

History of the Arthur Herbarium at Purdue University

J. W. BAXTER and F. D. KERN, University of Wisconsin and
Pennsylvania State University

The Arthur Herbarium at Purdue University is devoted exclusively to rust fungi and, with its 75,000 specimens, is the largest rust collection in the world. The history of the Arthur Herbarium is to a great extent associated with the life story of the man for whom it is named, Dr. J. C. Arthur. The original nucleus of the herbarium was a collection of rusts, chiefly from Iowa and Minnesota, accumulated by Arthur when he was a student at Iowa State College.

Joseph Charles Arthur was born at Lowville, New York, in 1850, and died at Brook, Indiana, in 1942. He was a collector in his boyhood, and had an intense interest in flowering plants and fungi, an interest that gradually narrowed down to the rusts. His very early years are best described by Dr. Arthur himself: "In my fifth year, my parents went on an excursion to Rochester, embarking at Sackett's Harbor for a steamer ride on Lake Ontario. Being the only child at that time, I was taken along. It was a stormy passage, and my earliest recollection of this or any other event of that period, was my being held over the rail of the vessel in much distress. If that indicated I was to be a traveller, it failed to show my after reaction to a sea voyage, for it was the only time I contributed to the waves."

"It could not have been long after this that my parents decided to try their fortunes in the West, and memory pictures my plight while left with an uncle's family in Sterling, Illinois, while they went northward to reconnoiter for a possible place of residence. During this interval I was to attend the nearby country school. I do not recall any antipathy to learning, but a decided dislike to the social situation. It was my first experience in upholding my individual position among strangers of my own age. The experiment did not work well. Either my new acquaintances were too aggressive, or I was too timid. I can not now recall the cause of my discomfort, but the picture of a small disconsolate boy reclining on a sunny bank under a row of locust trees, with his books beside him, is a vivid memory. It also includes the approach of the responsible uncle, who did not impersonate the irate parent, but on the contrary mildly took the shrinking child by the hand, gathered up his books, and turned toward home. There was no more school for him that summer."

When Iowa State College opened in 1869, Arthur was one of the first students, receiving his botanical training under C. E. Bessey. In 1877 he received the master's degree from Iowa State College, and in 1886 was granted the D. Sc. from Cornell. In 1887 he accepted a position at Purdue University, in what was called Vegetable Physiology and Pathology. In addition to his work in plant physiology and plant pathology, he continued his rust studies, and by means of collecting, exchanges, and material contributed by others, built up a collection which at the time of his death amounted to some 60,000 specimens.

During the early years of Arthur's rust work at Purdue, the herbarium was housed in a few wooden cases in a semi-private room separated from the laboratory by an interior hall. If this seems to imply a secret

beginning, the right impression has been given. In other words, the Arthur Herbarium had an unofficial origin. The Director of the Experiment Station personally had no objection to the concept of a herbarium, but officially he thought he ought to be opposed to the use of public funds for such a venture. Therefore, the money for packets, mounting paper, genus covers, and cases was provided personally by Dr. Arthur during the early years of development of the herbarium.

After the passage of the Adams Act in 1906 (Federal Funds for the support of research in State Experiment Stations), the official attitude toward the Arthur Herbarium gradually changed, and finally evolved to the point where official recognition and support were given to the rust project. This carried with it cost of materials for developing the herbarium, salaries for workers, and funds for collecting. Field trips were soon made, not only in Indiana but to neighboring states, to the Rocky Mountains of Colorado, and to the southeastern and southwestern states.

During this period of expansion there were several assistants who contributed much time to studying, classifying, and incorporating specimens into the rapidly growing collection. Miss Evelyn Allison (Purdue '04) deserves great credit for the work involved in receiving and preparing specimens. Others during this early period were R. E. Stone (1906-07), A. G. Johnson (1908-11), and C. R. Orton (1910-12).

After the Adams Act the next impetus to growth of the herbarium was the undertaking by Dr. Arthur to contribute the volume on the Uredinales to the North American Flora, which was being projected by the New York Botanical Garden. Vol. 7 on the Uredinales finally appeared in 15 parts over a period of 34 years (1906-1940). In order to gather as much information as possible about the identity and range of the species of this order, a considerable correspondence was carried on with mycologists in the United States, and also in other countries, and specimens were solicited.

