Fortunately there is a noticeable awakening of interest on the part of morphogeneticists and biochemists in the factors which control the origin and development of specific types of cells.

In order to awaken your interest in the great diversity of plant idioblasts, I am going to take you this evening on an "Alice in Wonderland" illustrated tour through the leaf tissues of some dicotyledons. Like the strange and confusing world of fantasy which Alice encountered in her journeys through Wonderland, our trip

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will reveal many bizarre and extraordinary sights in the microscopic realm of foliar tissues. Because of the almost "endless" variety of idioblasts and the difficulties which arise in preparing them for colored photomicrography, my selection of "types" was both arbitrary and limited. However an effort has been made to include examples from the following major categories of idioblasts, viz: secretory, crystalliferous, tracheoid and sclerenchymatous. Since some of the most striking types of idioblasts occur in plants of subtropical or tropical areas of the world, herbarium specimens provided much of the material which was used. The technique of clearing leaves by treatment with sodium hydroxide and chloral hydrate—and subsequently staining the cleared organs with safranin—often yields remarkably instructive three-dimensional views of idioblasts.

In the difficult and confused times in which we live, I think even botanists tend to become overly tense and perhaps unduly preoccupied about the "future" and the "significance" of their research. This often leads to a rather rigid frame of mind and the loss of that sense of wonder and astonishment at nature which, after all, is the chief stimulus to all our investigations. It is my hope that my travelogue may serve as one example of an uncharted and astonishing aspect of the cellular organization of plants which invites the combined efforts of histologists, taxonomists, morphogeneticists and biochemists for its ultimate clarification.

The plant idioblasts which you have seen this evening demonstrate to the thoughtful botanist an amazing range of morphological and physiological specialization which isolated cells may attain in the leaves of dicotyledons. In what appears to be a relatively simple condition, the idioblastic cell is distinguished from neighboring tissue-elements by its larger size and by the various types of metabolic products such as oils, fats, mucilage or crystals which it contains. Idioblasts of this sort illustrate various levels of physiological modification and sometimes are not sharply demarcated in form, size, or even wall structure from ordinary parenchyma cells. More complex and bizarre levels of morphological specialization are exemplified by the so-called "spiral cells" or "storage tracheids" and by ramified sclereids. In these, a conspicuous secondary wall is formed and the idioblast is greatly enlarged and strikingly different in form and size from adjacent cells. Ramified sclereids are often extremely individualistic in character since their branches may extend into the epidermis and may even penetrate the pores of stomata.

When one attempts to think broadly about the morphological and physiological diversity shown by idioblasts, a comment made by Pliny, The Elder, comes to mind. Pliny remarked: "Whereas Nature is to be found in her entirety nowhere more than in her smallest creations." From this philosophical point of view, questions inevitably arise concerning the function, ontogeny and "casual aspects" of idioblasts:

1. Are the various types of idioblasts of functional importance to the living plant? I have been repeatedly asked this question, and I regret my inability to give an answer based on sound experimental evidence. Haberlandt has discussed the role of idioblastic cells from the physiological-anatomical viewpoint, but it is evident that many of the supposed "functions" which he assigns to them are based upon conjecture rather than upon demonstrable "utility" or "need" to the plant. It is probable that idioblasts which contain crystals or other by-products of metabolism may simply represent excretory reservoirs for waste products. Whether such idioblasts are *essential* components of a given leaf tissue, however, remains to be shown. Other types of idioblasts, for example branched sclereids, are assumed to have a "mechanical" significance and hence to serve as strengthening cells in leaves and other organs.

2. How do idioblasts arise and become differentiated during the histogenesis of a given plant organ? Is the distribution of idioblasts in a mature leaf, for example, actually the result of random cell specialization, or can it be related to a definable "pattern" in histogenesis? At least partial answers to these important questions have emerged from recent work on the ontogeny of idioblastic sclereids and deserve brief consideration.

In some leaves, any cell in the young spongy parenchyma may become a branched sclereid. Such a diffuse and apparently "random" pattern of idioblast origin is characteristic of *Trochodendron* and some other dicotyledons. In contrast, a remarkably specific pattern of origin and distribution characterizes the foliar sclereids of certain other plants. Here the young idioblasts are predominantly restricted to procambial terminations of the veinlet ends. This results, in the mature lamina, in the distinctive patterns of "terminal sclereids" which have been illustrated in some of my slides.

