

A History of Field Crops 1870-1967

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Information has been taken freely from:
Annual catalogs, bulletins, and announcements
of the University of Missouri.
Annual reports of the Combined Soils and
Field Crops Extension Programs.
Annual reports of the Missouri Agricultural
Experiment Station, 1896-1967.
Bulletins, circulars, research bulletins, and special reports
of the Missouri Agricultural Experiment Station.
Circulars and project announcements of the
Missouri Cooperative Agricultural Extension Service.
Directories of graduates of the Missouri College of Agriculture.
Missouri Agricultural College Farm Bulletins, 1883-1888.
Missouri Farm Census Reports, Office of Missouri Agricultural Statistician,
Columbia, Mo.
Records of the Board of Curators, University of Missouri.
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1. FARM CROPS BECOMES A DEPARTMENT

Field crops as a branch of learning received departmental status in the University of Missouri in 1914 when the Department of Agronomy was divided to make the departments Farm Crops and Soils. The departmental name Farm Crops was changed to Field Crops in 1920. Departmental status was lost 53 years later when, in 1967, portions of the two departments, field crops and soils, were reunited to again form a Department of Agronomy.

The separation of agronomy into two departments in 1914 was made to resolve a conflict in the aspirations of two strong individuals. One was young and ambitious, seeking personal recognition, and the opportunity to advance a fledgling discipline. The other was kindly, appreciative, and conciliatory.

Claude Burton Hutchison, a forceful and promising young professor in the Department of Agronomy, had been offered a position at Cornell University. His price for staying at Missouri was a department of his own. That was an era of departmentalization in the Missouri College of Agriculture. Ten years earlier, in 1904, the Department of Agriculture had been divided to form departments of Agronomy and Animal Husbandry in order to bring about increased opportunities for specialization in those fields. Hutchison argued that separate departments of farm crops and soils would receive greater financial support and achieve more than a single Department of Agronomy.

Merritt Finley Miller had been brought in from Ohio in 1904 as chairman of the new Department of Agronomy. He appointed Hutchison, a 1908 graduate of the College of Agriculture from Chillicothe, an assistant in the department. Hutchison rose rapidly in the ranks from assistant to instructor (1909), assistant professor (1911), and professor (1913). Recognizing Hutchison's special capabilities, Miller soon assigned to him major responsibility for the field crops research while Miller looked after the soils research. Miller appreciated the loss to Missouri that would occur if Hutchison went to Cornell. So to keep Hutchison, Miller reluctantly recommended division of the Department of Agronomy into two departments, farm crops and soils. The change was approved in an executive session of the Board of Curators on Feb. 8, 1914.

Although Hutchison may be credited with the birth of the department, its growth and character were shaped by his successors, principally William C. Etheridge (chairman, 1916-55), Emmett L.

Pinnell (chairman, 1957-67), and Lewis J. Stadler, distinguished geneticist (1917-54).

Combining the departments of field crops and soils into a single Department of Agronomy in 1967 conformed to a common departmental pattern in U.S. land-grant universities. In Missouri, the separate departments were united in name, but the units were not wholly integrated in purpose or in practice; each kept its separate traditions, its separate goals, its separate programs, its separate living quarters.

The history of a department is made by its faculty and their activities. The faculty in a Department of Field Crops is distinctive in having a common interest and knowledge of field crop plants, however diverse the activities of individual faculty members at times may seem. The knowledge is communicated to students, enhanced through research, and interpreted to serve the agricultural community. These are the elements of this Field Crops history.

The time dimension for the Department of Field Crops in the University of Missouri was 1914 to 1967. But teaching and research in field crops started much earlier. To know this heritage, it is necessary to go back to the beginning of the College of Agriculture in 1870.

Many faculty and students have contributed to the history of Field Crops in the University of Missouri. Participants with University appointments from 1870 to 1967 are listed in Appendix No. 1. Students who received graduate degrees in farm crops/field crops or genetics with field crops department advisers are listed in Appendix No. 2.

2. FIELD CROPS, THE FIRST TWENTY-FIVE YEARS, 1870-95

Early History in the College of Agriculture

The College of Agriculture and Mechanic Arts was located in Columbia as a division in the University in 1870 amid great controversy. The Morrill Act, approved by the Federal Government on July 2, 1862, provided endowments to the states in the form of land grants. The federal lands transferred to the University could be sold and the money used for support and maintenance of a college that would "teach such branches of learning as are related to agriculture and the mechanical

arts." Eager for additional financial support, the Missouri General Assembly approved a resolution on March 17, 1863, accepting the endowment and pledging "faithful performance of the trust thereby created."

Implementation of the resolution proved far more difficult. Final approval for establishing a College of Agriculture and Mechanical Arts in the University of Missouri was not reached until February 24, 1870. A heated controversy developed over the location of the proposed college that delayed the final decision. Concerned groups were unable to agree whether the college should be located in Columbia as a division of the University of Missouri, or elsewhere as a separate institution. The bitter rivalry engendered among vested groups—the Board of Curators of the University, the State Board of Agriculture, the State Horticultural Society, and local groups representing communities seeking its location—would not be dissipated quickly. In its wake, growth of the floundering college was affected adversely for many years. Orderly development was further hindered by meager financial support for teaching staff, classroom facilities, and research laboratories.

Another formidable difficulty facing the College of Agriculture was the lack of a body of practical agricultural information to teach. In the controversy over location, the immediate benefits of the college to the farmers had been exaggerated. Authoritative knowledge about the best practices for crop production under Missouri farm conditions, or for other agricultural practices, did not exist. Generation of this knowledge would require experimentation by a staff knowledgeable in practical agriculture, with time and resources to devote to research activities. None of these necessary elements were present in the early years. It was not until the Hatch Act was passed by the U.S. Congress, on March 2, 1887, that financial support became available for mounting a modest research program to acquire sorely needed information.

The Hatch Act provided for the establishment of an Agricultural Experiment Station in each state and granted \$15,000 annually to the state for agricultural research. The Board of Curators of the University officially approved the organization of an Agricultural Experiment Station in the agricultural college on Jan. 31, 1888. This marked the beginning of an orderly flow of agricultural information based on scientific experimentation that enhanced classroom teaching and was passed to the farm public through lectures, short courses, agricultural institutes, and the federal/state Cooperative Agricultural Extension program that was formally organized in 1914.

As scientific agricultural knowledge grew, specialization and organization of the knowledge into disciplines followed. Departmentalization of disciplines in the college increased around 1900, leading to the

Department of Agronomy being established in 1904 and its division into Departments of Farm Crops, later Field Crops, and Soils in 1914.

Field Crops Under Swallow, the Scholar

After the College of Agriculture and Mechanical Arts was located at Columbia in 1870, Professor George C. Swallow, a geologist and University of Missouri faculty member since 1850, was appointed professor of agriculture. Earlier, Swallow had displayed an interest in teaching agriculture; in 1858, he had sought approval to establish a Department of Agriculture in the University, an effort that was later abandoned due to lack of student interest. Joining Swallow on the first agricultural college faculty were University professors of physics, chemistry, English literature, bookkeeping, political economy and the State Entomologist as a part-time lecturer in entomology. Distinguished as the faculty may have been in their respective fields, none, except perhaps the entomologist, was experienced in agriculture or knowledgeable in the application of science to agriculture. In 1872, Swallow was made the first dean of the College of Agriculture and Mechanical Arts.

Professor Swallow organized a class in agriculture in the fall of 1870 with six students. The course of study included the topic: "Farm crops—what should be cultivated, the management and culture of each." In the early courses, chemical composition of crop plants was usually emphasized. In the 1872 University of Missouri catalog, under the heading "Vegetable Chemistry," there is included in the course of study the topic, "Farm crops—their analysis and composition, what is desired from the soil and what from the air; how much each exhausts the soil, how to protect the more tender from its severities and changes." For several years, the college announcement in the University catalog stated, "Lectures will be given each day on the practical application of science to agriculture." But there were no textbooks in agriculture and a scarcity of practical agricultural information to organize and utilize for instruction.

The course in agriculture, "Agriculture in its Practical and Scientific Processes," initiated under Swallow was continued in various forms for nearly two decades, during which it underwent frequent changes in description and scheduling. In 1879-80, the portion devoted to farm crops was taught by S.M. Tracy, professor of entomology and botany and superintendent of gardens. Tracy, a graduate of Michigan State College of Agriculture, had been added to the faculty in 1877. A medal was awarded to the student with the best essay on "Indian corn." In 1880-81, the agricultural course of study "was made professional and reduced to two years" to be taught in the junior and senior years. The junior year was devoted to the study of horticulture, with a certificate



Built in 1871 with funds received from Boone County and the city of Columbia. Agriculture Hall housed the Department of Agronomy from 1904-09.

awarded upon its completion; farm crops was included only as a topic in the senior year.

Physical facilities of the college, like the teaching staff, were inadequate. As a consideration for the College of Agriculture being located in Columbia, "the county of Boone and the town of Columbia, were required to give as a bonus for the location, the sum of \$30,000 in cash and six-hundred and forty acres of land convenient to the present university grounds; as the agricultural college farm." The parcel of land received lay south and east of the University stretching to the Hinkson Creek and beyond at one point. The objective was to operate it as a model farm to make money and to give students experience by working on the farm. Portions of the farm were used for production of farm crops and pasture, but much of it was rough and undeveloped, and the college was without resources to improve it. Science Hall, later called Agricultural Hall, now Switzer Hall, was erected from the bonus money to provide offices, laboratories, and classrooms for the new college.

Criticism of the College of Agriculture was growing. It came from legislators, the State Board of Agriculture, and farmers. The criticism was directed toward the college faculty for teaching science instead of agriculture, and toward the University administration for not giving the college the support it deserved. In what appears to have been a defensive move, the 1881 University catalog contained the statement, "For ten-years we have labored in hope, doing the very best we could with the means at our command, to give an agricultural education." The effort was not sufficient. In 1882, Dean Swallow, a learned geologist and scholar, was dismissed as Professor of Agriculture by the Board of Curators. His replacement, made later that year, was Jeremiah W. Sanborn, a graduate of the New Hampshire College of Agriculture. Sanborn was reputed to be a "practical man of agriculture."

Field Crops Under Sanborn, "Practical Man of Agriculture"

Sanborn served as dean and professor of agriculture from 1882 to 1889. He struggled to improve the college farm, but his efforts were hampered by lack of resources. During his tenure, few changes were made in the teaching program. In the 1883 catalog, we find farm crops listed as a course. "Farm Crops—History, improvement by breeding and selection; their cultivation, harvesting and processing," the description reads. The 1887 catalog reports a small but valuable library of farm books and a museum containing 125 species of grasses of the state and 150 species of American farm seeds.

Sanborn's most important contributions were his numerous, well-planned, practical experiments directed toward solving common farm problems. Prior to Sanborn, two research efforts with farm crops were described in the 1880-81 university catalog: "Experiments with Indian Corn," a report on corn variety trials from 1877 to 1880; and "Field Trials of Wheat Varieties." "The question, 'What variety of wheat do you find to be best?' is asked almost daily and is one that is extremely difficult to answer, owing to the infinite variety of soils and locations." To disseminate the results of the college investigations, Sanborn started a Missouri State Agricultural College Bulletin series. Thirty-five bulletins were published in the series. Twenty-seven of the bulletins were written by Sanborn; 17 related to crops and soils. Bulletin 22 (1888), "Corn Harvesting," stated that yields of corn might be increased by farmers making and growing variety hybrids. A procedure for making the hybrids was outlined that was similar to one described earlier in Michigan. In Bulletin 29 (1887), "Rotations of Crops," Sanborn discusses the benefits from crop rotation. In the following year, he established a Rotation Experiment Field that in 1924 was named Sanborn Field in his honor. This rotation experiment field has now been

operated continuously for 100 years. In 1965, it became a national landmark.

Sanborn's practical approach to solving agricultural problems through research was generally recognized and appreciated. However, criticism of the teaching program and the appearance of the college farm continued. Sanborn was a stubborn and tempestuous person; eventually he became embroiled in an altercation over funds with the University administration and the Legislature that diminished his ability to lead the college effectively.

The period 1870 to 1888 was filled with controversy surrounding the college faculty, the University administration, the agricultural students, and the farmers. Admittedly, there were no precedents to follow, and the inadequate financial support received by the college was a constant problem. But in retrospect, several positive contributions affecting field crops information had been made:

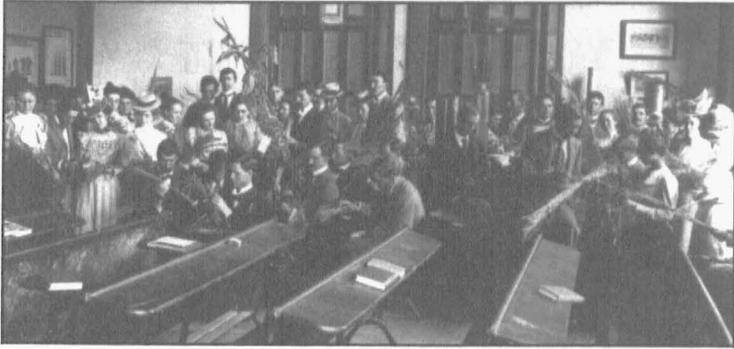
1. The beginning of an agricultural teaching program that included farm crops, although knowledge in the subject was meager.
2. Initiation of some practical agricultural research on farm crops and farm animals.
3. Development of an Agricultural College Farm Bulletin series in which college research results were documented and made available to the farm community.

