

A History of Plant Pathology

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EARLY YEARS — 1888-1932

The importance of botany to agriculture was recognized in the latter part of the 19th century by Dr. Howard Ayres, professor of biology, who taught a course in agricultural botany for the agriculture student. The passage of the Hatch Act in 1887 brought more attention to agriculture and prompted the Board of Curators, University of Missouri, to develop the Missouri Agricultural Experiment Station one year later.

Although the Hatch Act encouraged many states to add a botanist to their experiment station staffs, Missouri did not add one until 1897 when Charles Thom was made assistant botanist. Thom, who later became a renowned mycologist, was awarded the first Ph.D. in biology. He completed this work in 1899 under Ayres, who then left to become president of the University of Cincinnati. In addition to his responsibilities as the experiment station botanist, Thom taught two courses in cryptogamic botany, one on algae and the other on fungi. He was also responsible for a practical course in plant diseases for agriculture students. Like other classes in agriculture, this course was offered only in the winter semester, when students were less needed for farm work at home.

In 1902, Dr. B.M. Duggar joined the Missouri staff as professor of botany and initiated the first course in mycology. He continued the plant disease course until 1907, when the first bona fide course in plant pathology, parasitic fungi, was introduced into the curriculum. This same year, Dr. George Reed came to Missouri and offered a course in bacteriology and, in 1908, assumed Dr. Duggar's teaching responsibilities. Botany, previously listed in the College of Agriculture, became part of the Arts and Science College. Botany's ties in the College of Agriculture, however, continued through joint appointments and dual listing of courses. Under the guidance of Dr. Reed, 13 students obtained their M.S. degrees and one his Ph.D. Their theses varied from subjects strictly microbiological in nature to pathological, including diseases caused by *Fusarium*, *Puccinia* and the powdery mildew organisms.

Dr. W.E. Maneval, remembered chiefly for his excellence in teaching, arrived in 1915, a fresh young Ph.D. from Johns Hopkins University. During his long tenure of service, he assumed the entire teaching responsibilities in plant pathology and bacteriology. Four students benefitted from Dr. Maneval's leadership as thesis advisor. Dr. W.J. Robbins, who replaced Dr. Reed in 1919, changed the research emphasis into investigations primarily of a physiological nature. Robbins also was instrumental in bringing Dr. Phillip White, who started his classic tissue culture (onion root tip) in Missouri. Dr. White received

his Ph.D. from Johns Hopkins in 1928 and spent two years in Missouri when he was elected as a national research fellow to attend the Boyce Thomson Institute. In addition to his appointment in Botany, Dr. Robbins held an appointment as the experiment station physiologist. Simultaneously with Dr. Robbins appointment, Dr. Edwin F. Hopkins was employed as Missouri's first experiment station plant pathologist. Dr. I.T. Scott, a student of Dr. Robbins, succeeded Dr. Hopkins and stayed until 1931, when Dr. H.W. Ricketts was appointed for a one-year term. During this period, Dr. C.M. Tucker initiated his classic studies on *Phytophthora* and was awarded a Ph.D. in 1931. One year later, he was appointed associate professor of botany and experiment station plant pathologist.

GROWTH AND DEMISE OF PLANT PATHOLOGY - 1932-1967

With Tucker's appointment as associate professor of botany and experiment station plant pathologist, research in plant pathology began to accelerate. With his appointment as chairman of botany in 1938, an increased emphasis on plant pathology became apparent. During his tenure as chairman, Dr. Tucker identified a gene in a wild species of *Lycopersicon* that would confer resistance to *Fusarium*, the causative agent of fusarium wilt in tomato. He and his students then incorporated this resistance into commercially acceptable cultivars. In the early 1940s, one of his students, Dr. John T. Middleton, completed a study on *Pythium* which contains some of our most damaging plant pathogens, and published a monograph that remains the standard key for this genus. It was during those depression years that Dr. Carl Vinson joined the Department of Horticulture and started his work on tobacco mosaic virus. He was soon recognized as one of the leaders in plant virus research until ill health intervened and terminated his professional career.

In the World War II years, plant pathological research was limited to the studies on *Fusarium* and *Phytophthora* by Tucker and the plant disease survey by Dr. T.W. Bretz, who arrived in 1943. Two years later, Bretz was transferred to the Bureau of Plant Industries with responsibilities in shade tree research. This led to his finding and describing the

perfect stage of the oak wilt fungus. Oak wilt appeared as a threat to Missouri's extensive hardwood forests, chiefly oak. Bretz's careful research, however, demonstrated that standard routine sanitary practices would curtail this disease, removing the immediate threat to our forests.