Further insight into the factors which may regulate idioblast origin has been gained from the intensive study of so-called "differential divisions" during histogenesis. Bloch (1946) found that the branched sclereids in aerial roots of *Monstera* originate from the "polarized" and unequal divisions of certain cells at the basal ends of the vertical files of young cortical parenchyma cells. Following the unequational division of each "mother cell," the smaller of the two daughter cells is densely cytoplasmic, possesses an enlarged nucleus, and ultimately develops into a ramified sclereid; the larger of the two daughter cells becomes a parenchyma cell of the cortex. Bloch (1948) has expresed the view that further study of differential and unequal divi-

sions "is one of the most hopeful approaches to the problem of differentiation."

The German physiologist, Erwin Bünning (1953) in the latest edition of his stimulating book, "Entwicklungs—und Bewegungsphysiologie der Pflanze," has emphasized the significance of unequal cell divisions as a basis for the experimental study of cell determination. He cites many interesting examples of the way in which such unlike structures as root-hair forming cells, the "mother cells" of stomata, idioblastic sclereids, etc., arise from the smaller of the two cells produced by an unequal division. Such small, embryonic cells are termed "meristemoids" by Bünning. In his view, all meristemoids are fundamentally equivalent and hence "it depends upon later factors, which as yet have not been analyzed, whether a meristemoid of the epidermis forms a hair or a stoma, or whether one in the inner tissue gives rise to a raphide, to an oil, or to a sclerenchymatous idioblast." The problem of "pattern" in histogenesis is clearly important, and the suggestions made by Bloch and Bünning hopefully may provide a starting point for future exeprimental investigations of cell types and tissues.

3. What are the factors, genetical and physiological, which induce the development of idioblasts in plant tissues? This question is obviously only a part of the broader mystery which still surrounds our attempts to understand differentiation of organisms and their parts. Commoner (1949), in a recent review and analysis of the biochemical basis of growth and differentiation of single cells, has pointed out the difficulties at present inherent in this line of approach. He makes the interesting suggestion that "cellular differentiation may result from the segregation of specific biochemical systems within the parent cell and that this separation becomes finalized by the laying down of the wall between the two sister cells. If this were true, one would need to look for the fundamental agency of cellular differentiation in mechanisms capable of sorting out the biochemical processes of a single cell and rearranging them in a spatial pattern with reference to the plane of division."

As to the direction or directions which future ontogenetic and experimental studies on cell differentiation should take, I turn for my final remarks to the illuminating conversation between Alice and the Cheshire Cat.

Alice, it will be recalled, was proceeding through the woods when she was startled at seeing the Cheshire Cat sitting on a bough of a nearby tree.

"Cheshire Puss," she began, rather timidly, as she did not at all know whether it would like the name: however, it only grinned a little wider. "Come, it's pleased so far," thought Alice, and she went on, "Would you tell me, please, which way I ought to walk from here?"

"That depends a good deal on where you want to get to," said the Cat.

"I don't much care where—" said Alice.

"Then it doesn't matter which way you walk," said the Cat.

"—so long as I get *somewhere*," Alice added as an explanation.

"Oh, you're sure to do that," said the Cat, "if you only walk long enough."

POTZGER SCHOLARSHIP

The Editor has just received word of the death of Professor John E. Potzger, Butler University (Indianapolis), on September 18, following a heart attack. A Memorial Scholarship in Botany is being established at Butler University in memory of Dr. Potzger, head of Botany at Butler until his death and recent president of the Ecological Society of America. Persons wishing to make donations should send checks to the Botany Dept., Butler Univ., Indianapolis 8, Indiana, made payable to J. E. Potzger Memorial Scholarship Fund.

TREASURER'S PLEA

The Treasurer will be on sabbatical leave during the second semester of 1955-1956 and will be away from the U. S. from February through July of 1956. He bespeaks the cooperation of all members of the Society in sending in their dues checks as soon as possible after their receipt of dues notices for 1956. These notices will be in the mails about Thanksgiving-time. Thank you very much.

REPEAT RESEARCH ITEM WANTED!

The July 1955 number of this bulletin contained a request from A. R. Kruckeberg, Botany Dept., Univ. of Washington, Seattle, for seeds or living plants of any native, perennial species of *Silene*. Interested in the effectiveness of such requests, the Editor asked Dr. Kruckeberg for a report of results. Answer: no results. Come, gentlemen and ladies, you may have a research request some day! Bring sunshine into the lives of Dr. K. and of the editor with some seeds and/or plants of *Silene* consigned to the Univ. of Washington.