Clearly, the dominant figure of the period was Jeremiah Sanborn. Although it could not have been predicted at that early date, the crop rotation experiments started by Sanborn in 1888 are still contributing valuable research data 100 years later. In 1926, the University of Missouri belatedly awarded Sanborn the honorary degree Doctor of Laws in recognition of his contributions.

The Agricultural Experiment Station is Established

The Agricultural Experiment Station was established by the Board of Curators in January, 1888. In subsequent policy action, the College Dean was appointed Director of the Agricultural Experiment Station, and the respective department heads were delegated responsibility for research development. This interrelation of college and experiment station continues and profoundly enriches the college teaching programs. Dr. Paul Schweitzer, professor of agricultural chemistry, served as director for several months, but then Dean Sanborn became director under the policy of the dean serving in this position. Sanborn continued as dean and director for about one year, but his conflict with the Legislature and the University administration became irreconcilable, prompting his dismissal in January, 1889.

A field crops laboratory class meets in 1903.



Field Crops Under Porter

Professor Edward Porter, a native of Vermont with degrees from the University of Pennsylvania and Delaware College, and director of the Minnesota Agricultural Experiment Station, was appointed dean, director, and professor of theoretical and practical agriculture in August, 1889, following Sanborn's dismissal. He served until his death in January, 1895. Valiant efforts by Porter to improve the respectability of the College and the appearance of the college farm were stymied by prior attitudes and meager financial support. In 1891-92, the Curators' report noted that several years had passed without appropriations being made for the farm and the station. Their appeal was not effective because the Agricultural Experimental Station did not receive its first appropriation from the state until 1901.

In 1892-93, the agriculture teaching program was moved from the senior year to the first year. The teaching programs then included (1) a two-year program for students unable to attend the full four years, (2) a four-year collegiate program leading to a B.S. in Agriculture degree, and (3) a two-year post-graduate course. Two reference books were listed for farm crops, *How Crops Grow* (1868), and *How Crops Feed* (1870). Both books were written by Samuel W. Johnson, a chemist at Yale University. In 1893, a Department of Agriculture was established in the College with W.J. Quick from Colorado as professor. He continued until 1895 and taught the courses in farm crops, soils, and farm machinery. Henry J. Waters, an 1886 graduate of the college, served as agricultural assistant in the Agricultural Experiment Station from 1887 to 1891. An Agricultural Experiment Station (AES) Bulletin Series was started in 1888 to supplant the College of Agriculture Farm Bulletin series initiated by Sanborn.

As professor of agriculture, Porter contributed little to the farm crops teaching and research programs. The variety trials of corn and

wheat reported earlier were continued under the direction of Waters. The most notable crops and soils research during this period was done by Paul Schweitzer, the experiment-station chemist. This research included a "Study of the Life History of the Corn Plant" (AES Bulletins 5, 9), and researches on "Soils and Fertilizers" (AES Bulletins 19, 20). A preliminary study was reported by Charles Fox, an experiment-station chemist, on the potential for yield and quality in sugar beets in Missouri (AES Bulletin 17).

In an apparent attempt to silence criticism of the College and Experiment Station for not providing specific information on the best farm practices to the farmer, Schweitzer (undated, about 1889) concludes his discussion of the "Study of the Life History of the Corn Plant" with these statements:

"Agriculture is a profession that demands, at the present time, outside of industry and frugality, much nicety of judgment, a considerable stock of knowledge, and some capital. . . . I conceive to be the truth, namely: That it is illusory for farmers to expect from any source such specific directions for the conduct of their business as to render the higher manifestations of intelligence on their part unnecessary. At the best only general statements, embodying general truths, can be promulgated, from which each one must make his individual application."

Schweitzer's "truth" was manifested in the rising strength of American agriculture in the first three-quarters of the 19th century. Even as agricultural recommendations became more precise, American agriculture's strength rested on the management skills of the thousands of farmers applying those recommendations.

3. WITH WISE LEADERSHIP THE COLLEGE RESPONDS, 1895-1904

Waters and Mumford Advance the College

Henry Jackson Waters was appointed dean of the College of Agriculture, director of the Agricultural Experiment Station, and professor of Agriculture in September, 1895. A native Missourian, he returned to Missouri after four years as professor of agriculture at Pennsylvania State College. Waters' leadership was wise, inspiring, and productive. When Waters left in 1909 to become president of Kansas State College, the College of Agriculture had gained a fair measure of respectability, a goal that had eluded previous deans.

Frederick B. Mumford also came to the college in 1895 as professor of agriculture. Mumford had graduated from Michigan State Agricultural College in 1891, and after farming briefly, he returned to Michigan State and received the M.S. degree in 1893. Mumford served as acting dean from 1903 to 1905 while Waters was on leave. When Waters resigned in 1909, Mumford was appointed dean and director, positions that he filled with distinction until 1938.

Teaching in Field Crops

When the College of Agriculture was established in 1870, there were two staff positions in agriculture, the professor of agriculture, and the horticulturalist. Teaching in field crops and soils evolved slowly through the years as a part of the teaching program of the professor of agriculture, but a Department of Agriculture was not established until 1893. The Department of Agriculture teaching staff from 1895 to 1901 consisted of Waters and Mumford. The 1897-98 course of study contained these titles relating to crops and soils, all taught by Mumford: "The Soil," and "Principles of Manure and Manuring." The latter contained the sub-titles: "Constituents of Plants," and "Farm Crops."

The description of Farm Crops reads:

Farm Crops: Plant breeding, variation, selection, self- and cross-fertilization; practical methods for increasing the yield of crops; condition of germination and plant growth; rotation of crops; planting, growing, harvesting and storing crops. The results of experiments at the station are used in discussing the best methods of culture.

Here is acknowledgement that research results obtained through the Agricultural Experiment Station are contributing to the teaching program. Waters, the dean, was scheduled to give 25 lectures on agriculture to the short-course students in that year. The short course was a two-months winter course taught for farm youth who could not attend collegiate courses.

In 1902, Dr. George M. Tucker was appointed instructor in soils and crops, permitting Mumford to spend full-time on animal-related teaching and research. This was an initial step in defining more clearly the teaching mission in crops and soils. The first use of the term, Agronomy, is found in the listings of the Collegiate Course in Agriculture for 1902:

1a - Agronomy: A. Soils, B. Fertilizers

1b - Agronomy: Farm Crops

Both courses were taught by Tucker. An additional course, 13W Farm Crops, taught by Dean Waters, was introduced in 1902-1903. Entrance requirements for agricultural students were increased so that they equalled those for students in other divisions of the university. The

college farm "used exclusively for instructional purposes" was improved out of its earnings.

The Research Mission

The research mission of the Experiment Station was also becoming defined more clearly. The Annual Report of the experiment station in 1896 contained these policy statements: "It is held that thorough and continuous work along a few of the most important lines of investigation will be productive of far greater good to the Agricultural interests than will be superficial and unscientific work covering many lines. . . It is not within the power of the Station at the present time to undertake the solution of all the problems confronting the farmer, stockman, dairyman, fruit grower and gardener, nor indeed is it advisable that we should." The application of this policy was described in the 1901 University catalog: "It is the policy of the Station to confine its work to the principal lines of agricultural activity in the state, livestock husbandry and horticulture." Agronomy was not favored in the application of the policy. The importance of productive pasture and feed-grain enterprises for a successful farm livestock industry was not given a high priority.

Although support for the Agricultural Experiment Station was limited, practical research in field crops was being undertaken by Waters, Tucker, and the experiment station assistants in Agriculture, C.M. Conner (1893-97), D.W. May (1897), T.I. Mairs, (1897-02), and E.L. Shaw (1902-03). Tucker continued until 1904 when he became Secretary of the Missouri Corn Grower's Association. Field trials with corn carried out on the station at Columbia in 1889, 1892, and 1895 were reported by Waters and Conner in AES Bulletin 32. Golden Beauty was the highest yielding variety, 57.4 bushels; 10 tons/acre of fresh barnyard manure increased yields 19 bushels/acre; 3 stalks per hill gave higher yields than 2 stalks; plowing 4½ inches deep gave higher yields than plowing 9 inches deep. In 1902, Tucker described the ear and kernel characteristics desired in selecting seed corn; uniformity as desired in corn shows was emphasized (AES Bulletin 59). The fallacy of selecting for fancy ear and kernel characteristics rather than for yield would be revealed a decade later. Field experiments with wheat conducted over a six-year period on the Experiment Station at Columbia were reported by Conner in 1893 (AES Bulletin 21). "Mixtures of varieties gave higher yield than average of the same varieties grown separately." This truth was rediscovered with soybeans in the 1960s and '70s. The sugar beet as a crop for Missouri was laid to rest by Waters with the statement, "Missouri is not favorably situated for producing beets of highest quality," even though yields had proved satisfactory (AES Bulletin 45). Unlike the corn and wheat experiments, which were

conducted only at Columbia, the sugar beet samples that were analyzed came from 69 counties in Missouri.

In 1896, an Agricultural Experiment Station Circular series was started. The circulars were designed to present agricultural practices in a simple, abbreviated form and were sent to farmers and rural schools. Two circulars published during this period are worthy of comment here. Circular No. 6, written by Waters in 1898, describes the value of clover and cowpeas as green manure crops to enhance soil fertility. Waters writes, "The greatest waste occurring on Missouri farms is the waste of soil fertility. This is brought about in several ways: First, by the combined selling off the farm of crops containing large quantities of plant food. . . Second, by allowing most of the manure produced from the stock on the farm to go to waste. . . Third, the fields are allowed to remain bare and subjected to washing by rains and loss through leaching." Further he writes, "Every landowner ought to be interested in keeping up the fertility of his soil. Strictly speaking, it is not the land that constitutes his capital, but it is the amount of plant food contained in that land." The destructiveness of soil erosion and the importance of soil conservation were recognized at this early date.

The other circular, No. 15, "The Seed," was written in 1903 by Mumford. The circular is intended as the first in a series "to present in a pedagogical form" the principles of plant production and was to be followed by circulars on plant growth, the soil, fertilizers, and farm crops. The following year Mumford was made Professor of Animal Husbandry and devoted full time to livestock studies thereafter, so the latter circulars were never written.

The annual report of the Agricultural Experiment Station for 1903 lists the more important lines of research in the various departments. For agronomy, the research topics were: "The necessary conditions for successful alfalfa culture; vitality of clover seed from different countries; effect of soil on composition of wheat; effect of climate on corn; methods of harvesting bluegrass seed; developing varieties of cowpeas for Missouri; variety tests of corn; rotation experiments and cooperative fertilizer experiments." The extent of the research into each of these topics is not reported, but it is evident that the breadth of the field-crop-related research activity had been expanded since the establishment of the Agricultural Experiment Station. Much of the credit must be given to the leadership of Waters as director.

The administration of Waters as dean and director was described magnificently by Etheridge writing for *The History of the Missouri College of Agriculture* in 1944:

"Then came Waters, wise, perceptive, kindly, magnetic. He very soon captured the sun of public approval and with it warmed the winds

which had chilled many efforts of the earlier Deans. He assembled a small but highly efficient faculty and most of them as well as himself began writing indelible titles in Missouri agriculture history."

4. FIELD CROPS IN THE DEPARTMENT OF AGRONOMY, 1904-14

Early Departments in the College of Agriculture

In 1904, the College Department of Agriculture was divided to form a Department of Agronomy and Animal Husbandry. Agriculture and horticulture were the original subject matter areas in the College of Agriculture when it was founded in 1870. At that time, there was an active State Horticultural Society that strongly supported the establishment of the college and a horticultural teaching program in the college. In 1878, Horticulture became the first department to be established in the college. A decade passed before technical agricultural knowledge became sufficiently specialized that additional departments would be created. The next was a veterinary department, established in 1888. Then followed departments of agriculture (1893), agricultural chemistry (1894), entomology (1894), home economics (1900), dairy husbandry (1901), and agronomy and animal husbandry (1904).

Miller Joins the Faculty

Professor Merritt Finley Miller joined the University of Missouri on Sept. 1, 1904, as Professor of Agronomy. In later years, Miller wrote, "I came to the University as head of the Department of Agronomy, which had just been formed. This was one of the first departments in the country with that name. I was one of the very first full professors to have the title Professor of Agronomy" (AES Bulletin 131). Miller had graduated from Ohio State University with a Bachelor of Science in Agriculture and had obtained a master's degree from Cornell University. Prior to his appointment, he was an assistant professor of agronomy in the Ohio State College of Agriculture.

Professor Miller joined a group of distinguished agricultural teachers and scientists in the faculty of agriculture at Missouri. They included Waters, dean; Mumford, professor of animal husbandry and acting dean while Waters was on study leave; Schweitzer, agricultural chemistry; John W. Connaway, veterinary science; John C. Whitten, horticulture; John M. Stedman, entomology; Curtis F. Marbut, geology and soil

survey; Benjamin M. Dugger, botany; and Clarence H. Eckles, dairy husbandry. Gifted in research and inspiring in leadership, these men brought recognition and respect to the College of Agriculture from other divisions of the University and the farmers of Missouri. In was an auspicious time to inaugurate a Department of Agronomy.

Recognition of agronomy as an area of specialization had begun several years earlier. Since 1899, the Agricultural Experiment Station Reports had described research in "agronomy" and "animal husbandry," equating these two subject matter fields with established departments such as "horticulture" and "entomology," and the 1901-02 University of Missouri Catalog listed courses in agronomy as noted earlier. No longer was farm crops tucked into the course "Agriculture in its Scientific and Practical Aspects" where it had been for three decades. In 1903-04, additional courses in agronomy were offered, 3a, "Advanced Agronomy": (an advanced course in soils), and 4b, "Advanced Agronomy": A study of special crops and improvement by cultivation, seed selection, and breeding. All were taught by Professor Tucker.

