

**The Arthur Herbarium Centennial:
100 Years of Uredinology
in Indiana
and the Great Lakes Region**

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In January, 1883, Dr. J. C. Arthur published his first manuscript on uredinology, the study of the taxonomy and biology of the rust fungi, the Uredinales. This we take as the starting date for the Arthur Herbarium. Because the Arthur Herbarium (PUR), now at Purdue University in West Lafayette, Indiana, has now for 100 years been the major site in the United States, and possibly the world, for taxonomic studies of these important plant pathogens, a review of the history of Indiana Uredinology is in order. Parts of Dr. Arthur's story have been published before (11, 16, 17, 19, 24, 30), so new information was sought for this report.

The Arthur Herbarium is in its centennial year, but rust collecting in Indiana began more than 100 years ago. Jackson (23) credited the first explicit report of a rust fungus in Indiana to Dr. John M. Coulter in 1876, who found a rust on *Lespedeza violacea* (L.) Pers. (bush clover: Leguminosae), presumably near Hanover. Because there was then no Arthur Herbarium, Coulter sent the rust specimen to Dr. Charles H. Peck, New York State Museum at Albany, for identification. Peck identified the fungus as *Uromyces lespedezae-procumbentis* (Schw.) Curtis, then called *U. lespedezae-violaceae* Schw., but added,

". . . inasmuch as the name is objectionable both because of its compound character and because of it implied limitation of the habitat of the fungus, which occurs on the leaves of all of our species of *Lespedeza*, it seems best to . . . change . . . the name of this fungus (14)."

Therefore, Peck simply shortened it to *Uromyces lespedezae* Peck, a savings of four syllables and twelve letters—a noble, but unfortunately an illegal, change under the International Code of Botanical Nomenclature.

John M. Coulter is known to Indiana botanists as a professor of botany and as the editor of the *Botanical Gazette*. He was also the brother of Stanley M. Coulter, early curator of the vascular plant herbarium at Purdue University. Perhaps it is less well known why J. M. Coulter became a botanist. Although Coulter studied botany in college, his main interest was geology—and Latin (31). His first scientific position was as an assistant on a U.S. Geological Survey of Colorado, Utah, Idaho, Montana, and Wyoming. Every evening his companions socialized. Because of his inability to play cards, Coulter sought something else to do and became interested in the plants of the "Far West (35)."

There is a less exact reference to a rust disease in Indiana two years prior to Coulter's report. A rust was destroying the foliage of blackberries in Henry and Wayne counties from 1872-1874 (22). The reporter stated, "It is evidently a contagious trouble. I think it of cryptogamous origin." No Latin name or further description was included, but it probably was the orange rust of *Rubus*, caused by *Gymnoconia peckiana* (Howe) Trott.

Another nebulous early report is of a specimen labeled "*Aecidium dircatatum* Ind." Arthur and Bisby (9) interpreted this notation to mean that it "must have

been collected" by the Moravian missionary, Lewis David von Schweinitz, during a visit to Hope, Indiana, in 1831. The fungus, now known as *A. hydnoideum* Berk. & Curt., was collected on *Dirca palustris* L. (Thymeleaceae). This specimen was not available to us in time for verification of this report.

The first compilation of Indiana rust fungi appeared in the Indiana Academy of Science proceedings for 1893 (36). The tally included 7 holomorphic genera, 4 anamorphic genera, and 88 species. Several of the *Aecidium* anamorphs are now connected to teliomorphs in such genera as *Gymnoconia*, *Pileolaria*, and *Tranzschelia*.

Thus, Indiana uredinology dates to 1831, 1872, or 1876, depending on the validity of the blackberry and *Dirca* rust reports. How does this compare to other Great Lakes states or to the rest of North America? The first American fungal studies were those published by von Schweinitz in 1831 in Pennsylvania (1). These could hardly have been done earlier, for Schweinitz still had to combat "the prevalent notion of the times that fungi were mutations or transformations usually from parts of higher organisms" and, therefore, not suited for true classification (7).

In Ohio, the earliest literature report of a rust fungus appears to be of *Uromyces ari-triphylli* (Schw.) Seeler on *Arisaema dracontium* (L.) Schott. (green dragon: Araceae) near Toledo in 1877 (21). Burrill reported *Aecidium physalidis* Burr. *Sp. nov.* on *Physalis viscosa* L. (= *P. heterophylla* Nees., groundcherry: Solanaceae) from Urbana, Illinois, in 1879 (13). This anamorph may be associated with the species *Puccinia kansensis* Ell. & Barth. on *Buchloë* (buffalo grass: Graminae) (10). The earliest rust collection on record in the Arthur Herbarium for the state of Michigan is the type specimen of *Aecidium polygalinum* Peck on *Polygala senega* L. (Seneca snakeroot: Polygalaceae). Now known to be an anamorph of *Puccinia andropogonis* Schw. (on *Andropogon* spp., bluestem grasses: Gramineae) (29), it was collected near Ann Arbor in 1878. One of the earliest lists of rust species in Michigan was by Lee Bonar (12), later a distinguished California mycologist but then working as a graduate teaching assistant at the University of Michigan for a salary of \$300.00 per year (34).