NEW SOCIETY

The Weed Society of America was founded at Fargo, North Dakota, in December 1954. All persons who join this society during 1955 will be listed as charter members. Annual dues are $6.00; this includes a subscription to the journal *Weeds*. Dr. W. C. Jacob, Ill. Agric. Exp. Sta., Urbana, Ill., is accepting memberships. Manuscripts for publication in *Weeds* should be sent to K. P. Buchholtz, Univ. of Wisconsin, Madison, Wisc.

NEW BOOKS IN PLANT SCIENCES

Merrill, E. D. — *The Botany of Cook's Voyages*. Chronica Botanica, Waltham, Mass.

Wardlaw, C. W.—*Embryogenesis in Plants*. Wiley, New York.

James, W. O.—*Plant Physiology*. Oxford Univ. Press, New York. (5th ed.)

Hayes, H. K., F. R. Immer, and D. C. Smith—*Methods of Plant Breeding*. McGraw-Hill, New York. (2nd ed.)

An American Botanist in Japan

Report of the Botanical Society of America's Delegate to the 1951 Annual Meeting of the Botanical Society of Japan

EGBERT H. WALKER
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Relatively little intermingling of American and Japanese botanists has occurred, a condition which has been detrimental to the best interests of both. It was, therefore, a happy circumstance which enabled me to accept the invitation of Dr. Yudzuru Ogura, President of the Botanical Society of Japan to attend their annual meeting at Tsuruoka, Yamagata Prefecture, in September 1951, and to represent the Botanical Society of America and the Pacific Science Board of the National Research Council, National Academy of Sciences. I was then in Okinawa as the first scientist of the program of Scientific Investigation of the Ryukyu Islands being conducted by the Pacific Science Board for the U. S. Civil Administration of the Ryukyu Islands. Accordingly I adjusted my return from this assignment so that I could be with my Japanese botanical friends on this annual occasion. Dr. Ralph Chaney, the well-known American palaeobotanist, then in Japan, was also invited, but illness prevented his attendance, thus leaving me the only foreign delegate.

The whole day of September 21st was spent on the train, enroute from Tokyo to Tsuruoka on the Japan Sea side toward the north end of Honshu, the main Island of Japan. I was ably conducted by Professor Hiroshi Hara, taxonomist of the University of Tokyo and Dr. Hisayoshi Takeda, the well known specialist in Japanese alpine plants, then with the Natural Resources Section, SCAP. Could there be anything more delightful than a ride through the Japanese countryside at rice harvest time and up and over the mountains and down to the seashore beyond? The traditional stay-at-home tendency of the Japanese people was easy to understand that day.

Lodgings were provided in spotless picturesque hotels, which supplied all comforts in local style. Tsuruoka is a delightful industrial city on an agricultural plain between superb mountains and the colorful sea. The region abounds in hot springs and mineral baths most appropriately put to human use. The distinguished gathering of botanists from all over Japan was given a sincere and hearty welcome on all sides by the townspeople and their officials, with dinners, speeches and gifts of local products.

The scientific meetings were held at the Agricultural College of Yamagata University, a fine large school still showing marks of the austerity imposed by the war. The formal sessions were conducted much as those at our own conventions, with many well prepared and illustrated papers, all of course, unfortunately from my point of view, given in Japanese. Between sessions one could see exhibits by various educational, scientific, and commercial interests and take trips to industrial plants, museums, gardens, and temples. There were dinners and public lectures, small informal gatherings and opportunities to visit with famous and lesser Japanese botanists, most of whom had previously been just names to me. Now they became vivid personalities never to be forgotten. It was an especial pleasure to visit with the most prominent of Japanese taxonomists, Dr. Takenoshin Nakai, who passed away in 1952, less than a year and a half later, and to enjoy his delightful personality and his keen appreciation of Nature as we climbed a mountain together on the post-sessional trip.

At a joint session of all sections of the convention I presented greetings from the organizations I represented and showed pictures of my work in Okinawa and the southern Ryukyu Archipelago, familiar territory to some members of my audience. At an informal gathering of taxonomists much interest was shown in my other pictures of Japan and Okinawa, and I was assured of needed help in identifying my Ryukyu collections. The mayor of Tsuruoka, brother of the president of the Botanical Society, gave a dinner to all delegates, enlivened with entertainment by professional dancers and with impromptu songs, skits, and remarks by the delegates, making it an occasion long to be remembered. During the final business session both Dr. Chaney and I were invited to become corresponding members, honors deeply appreciated.