Field Crops Teaching in the Agronomy Department

When the Department of Agronomy was established in 1904, the enrollment in the College of Agriculture totaled 147 (72 in the winter short course, 74 in the four-year collegiate course, and one graduate student). The office of the professor of agronomy and the agronomy laboratories were located in Agricultural Hall (later Switzler Hall). A.E. Grantham was appointed instructor (1905-07) to help Miller with crops teaching and research, followed by appointment of L.F. Childers (1906-08) as instructor in soils. Childers received a master's degree in 1908, the first student to receive a graduate degree in agronomy.

Curriculum changes were made that reflected the greater visibility given to teaching in field crops and soils. The course "Grain Judging" was added in 1904-05, and "Farm Crops" became "Field Crops," the first use of field crops in a course title. The 1907-08 University catalog lists these courses that relate to field crops:

- 1b. Grain Judging.
- 2a. Crop Production: Methods of producing and handling cereals and forages.
- 7b. Field Crop Management: A study of crop rotations and cropping systems.
- 9a. Cereal Breeding: A study of the methods of plant breeding as applied to cereals and forage crops.
- 12b. Crop Production: A study of different farm crops, varieties, rotation and cultivation, seed treatment, judging, testing and grading, promising new crops.



From 1909 until 1967, Waters Hall successively housed the departments of agronomy, farm crops and field crops.

Courses in soils and agricultural engineering were taught also in the Agronomy Department.

A short-course class in "Plant Production" was introduced in 1906-07 with 14 students. Three additional short-course classes were taught that related to field crops: "Grain Judging," "Tillage and Cultural Methods," and "Crop Production and Crop Rotation." Additionally, courses in "Soil Fertility" and "Farm Buildings" were taught by agronomy staff members as part of the short course in plant production.

In 1908, Claude B. Hutchison was appointed assistant in agronomy. In 1909 he was promoted to instructor, in 1910 to assistant professor, and in 1913 to professor. Other appointments in Agronomy to assist with field crops teaching and research during this period included H. D. Hughes (1907-10), E.H. Demaree (1908-11), J.C. Hackleman (1910-19), W.J. Hendrix (1910-12), T.R. Douglas (1911-14), A.R. Evans (1912-16), and E.L. Bentley (1913-14). Agronomy appointments in soils were C.A. LeClair, and R.R. Hudelson, assistants; in soil survey, R.C. Doneghue, H.H. Krusekopf, and M.M. McCool; and in farm mechanics, M.A.R. Kelly.

In 1909, the Department of Agronomy offices and laboratories were moved from Agricultural Hall on the red campus to the newly constructed agricultural building on the white campus. In 1925, this building was named Waters Hall, honoring former Dean Waters. The crop laboratories were described in the 1909-10 University catalog as follows:

"Farm Crops Laboratories include a large judging and exhibition room for instructional work in judging, grading, and handling of grain,

a room for storing demonstrational material, a germinating room for the testing of farm seeds, and special research laboratories." The judging and exhibition room, Waters 1, was used as a teaching laboratory for the course Field Crops 1 until the late 1960s.

Soils and Crops Experiment Fields

Agronomic research developed rapidly after 1904. Agronomy was a new discipline in the College of Agriculture, and Miller, the new professor of agronomy, was a man of vision with a keen mind. He was also a practical man. He set for his immediate goal the task of becoming familiar with the various soil areas of Missouri, the crops adapted on them, and the means for their improvement. A fortunate event happened in 1905 that aided him in reaching this goal. The State Legislature appropriated \$5,000 to start a soil survey in Missouri. The soil survey would be directed by C.F. Marbut, a University professor of geology, but it was cooperative with the new Department of Agronomy and the Federal Bureau of Soils. Included in the legislation was a provision for establishing outlying experiment fields to investigate the fertility needs and crop adaptation for each soil area. This provided Miller an opportunity for in-depth study of the soils and crops of Missouri and the agricultural systems supported by them.

Miller lost no time in implementing the research. In 1905, soils experiment fields were established in five counties - Jefferson, Barton, Christian, St. Charles, and Putnam - with additional fields established in Pike, Montgomery, Knox, and Linn counties in 1907. From 1909, the outlying experiment field appropriation was separated from that of the State Soil Survey. The experimental fields were operated for periods varying from five to ten years and then discontinued. The general pattern was to rent 5 to 10 acres of land on which a crop rotation would be established. The field would be divided into plots equal in number to the number of years required to complete the rotation, with each crop in the rotation being harvested every year. Fertilizer treatments were applied uniformly across the plots, usually lime, phosphorus, and potassium, applied singly or in combinations. A no-treatment plot was included to which yields of treated plots could be compared. The farmer from whom the land had been rented was paid for planting and harvesting the crop, under supervision from the Agronomy Department in Columbia. The crop rotations and treatments were varied as appropriate for the edaphic and climatic conditions of the soil area and the agricultural practices adopted by farmers in the area. A legume was always included in the rotation to add nitrogen to the soil.

Experiments conducted on the soils and crop experiment fields generated a wealth of information on soil fertility needs and crop production problems in the different soil areas of Missouri. The research

data collected became a basic resource for teaching Missouri agronomy students and in formulating soil- and crop-management recommendations for Missouri farmers. The course, "Field Crop Management: A study of crop rotations and cropping systems," was introduced in 1908 and was continued in the field crops curriculum until about 1970. The results of these crop rotation/soil fertility experiments were published in a series of Agricultural Experiment Station Bulletins, beginning in 1910 and continuing until 1926 (Bulletins 83, 84, 86, 88, 118, 119, 126, 127, 128, 129, 130, 148, 183, 202, 203, and 238).

Cooperative Experiments with Farmers

While Miller was researching the soils and crops of Missouri through crop rotation/soil fertility investigations on outlying experimental fields, research on selected field crops was going forward across the state through cooperative experiments with farmers. Tucker had initiated a systematic survey in 1904 of the successes and failures of growing alfalfa by Missouri farmers. R.E. Hyslop, who held a fellowship in agronomy in 1905-06, continued to collect information and interpret the results. Hyslop's summaries, representing the experience of 342 farmers, show that 103 (30%) had failures in obtaining stands of alfalfa. Miller, reporting on the study in AES Bulletin 72, stated that most of the failures were on soils with tight subsoils or were due to flooding, and that most of the successes were on dry bottom lands along the Missouri and Mississippi rivers, or on better uplands with less compact subsoil. Cooperative experiments initiated in 1907 to find the best means for securing a stand of alfalfa confirmed results of the earlier observations, that "the character of the subsoil seems to be one of the great controlling factors in the successful growing of alfalfa in Missouri."

Farmer cooperation in field crops research had really begun with the sugar-beet research several years earlier. In 1897, packets of sugar-beet seed were sent out from the Experiment Station to 1,300 farmers with instructions on how to grow the crop and a request that beets be returned for chemical analysis, 304 samples of beets were returned. The U.S. Department of Agriculture sent out 3,000 packets of seed to Missouri farmers in the same year and received back 344 samples of beets. In 1898, 2,000 farmers volunteered to grow the sugar-beet trials, and 114 samples were returned for analysis. Although the number of farmers returning samples was relatively small, the expense incurred by the Experiment Station in obtaining the samples from a wide area of Missouri was very modest.

Questionnaires regarding successful practices for growing cowpeas were sent to Missouri farmers in 1906. Reports received were summarized by A.E. Grantham, Instructor of Agronomy, in AES Bulletin 73. The bulletin also contains an extensive discussion on culture of cowpeas.

Cowpeas received much attention during this period as a forage crop on soils where red clover frequently failed, or as a green manure crop on infertile soils. Miller included cowpeas in many of the early crop rotation studies, either as a soiling crop to be planted in corn at the last cultivation, or as a catch crop following the failure of a crop in the rotation.

In 1905, the Department of Agronomy began a series of cooperative corn variety trials with farmers in various parts of Missouri. The objectives were: (1) to determine the best adapted varieties for the various soil areas and sections of the state, (2) to emphasize the value of using well-bred varieties, and, (3) to distribute samples of pure seed of standard varieties to farmers throughout Missouri. As a reward for cooperation, the farmer was supplied with a peck of pure seed of the variety of his choice, which he would determine from the results of the trial. The general plan of the experiments was to supply the farmer with seed of 10 or 12 recognized varieties, which were to be planted side-by-side across the field on uniform land of average fertility. The farmer recorded general observations and yields of grain on data forms sent with the seed. Reports of the trials for the years 1905 to 1909 are given by Miller and Hughes in AES Bulletin 87, which also includes a history and description of the leading varieties of corn in Missouri. The number of farmers participating in the trials varied from 24 in 1905 to 83 in 1909. Yields were averaged across the state and for different regions of the state. The leading varieties in yield across the state were the widely grown varieties Boone County White, Commercial White, St. Charles White, and Reid's Yellow Dent.

The Ozark region was not neglected in the quest for a better understanding of the agriculture of Missouri. In a region with such wide diversity in soils, there was likewise a great diversity in the agriculture, but the larger part of the area seemed best suited to grazing. On this premise, a systematic investigation of the grasses in the Ozark uplands was begun in 1906 that was reported by Miller and Hutchison in AES Bulletin 108. The study consisted of cooperative field experiments with grasses and clovers, and a detailed study of the methods practiced by the best farmers.

The general plan of the field experiments was to have the farmer seed several grass and clover species, singly and in mixtures in one-tenth acre plots on a uniform soil area that had been plowed so a seedbed could be prepared. Soil treatments were applied across the seeded species, with a no-treatment plot for comparison. These cooperative test plots were established with 17 farmers in 13 Ozark counties over the period 1906 to 1911. Overall results indicated that orchardgrass, redbud, Kentucky bluegrass, and timothy were the best adapted grass species. Universally

beneficial results were obtained from applications of farm manure and bone meal. In only one instance was limestone beneficial.

Field surveys of pastures were conducted as an adjunct to the cooperative field experiments by A.W. Orr in the summer of 1912. Orr traveled in 25 Ozark counties, by horseback or by horse and buggy, interviewing scores of farmers and recording their experiences. His observations show that farmers in the region preferred bluegrass for pasture and timothy for hay. Japanese clover (*Lespedeza striata*), a low-growing annual legume that had spread rapidly across the Ozark area, was causing concern among some farmers, but a majority of those interviewed considered it a useful pasture species. Controlling sprouts and undergrowth was considered a major problem in pastures. With the large acreages of timber-covered land, the open-range policy, and the low soil productivity, little effort was being expended to establish permanent pastures.

Cooperative variety experiments with farmers were also conducted with wheat, winter and spring oats, and winter and spring barley. The general plan of the small-grain variety tests was to supply the farmer with one peck of seed of several varieties of the crop. The varieties were planted side-by-side in strips across the field. The farmer made general observations on lodging, maturity, and rust resistance and recorded yields of harvested grain. If care was taken to prevent mixing of varieties during harvest and threshing, the farmer could recover pure seed for planting the variety that had proved to be best on his farm.

According to the Agricultural Experiment Station Report for 1911-12 (AES Bulletin 111), the Agronomy Department conducted 235 cooperative experiments in 108 counties. From these cooperative investigations, a large amount of practical information was accumulated. In 1910 and again in 1912, Experiment Station Circulars (36 and 54) were issued in which the cooperative testing program was explained. Tear-off sheets were included for a farmer to return if he wanted to participate. A Missouri Agricultural Experiment Association was organized by students of the winter short course in agriculture in 1906 to assist with cooperative experiments in agronomy and other departments, and to plan exhibits for Farmer's Week. Because the exhibits duplicated work of the Missouri Corn Grower's Association, the Agricultural Experiment Association was abandoned in 1912.

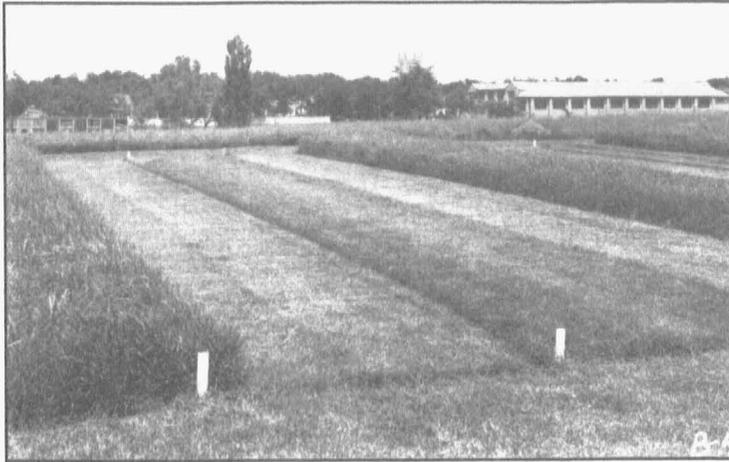
Since the cooperative experiments were being carried out by farmers unskilled in experimentation, using non-replicated treatments as was the custom at that time, the accuracy of the data collected may be questioned. Regardless of accuracy, it seems that interpretations of the data may have given more emphasis to local adaptation of varieties than the information justified. What could not be measured were the

educational benefits to the farmers who grew the cooperative tests and to neighboring farmers in the community. No doubt the cooperative tests and field experiments played an important role in changing attitudes of farmers toward the College of Agriculture and in increasing farmers' confidence that the College was dedicated to improving agricultural practices.