The oldest specimens of rust fungi to be found in herbaria usually were collected incidentally as higher plant taxonomists were sampling the host plants of the rusts. So it was with the oldest PUR collection (PUR-F18269). This fungus, *Puccinia meyeri-alberti* P. Magn. (27), caused a tiny leafspot on a specimen of *Berberis ilicifolia* Forst. (Berberidaceae) collected in Tierra del Fuego in January, 1769, by Sir Joseph Banks and Dr. Daniel Carl Solander during the first voyage of Captain James Cook. The expedition party was trapped overnight in a blizzard on a mountainside after collecting this plant. Two black servants, Thomas Richmond and George Dorlton, froze to death (32) but are memorialized by the Arthur Herbarium's oldest specimen.

Thus, uredinology began in several of the Great Lakes states at about the same time, but Indiana is the state where rust taxonomy flourished. This can be credited to the work of one man: Joseph Charles Arthur. Arthur showed early promise as a botanist. He passed botany exams given by his Iowa State University professor, Dr. Charles E. Bessey, by being "able to give the Latin names of the required fifty specimens by the shadow seen through the mounting paper when the sheets of dried plants were held at the window with the backs turned toward" the students (31). Dr. Arthur began his studies of rust fungi over 100 years ago, in 1877, when Dr. Bessey acquired a collection of unidentified rusts from the Curtis Herbarium at Harvard. Among these was the subject of Arthur's first publication on rust fungi (30), the same species Coulter found in Indiana in 1876, *Uromyces lespedezae-procumbentis*. This publication (3) began the first cen-

tury of sharing with the world knowledge gained from what became Arthur's herbarium.

Arthur's second rust publication (5) soon followed but was published obscurely because, in Arthur's words (7),

" . . . it was then held and long afterward by Dr. Asa Gray and concurred in by Dr. Farlow, that for the good of American science no naming of phanaerogamic or cryptogamic plants, particularly the latter, should be undertaken outside the precincts of Harvard University, because in no other place was there to be found adequate material for comparison."

W. G. Farlow then held the Chair of Cryptogamic Botany at Harvard. Because this work was done while Arthur was an instructor at the University of Wisconsin, Farlow refused to acknowledge it, even though he and Arthur were good friends. However, Arthur's visit to Farlow's laboratory in 1884 led Arthur to specialize in the rust fungi. Seeing that Farlow had a backlog of unexamined specimens (including some of Arthur's own), Arthur decided that Farlow could not manage the task alone. In a letter to Bessey, Arthur announced that he had "concluded to look into the life and habits of some of the plants that cause diseases of cultivated crops, such as the rusts etc. (31)." Dr. Arthur came to Purdue a few years later and, through his work, now at least one place other than Harvard contains adequate rust material for comparison of specimens.

In his second rust manuscript (5), Arthur's future research direction is evident. Perhaps this course was explained best in a review by Coulter (15):

" . . . if ever the study of the lower cryptogams ceases to be a bugbear, it will largely be due to just such workers as Prof. Arthur. The novel part about the present paper is that it attempts to group under each species all the three stages in its life history. Of course this is the thing to do, and it has only been because of our ignorance of the true relationship among these scattered phases, that it has not long since been done. A careful set of cultures is what is needed to unravel the snarl. In the meantime it has been customary to base species upon the characters of one or two phases, and to distribute the phases under separate genera, and Prof. Arthur shows considerable boldness in cutting loose from the old models, and attempting a natural grouping."

This article contains the first of Arthur's numerous published species of Uredinales, *Uromyces acuminatus* Arth. on *Spartina pectinata* Link. (prairie cordgrass: Gramineae), and the new variety *U. euphorbiae* Cke. & Peck in Peck var. *minor* Arth. (on *Euphorbia marginata* Pursh: Euphorbiaceae), a taxon we do not still accept. Surprisingly, Arthur's first named taxon was not a rust fungus but a new variety of walking fern, *Camptosorus rhizophyllus* Link var. *intermedius* Arth. (4), published one month before his first named rust species.

Arthur came to Purdue University in 1887 as Professor of Botany, became botanist in the Purdue Agricultural Experiment Station one year later, and remained at Purdue even after his retirement in 1915. His friendship with J. M. Coulter and with C. R. Barnes, Arthur's predecessor as botany teacher at Purdue, led to collaboration in the textbook *Handbook of Plant Dissection* (8), which became a standard that students used to learn their ABC's (Arthur, Barnes, and Coulter) of plant anatomy. Note that the ABC publication predated that famous alphabetically-authored cosmology paper of Alpher, Bethe, and Gamow (2) by 62 years.

Arthur seems in some ways like a part of the distant past, a picture on the wall, but 100 years is not so long. Indeed, some of his ideas sound like 1982. For example, consider the following excerpt from another unpublished Arthur note (7), on file in the Arthur Herbarium:

“ . . . Those who fatten at the public feeding trough, have at times been transformed from statesmen into pork-barrel politicians, but it would not be expected that a parallel could be found in the non-monetary field of botany. But something very like it has happened. Among the Washington botanists, quite an army at present, one can expect little cooperative assistance.