Following the cessation of World War II, Dr. C.H. Kingsolver was added to the experiment station and botany staff as assistant professor with responsibilities in the cereal and forage crops. In 1947, Dr. E.S. Luttrell arrived to teach plant pathology, bacteriology, and mycology. He left two years later. His position was filled by Dr. John Hollis, plant pathologist and assistant professor and by Dr. R.F. Brooks, bacteriologist and associate professor in botany and animal husbandry. Hollis had the responsibilities of teaching plant pathology and mycology while Brooks handled bacteriology. In 1950, Dr. Kingsolver accepted a position with the U.S. Biological Warfare Division at Camp Detrick, leaving a vacancy which was filled in 1953 by Dr. Merle Michaelson. That same year, Hollis left the botany department and was replaced by Dr. J.E. Peterson.

In 1954, the plant pathology section in the experiment station was disbanded and transferred from botany into appropriate plant science departments. Effective July 1, 1954, Millikan became a member of the Department of Horticulture, Michaelson became a member of field crops, and Bretz became a professor of forestry.

Plant pathological research in the 1950s was evidenced by Dr. Goodman's efforts in horticulture and a continuation of Michaelson's work in field crops by Dr. Marvin Whitehead, who arrived in 1955. Goodman's work on the fireblight disease in the early 1950s resulted in recommendations for control, which have remained unchanged. In 1958, Dr. O.H. Calvert was added to the field crops department, and in 1960, Whitehead left Missouri and was replaced by Dr. T.D. Wyllie. In 1963, Dr. B.G. Tweedy replaced Professor Swartwout in horticulture, who had the responsibilities of the spray programs for Missouri's fruit crops. Additional plant pathologists were added to the field crops department. These included Dr. Einar Palm in 1964, Drs. John Miller and William Bugbee in 1965, and Dr. Fred Morgan in 1967. Dr. Morgan left shortly thereafter and was replaced by Dr. R.F. Scherff, who stayed for two years; the position was then closed. Other additions were made in the forest service. Dr. A.D. Partridge arrived in 1956, only to be replaced by Dr. Fred Berry two years later.

DEPARTMENTAL STATUS —

1967-1988

On September 1, 1967, the College of Agriculture restructured for greater efficiency of its resources. Four new departments were formed, and two others, field crops and soils, were combined to form agronomy. In this restructuring, plant pathology was recognized as a discipline and was created by transferring those staff members involved in phytopathological work in different departments into one. The personnel involved in this move included Drs. Goodman, Millikan, Ross, and Tweedy in horticulture; Drs. Bugbee, Calvert, Miller, Morgan, Palm, Sehgal, and Wyllie from field crops; and Bretz from forestry. Bretz was named chairman, but after his untimely death on Dec. 31, 1967, Dr. R.N. Goodman was appointed to succeed him. The department was then authorized another position to cover some of Dr. Goodman's research activities. Dr. L. Lovrekovich accepted this position, and his wife was appointed as his technician. On Jan. 1, 1968, Dr. W.Q. Loegering also joined the University on a 50 percent basis as professor of biological sciences and plant pathology. That same year, Drs. Bugbee and Miller, who were stationed at the Delta Station, left Missouri for other positions. Bugbee's position had been funded by USDA and was closed out, but Miller was replaced by Dr. Charles Baldwin. On Sept. 1, 1968, Dr. Merton F. Brown assumed Dr. Bretz's responsibilities as forest pathologist and became the first director of the electron microscope facility. (See *History of Electron Microscope Facility* by R.N. Goodman.)

In 1969, the department was expanded to cover nematology with the appointment of Dr. V.H. Dropkin as professor of plant pathology. His technician, Juanito Acedo, arrived in October to set up his laboratory. In the early spring of 1970, the department had its periodic review by the USDA and was given the green light to continue research in the same general directions. In June, the department hosted the northcentral division of the American Phytopathological Society, with Dr. Wyllie serving as the president. The highlight of the activities was the dedication of Tucker Hall, named for the deceased Dr. C.M. Tucker, who was a president of the American Phytopathological Society and served for many years as chairman of botany, which is now part of the division of biological sciences. The activities also included the Tucker symposium of the genus *Phytophthora*, for which Dr. Tucker was recognized as the world's authority. In June 1970, Lovrekovich left the Department of Plant Pathology for a position in Kansas City and was replaced by Dr. A. Novacky.

In 1971, the work load and teaching responsibilities of the Electron Microscope Facility necessitated the addition of Dr. J.A. White as assistant manager, and the department was honored when Dr. W.Q. Loegering was elected a fellow of the American Phytopathological Society. In October-November, 1972, Dr. Loegering presented his course in interorganismal genetics in Argentina at the University of Castelar.