Crop Research on the Experiment Station, Columbia

The crop rotation studies on the soils and crops experiment fields and the cooperative testing of field crops varieties on farmers' fields constituted a significant share of the field crops research in the Department of Agronomy during the 1904-14 period. In addition, though, the corn and wheat variety tests, initiated by Tracy on the college farm in 1877, were continued and expanded to include other crops. Miller and Hughes (AES Bulletin 87) reported that 15 to 25 varieties of corn were grown at Columbia each year after 1905; varieties that produced superior yields were then entered into the cooperative tests with farmers. In studies of the association of plant, ear, and kernel characteristics with yield in corn, varieties with large plants having medium-depth kernels containing a large germ and a high percentage of hard starch were most productive. The opinion held by farmers that "yellow corn feeds better than white corn" was refuted by the College because chemical analyses showed no difference between the two kinds. This stance became an embarrassment to the College when the nutritional importance of vitamins in yellow corn was discovered. Farmers were advised to grow a breeding plot for seed production in which only superior ears would be planted "ear-to-row," following procedures being promoted by corn breeders of that period. Moving seed east or west from where it had been produced was considered safe, but not more than 100 to 150 miles north or south, since "seed corn must be acclimated in the region in which it is grown."

Wheat and oat variety investigations were expanded to include breeding studies. The studies had reached the point that several wheat selections from local varieties were being increased for farmer testing, and about 100 wheat selections from hybrid progenies were ready to be introduced into experiment station tests. The selection procedure was to select a single grain from a single head. Miller acknowledged later that the "method was really faulty and never attained popularity." Variety and cultural experiments with soybeans, cowpeas, alfalfa, and sweet clover were also being conducted (AES Bulletin 117). The site on which the experiment station tests at Columbia were located was not described, but a photograph of wheat plots with Jesse Hall in the background in a 1912 circular identifies the site as the area south of Rothwell Gymnasi-



Forage crops experiments south of Brewer Field House in 1936. This area was the principal site for field crops research until 1930 and continued as a forage and corn genetic research area until 1942.

um and Rollins Field. This area was the principal Crops and Soils Experiment Field at Columbia until the Beazley Farm was purchased in 1930 and was continued as a research area for forage crops and corn genetics until 1942.

From the outlying experiment fields, the cooperative experiments with farmers, and the observation of practices of the best farmers, a wealth of knowledge and experience on crop production practices and soil fertility problems in Missouri was accumulating. Considering the paucity of factual agronomic information in Missouri in 1904 when the Department of Agronomy was established, the new information accumulated during this period was important in establishing credibility of the Department with the farmers.

Miller was not one to let information go unused. A series of experiment station circulars were prepared that covered such topics as methods of seeding alfalfa, clovers, grasses, and cowpeas; procedures for growing corn, wheat and oats; and seed selection in corn and cotton. The circulars were practical and written to help farmers. They also became widely used by teachers of agriculture. College, high-school, and rural school students all profited from their content.

Significant Appointments of the Period

Three appointments in agronomy reported earlier merit special consideration:

Harold Demott Hughes: Hughes, a graduate of the Illinois College of Agriculture, became an instructor and assistant professor from 1907 to 1910. He assisted in field crops teaching and with the cooperative corn

variety experiments. In 1908, he received an M.S. degree, the first crops student to receive a graduate degree in the Department of Agronomy. In 1910, Hughes moved to the Iowa State College of Agriculture where he later received national recognition for his teaching and his textbooks in field crops.

Claude B. Hutchison: Hutchison, a 1908 graduate of the College of Agriculture from Chillicothe, Missouri, was appointed an assistant in agronomy in that year. When Hughes left in 1910, Miller assigned major responsibility for the field crops studies to Hutchison and devoted his attention to the soils investigations. Hutchison was co-author with Miller of most of the AES Bulletins prepared during this period on agronomic topics, including those reporting on the crop rotation studies on the Soils Experiment Fields. Hutchison was advanced to professor in 1913 and granted a leave to study at Cornell, where he received a master of science degree. In 1914 he became chairman of the new Department of Farm Crops.

Jay Courtland Hackleman: Hackleman received a B.S. in Agriculture at Purdue University in 1910 and an M.S. in Agronomy at the University of Missouri in 1912. From 1910 to 1917, he served as assistant, instructor, and assistant professor in the Agronomy/Farm Crops Departments. In 1917, he became the first extension professor in farm crops and was secretary of the Missouri Corn Growers' Association, 1917-19. In 1919, he resigned to become extension professor in agronomy at the University of Illinois.

Significant Events of the Period

In 1902, students in the College Agriculture Club proposed formation of an organization to promote improved seed corn and corn cultural practices. From this beginning, the Missouri Corn Growers' Association was formally organized in 1904. Special objectives were the promotion and establishment of an annual corn school and exhibit, and the development of a score card for judging Missouri corn shows. Dr. G.M. Tucker, a member of the Department of Agronomy, was the first secretary of the association. The corn show, which was held in the field crops laboratories, attracted many entries and became an attraction of the annual winter Farmers' Week sponsored by the College. In 1912, the Corn Growers' Association was active in securing a \$3,000 legislative appropriation for corn improvement. The funds were utilized to print and circulate bulletins on improved methods for corn production, increase the prize money for the annual corn show, and organize a Boy's Corn Growing Contest for youths under age 20. Participants were required to plant and harvest one acre of corn following instructions prepared by the Department of Agronomy. About 3,000 farm youths entered the contest in 1913. The winner received a \$100 scholarship to

the College of Agriculture Winter Short Course. Some young farmers began selling seed corn following their experience in the corn-growing contest.

The annual Farmers' Week was growing in popularity as 1,381 persons registered in 1913. The event brought together at the College the most progressive and intelligent farmers of the state. A boys' short course for farm youth, age 12 to 16, was organized featuring instruction in grain and livestock judging.

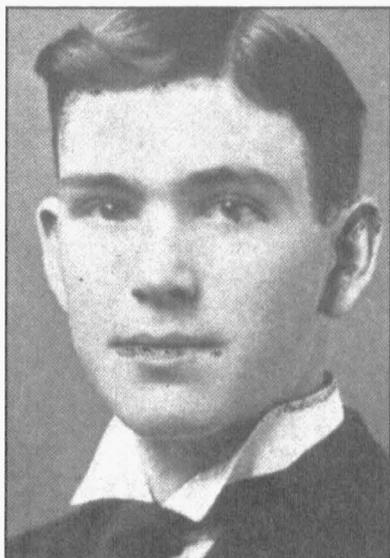
A Seed Testing Laboratory was established in 1908 in cooperation with the U.S. Department of Agriculture, Bureau of Plant Industry. Samples of farm seeds were tested for germination and purity without cost to the person submitting the sample. In 1913, 751 samples of seeds from farmers and 586 samples from seedsmen were received and tested. The organization of the Seed Testing Laboratory was the first in a long series of cooperative efforts with the U.S. Department of Agriculture that affected the history of the Department of Field Crops in Missouri.

While the Corn Growers were stimulating interest in the planting of good seeds, the College was initiating breeding experiments in corn and wheat. However, the consequences of the selection procedures were not fully understood, as illustrated by a discussion in the Second Corn Growers' Meeting in 1905 on whether to select seed corn on rich soil or poor soil. Corn selected on rich soil "will have the power to sustain those characters in poor soil" it was stated. But the nature of corn selection changed drastically when Dr. G.H. Shull, from the Cold Spring Harbor Research Institute, described to the American Breeders' Association, meeting in Columbia, Mo., in January, 1909, a procedure for producing single-cross hybrid corn essentially as practiced today. Also, the research of Mendel (laws of heredity, discovered in 1900), Johannsen (pure line theory of selection in self-pollinated crops, 1903), and other researchers in this period, opened up new vistas in genetics and breeding that would be pursued vigorously in the College in the years ahead.

Mumford's Administrative Design

Frederick Blackmar Mumford was acting dean and director in 1903-04, and it was during this period that the College Department of Agriculture was divided to form the Departments of Agronomy and Animal Husbandry. With Waters' resignation in 1909, Mumford was appointed dean and director, a position he held until 1938. During Mumford's administration—the Department of Agronomy was divided to form the Department of Farm Crops and the Department of Soils. As dean, Mumford was stern, aristocratic, efficient, effective, and respected. His influence was felt in all College departments. His direct approach is illustrated in the College policy toward teaching and research, enunciat-

Claude B. Hutchison in 1908 when he became an assistant in agronomy; in 1914 he was appointed chairman of the new Department of Farm Crops.



ed in the 1912 Report of the Agricultural Experiment Station (AES Bulletin 111):

“No hard and fast dividing line is drawn between the College and the Station, but it is the general policy of the institution to require each member of the staff to engage in some original investigation. The men who develop unusual capacity for research will be encouraged to devote more time to investigation; those who exhibit special ability for teaching are encouraged to devote more attention to instruction.”

After Mumford had retired, Etheridge, then department chairman of field crops, succinctly summarized Mumford's administrative design:

“The basic lines of the pattern were simple and clear. First, the major subordinates were impressed with the dignity and honor of their opportunity for service in the Missouri College of Agriculture. Next, they were charged with deep responsibility for results of the highest order of excellence. Lastly, they were given within available means a complete and unhindered authority for executing their assigned purposes. Advancement in departmental prospects were contingent upon current success rather than other conditions of tenure. All of these principles being understood and extended throughout the whole membership of the College, inspiration and discipline for good work arose without being prompted by method or rule.”

In this academic environment, the Department of Farm Crops was born.

5. HUTCHISON'S DEPARTMENT OF FARM CROPS, 1914-16

The Department of Agronomy was divided in 1914 to make three departments: farm crops, soils and agricultural engineering. Professor Hutchison was named head of the new Farm Crops Department, Miller became head of the Soils Department, and M.A.R. Kelly became instructor in charge of Agricultural Engineering. In later years, Miller discusses the events leading to the formation of the new departments (AES Bulletin 769):

"In 1914, Hutchison, who had attained the rank of a full professor, was offered a position at Cornell University. The money we had to pay was insufficient to hold him, and we gave him a department of his own -the Department of Farm Crops, as it was then called. I retained the work in soils under the Department of Soils."

The Farm Crop's staff, in addition to Hutchison, included J.C. Hackleman, Elmer M. McDonald (a graduate of the Massachusetts Agricultural College), A.R. Evans, Clarence E. Neff, and Franklin L. Bentley, although Bentley resigned shortly thereafter to accept an appointment in the Department of Animal Husbandry. The Farm Crops courses were reorganized and then included the following:

Farm Crops (5 hrs.)	Cereal Crops (4 hrs.)
Grain Judging (3 hrs.)	Forage Crops (3 hrs.)
Field Crops Management (2 hrs.)	Fiber Crops (2 hrs.)
Field Crops Improvement (3 hrs.)	Special Problems
Seminar	Research

This basic course pattern continued in the department for many years. The courses in Farm Crops and Field Crops Improvement (or an alternative animal-breeding or horticultural-breeding course) were requirements in the "Four-year Curriculum in Agriculture for Men." The "Four-year Curriculum in Agriculture for Women" had required courses in Horticulture and Dairying, but not in Farm Crops, reflecting the view of that period for division of labor in the farm household.

The Farm Crops Department took over the variety-improvement research on the Experiment Station in Columbia, the farmer-cooperative experiments, the outlying crops experiment fields, and continued cooperation with the U.S. Department of Agriculture for the seed laboratory; the Soils Department assumed responsibility for the rotation-experiment field established by Sanborn, the crop-rotation studies on outlying experiment fields, and the soil-survey activity. In 1915, the Farm Crops Department was conducting breeding investigations on wheat, winter oats, and winter barley at Columbia; cultural studies with

alfalfa, soybeans, sweet clover, and forage crops at Columbia and on seven outlying Crops Experiment Stations; and numerous farmer-cooperative experiments with corn, wheat, oats, barley, alfalfa, winter vetch, crimson clover, sweet clover, cowpeas, soybeans, sudan grass, cotton, and Spanish peanuts. This was a rather ambitious program for an infant department.

In earlier years, Experiment Station staff often devoted much time and effort to extension-type activities. These activities often interfered with serious research efforts. With the organization of the Agricultural Extension Service in 1914, the Experiment Station staff was relieved from some of the extension-type activities, permitting fuller use of Experiment Station funds for research.

Two years after the Department of Farm Crops was established, Hutchison received a second offer from Cornell, and this time he accepted. Hutchison remained at Cornell as professor of plant breeding until 1922. At that time, he moved to California where he later became vice-president for agriculture at the University of California, Berkeley. In 1937, the University of Missouri granted the honorary degree Doctor of Laws to Hutchison for his professional contributions in field crops and his administrative accomplishments.

6. ETHERIDGE BECOMES THE “HELMSMAN”, 1916-55

William Carlyle Etheridge became professor and chairman, Department of Farm Crops, in September, 1916, following the departure of Hutchison, and remained in that position until his retirement in 1955. In 1920, the departmental name was changed to Field Crops.

William Carlyle Etheridge: Etheridge was a 1906 graduate of North Carolina State College and served as an agronomist in the North Carolina Agricultural Experiment station until 1911. He went to Cornell University where he received an M.S. degree in soils (1912) and a Ph.D. in field crops (1915). His doctoral thesis, “A Classification of the Varieties of Cultivated Oats,” became a classic publication in its field. The year 1915-16 was spent as professor of agronomy at the University of Florida. Etheridge was born the son of a seafaring family on Roanoke Island off of the North Carolina coast. As a young man, he often worked on the fishing fleets. He once spoke of his career in agronomy as “his adventure in agriculture.” As “helmsman” in Field Crops, his adventure was long, the course was straight, and the contributions to Missouri agriculture were abundant.

Miller described Etheridge thus: "Dr. Etheridge was the thoughtful, philosophical type, with resourcefulness as to ideas and problems. He had a brilliant mind and could be depended upon to see a problem in its entirety." But Miller and Etheridge charted widely different courses for their respective departments. Miller surrounded himself with colleagues—Albrecht, Bradfield, Jenny, Bayer, Marshall—whose basic researches brought a national reputation to the Missouri Soils Department.