The list of correspondents would be a long one. A few of those who were especially helpful must be included here: E. Bartholomew (Kansas), J. M. Bates (Neb.), E. Bethel (Colo.), J. F. Brenkle (N. D.), J. J. Davis (Wis.), J. Dearness (Ontario), G. P. Clinton (Conn.), W. P. Fraser (Nova Scotia), A. O. Garret (Utah), E. W. D. Holway (Minn.), W. A. Kellerman (Ohio), W. H. Long (U. S. D. A., N. Mex.), E. W. Olive (S. D.), C. L. Shear (U. S. D. A., D. C.), J. L. Sheldon (W. Va.), F. L. Stevens (N. C.), and H. H. Whetzel (N. Y.). It is interesting to note the vocations represented here—a farmer, a minister, a banker, an experiment station worker, two physicians, two high school teachers, two U. S. D. A. workers, and seven college professors.

Two collectors who contributed a great deal of valuable material to the Arthur Herbarium and who aided greatly in extending our knowledge of the rust fungi were Elam Bartholomew and E. W. D. Holway. Edward Willet Dorland Holway was a banker who lived in Decorah, Iowa and whose hobbies were mountain climbing and collecting. Holway was fortunate in that he could frequently pursue both hobbies at one and the same time. Although he was rather frail in childhood, Holway in later life climbed so many mountains in the Canadian Rockies that a mountain was finally named after him, and a mountaineering friend was once heard to say, "Holway is made of India rubber and steel springs." His collecting

expeditions to Central and South America yielded a wealth of material. In the words of L. H. Pammel of Iowa State College, "It is probably correct to say that Holway discovered more new plant rusts than any other botanist."

Elam Bartholomew was a Kansas farmer who had been a school teacher and had a good general knowledge of botany. For several years he collected only flowering plants, until one day in 1885 when he was visited by W. A. Kellerman, then professor of botany at Kansas State. As they were walking around the farm, Kellerman plucked a leaf of pigweed, showed Bartholomew the pustules of *Albugo* on the lower surface and said, "Bartholomew, why don't you study something that is really interesting?" From that day on, Bartholomew concentrated on fungi. On his trips, which took him into every state in the Union, as well as Canada and Mexico, he personally collected more than 290,000 specimens and discovered about 470 new species of fungi.

In addition to material contributed to the Arthur Herbarium by collectors in the United States, many type specimens were obtained through correspondents in foreign countries. Also the aid received from some of the large herbaria both in this country and abroad was considerable. This was accomplished through duplicate specimens and by division of specimens where abundant material made that possible. It was found that flowering plant specimens often bear rusts, and examinations of such material became a source of mycological specimens. The cooperating herbaria deserving especial mention include those at the New York Botanical Garden, Harvard University, Smithsonian Institution, N. Y. State Museum, and Academy of Natural Sciences (Philadelphia). The relations with these institutions were furthered by more or less extended visits by Arthur and Kern, during the years from 1904 to 1910, and were very fruitful.

This account would be incomplete indeed if reference were not made to the illustrations in the Arthur Herbarium. Mycological specimens in packets are not observable and even when opened for examination yield only gross characters which may not be very distinctive. Only through microscopic study of spores and sometimes sections can the necessary characters be determined. When these studies were being pursued camera lucida drawings were frequently made. These drawings, mounted below a packet, served to reveal the identity of a specimen and often precluded the repetition of detailed and time-consuming studies. Of course not every specimen could be so illustrated, but the inclusion of many illustrations, together with measurements and a recording of other data, promoted the studies and enhanced the working value of the herbarium. It should be noted that every illustration was dated and initialed, thus making it possible for later investigators to have a guide to its reliability. It should also be noted that photomicrography later came in as an illustrative supplement.

In 1899, J. C. Arthur began an extensive series of culture experiments that were continued until 1917, in the course of which the life histories of a great many host-alternating rusts were worked out by means of carefully controlled inoculations of host plants in the greenhouse. Arthur was aided in these studies by the field observations and outdoor culture work of Ellsworth Bethel, of Denver, Colorado. Bethel did a considerable amount of collecting, but it was a rather specialized type of collecting. In a letter

to Arthur in 1918, Bethel, in describing a hurried trip to California, says, "There was no time for exploration, and I was so rushed, could only grab what I saw in passing. Speaking of grabbing, I will say *sub rosa* that outside of yourself and your men, I find no real collectors, only 'grabbers,' I call them. Most collectors never stop to look for the various stages or connections. I am likened to an 'old granny' in spending hours with my magnifier on a little grass plot. Well, I am not ashamed of the name, as I can get several times as many things as most collectors."