The phyto-bacterial group was expanded in 1972, with the addition of Dr. J.S. Huang as research microbiologist. The wisdom of this appointment became apparent the following year when Dr. Huang was instrumental in isolating and partially purifying the toxin associated with wilting occurring during infection of the fireblight organism. It was also in 1973 that Drs. Tweedy and Ross left for more lucrative positions with the Ciba Geigy Corporation in North Carolina.

The year 1974 featured additions rather than losses in staff. Dr. Arthur Karr was chosen from an impressive list of well-qualified candidates to assume Tweedy's responsibilities in teaching and research in the area of fungal physiology. Dr. Karr had a Ph.D. in biochemistry and had spent three years in post-doctoral research in plant biochemistry. Dr. Paul Steiner was also hired to beef up our extension effort and handle our spray program which had been another area of Tweedy's responsibilities. At our annual Phytopathology meetings, Dr. Goodman was elected fellow of the society. One year later, Dr. Millikan was elected as a foreign member of the Polish Academy of Science, an honor which is limited to a few Americans. Dr. Huang left for a position as assistant professor at North Carolina State University and was replaced by Dr. Demetrios Politis. Plant pathology also gained a position when Jack Wallin transferred from Iowa State University. His responsibilities were in the area of epidemiology and corn pathology, particularly as it deals with aflatoxin production.

The following year, 1976, was a memorable one for Missouri plant pathologists. The national meetings of the American Phytopathological Society were held in Kansas City, Mo., and hosted by the departments of plant pathology at Kansas and Missouri. At this meeting, the Missouri Plant Pathology Department had its first social hour, which now has become tradition. The department also was honored by the National Academy of Sciences, which nominated Jack Wallin as a member on the Committee on Aerobiology. The department had its second review from Cooperative State Research Services when Dr. John Fulkerson and associates came to look us over. Since there were no real criticism, the direction of our research efforts apparently was satisfactory. In 1977, Dr. Arnold Foudin of APHIS joined the department. He had obtained his doctorate from Georgia and had remained as a post-doc

until this position opened up. The department also had a unique series of lectures (Bretz Memorial) in which seven outstanding scientists gave lectures in our classes, presented a seminar and spent an evening with our students. Additional departmental recognition came with the completion of the three-volume series on mycotoxins by Drs. Wyllie and Morehouse and with a chapter by Karr in the revised *Plant Biochemistry* by Bonner and Varner.

The year 1978 began with Dr. W.Q. Loegering's retirement for the second time. Ten years before, he had taken early retirement from the USDA and came to Missouri on a half-time basis. This retirement was accompanied with the emeritus title, effective January 1978. However, he continued his cooperative work with Dr. D. Sechler on wheat breeding and completed his responsibilities on a grant with Dr. Slepser in agronomy. The latter included the doctoral study of his student Mary Lou Schubert. It was during the late summer of that year that Dr. Goodman announced to the deans his intention of stepping down as chairman of plant pathology, effective Aug. 31, 1979.

Activities started in 1979 when a log from a dead Scots pine was brought to the clinic for diagnosis. A post-doctoral fellow in the department from Japan suggested that the log be examined for nematodes, which were found in abundance. Drs. Dropkin and Foundin then identified the villain as *Bursaphelenchus lignicolus*, the causative agent for pine wilt. This pathogen is destroying the water shed forests of Japan, but this was the first report of pine wilt in the western hemisphere. Its presence in other parts of the United States and Canada was soon confirmed by other workers. At our annual meeting of the American Phytopathology Society, Dr. V.H. Dropkin was elected as a fellow in the society. On Sept. 1, 1979, Dr. Goodman turned the responsibilities of the chair to Dr. Dropkin and took off for a six-month sabbatical. Dr. Goodman had served as chairman for plant pathology for 11 years. During this time, he collected and supported a staff which enjoys national recognition for its expertise and productivity. The first half of the 79-80 school year started with Dr. Loegering responding to the students and teaching his course on interorganismal genetics for the final time. These lectures have been preserved on tapes.

The 80s started with Dr. Dropkin completing and publishing a book on phytonematology. This book has become the standard classroom text and is undergoing revision at this time. Dr. Al Wrather also completed his doctorate and accepted duties as extension plant pathologist at the Delta Station in southeast Missouri. Dr. Calvert was appointed senior editor of the journal, *Plant Disease*. Both Drs. Goodman and Dropkin prepared chapters in the current volume of *Plant Diseases: an Advanced Treatise*. In late April, Dr. Loegering was invited to visit China and presented three weeks of lectures on interorganismal

genetics. Within six months, these lectures were prepared in textbook form for use in Chinese agricultural universities.

The second year of the 80s found attrition taking its toll through-out academia, and plant pathology was no exception. Dr. P.W. Steiner was offered an opportunity to join the University of Maryland, which he could not refuse. Dr. C.H. Baldwin also left for a more attractive position in industry. Due to the economic climate, neither position was filled. In September, Dr. Dropkin participated in the International Union of Forest Research Organizations congress and presented a paper on his work on pinewilt, and Dr. T.D. Wyllie was appointed associate editor of *Phytopathology*.