Etheridge disdained the national scene; he remained steadfast to the principle that departmental research in field crops should be dedicated to improving the welfare of the Missouri farmer. He expressed it as follows: "Always the philosophical objective of this department has been utility, and every research project or curricular development has been planned and pursued to that end. If sometimes the end was not clear, we could at least hope that it would ultimately be useful. And so we have been little impelled merely to make contributions to science; and indeed little concerned with this technical exercise, unless it promised an added value to the crop resources of Missouri." Yet, his department became world-renowned for the basic contributions to the genetics of corn and wheat that emanated from it. Two faculty members from the Department of Field Crops, Lewis J. Stadler and Ernest R. Sears, were elected to the prestigious National Academy of Science.

Etheridge had a prodigious memory. He always taught the introductory course in field crops and could recite the details point by point. He remained seated at a table on the podium while lecturing. At the beginning of the class period, he carefully removed a large watch from his pocket and laid it on the table in front of him. If at the end of the hour the bell rang as he had completed point number 3 of the subject under discussion, he picked up his watch and walked out of the classroom. The next period, he would enter the classroom, lay his watch on the table, and proceed, "Number 4. - - -". And he never carried notes to the classroom. Some students thought his lectures uninteresting; he made subject matter so simple that they didn't appreciate the complexity of the material they were hearing.

Etheridge's administrative pattern was one of concentration on broad policy and detachment from departmental details. (He once said to me, "When I assign a responsibility, I assign it." The responsibility in the Department then became yours.) Once each season he would agree, reluctantly it seemed to me, to accompany me on a Sunday-morning visit to the wheat-breeding nursery. After wandering around the plots for a while, he would ask to be taken to an Animal Husbandry field where cattle were grazing on a wheat-lespedeza pasture. This he viewed with pride. I wasn't always sure that he had seen the wheat plots. But a few days later he would call me into his office and make a suggestion. Yes, he had seen the plots, and after rolling some ideas

around in his mind, he had conceived an idea that he thought might be worth pursuing. Whether I pursued it or not was my decision. He never pressed me on it.

Etheridge was a writer *extraordinarius*. He was the author of textbooks, farm bulletins, newspaper articles, and policy statements, as well as a ghost writer on agricultural policy for Missouri governors. His writings were distinguished by their style and simplicity. As an unofficial adviser to many state and national government officials, his thinking and planning helped shape much agricultural policy during his 39 years as Department chairman.

Etheridge's tenure in the Department embraced two World Wars and the Great Depression. Each of these events decimated Departmental staffs and interfered with development of Departmental programs. Military leaves were granted during the war periods, but during the Depression, three of nine major staff positions were terminated and salaries of remaining staff temporarily reduced by 5 percent to 15 percent. The period following World War II was one of growth. Students flocked to the University as G.I.s were discharged from military service and given financial support for additional education.

When Etheridge became chairman of Farm Crops, three faculty members remained from Hutchison's staff: E.M. McDonald, J.B. Smith, and J.C. Hackleman. McDonald resigned in 1920 after taking military leave from 1917-19. Smith was granted military leave in 1917 and did not return to the Department. Hackleman served as extension assistant professor and secretary of the Missouri Corn Growers' Association from 1917-19 and then resigned to accept a similar position at the University of Illinois. Etheridge was joined in the Department in September, 1916, by another new staff member, Charles A. Helm, a 1913 graduate of the College who had been recruited by Hutchison. **Charles Alton Helm** (1916-55). Helm was born near Sheldon, Mo., but spent his early years on the Western range. He returned to Missouri for the B.S. in agriculture degree, which he received in 1913, and then received a master's degree in agronomy in Nebraska in 1916. Hutchison brought him back to Missouri, and he came into the Department at the same time as Etheridge. The two became trusted friends and colleagues, working together for 39 years as a team. Unlike Etheridge, who liked to consider problems deliberately and make unhurried judgments, Helm made quick decisions and pursued their implementation aggressively. Etheridge once said, "Helm makes the best snap judgments of anyone I ever met, but if he stops to think, he's lost."

Helm was a tireless and efficient worker, who never hesitated to take on an additional responsibility in the Department, or a civic duty, such as being a Columbia City Councilman. He had responsibility for

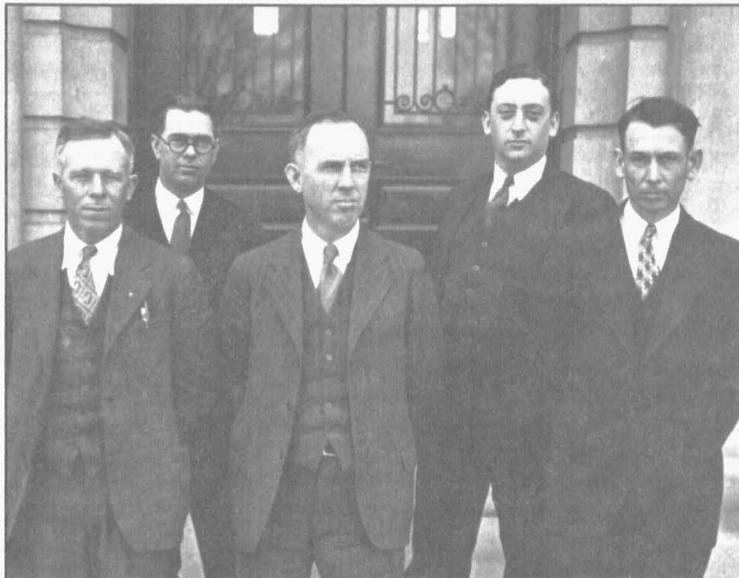
operations and research on Field Crops land at Columbia, and at various times on outlying fields at Shelbina, Paris, Stark City, Green Ridge, Cuba, and Pierce City. Working closely with Etheridge, he had major roles in the introduction into Missouri agriculture of soybeans, lespezeda, and winter barley. For his entire career, he taught the course "Field Crops Management." He vigorously promoted replacement of corn with winter barley to reduce soil erosion. Charlie-Barley No-Corn Helm, the students fondly named him. From 1930 to 1955, he served as secretary of the Missouri Corn Grower's Association, later named Missouri Seed Improvement Association. He traveled widely about Missouri inspecting fields for seed certification or managing the outlying experimental fields. During these travels, he observed cropping practices of the more successful farmers, astutely recognizing those with potential utility. He would then try them in the experimental fields; those found practical were taught in the classroom and explained to farmers and county agents during field days and short courses. As a student assistant under Helm, I was assigned tasks on every project in the Department. This was the apogee of my undergraduate education. In a eulogy to Helm, Etheridge in 1955 characterized him as "the prototype of the old-fashioned agronomists, a stalwart and strenuous breed, now diminishing, who in the last 50 years have developed immeasurable farm benefits."

7. ETHERIDGE AND HIS "BOYS"

A Faculty Filled From the Ranks

Etheridge filled his faculty from the ranks and referred to them as his "boys." He looked for Missouri graduates who were bright, dedicated, and possessed integrity. For many, financial assistance was provided for graduate study, and if the internship was satisfactorily concluded, a position would be waiting in the Department. Promising young county extension agents or vocational agriculture instructors were also brought into the Department on occasion. The policy brought stability to the Department and a dedication for serving Missouri agriculture. Including their years of service after Etheridge's retirement, 12 core faculty recruited by Etheridge in this fashion served the Field Crops Department and its successor the Agronomy Department for more than 25 years; six remained for more than 35 years. Those serving for more than 25 years in Field Crops and Agronomy are:

Members of the Department of Field Crops in 1927-28 were, from left: C.A. Helm, R.T. Kirkpatrick, W.C. Etheridge, L.J. Stadler and B.M. King.



Lewis John Stadler (1917-1954)*. Stadler was born in St. Louis, Mo., attended the University of Missouri (1913 to 1915) and the University of Florida (1915-1917), where he received the degree B.S. in agriculture. Stadler was enrolled in several of Etheridge's classes, during Etheridge's year in Florida. Commenting on Stadler in later years, Etheridge wrote, "So I could, and did, say of him, 'This boy has a first-class mind; he is a thinker'." And so Etheridge brought him back to Missouri in 1917, to pursue graduate studies on improvement of cereal crops with a scholarship funded by the U.S. Department of Agriculture. Stadler received the M.A. degree in 1918, and a Ph.D. in 1922. He was appointed an assistant in Farm Crops in 1918 and, except for a short leave for military service and a term at Cornell University, he was associated with the Department of Field Crops until his death in 1954. From 1930, he was employed jointly by the University of Missouri and the U.S. Department of Agriculture.

Stadler's early research was in crop improvement, for he had been given responsibility for breeding projects in corn, wheat, oats, barley, and soybeans. He discovered and developed the Columbia variety of oats, released in 1930, which for two decades was the leading variety in the Southern Corn Belt. As his interests turned toward fundamental

*Period of service in the Department.

genetic research, he published in 1925 a study on "Variation in Linkage in Maize." His publications in 1928 reported the mutagenic effects of X-rays and radium on plants. In later years, his research was dedicated to a fundamental understanding of the gene, in which the spontaneous mutations at the *A* and *R* loci in maize performed classical roles.

Stadler may well have been the most brilliant scientist that has graced the University campus. He possessed an amazing power for imagination and reasoning and for the clarity that he could bring to complex situations. Stadler's fundamental research did not fit Etheridge's mold of research to directly benefit Missouri agriculture. Yet Etheridge was cognizant of the brilliance of the man, provided him with resources within the means available, and turned him loose. Stadler's stature worldwide brought fame to the Department for its genetic research with maize. In 1938, Stadler was elected to the National Academy of Science, the first University of Missouri professor to receive this honor. His career was cut short by his death from cancer in 1954.

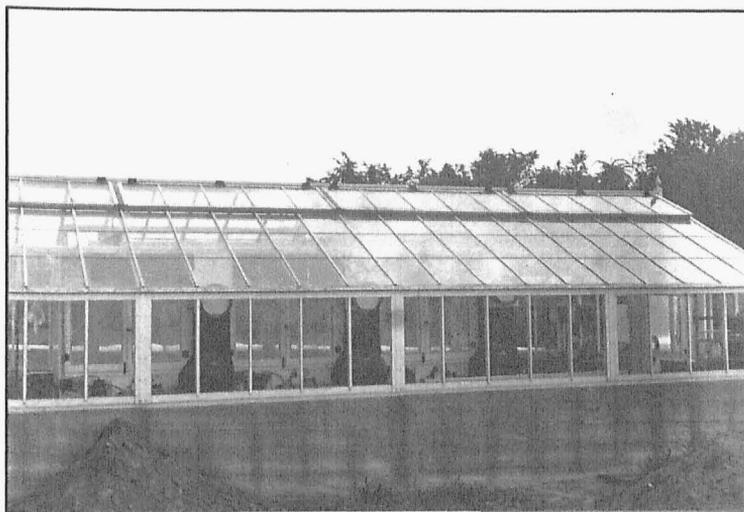
Bascom Milton King (1921-47). A native of Stockdale, Texas, King received a B.S. in agriculture from Missouri in 1921 and an M.A. degree in 1922. He was an assistant in the Department in 1921-22. From 1922 to 1924, he was located at the Cotton Breeding Station, Greenville, Texas. He returned to the Field Crops Department in 1924 as an instructor (cotton specialist), and successively received appointments as assistant professor (cooperatively with the U.S. Department of Agriculture) and associate professor before his untimely death in 1947. King was called upon to conduct an abundance of endeavors in the Department. As cotton specialist, he organized the Southeast Missouri Experiment Station at Sikeston and directed the cultural research and varietal testing with cotton from 1924-47; he developed a Rice Experiment Station at Elsberry and, after selecting and naming an early variety of rice adapted to the area, demonstrated the utility of a rice-soybean rotation on heavy gumbo soils; he conducted the soybean breeding program from 1924 until 1947, and the oat and winter barley breeding projects from 1933 to 1939. King's teaching included courses in "Grain Crops Production" and "Fiber Crops."

King was modest, kindly, but insecure. His teaching and research never reached the level of perfection he desired, a situation that might be expected considering the workload he carried. As he returned from a course lecture, he would toss the lecture notes into a wastebasket, next term rewriting them, hoping for improvement. The Department and his students were shocked when one day after giving one of his better lectures, he hurried home and killed himself.

Eliphail Marion Brown (1929-1961). Brown from Charleston, Mo., received the B.S. degree in agriculture from the University in 1921. In 1929, after teaching vocational agriculture in Missouri and Illinois high

schools for eight years, he was appointed a research fellow in field crops under Stadler and received the M.A. degree in 1930. His interest changed to pasture research, and for the next 30 years, his career was devoted to solving Missouri pasture management problems. He received the Ph.D. (botany) in 1938. The thesis research was a classic study of the effect of temperature on root- and top-growth of cool-season grasses. It provided the basis for pasture-management recommendations with these grasses throughout the Midwest. The study was conducted in a specially designed temperature-controlled greenhouse, a prototype for modern plant-growth chambers. He participated in development of an all-year pasture system for Missouri, and his publications on the seeding, management, and improvement of permanent pastures were gratefully received by Missouri farmers. Brown conducted his field research with a penchant for excellence, pride in appearance, and accuracy in detail. He believed that for field-plot research to have credibility, the plots should be attractive as well as the experiment being accurately conducted. His research plots were a model, unmatched by other field-research workers in the Department. For 20 years, he taught the course "Forage Crops," a popular elective course in the College of Agriculture. Long-term Field Crops staff members—Poehlman, Baldrige, Murphy, and Fletchall—all were associated with Brown for periods as junior staff associates, graduate students, or student assistants. For all of his career, Brown was an employee with the U.S. Department of Agriculture. Being embarrassed by his first name, he always signed, E. Marion, much to the consternation of U.S. government administrators who wanted his signature to include his first name, which they never learned, and the middle initial. After retirement, Brown returned to Charleston to manage the family farm, finally accomplishing the ambition he held when he first entered the University in 1917.