On the third day came the post-sessional field trip to Mt. Haguro, famous for its centuries-old avenue of giant cryptomeria trees lining the path leading up to a large, quiet old temple and monastery, whence was viewed the still snow-spotted volcanic cone of Chosai-san. Of course there was much plant collecting and photographing and converse with Professor Nakai and others as we trod upward on this ancient pilgrim's route. Our hosts of the monastery served an especially appropriate luncheon for their botanist guests, the food being all vegetarian in accordance with Buddhistic custom. On returning to the lowlands there was still time for a visit to a modern distillery in Oyama village and a final chit-chat in a local park before most delegates entrained for home.

The taxonomists, however, were not yet through. Most spent that night in Atsume in the mountains, a village famous for its hot springs. There I presented samples of the aluminum plant driers which I used most successfully in Okinawa, equipment formerly not used in Japanese plant collecting. A field trip next day in the mountains and some hours of collecting at the seashore before returning by night to Tokyo were a fitting close to this botanical convention and excursion.

The outstanding impression gained from the contacts at this convention is that the Japanese botanists are eager for closer contacts and exchange with American botanists. The language barriers and the traditions of Japan, and likewise of America, are obstacles that

can be and are being slowly dissolved. I trust that my appointment as delegate from the Botanical Society of America and the Pacific Science Board has helped accelerate a greater accord between the botanists of these two countries.

EDITOR'S SUMMARY OF MORE IMPORTANT ITEMS

From Secretary's Minutes of the Business Meeting of the Society—East Lansing, Mich., Sept. 5-8, 1955

Officers elected for 1956: President—Harriet Creighton (Wellesley); Vice-president—Wm. Randolph Taylor (Univ. of Mich.); Member of the Editorial Committee—Paul Kramer (Duke). . . . The society will continue to meet with AIBS through 1960. The 1956 meeting will be held at Univ. of Conn. at Storrs, Conn.; the 1957 meeting will be at Stanford Univ. . . . A report prepared by the Committee on the 50th Anniversary of the Society (Hiden T. Cox, chairman) presented the following plans which were approved: 1. Publication of a "Golden Jubilee" volume of invited papers on historical developments in various fields of plant science during the past half-century. 2. Award of 50 "Certificates of Merit" to outstanding American botanists to be selected by a special committee; these awards will be continued at the rate of at least 1 per year after 1956. 3. Presentation of a major address to commemorate our 50th anniversary at the Storrs meeting (possibility that the Secretary of Agriculture might be invited to deliver this address). 4. Invitations will be extended to distinguished foreign botanists to attend the Storrs meeting. 5. Reception of special delegates from other plant science societies. 6. The presidential address at the Storrs meeting will be of a historical nature. 7. Special symposia will be arranged by Bot. Soc. and other plant science societies at the Storrs meeting. 8. Special press and possibly TV coverage of the Storrs meeting will be arranged. . . . The budget for 1956 as proposed by the Treasurer was approved, with one major change, namely, that the Editor's honorarium of $1,000 will be paid from funds of the American Journal of Botany, rather than from the treasury. As a consequence of this change, the treasury should have a 1956 surplus of about $250.00. . . . Officers of the Society were authorized to cash up to $5,000 of the Society's government bond holdings, should such action be necessary to finance the Golden Jubilee celebration. . . . R. E. Cleland, the Society's representative to the governing board of AIBS, presented the revised constitution of AIBS for approval; approval was voted. . . . The Society's Committee on Guidance presented a report, which included material for a booklet suitable for high-school and college students intereested in careers in plant science; an editorial committee was appointed to prepare the booklet in final form and to make arrangements for its publication and circulation. . . . The following foreign botanists were elected to corresponding membership in the Society: T. H. Harris, paleobotanist, England; Irene Manton, cytologist and morphologist, England; Hiroshi Hara, taxonomist, Japan. . . . Charles Heimsch, chairman of the Committee on Membership, reported upon the activities of that committee, which will circulate invitations to members of other plant science societies to become members of our Society; a new Committee on Membership is to be appointed by the President. . . . A resolution, expressing the appreciation of the Society to AIBS, Michigan State Univ., William B. Drew, and other local botanists for their arrangements, was adopted unanimously. . . . The annual dinner of the Society was held on Sept. 8 in Brody Hall, with approximately 230 members, spouses, and other impedimenta in attendance. Award of the Darbaker Prize in Phycology to Richard Starr (Indiana University) was made at the dinner; Dr. Starr, who was present at the dinner, received a check for $150.00. The retiring president, Adriance Foster, presented an informative, unexpectedly literate, and entertaining lecture on "Plant Idioblasts: Remarkable Examples of Cell Specialization," illustrated with Dr. Foster's usual incomparable Kodachrome slides. President Tippo, introducing guests and officers of the Society, fell somewhat short of being liable to a charge of libel. . . . Secretary Bold presented proposed changes in the by-laws for approval. The approved changes are these: the last sentence of Article II. 1. (a.) was deleted; in Article II. 1. (a), the word "Treasurer" was substituted for "Secretary." . . . Reports were made by the Business Manager and Editor of the American Journal of Botany, by the Treasurer, by the Editor of Plant Science Bulletin, and by various committee chairmen. . . . A full report of the minutes will appear in the next edition of the Yearbook.