“My acceptance of the task of listing and describing the rusts of North America began before anyone of those who now guard their discoveries among the rusts with the methods of a secret service man had any flickering of interest in the subject, so long ago that the New York Botanical Garden, which has fostered the enterprise, was only in the heads of its promoters, and the extensive grounds were an unopened, rocky pasture.

“I undertook the work with the conviction . . . that it was to be for the benefit of science in general . . . I received no financial aid from any source whatever. I bought all books needed in my works from my slender salary as a teacher, a salary so small that I felt ashamed to name the amount, even to a friend . . . My work was done at odd hours, often at the sacrifice of social and recreative periods, and even of normal hours of sleep.”

The work mentioned in this quotation was the portion of the North American Flora devoted to the rust fungi (6), which had been assigned to Arthur in 1885 (31). Although we do not know when or why these paragraphs were written, some of Arthur's personality shows through in this quote. For example, there is that pride in his work which led him to pack up the entire herbarium and move it to his home during a disagreement with Purdue University over ownership of the herbarium (17). When the debate was resolved, on 05 August 1918, and the herbarium returned to the campus, it was officially dedicated as the “Arthur Herbarium.”

Arthur, though he retired in 1915, stayed active as curator of the herbarium until about 1938, when he was 88 years of age. Thus, not only are the PUR specimens well-preserved, but so, apparently, are the Arthur Herbarium researchers. One of Arthur's early assistants, Dr. Frank D. Kern, published his last book (26) at 90. Arthur's successor, Dr. George B. Cummins, named over 600 new taxa or combinations in a 33 year career as curator of the Arthur Herbarium and best softball pitcher in the Purdue University School of Agriculture. However, Cummins has been even more prolific as a writer following his formal retirement, and is now finishing his sixth book since leaving Purdue. Cummins, who signs his letters “the burned-out botanist,” is 78 years old but not yet rusty. The following quote (18) is representative of Cummins' trademark dry wit:

“ . . . The abbreviation of Purdue University Retirees (PUR) is antedated by some years by PUR, the official international designation for the Arthur Herbarium . . . The two PUR's have something in common. The PUR (Arthur Herbarium) is a repository of about 80,000 specimens, many quite old. Purdue University Retirees probably do not number so many, but the rest of the comparison has some validity. And I am in a position to know.”

Finally, still actively working in the Arthur Herbarium today is Ibra L. Connors,

retired former Curator of the Canadian National Mycological Herbarium in Ottawa, Ontario, who celebrated his 88th birthday on 05 July 1982.

This has been a brief review of Indiana uredinology and of the Arthur Herbarium on the occasion of its centennial celebration. What is the status and significance of the PUR today? Specimen holdings now approach 100,000 (Table 1). No up-to-date compilation of Indiana rust fungi is available, but a recent tally

TABLE 1. *Specimen and record holdings of the Arthur Herbarium (PUR), October 1982 (estimated figures)*

86,000	accessioned rust fungus specimens
10,000	new rust fungus specimens under study
3,000	type specimens of rust fungi
5,000	specimens of other fungi for teaching use
120	teliomorphic genera of rust fungi (of 120 known in the world)
9	of the 10 anamorphic genera of rust fungi
4,000	species of rust fungi (of 6,000 known in the world)
1,000	genera of host plants
5,000	species of host plants
4,000	photomicrographs, camera lucida and free-hand drawings, annotation notes (including spore measurements)
23,000	entry bibliographic file
6,000	reprints from world literature
21	U.S. states-sources of correspondence or specimens exchanged with PUR in last two years
26	foreign countries-sources of contacts within last two years

of Michigan rusts (McCain, unpublished manuscript) included 29 genera, 171 species, and 6 varieties, a notable increase over Underwood's 1893 list of 88 Indiana rust fungi. The herbarium is a valuable source of plant distribution records, e.g., some of the citations in Deam (20) came from PUR records. The herbarium is also a reference for identification of species, such as the first Indiana record of *Viburnum* rust, *Coleosporium viburni* Arth., which was collected on *V. lentago* L. (nannyberry: Caprifoliaceae) from South Bend, IN, on 3 September 1982, by B. Cummings (PUR 66499). Another use of PUR records is for biogeographic studies (28). There is still no explanation for such extraordinarily disjunct species as *Cerotelium tanakae* Ito, which occurs on *Amphicarpa* (hog-peanut: Leguminosae) in Japan and in Brown County, Indiana, but apparently nowhere else. The rust was collected again in 1982 at the previous location in a ravine near the Abe Martin Lodge in Brown County State Park. However, in a survey of the host in other nearby locales, P. Buriticá and J. F. Hennen failed to locate any additional rust specimens.

In short, as the Arthur Herbarium begins its second century, it continues to be a haven for taxonomists, "those sainted professionals who have taken on the ostensibly boring task of naming new species and untangling the web of synonyms applies to old ones (33)," morphologists and ultrastructuralists, those who study by the light of the flickering cathode ray tube, and phylogenists, those who seek to answer the old question: which came first—*Sempervivum tectorum* L. or *Solanum melongena* L.?

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