John Milton Poehlman (1936-80). I was one of Etheridge's "boys." I came to the University of Missouri as a student in the fall of 1927 from Macon County, Mo. Like most of Etheridge's "boys," I was reared on a farm. Farm boys in that period of low farm prices needed additional income to meet college expenses, and I had the good fortune to meet that need through student employment in the Department of Field Crops. The pay was modest, 25 cents per hour, then 30 and finally 35, but it kept me in school. The real reward was the experience I gained. When I graduated, I had observed and recorded mutant barley plants for Stadler, planted and harvested rod rows of wheat in the wheat-breeding project, assisted with germination tests in the seed laboratory, conducted field trials on the outlying Crops Experimental Fields, inspected farmers' fields for seed certification, and countless other tasks for Stadler, Helm, Etheridge, and King. One summer, I drove the "Clover and



Built in 1935 and utilized by E.M. Brown for grass physiology studies, this greenhouse with temperature and humidity controlled compartments was a prototype for modern environment control chambers.

Prosperity” demonstration truck for the Agricultural Extension Service.

Just prior to my graduation, Etheridge returned from Washington with U.S. Department of Agriculture funding for a forage legume project. Provisions were included for a graduate thesis study, which I was invited to conduct. It was the height of the Great Depression, and there were few jobs for new graduates, so I readily accepted. The graduate program was conducted in the Department of Botany with Dr. W.J. Robbins as adviser. While I was finishing my graduate study, Etheridge obtained U.S. Department of Agriculture funding for an expanded pasture-research program. The national soil conservation program had just started, and much emphasis was being given to grass. Brown was the principal researcher, and I was offered a position as Cooperative Agent, starting July 1, 1935. I had a name problem with the government similar to Brown's. Although I had always used my middle name, Milton, I suddenly became John M.

Beginning March 1, 1936, the University funded one-third of my salary, for which I was to teach Field Crop Laboratories, and conduct a wheat-breeding project. In 1939, I was offered a full-time University position, teaching “Field Crops Improvement” and “Grain Crops,” and conducting the wheat-, winter barley-, and oat-breeding projects. In later years, instead of “Grain Crops.” I alternately taught graduate courses, “Development of Plant Breeding Concepts” and “Field Crops Experimentation,” and organized a Field Crops graduate “Seminar.” I relate these details here because they are fairly typical of Etheridge's

J. Ross
Fleetwood, crops
extension
specialist,
inspecting a
seed field of tall
fescue.



policy of providing resources for graduate study for a young man and then placing him in a Departmental position. I remained in the Department of Agronomy until retirement in 1980. During the years 1963 to 1965, I served as Research Adviser to the Orissa University of Agriculture and Technology in India on the University of Missouri/U.S. Agency for International Development Program.



Joe D. Baldrige presents a book of letters to E.M. Brown on the occasion of Brown's retirement in 1961.

Jasper Ross Fleetwood (1936-66). Fleetwood was born in Lawrence County, Mo., and received the B.S. in agriculture in 1921 and an M.A. in soils in 1924. After graduation, he held positions as vocational agriculture instructor, county extension agent, state 4-H club agent, and soil conservation specialist. He received an appointment in 1936 as an extension specialist in field crops and continued in this position until his retirement in 1966.

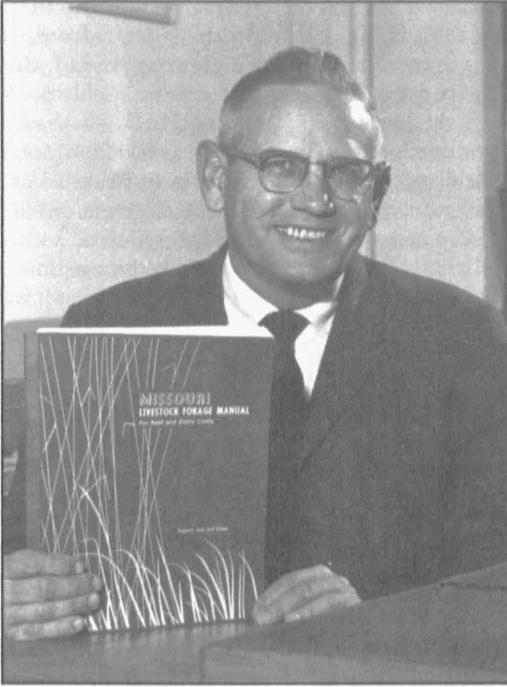
Fleetwood could address a wide range of topics with a clarity that mirrored his understanding and analysis of the problem. He would blend detailed information gained from research findings with farmers' broad experiences to develop sound, practical approaches to solving field-crop problems. His succinct, pithy manner of expressing his ideas made him a popular extension specialist. He was sought after as a speaker for many occasions—extension conferences, farmers' soils and crops conferences, seed meetings, crops field days, Peace Corps workers conferences, meetings of crop-insurance adjusters, or Rotary Club luncheons. In 1955, he received a Superior Service Award from the U.S. Department of Agriculture for helping farmers to improve pastures and pasture systems, promoting legumes for soil improvement and feed production, encouraging systems of short rotations, and promoting improved practices for tobacco production.

Joe Daniel Baldrige (1941-75). Baldrige, a native of Putnam County, Mo., received a B.S. in agriculture in 1939 and a Ph.D. (botany) in 1946. As an undergraduate student, he worked on the pasture-research project under Brown. When Poehlman withdrew from

the pasture project in 1939 to work with small grains, Baldrige was selected as the replacement in the Division of Forage Crops, U.S. Department of Agriculture program and had continuous employment in that organization throughout his active career. He was appointed an assistant in field crops in 1941. His doctoral thesis research was on the growth interaction between bluegrass and lespedeza. Like Brown and Pochlman before him, his graduate study, although supported through the Department of Field Crops, was conducted in the Department of Botany. His research career was devoted to improvement of disease resistance and stand persistence in Korean lespedeza and birdsfoot trefoil. Baldrige had an amazing curiosity about a wide range of agronomic topics. He was persistent in his questioning until he got the information he wanted or had exhausted a person's knowledge of the subject, all of which was meticulously recorded on note sheets. How he expected to utilize the information, I was never sure. Baldrige taught "Forage Crops" from 1948 until 1967. He continued research in the Agronomy Department until his retirement in 1975.

Wynard Earl Aslin (1947-87). Aslin came to the University from Bloomfield, Stoddard County, Mo., and received the B.S. in agriculture in 1942. While a student, Aslin worked in the Field Crops Department. In the summer of 1941, he worked as a fieldman for a flour mill in Boonville, Mo., promoting the growing of wheat varieties with superior milling qualities by farmers in the community. From 1942 to 1946, he served in the Armed Forces. Upon completion of his military service, he was appointed assistant-secretary of the Missouri Seed Improvement Association with responsibility for maintenance and seed production of inbred and single-cross lines of corn needed by Missouri farmers for production of certified hybrid seed corn. In 1962, this seed-production activity was transferred to the Department; in the reorganization, Aslin was appointed executive secretary-treasurer of the Missouri Seed Improvement Association. In this position, he has been responsible for the field inspection and certification of all field seeds in Missouri. Throughout, Aslin emphasized production of high-quality seeds and rigidly enforced certification standards to this end. Aslin held appointments in the Department of Field Crops beginning in 1947, becoming an assistant professor in 1954. When the activities of the Missouri Seed Improvement Association were distanced from the Department in 1962 and Aslin became executive secretary-treasurer, his appointment was changed to research associate. It remained as such until his retirement in 1987.

Lloyd Earl Cavanah (1948-85). Cavanah was born in Keytesville, Mo., and received the B.S. in agriculture in 1948 and an M.S. in 1950, after serving in the Armed Forces from 1942-46. Cavanah's career was devoted to seed technology. Etheridge was attracted by Cavanah's managerial capabilities and appointed him assistant-secretary of the



William J. Murphy poses with a copy of the Missouri Livestock Forage Manual.

Missouri Seed Improvement Association in 1950. With Helm's death in 1955, he was elevated to executive secretary-treasurer. In the reorganization of the association's activities in 1962, Cavanah was made director-manager of the departmental Foundation Seed Stocks Program, a responsibility he held until his retirement in 1985. Cavanah served on numerous seed-related committees of the Department, the North Central Experiment Station region, the National Seed Storage Laboratory, and the International Crop Improvement Association (later called the Association of Official Seed Certifying Agencies). But not all of Cavanah's efforts were related to seed production. He was superintendent of the Field Crop Research Farm (1956-67) and the Kansas City Collegiate Grain Judging Contest (1952-61). For varying periods, he taught "Grain Crops Production" and "Grading and Examination of Field Crops Products." Twice, he served as interim chairman, 1956-57 for the Department of Field Crops and 1972-73 for the Department of Agronomy.

O. Hale Fletchall (1948-85). Fletchall, a native of Grant City, Mo., received a B.S. in agriculture from the University in 1942. After four

years in the Armed Services and one year on the farm, he returned to the University and received a Ph.D. in 1954. As an undergraduate, he worked on the pasture project under Brown's supervision and then conducted his Ph.D. thesis research on a forage-related problem. As Fletchall was completing the requirements for the Ph.D., Etheridge explained to him that new developments in herbicide production would be making changes in field-crop production practices in Missouri and opening up new areas for agronomic research. The Department of Field Crops should be engaged in this research, Etheridge believed, and he offered Fletchall this challenge. Fletchall accepted and became a pioneer in weed-science research. He worked closely with industry and was influential in the labeling and distribution of new herbicides and the formulation of recommendations for their utilization by farmers. He organized and taught the first courses in the college on "Weed Science," and advised many graduate students. Fletchall continued weed-science research and teaching in the Agronomy Department until his retirement in 1985. A noteworthy aspect of Fletchall's career is that he developed a new field in agronomy, distinctly different from that in which his graduate studies had taken him, an accomplishment typical of the Etheridge tradition.

William Joseph Murphy (1949-81). Murphy was reared on a farm in Monroe County, Mo., and received a B.S. in agriculture in 1939 and an M.S. in 1964 with thesis research on weed control in grass establishment. He was appointed an extension field crops specialist in 1949 after service in the Armed Forces and as an extension agent. Murphy possessed an amazing fund of knowledge about Missouri agronomy and could always be depended upon for sound ideas on utilization of this resource. During his career, he developed extension programs for corn, wheat, rice, grain sorghum, soybeans, pasture and forage crops, tobacco, cotton, weed control, and seed improvement. He was active in programs for drought relief, irrigation, and farm-family development. He was a popular speaker for extension farm meetings, soils and crops conferences, and countless other farm groups. The agronomic information that he provided extension agents and farmers was of highest quality, and the recipients always had utmost confidence in its accuracy. Murphy continued as an extension specialist in the Agronomy Department until his retirement in 1981. During that period, he served as a consultant on seed production for two years in Bihar State, India, and as a consultant on drought relief and seed production in Tanzania, East Africa.

Dale Truman Sechler (1955-60, 1967-†). Sechler was born in Polk County, Mo., and received the degrees B.S. in agriculture (1950),

†Continues active in the Department of Agronomy, as of December, 1988.

M.Ed. (1954), and Ph.D. in field crops (1960) at the University. Sechler was first hired by Etheridge but never served under him. Just before Etheridge retired, he observed that two instructors would be needed to assist with field-crops teaching. Sechler was one of those selected, and he began his teaching duties one day after Etheridge retired. After completing the Ph.D., he was employed for seven years by the University of Florida as a small-grains breeder. In 1967, he went to India as an adviser on research development on the University of Missouri/U.S. Agency for International Development program—with the understanding that when his tour in India was completed that he would return to Missouri. When he returned he was given responsibility for the wheat- and oat-breeding research projects and for teaching the course “Grain Crops Production” in the new Department of Agronomy.

William Paul Sappenfield, Sr. (1948-51, 1956-88). Sappenfield came to the University from Lees Summit, Mo., following service in the Armed Forces, and received a B.S. in agriculture in 1948 and a Ph.D. in 1952. From 1948 to 1951, he was an assistant instructor in field crops, assisting with the small-grains breeding projects and teaching “Grain Crops Production.” After positions as cotton breeder in the New Mexico College of Agriculture and the Southwestern Irrigated Field Station, Brawley, Calif., he returned to the University early in 1956 to develop a cotton-breeding program at the Delta Research Center, Portageville. Sappenfield was the last of “Etheridge’s boys.” Etheridge had planned for this position but had been unable to fill it before his retirement, so he reserved that duty for himself and continued the quest after his retirement in 1955. Sappenfield soon developed an innovative research program combining the breeding of early-maturing, multi-disease and insect resistant, high-fiber-quality varieties with a short-season, economically efficient production system. He continued this research in the new Agronomy Department.

Other Missouri graduates brought in to fill key positions in the Field Crops Department, but who remained for shorter tenures included: **Clarence Edgar Carter (1920-34).** Carter was a 1915 graduate of the College of Agriculture from Macon County. After one year of teaching in high school and four years as county extension agent of Knox County, Carter was appointed extension specialist in field crops to replace J.C. Hackleman, who had resigned. During 1920 to 1922, Carter served as secretary of the Missouri Corn Growers’ Association. With Paul Schowengerdt, soils extension specialist, he initiated the “Clover and Prosperity” extension program. He received a doctorate from the University of Illinois in 1930. In 1934, he resigned to become extension agronomist in the U.S. Department of Agriculture, Washington, DC.