IDENTIFICATION

The third item listed under "Thoughts for The Day" in the July number of the Bulletin is from the writings of Thomas Jefferson. Theodore Kozlowski of Univ. of Mass. won the proffered cigar for being first to identify the source of the quotation.

DARBAKER PRIZE—1955

At the annual dinner of the Botanical Society held at Brody Hall, Michigan State University, on September 8, 1955, award of the Darbaker Prize to Professor Richard C. Starr was announced by President Oswald Tippo. This is the first time the prize has been given. The award had been recommended by an *ad hoc* committee of which Professor William Randolph Taylor served as chairman. Dr. Starr was presented with a check for $150.00. The Darbaker Prize funds are available to the Society under the terms of the will of the late Dr. Leasure K. Darbaker of Wilkinsburg, Pa. The award is made for meritorious work in the study of algae, particularly the microscopic algae. Dr. Starr has published a number of contributions dealing with the morphology and taxonomy of the Chlorococcales and, more recently, papers on the sexuality and genetics of desmids. An assistant professor of Botany at Indiana University, Starr also is in charge of the Culture Collection of Algae there. Dr. Starr has served on the staff

of the Marine Biological Laboratory, Woods Hole, Mass. for four seasons. As Fulbright Scholar, Starr studied with Dr. E. G. Pringsheim at Cambridge University. Announcement of the date and place for submitting nominations for subsequent awards of the Darbaker Prize will be made in the near future.

STATEMENT FROM THE SOCIETY'S COMMITTEE ON MEMBERSHIP

Plant Science Bulletin affords an opportunity to direct the attention of the entire membership of the Botanical Society to considerations relating to the enlistment of new members. New member enlistment has been the objective of a continuing program maintained by several different Membership Committees of the Society during the last ten or twelve years. Whereas many individual members of the Society have contributed to this program, our full recruiting potential has not been realized.

Of the many factors which operate in the acquisition of members, personal contacts of the active members are exceedingly important. Each member has an opportunity to further the Society's interests and objectives by extending membership invitations to students and colleagues who are not now members. All members are urged to take this initiative in behalf of the Society.

Membership application has been facilitated by a recent change in the by-laws to eliminate the requirement for sponsors and the inclusion of application forms in the back of some numbers of the American Journal of Botany. If additional forms are required they may be obtained from the Secretary, Harold C. Bold, Box 1501, Vanderbilt University, Nashville, Tenn., or the Treasurer, H. J. Fuller, Univ. of Illinois, Urbana, Ill.

Current dues for graduate students are $5.00, for all others, $7.50. Family membership dues for husband and wife are $10.00; this includes but one subscription to the American Journal of Botany. Completed application forms with payment for dues should be sent to the Treasurer, Harry J. Fuller, Department of Botany, University of Illinois, Urbana, Illinois.

Personal

Rogers McVaugh of the University of Michigan has been granted a year's leave of absence from September 1st to work as program director in systematic biology for the National Science Foundation, Washington, D.C.

Dr. E. K. Janaki Ammal, director, Central Botanical Laboratory, Lucknow, India, was awarded an honorary doctoral degree by the University of Michigan in June.

Russell Seibert, director of Arboreta and Botanic Gardens of Los Angeles County, has been appointed director of Longview Gardens at Kennett Square, Pennsylvania, beginning July 15. Longview Gardens are supported principally by members of the duPont family.