The austere economic climate that prevailed in 1981 eased a bit, but not enough to seek replacements. Drs. M.F. Brown and Ed King wrote two chapters in *Methods and Principles of Mycorrhizal Research*. The department was also recognized in the honors program for gifted students, when Dr. Dropkin presented the course Science and Society. This was very well received and was presented again two years later. Dr. O.P. Sehgal represented the department as an invited participant in a meeting at Washington State University on monoclonal antibodies. Dr. A. Novacky was awarded the Alexander von Humboldt and U.S. Senior Scientist Award for an eight month work study leave in West Germany. Only two other plant pathologists have been honored with this award. Dr. Dropkin announced to the deans that it was his desire to step down as chairman, effective Sept. 1, 1983. Aside from Dr. Wrather's change from 100 percent extension to 56 percent extension and 44 percent research, 1983 was the year that was spent in search of a new chair. In 1984, Dr. S.G. Pueppke accepted the responsibilities of fourth chairman of plant pathology at UMC. His predecessor, Dr. Dropkin, had served the college well during five of the most economically stressful years since the Great Depression. Dr. Dropkin also found time to co-sponsor a joint U.S.-Japan seminar on pine wilt in Hawaii in May, where he presented his research and edited the proceedings. In August, he reported on the concept of race in soybean cyst nematode, an area in which he is recognized as the authority. He also chaired a section of the International Society of Nematology at Guelph, Canada. Om Sehgal was elected president of the northcentral division of the American Phytopathological Society. The expertise of plant pathology personnel was also recognized when Dr. Novack was awarded a stipend by the Japanese Society for the Promotion of Science. This enabled him to spend three months doing research and visiting the outstanding universities where he gave guest lectures.

Two important events happened in 1985. The department of plant pathology had its third review since it was formed. The team was rather

critical and made suggestions for improvement in facilities and teaching responsibilities. All of these suggestions, except for one which involved a specialty type of course, were implemented within six months. In June, the department also hosted the northcentral division (Sehgal was president) of the American Phytopathology society for the second time. A special symposium was set up honoring Professor Emeritus, W.Q. Loegering. This featured the gene-for-gene concept originally proposed by Flor, but extended by Dr. Loegering. Due to Animal and Plant Health Inspection Service policies, Dr. Arnold Foudin left the department for Washington, D.C. and was not replaced. Dr. Goodman not only took a five-month leave for consulting research in England, but was invited to spend four weeks in China, three of which involved lectures at three different universities. On Aug. 31, 1985, Dr. Dropkin was awarded emeritus status as he requested early retirement to spend more time on the revision of his textbook.

In 1986, several events of special recognition to staff members occurred. In April, Dr. Loegering was made a charter member fellow of the Missouri Academy of Sciences. That same night, Dr. Dropkin was honored as scientist of the year, the second one since the organization of the Academy. In June, Dr. Wyllie shared the first of what will be an annual award for special service to plant pathology in the northcentral division. Later that year, Dr. Novacky was recognized for his elegant research by being made fellow of the American Phytopathological Society. Dr. Goodman was made foreign member of the Hungarian Academy of Sciences. This is an honor bestowed on very few foreigners. A shift in the direction of phytopathological research towards biotechnology occurred in the eighties. This was stimulated by an innovative program known as Food for the 21st Century. This program was proposed by Dean Lennon, enthusiastically endorsed by Dean Mitchell, and funded with seed money by Chancellor Uehling. Food for the 21st Century furnished funds for Dr. S.G. Pueppke's laboratory and will support two additions to the staff during the 1987-88 fiscal year.

In its 20 years of existence, the Department of Plant Pathology has awarded 82 advanced degrees (up to January, 1987), 36 of which have been Ph.Ds. Prior to the formation of the department, several significant works were made in phytopathological research. These include the monographs on *Phytophthora* (Tucker, 1931) and *Pythium* (Middleton, 1943), both of which remain as the authoritative keys. They also include the discovery of a gene in *Lycopersicon* species which confers resistance to the Fusarium wilt organism in tomato (Tucker, 1939). Bretz's discovery of the perfect stage of the oak wilt organism and Goodman's work on the fire blight disease resulted in a control recommendation, which is still effective after 35 years. Since the department's founding, several other

types of research have made impacts. These include the isolation of the toxin associated with the fire blight disease by Dr. Goodman and his group, and Dr. Dropkin's reporting of the pine wilt disease for the first time in the western hemisphere. Also included is the great assistance that the electron microscope facility has had on implementing research across the campus. This facility is funded by the College of Agriculture and the Graduate School.