Roy T. Kirkpatrick (1921-33). Kirkpatrick received a B.S. in agriculture in 1918 and an M.A. in 1924 from the University. During 1924 to 29, he was secretary of the Missouri Corn Growers' Association. He taught general field crops laboratories and grain grading, and conducted research on corn, oats and barley breeding. Kirkpatrick's position was terminated in 1933 due to reduction in University funds during the Great Depression.

Kenyon G. Harmon (1923-32). Harmon received the B.S. in agriculture in 1921, and in 1923 he was appointed an extension assistant professor in field crops. He was recommended to Etheridge for this position while teaching vocational agriculture at Paris, Mo., by a member of the Board of Curators. Harmon's appointment was terminated during the Great Depression due to reductions in University funds.

Wendell R. Tascher (1927-33). Tascher came to Missouri from the University of Illinois and was appointed a research fellow working in genetics with Stadler. After receiving a Ph.D. degree in 1929 he was appointed assistant professor and given responsibility for the wheat-breeding project. His appointment was terminated in 1933 when university funding was reduced during the Great Depression.

Marion Samuel Offutt (1951-56). Offutt, a native of Mexico, Mo., received a B.S. in agriculture in 1948, an M.S. in 1952, and a Ph.D. in 1954, both graduate degrees in field crops. Offutt was Etheridge's choice for his successor when Etheridge retired in 1955. After serving as chairman of the Department of Field Crops for one year, 1955-56, Offutt resigned due to family health problems and took a position in forage breeding at the University of Arkansas.

Carl C. Hayward (1953-75). Hayward received a B.S. in agriculture in 1943 and an M.Ed. in 1953. After teaching vocational agriculture for 10 years, he was appointed superintendent of the Crops Experiment Field at Pierce City (1953-59) and the University of Missouri Southwest Research Center at Mt. Vernon (1959-65). From 1965 until his retirement, he served as assistant superintendent of the Agricultural Experiment Station operations in Columbia.

Arnold Matson (1955-65). Matson received a B.S. in agriculture in 1944 and a Ph.D. (field crops) in 1961. He was associated with Dr. Leonard Williams on the soybean-breeding project and served for a period as the soybean breeder at the Delta Research Center. He resigned in 1965 to accept an industry position as a soybean breeder.

Charles Franklin Hayward (1955-66). Hayward came to the Department to assist with the teaching program at the time of Etheridge's retirement in the same move that brought in Dale Sechler. Hayward was born at Dadeville, Mo. He had taught vocational agriculture in Missouri high schools from 1950 to 1955 and was working on an M.S. (Ed.) degree, which he completed in 1956. He assisted with the

wheat-breeding project and received a Ph.D. in 1961. Hayward was personable, communicated well with students, and was retained on the Department staff to teach the introductory course. He helped design and team-teach the first plant science course, cooperative with the Department of Horticulture. He resigned in 1966 to accept a hybrid-wheat breeding position in a commercial seed company.

Other Etheridge Appointees

On occasion, Etheridge went outside the ranks in order to find potential faculty members with special talents. These included:

Viola May Stanway (1941-79). Stanway was reared on a farm in the rich bottom-land soils of Carroll County, a fact she often recalled. In 1936, she received a B.S. in education with a major in biology, and in 1938 an M.A. in botany, both degrees from the University. From 1941 until her retirement in 1979, she was the seed analyst in charge of the Missouri Seed Testing Laboratory in the Department of Field Crops (later Agronomy). She taught courses in seed technology and developed a "Manual for Beginners in Seed Analysis." During this period, she served on important decision-making committees of the Association of Official Seed Analysts. Stanway was regarded by her colleagues in seed technology as one of the few "classical seed analysts" that made seed analysis a profession. Farmers and seedsmen were sometimes critical that her high standards for accuracy in germination tests would not permit marginally substandard seed samples to meet certification regulations. But she fit the mold that Etheridge set for his "boys"—dedication, reliability, and integrity.

Idé Peebles Trotter (1923-36). Trotter was born in Brownsville, Tenn., and received B.S. (1919) and M.S. (1921) degrees from Mississippi State University and a Ph.D. (1933) from Wisconsin. With the rapid increase in cotton acreage in the early 1920s, a need developed for a field crops extension specialist with expertise in cotton production. Trotter was brought into the Department in 1923 to fill that position. He resigned in 1936 to join the Texas A&M College, where he became chairman of the Department of Agronomy and, later, graduate dean.

John Randolph (Dixie) Paulling (1937-47). Paulling was born in Matthews, S.C., and received a B.S. in agriculture at Clemson College, Clemson, S.C., in 1926. He came to Missouri for graduate study in the Department of Dairy Husbandry, where he received an M.A. degree in 1927. Paulling served successfully for 10 years as county extension agent in Ripley, Vernon and Caldwell counties. When Trotter resigned as field crops extension specialist, Etheridge again turned to a native from a Southern state to serve as an extension specialist for the cotton production area of southeast Missouri. Paulling's southern accent and courtly manners earned for him the cognomen, "Dixie." He never

addressed a person without use of the courtesy, "sir" or "ma'am," as appropriate, and never failed to hold open a door so a companion could pass through first. In 1949, he resigned to become an agronomist for the Deering Farms in southeast Missouri. He later served the Food and Agricultural Organization in Rome and the Agricultural Extension Service, U.S. Department of Agriculture, Washington, D.C.

Norman Brown (1951-73). Brown was born in Wiggans, Miss., and received a B.S. in agriculture in 1950 and an M.S. (agronomy) in 1951 at Mississippi State University. He came to Missouri in 1951 to pursue study for the Ph.D., which he received in 1972. Etheridge seized the opportunity to utilize Brown's knowledge of cotton production and appointed him superintendent of the Crops Experimental Field at Sikeston. In 1959 he became superintendent of the Delta Research Center at Portageville and served in that position until his death in 1973.

Myron Gerald Nuffer (Neuffer) (1948-†). Nuffer came into the Department of Field Crops during Etheridge's tenure as chairman but is really a Stadler protégé rather than one of Etheridge's "boys." A native of Preston, Idaho, with a B.A. degree from the University of Idaho, Nuffer came to Missouri as a graduate student in field crops under Stadler and received an M.S. in 1948 and a Ph.D. in 1952 in the genetics program. He inherited leadership of the genetics group after Stadler's death and Laughnan's one-year tenure in Missouri. With the restructuring of departments in 1967, he became chairman of the newly created Genetics Department. Nuffer's research concerned the mutational behavior of selected loci in maize. He taught introductory "Genetics" from 1959 to 1962 and a graduate course, "Gene Structure and Function." In 1964, he changed his name from Nuffer to Neuffer.

John R. Laughnan (1954-55). Laughnan received a Gregory Fellowship in Genetics from the University (1943-47); after completing his Ph.D. under Stadler in 1946, he joined the University of Illinois. He was a native of Spring Green, Wis., and had received a B.S. at the University of Wisconsin in 1942. After Stadler's death, he was invited back as a professor of field crops to lead the genetics group. He stayed one year before returning to the University of Illinois as head of the Department of Botany.

The Plant Pathology Connection

Teaching and research on field-crop diseases evolved in the Department of Botany. Early Experiment Station plant pathologists in the Botany Department were G.M. Reed (1908-19), E.F. Hopkins (1921-22) and I.T. Scott (1921-30). Reed's research project embraced the powdery mildews, cereal smuts, and cereal rusts. Hopkins continued research on the smut diseases and initiated projects on corn root rot and wheat scab

diseases. In 1927, B.B. Branstetter completed a Ph.D. thesis on "Corn Root Rot Studies" that had been started in 1922 under Hopkins while Branstetter was an instructor in field crops. Scott evaluated wheat varieties for resistance to the wheat scab organism but directed more attention to diseases of vegetables and fruits. C. Mitchell Tucker (1931-54) succeeded Scott; his principal research interests were resistance to the Fusarium wilt in tomato and classification of the genus *Phytophthora*.

As the crops extension programs expanded, assistance was needed on identification and control of crop diseases, and increased emphasis on breeding for disease resistance also required cooperation with plant pathologists. Tucker, by then chairman of the Botany Department, sought to expand the cooperation by adding C.H. Kingsolver (1946-51) and later Merle Michaelson (1952-54) to the Botany Department staff. Neither were provided resources commensurate with their research needs. The excellent cooperation between Field Crops and Botany that had existed when William J. Robbins was chairman of Botany had declined after Tucker became chairman. Etheridge and Robbins had been graduate students together at Cornell, and their relationship was based on mutual respect and trust. Etheridge had sent Branstetter, Brown, Pohlman, Allen, Baldrige, and Giles for graduate study in Robbins' department.

Tucker, a 1920 graduate of the College of Agriculture, had not distinguished himself in Etheridge's classes, and the relationship between Botany and Field Crops diminished when he became chairman. Following Tucker's death in 1954, the College and the Experiment Station moved to correct the deficiency in plant pathology by bringing plant pathologists into the Field Crops, Horticulture and Forestry Departments. The first in the Department of Field Crops was Marvin Whitehead, a graduate of Oklahoma State (B.S. 1939; M.S. 1946) and Wisconsin (Ph.D. 1949), who was appointed an associate professor of field crops in 1955. He stayed until 1960, developing and teaching the course "Field Crop Diseases."

8. COOPERATION WITH U.S. DEPARTMENT OF AGRICULTURE, 1917-55

Etheridge developed a close working relationship between the U.S. Department of Agriculture (Bureau of Plant Industry, Divisions of Cereal Crops and Diseases and Forage Crops and Diseases, later Agricultural Research Service, Field Crops Branch) and the Department of Field Crops. Some of the early leaders in the Department of Agriculture had been classmates of Etheridge at Cornell; they respected and trusted each other. And so this cooperation was born of trust and belief that by working together, more could be accomplished than by working separately. In later years, if this spirit of trust should begin to fade as new faces came into leadership in the Department of Agriculture, Etheridge could always play his trump, a close friendship with Clarence Cannon, member of the House of Representatives from Elsberry, Mo. As powerful chairman of the House Appropriations Committee, Cannon could make things happen in Washington.

The Departmental relationship with the U.S. Department of Agriculture started with the establishment of the Seed Laboratory in 1908. But the faculty relationship began with Stadler. Stadler pursued his master's degree on a fellowship provided by the Division of Cereal Crops and Diseases, and from 1930 onward, held split appointments with part of his salary being paid by the U.S. Department of Agriculture. Split appointments were also arranged for Kirkpatrick and King and for the early years of Brown's, Poehlman's, and Fletchall's tenure in the Field Crops Department. But split appointments were unpopular because part-time employees were not eligible either for University or federal retirement programs. So Brown became a full-time U.S. government employee and Poehlman and Fletchall opted for the University. Initially, these men had been brought into the Department of Field Crops by Etheridge with his policy of recruiting from the ranks; U.S. Department of Agriculture funds were used to supplement local funds for salaries. Afterwards, the U.S. Department of Agriculture began to send federal scientists to the Department of Field Crops to conduct research on cooperative projects. The federal scientists were conferred academic titles in the University, Experiment Station research projects were formalized, and Experiment Station funds were pooled with federal funds for the research. Several of the USDA employees served long tenures in the Field Crops Department. They included: **Ernest Robert Sears** (1936-80). Sears was born on a farm in Bethel, Ore., received a B.S. in agriculture at Oregon State University in 1932



Ernest R. Sears, a USDA wheat geneticist, crosses wheat plants in a University greenhouse.

and an M.A. and a Ph.D. from Harvard University in 1934 and 1936, respectively. He was a research geneticist in the U.S. Department of Agriculture and served his entire career at the University, except for periods as a visiting scholar in Germany, Australia, Israel, England, and South Africa. Sears came to the Department to study the polyploidy

relationships in wheat. Soon, he was receiving worldwide recognition and respect for his research on the aneuploids of wheat. Aneuploids are plants with an irregular number of chromosomes, and Sears pioneered in their utilization for identification of genes with specific chromosomes or for transfer of genes among varieties and related species of wheat. His research increased manyfold the efficiency of studies in wheat genetics and contributed to a broader understanding of the evolutionary development of polyploid plants.

Sears pursued his research with modesty and humility, with simple experiments exquisitely designed and meticulously performed. He was stimulated but not overwhelmed by the presence of Stadler. He advised graduate students but never taught a formal course. Sears generally worked alone or with a few respected colleagues including his wife, Dr. Lotti M. Sears. But his knowledge and his genetic materials were generously shared with wheat breeders and geneticists everywhere. Sears received many national and international honors for his research, including an Honorary Doctor of Science from the University of Göttingen, Germany; the Israel-based Wolf Prize for agricultural research; and election to membership in the U.S. National Academy of Science, the second recipient from the Department of Field Crops and the University of Missouri to receive this honor, and election to the American Academy of Arts and Sciences. Sears formally retired in 1980, but continues his wheat research.

Joseph George O'Mara (1936-43, 1945-50). O'Mara, a native of Boston and graduate of the University of Massachusetts, Amherst (1933), received an M.S. (1934) and a Ph.D. (1936) at Harvard University. He came to Missouri with Sears in 1936, as a cytogeneticist with the U.S. Department of Agriculture, to work on the polyploidy project in wheat. He became involved in research on triticale and cytogenetics of oats. From 1943 to 1945, he worked as a cytogeneticist on guayule in a wartime research project seeking alternate sources of rubber. O'Mara's flaming red hair and ready wit reflected his Irish heritage. O'Mara resigned in 1950 to become professor of genetics at Iowa State University. In 1965, he became professor and chairman of botany, Pennsylvania State University.