Walter S. Beach, professor of plant pathology, Pennsylvania State University, retired from that post on July 1st, after 37 years of service.

Selman A. Waksman, director of the Institute of Microbiology, Rutgers University, has been elected a foreign associate of the French Academy of Sciences.

Edgar T. Wherry, member of the faculty of the University of Pennsylvania since 1930 has retired. Dr. Wherry is known for his contributions to crystallography, as well as to plant geography, ecology, pteridology, and other branches of plant science. His "Guide to Eastern Ferns" is perhaps the most widely used semi-popular work on this subject.

A. G. Vestal, University of Illinois, has been on sabbatical leave during the second semester of 1954-55, engaged in field work and collecting in California, with headquarters at the Dudley Herbarium at Stanford University.

C. R. Orton, emeritus dean of the College of Agriculture of West Virginia University, died on June 16 at the age of 70. Dr. Orton, known for his work on rusts and potato diseases, was former president of the American Phytopathological Society.

Samuel L. Meyer, head of Botany and director of the Marine Station of Florida State University, has resigned those posts to become Dean of Central College, Fayette, Missouri.

Arthur Galston has resigned his post at California Institute of Technology to become Professor of Plant Physiology, Osborn Botanical Laboratory, Yale University, effective July 1, 1955.

Jacob Rietsema, Smith College Genetics Experiment Station, has been appointed Assistant Professor of Plant Physiology, Forestry School, Yale University, effective October 1, 1955. James R. Troyer, University of Alabama, has been appointed Instructor in Plant Physiology, Forestry School, Yale University, effective September 1, 1955. Both Drs. Rietsema and Troyer will be stationed at the John Hartford Forestry Research Center, Valhalla, New York.

Elbert L. Little, Jr., Dendrologist in the U.S. Forest Service, is spending three months in British Guiana to work with International Cooperation Administration. He will conduct vegetational and ecological studies in conjunction with a vegetational mapping and soil survey study.

Sterling Emerson of California Institute of Technology will serve as geneticist with the Atomic Energy Commission in Washington, replacing Earl Green of Ohio State. Dr. Emerson is on leave from CalTech for this appointment.

Carl LaRue of the University of Michigan died following a stroke on August 19. Dr. LaRue was widely known for his work in morphogenesis and in other fields of plant physiology and in morphology. Interested also in economic botany, he had worked on rubber projects in South America for both the U. S. government and for the Ford Motor Co. He was not only a discerning and productive investigator, but was also a stimulating teacher of both undergraduates and graduate students. His place will indeed be difficult to fill.

John S. Mooring, formerly of UCLA, has joined the botany staff at State College of Washington. Adolph Hecht is new chairman of botany at that institution,

having succeeded Noe Higinbotham, who will remain in that department as professor of botany.

Douglas Post, who just received his Ph.D. from University of California (Berkeley), has been appointed instructor in botany, University of Illinois, to succeed Joseph A. Sacher. Dr. Post will teach plant anatomy and histological technique and will assist in teaching general botany at the Univ. of Illinois.

Raymond J. Pool, professor-emeritus, Univ. of Nebraska, is serving as Visiting Professor of Botany, Southern Illinois University, Carbondale, Ill.

David R. Goddard, Univ. of Pennsylvania, is visiting the Botany Dept., Univ. of Washington, during the fall quarter as Walker-Ames Professor. He will give a series of lectures on "Cellular Metabolism." Ralph Erickson is acting chairman of botany at Penn. during Dr. Goddard's absence.

Robert E. Woodson, Jr., has resigned the curatorship of the herbarium of the Missouri Botanical Garden; he will continue as Professor of Botany in the Henry Shaw School of Botany, Washington University. George Van Schaack of the Dept. of Math. of Washington Univ. has been appointed acting curator of the Mo. Bot. Garden herbarium.

Arrangements have been made at Purdue University between the Dept. of Biological Sciences and the Dept. of Botany and Plant Pathology in the School of Agriculture whereby the elementary courses in botany and the latter department were transferred to and merged with similar courses in the Plant Science Division of the Department of Biological Sciences. J. H. Lefforge, S. N. Postlethwait and F. W. Stears were transferred to the latter department to teach the combined elementary courses. All courses in plant pathology were transferred to the Dept. of Botany and Plant Pathology. John Merkle, on leave from Texas A. & M. College for 1955-56, will be Visiting Prof. of Botany in the Dept. of Biological Sciences, where he will do research with A. A. Lindsey on ecology of flood plains.