Bethel was interested not so much in accumulating a large number of specimens as he was in finding material that could be used in establishing life cycle connections, which he did by means of outdoor inoculations. His outstanding contribution was in working out the aecial host range of the remarkable grass rust *Puccinia aristidae*, which is now known to form its aecia on about 100 species in 24 families of host plants.

Members of the Purdue staff who made important contributions to the growth of the herbarium during the period of 1912 to 1920 were G. R. Bisby, F. D. Fromme, H. S. Jackson, C. A. Ludwig, and H. C. Travelbee. Dr. Jackson stayed on through the twenties, and through his efforts many South American specimens were added to the herbarium.

In 1920, a few years after Arthur's retirement at Purdue, a crisis arose that is best described in Arthur's own words: "One day I was called into the Director's office and questioned about the work in the herbarium. I was informed, much to my surprise and chagrin, that the herbarium was considered the property of the station. I objected, and pointed out that the larger part was collected by myself and my collaborators, much of it before I became a member of the Station, that I had paid for all of the mounting paper, genus covers, packets and labels; further that my labor on it had been largely outside of Station hours, and certainly since my retirement, two years before, had cost the Station nothing. The Director maintained that any and all material brought into the Station became property of the Station. This statement seemed to me unjust, and a poor return for the years of labor I had put into building up the collection. I asserted my ownership, and to prove it, removed the whole mounted collection to my home in the city, where I felt that I might carry on the work I had had so much at heart for nearly fifty years."

There is no record as to how long Dr. Arthur kept the collection at home. Eventually a committee was appointed to negotiate with him, and after a few summit meetings a mutually satisfactory agreement was drawn up, the collection was returned to the cases, and, in Arthur's words, "From this time to the present the status of the herbarium, and the character of the work in connection with it, have not been called into question."

This had been a discouraging period for Arthur, but he had had the support and encouragement of friends and collaborators throughout the country. In a letter to Arthur from Ellsworth Bethel, we find the following: "Keep up your spirits and enthusiasm and all will come out well yet. I find that my troubles usually turn to something good—a change for something better than I had planned or anticipated. Now if all your trouble should result in your giving to the world some publication on the biology of rusts and a working manual for beginners, what a great thing it would be for the advancement of knowledge. This would be of far greater value than the determination of species for correspondents or the publi-

cation of rust species. You have described enough species—perhaps too many, and if you could help the younger men to do this work, since they must ere long take your place, it would be of inestimable service to science. Now please consider seriously the matter of giving us something which will give us younger men, and especially beginners, a start and a guide in the study of the most interesting and important group of plant diseases.”

At this time Arthur was working on the second number of the rust portion of the North American Flora, the first of which had been published in 1907, but the publications that Bethel considered to be so much needed were eventually to appear. In 1929 Arthur published “The Plant Rusts,” in collaboration with Kern, Orton, Fromme, Jackson, Mains and Bisby, and in 1934 he brought out his “Manual of the Rusts in United States and Canada,” with illustrations by George B. Cummins. In his manual, Arthur abandoned the life cycle classification that he had introduced in the North American Flora, a scheme of classification that had not been generally accepted. The manual of rusts proved to be the “good working manual” that Ellsworth Bethel had envisioned.

In addition to Arthur’s publications, major contributions from the Arthur Herbarium include F. D. Kern’s study of the genus *Gymnosporangium*, taxonomic studies of various groups by Bisby, Orton, and E. B. Mains, and H. S. Jackson’s paper on life cycles and evolutionary tendencies in the Uredinales. Outstanding contributions by the present curator, George B. Cummins, include a study of the phylogenetic significance of the pores in rust urediospores, a monograph of the genus *Prospodium*, a recently published manual of rust genera, and studies of major groups of grass rusts, some cooperatively with H. C. Greene and J. F. Hennen.

Current research projects at the Arthur Herbarium include a manual of the grass rusts of the world, G. B. Cummins; a study of the morphology and taxonomic significance of rust spermagonia, Yasuyuki Hiratsuka; studies of the rusts of Mexico and Central America, G. B. Cummins, J. W. Baxter and J. F. Hennen; a monograph of the genus *Ravenelia*, J. W. Baxter; and a taxonomic study of the genus *Pileolaria*, J. F. Hennen.

Literature Cited

1. BARTHOLOMEW, E. W. 1935. Elam Bartholomew. *Mycologia* 27: 91-95.
2. DEARNESS, J. 1946. E. W. D. Holway. 1853-1923. A banker’s avocations. *Mycologia* 38: 231-239.
3. MAINS, E. B. 1962. Joseph Charles Arthur (1850-1942). *Mycologia* 34: 601-605.