LIMNOLOGICAL EXPEDITION OF ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA

The Limnology Department of the Academy of Natural Sciences of Philadelphia under the direction of Dr. Ruth Patrick, Curator of the Department will undertake an expedition to Peru to study the aquatic life in certain headwater tributaries of the Amazon and of the main trunk of the Amazon. The expedition which will be carried out in September and October, 1955 is sponsored by the Catherwood Foundation of Bryn Mawr, Pennsylvania and the group will make studies in the vicinity of Tingo Maria and Iquitos.

The purpose of this expedition is to establish whether there is a greater diversity of aquatic life in tropical streams and rivers than there is in similar temperate zone streams and rivers. The Limnology Department's scientific staff during the last several years has established that in natural streams in the temperate zone a great many different kinds of species of aquatic life exist. The number of species for each of the various groups of organisms in similar regions of natural temperate zone streams are of a very similar order of magnitude although the kinds of species may vary greatly. One would suspect from knowledge of land plants and animals that there would be a greater number of species in the various groups of organisms in tropical rivers. This expedition will attempt to establish whether or not this is true and what is the order of magnitude of difference.

In order to achieve their goal the Academy's scientists will use two methods of study. In one, various groups of aquatic life in selected sections of the rivers will be collected, identified as to species and correlated as to numbers, kinds and ecological types with those which have been found in similar temperate zone rivers. The second method will concern itself with the diatom flora. The structure of the diatom population will be studied by means of an instrument known as the Catherwood Diatometer. This instrument, placed in the stream, collects represeentative samples of the diatom flora. Former studies sponsored by the Catherwood Foundation have shown that the structure of diatom flora in streams not adversely affected by pollution most nearly conforms to a truncated normal curve. In temperate zone rivers the height of the mode and the dispersion factor remain relatively constant. These studies will seek to determine if the height of the mode and the dispersion factor remain approximately the same as in temperate zone rivers and if they do not, what is the magnitude of their variation. The scientists who will make the study are: Dr. John Cairns, Jr., Protozoologist, Dr. Frederich A. Aldrich, Invertebrate Zoologist, Dr. Selwyn S. Roback, Entomologist, Dr. Matthew H. Hohn, Algologist and Dr. Patrick, Algologist and director of the survey and Miss Yvonne H. Swabey, Chemist. Dr. Cairns and several Peruvian scientists will carry out the fishing.

COMMENTS UPON "THE RESPONSIBILITIES CONTINGENT UPON THE SOLICITATION OF APPLICATIONS"

The anonymous article on this subject, published in the July number of this Bulletin, has brought 12 letters to the Editor's desk, 9 of them praising the viewpoint of the authors, 3 of them reporting very different experiences. Best letter from the minority is the following, published with permission of its writer:

May I present another side of the picture to "The Responsibilities Contingent upon the Solicitation of Applications." I hope that it will not weaken the cause of the two Ph.D.s who remain anonymous. They may be friends and besides that I can appreciate their positions. I certainly agree that only the most stubborn stay in the race.

Having mailed about sixty-five "applications" to botany department heads and having gotten over ninety-five per cent answers in a reasonable length of time, I felt that my prospective colleagues were interested even though all of them could not offer positions. In fact, their replies were most encouraging when my morale needed a boost. It was gratifying to my wife, also, who typed each application and painstakingly

typed each one a full page letter with no erasures or carbons. We have each reply neatly filed in our archives.

But the story does not end there. A few weeks later when I arrived for an interview with one of these correspondents, he met me at three o'clock on a terribly hot night to drive me to the hotel. There were other cases that led me to think that these gentlemen were a pretty decent group. As long as a year later, I received a letter informing me of a second opening at the same institution. I think they try to do the best they can with a budget that must be stretched in many directions.

Maybe this report is an exception to the situation. I know there are fewer agonizing times than those when you wait for a reply which you feel you are justified in receiving.

The last thing in the world would be to hope for a scientist to fall into practices of strict business administration. After all, an efficient and well paid secretary could handle those matters.

An onymous and very stubborn candidate,
EUGENE H. SANDERS
Corn Products Refining Company

CAREERS IN BIOLOGICAL SCIENCES

The Biological Education Committee of the National Research Council has prepared a 26-page document, Bibliography of Literature on Careers in the Biological Sciences. This mimeographed pamphlet is distributed by the AIBS office, 2000 P St. NW, Washington 6, D.C.

RESEARCH ITEMS WANTED

Dr. Juan Hector Hunziker, Instituto de Botanica, Araos 2875, Buenos Aires, Argentina, wishes to obtain viable seeds of North American species of Ephedra. If you are able to abet the Good Neighbor policy by furnishing such seeds to Dr. Hunziker, please send them to the above address, preferably by air mail.

FIFTIETH ANNIVERSARY CONTRIBUTIONS REQUESTED

The Council, at its meeting on Sept. 5 at East Lansing, asked the Editor to request readers of Plant Science Bulletin to make contributions to aid in defraying expenses of the 50th anniversary orgies at Storrs next September. Therefore, if you have a wealthy wife, or live in California or Texas, or clip coupons as an avocation, or are otherwise in the chips, send your check to aid the celebration to the Treasurer, H. J. Fuller, 203 Nat. Hist. Bldg., Univ. of Illinois, Urbana, Illinois. Make your check payable to "Bot. Soc. 50th Anniversary Fund." Thank you!

LAST-MINUTE PERSONAL ITEMS

Nicholas Polunin, who has been at Yale as a private investigator, has joined the faculty of Univ. of Bagdad, Iraq.

José Gurgel, assistant prof. at Univ. of São Paulo, Brazil, is spending a year as a Rockefeller Foundation Fellow at the Univ. of Illinois to work with M. M. Rhoades. Margaret Emmerling, formerly assistant prof. at Univ. of Missouri, is also visiting the Univ. of Illinois this year on a National Institute of Health Fellowship to continue maize investigations with Dr. Rhoades.

Harlan Lewis of U.C.L.A. is on the Stanford campus this fall while on sabbatical leave from his university. He is working at the Carnegie Inst. with Drs. Hiesey and Clausen.

Winslow R. Briggs has joined the Stanford faculty as instructor to replace W. C. Steere last spring as graduate dean at Stanford.

MISSOURI BOTANICAL GARDEN SYMPOSIUM

The Missouri Botanical Garden will hold its second symposium on systematics on Nov. 4-5, 1955. Dr. Robert E. Woodson of the Garden Staff will preside, and the discussion will be led by Dr. Karl P. Schmidt, Chicago Natural History Museum. Open house will be held at the Adminisiration Bldg. on Nov. 4, and there will be a smoker in the same building on the same evening from 7 to 10. Symposium sessions will be held on Saturday at 9:30 a.m. and 1:30 p.m. On Saturday at 8 p.m. there will be an exhibit of publications and an informal meeting to discuss professional subjects. Inquiries should be sent to Dr. Rolla Tryon at the Garden, 2315 Tower Grove Ave., St. Louis 10, Missouri.

ASSOCIATION OF SOUTHEASTERN BIOLOGISTS

This association, meeting with AAAS in Atlanta during the Christmas holiday, is sponsoring the following program:

WEDNESDAY AFTERNOON, DEC. 28

2:00 p.m.; Session 1; Committee Room 2, Municipal Auditorium; *Symposium: The Species Problem.* Joint session of AAAS Sections F and G, Society of Systematic Zoology and American Society of Parasitologists. Arranged by Ernst Mayr, Harvard University.

ERNST MAYR, Harvard University, *Presiding*

1. Introduction. ERNST MAYR, Harvard University
2. The Geneticist's Viewpoint. H. L. CARSON, Washington University
3. The Species Problem with Plants. V. GRANT, Rancho Santa Ana Botanic Garden, California
4. The Species Problem with Freshwater Animals. J. L. BROOKS, Yale University
5. The Species Problem with Fossil Animals. J. IMBRIE, Columbia University

THURSDAY AFTERNOON, DEC. 29

2:00 p.m.; Session 2; Committee Room 2, Municipal Auditorium; *Symposium: The Species Problem.* Joint session of AAAS Secctions F and G, Society of Systematic Zoology and American Society of Parasitologists. Arranged by Ernst Mayr, Harvard University.

ERNST MAYR, Harvard University, *Presiding*

1. The Protozoologist's Viewpoint. T. M. SONNEBORN, University of Indiana
2. The Embryologist's Viewpoint. J. A. MOORE, Columbia University
3. The Physiologist's Viewpoint. L. PROSSER, University of Illinois
4. Summary, E. MAYR, Harvard University