Luther Smith (1936-43). Smith, a native Missourian, received a B.S. in agriculture in 1932 and a Ph.D. in 1936 at the University. Smith was a student of Stadler; as an undergraduate, he had worked on Stadler's radiation projects. His Ph.D. thesis involved the cytogenetic relationship among primitive species of *Triticum* and common wheat. Smith came into the Department of Field Crops in 1936 on the U.S. Department of Agriculture-sponsored wheat project on polyploidy, along with Sears and O'Mara. He resigned in 1943 to accept a position at Washington State University working in barley genetics.



Marcus Zuber and Clarence Grogan, USDA corn breeders, weigh corn yield test plots in 1950.

Marcus Stanley Zuber (1946-82). Zuber was born on a farm at Gettysburg, S. Dak., and received a B.S. in agriculture at South Dakota State College in 1937, and an M.S. (1940) and a Ph.D. (1950) in plant breeding at Iowa State College. As a farm youth in the 1920s and 1930s, Zuber had endured the rigors of South Dakota droughts and the Great Depression. He brought his strong constitution and an abounding enthusiasm to Missouri and became renowned as a corn breeder and a mentor of graduate students.

When Zuber came to Missouri in 1946 as a corn geneticist for the U.S. Department of Agriculture, University research on development of corn inbred lines and hybrids was still in progress, with hybrid seed

being produced by farmers under the seed certification program. But this activity was rapidly being taken over by private hybrid-seed-corn companies. Zuber skillfully made the transition from breeding for the benefit of a few farmer seed growers to breeding for the benefit of the hybrid corn industry at large. He did this with corn population improvement programs, the populations being improved for a specific characteristic—strong root systems, stronger stalks, earworm resistance, or higher lysine. Inbreds were isolated with the superior characteristic and distributed widely to corn breeders for use in their individual breeding programs. His Mo17 inbred is utilized in corn hybrid research throughout the world. Research was also conducted in areas not touched by industry breeders, such as the development of hybrids with large cobs for the cob pipe industry, white corn hybrids for the corn milling industries and studies on aflatoxin production in corn. In the process, valuable experience was gained by many graduate students who were eagerly sought for positions in the hybrid corn industry.

Zuber was particularly adept in bringing together research workers from various disciplines for a common attack on the problem at hand, with all sharing in the publication of results on an equal basis. Zuber's research brought him many honors and national recognition to the U.S. Department of Agriculture and the University.

Darnall Whitt (1946-55). Whitt was a native of Greensboro, N.C., and received a B.S. in agriculture from North Carolina State University in 1934. After obtaining an M.A. in soils at the University in 1935, Whitt was employed by the U.S. Department of Agriculture, Soil Conservation Service. From 1946 to 1955, he was stationed at the University while conducting agronomic research on the Midwest Claypan Experiment Station, McCredie, Mo. In 1952, he received a Ph.D. (field crops) with a thesis study on the production and economic returns from pastures on claypan soils. Whitt was transferred to Beltsville, Md., in 1955.

Leonard Freeman Williams (1951-65). Williams was born in McKeesport, Pa., and received a B.S. in agriculture (1932), M.S. (1935), and Ph.D. (1938) at the University of Illinois. His graduate thesis research was in soybean genetics and, beginning in 1936, he was appointed a soybean geneticist in the U.S. Department of Agriculture, Soybean Laboratory, at Urbana, Ill. He was transferred to the University in 1951 to conduct soybean breeding and genetic research. His productive career with soybeans came during a period of rapid expansion in soybean research and close cooperation among the researchers, both fostered by the Soybean Laboratory. Williams was admired by his peers for his vast knowledge of soybean genetics and respected for his vision in soybean breeding. Many of the soybean varieties developed during this period were selected from progenies of his crosses. Williams' relation-

ship with the Soybean Laboratory administration became strained due to his negligence in writing reports and failure to document research results. Etheridge approved the transfer of Williams to Missouri as he valued good varieties above fully documented reports. Williams had a habit of falling asleep in seminars, but should a student make an incorrect statement, Williams would immediately awaken and challenge him. Williams' brilliant career was cut short by a fatal automobile accident in 1965. The Williams variety of soybeans, widely grown in the cornbelt for many years, was named in his honor.

Edward H. Coe Jr. (1955-†). Coe was born in San Antonio, Tex., and received a B.S. in agriculture (1949), M.S. (1951) degrees in agronomy and plant genetics in the University of Minnesota, and a Ph.D. (1954) in botany and genetics at the University of Illinois. After one year as a research fellow at the California Institute of Technology, Coe came to Missouri as a maize geneticist for the U.S. Department of Agriculture. His research had been devoted to the study of genetic mechanisms that control biological functions in the corn plant. For many years, he has served as editor of the **Maize Cooperative Newsletter**, designed to keep maize geneticists informed of each other's research. He taught a graduate course in field crops, "Genetic Techniques," and advised graduate students. Coe came into the Department in the last months of Etheridge's chairmanship and served under him only briefly. He later participated actively in the establishment of a graduate degree program in genetics.

Additional U.S. Department of Agriculture scientists in the Field Crops Department prior to 1955 included **George F. Sprague** (1936-39), **Dean G. Anderson** (1939-44), **Carl V. Feaster** (1948-50), **Leonard M. Stahler** (1951-53), **Dayton Klingman** (1953-56), and **Clarence O. Grogan** (1954-59). **Clara Fuhr** (1924-44) was a Seed Analyst in the Federal/State Seed Laboratory.

A key to the long-term successful Department of Agriculture/Field Crops cooperation was the policy that federal workers in the department should have the same independence for their research and full Departmental recognition enjoyed by state employees. Etheridge's firm adherence to this policy was emphasized in a letter to College of Agriculture dean, John H. Longwell (January 20, 1954). The Bureau of Plant Industry was transferring the Midwest Claypan Experiment Station at McCredie to the University. The memorandum gave the highest ranking federal man on the staff responsibility for all other federal men on the project. Etheridge replied, "The latter provision is not satisfactory to the Department of Field Crops. It is contrary to the Bureau of Plant Industry formula, long in successful operation here, under which each man works wholly on his own responsibility assigned jointly by the Bureau and the Missouri Station. This formula was developed by long

cooperative experience. The federal men should come to us strictly on a project basis, with rank according to qualifications, and bona fida Departmental membership." But the policy cherished by Etheridge of individual responsibility for each federal worker became a casualty of subsequent reorganizations within the Department of Agriculture. Under the policy, one of the federal workers in the Department was given the title "research leader" and administrative responsibility for other federal workers.

9. ADMINISTRATIVE LEADERSHIP

Graduate Students in Field Crops

In his early years as Department chairman, Etheridge did not give a high priority to graduate students, except for those being sought as future faculty. Research funds being limited, the funds went for project operations rather than graduate student stipends, exceptions occurring when grant funds were received to support graduate fellowships. In addition to Etheridge's recruits, most of the early graduate students were attracted by Stadler and supported by grant funding in the genetics research area. Etheridge's graduate-student policy hurt the Department in later years because there were so few Missouri field crops graduates teaching in other agricultural colleges who could assist in recruiting top-quality faculty or graduate students when help was needed.

The influx of students following World War II brought changes in the graduate program. Graduate assistants were needed for teaching, and former students were returning and wanting to pursue graduate study. Those assisting with teaching were given appointments as assistant instructors or instructors and worked on research projects during the summer months. Others were given appointments as assistants to work on research projects while pursuing graduate study. This policy provided the students with valuable experience in teaching and in the conduct of research projects, in addition to their graduate studies. Those receiving appointments as instructors or assistants during this period are included in Appendix No. 1.

Administrative Appointee

In 1952, Charles Kenneth Cloninger was appointed administrative assistant to the dean and director and assistant professor in field crops. Cloninger had received a B.S. (1942) and a Ph.D. (1951) in field crops. During interim periods, he served in World War II and the Korean war. He resigned in 1954 to accept a position in industry.

Etheridge and the College Deans

The office of dean and director was filled by four men during the period 1916 to 1955. F.B. Mumford was dean when Etheridge came to Missouri in 1916 and remained in that position until 1938. Etheridge admired and respected Dean Mumford; his evaluation of Mumford's administrative style was quoted earlier.

As Mumford approached retirement, speculations arose regarding his successor, with Etheridge among those discussed. No doubt Etheridge cherished the hope that he might someday be appointed dean; in 1928, he had turned down an offer of deanship at Oklahoma A&M College, in Stillwater. But it was M.F. Miller whom the University President turned to; after all, Miller had seniority, and he was highly respected by the faculty and students. Miller served as dean and director from 1938 until 1945. The College's activities were interrupted in this period by World War II, during which student enrollment declined precipitously, reaching a low of 300 in 1944-45. Departmental faculties were reduced as the younger men were called, or enlisted, to serve in the Armed Forces or in war-related industries. Yet, under Miller, the College remained stable and productive, just as the Departments of Agronomy and Soils had been under his administration.

Miller was succeeded as dean by Edwin A. Trowbridge, a graduate of the University of Wisconsin, who had been appointed to the Animal Husbandry Department in 1906. Trowbridge was an affable teacher, a noted judge of livestock, highly respected by the livestock industry, and a senior member of the faculty. Trowbridge became dean and director just as World War II was ending. Veterans of military service received educational benefits and flocked back to the University, swelling the 1945-46 enrollment in the College of Agriculture to 2,230 students. Adjustments had to be made quickly, as new classes were opened and new teachers hired. Unfortunately, Trowbridge's tenure as dean was ended soon by his death from cancer in 1948.

To succeed Trowbridge as dean, President Middlebush went outside the College faculty. Speculation had centered on Sam B. Shirky, a 1918 graduate of the College from Ray County, Mo. Since 1920, Shirky had been an assistant to the deans and had handled many administrative duties in the office. He served as acting dean in the interim following Trowbridge's decease and was respected by the faculty and students. However, the position went to John H. Longwell, at that time president of North Dakota State University. Longwell was a 1918 graduate of the college, with a M.A. and a Ph.D. from the University of Illinois, and had served in the Animal Husbandry faculties in Washington State, West Virginia, Illinois, and North Dakota. He came back to the University in 1945 and served as dean and director until 1960. Shirky

was elevated to associate director in 1948 and associate dean in 1955. In these positions, Shirky efficiently managed the teaching program and the budget for the College and the Experiment Station.

Etheridge worked comfortably with Miller, Trowbridge, and Shirky. He had served with them for many years on Mumford's Policy Committee. Together, they had helped shape College policy for more than two decades. Miller wrote of Etheridge: "Etheridge had one of the keenest minds of any of the individuals on the University faculty. - - - He knew how to handle men having political ambitions, and in my occupancy of the Dean's office, I could always depend upon him to deal with such individuals." Etheridge was often given the task of writing important policy documents for the College. His generous vocabulary and precise choice of words enabled him to convey the desired message, forthright and accurately. The Soil District Law in Missouri and the Missouri River Basin Policy were largely his handiwork.

Etheridge was less comfortable with Longwell's administration. Longwell's grasp on the total picture was not as clear as that of his predecessors, and changes were being made that deviated from the long-term policies. Those policies had been carefully crafted through the Waters, Mumford, Trowbridge, and Miller administrations and had been designed to gain and keep the College progressive and respectable in the eyes of the Missouri agricultural community. Longwell gave strong support to the genetics program that under Stadler had drifted away from the mainstream of Etheridge's departmental priorities.

Etheridge's Administrative Style

Etheridge's style of operation would not be received with favor in today's climate of faculty participation in personnel and policy-making decisions. Etheridge was never autocratic in the Mumford manner. He followed Mumford's style of delegating teaching and research responsibilities, but he reserved for himself major departmental decisions on personnel, budget, and policy. The decisions were never made hastily or with malice, only after deliberately weighing the alternatives. And they were crafted in a carefully conceived view for the greater good of the Department and its responsibility for serving Missouri agriculture. In later years, Etheridge was aware of the changing administrative climate and the restrictions progressively intruding on the chairman's freedom to make and implement critical decisions affecting departmental welfare. Shortly before retirement, he expressed his exasperation by saying, "It's just getting so you can't do your job anymore."

Etheridge was both a joy and an exasperation to work under. He was a joy in the freedom and support he gave for pursuing one's teaching and research responsibilities as one saw them without interference. Yet he was an exasperation when his detachment left one wondering whether he

was really interested in one's departmental contributions, or when his tight control and manipulation of department finances caused uncertainty about how many student workers could be hired for the summer. But Etheridge's support for his staff was solid as long as useful contributions were forthcoming.

10. A DEPARTMENT IN TRANSITION, 1955-57

Etheridge retired August 31, 1955, having reached the University's mandatory retirement age of 70. He had recommended that Helm, his long-time colleague in the Department, be appointed his successor. The University administration had approved the appointment. Helm, born in 1889, was eligible to serve as chairman for four years before retiring. Unfortunately, Helm suffered a massive heart attack and died, July 8, 1955, before ascending to the chairmanship. After Helm's death, Etheridge recommended that the chairman position go to Marion Offutt, a young faculty member in the Department. On January 10, 1956, Etheridge suffered a fatal heart attack, ending a long and productive era in the Department's history.

Marion S. Offutt (1911-56). Offutt was a graduate of the College from Mexico, Mo. He had served in the U.S. Air Force, European Theatre, from 1940 through 1944, and, after receiving his B.S. degree in 1948, he served for two years in the Agricultural Extension Service. As an undergraduate, Offutt had graded papers in Etheridge's field crops course. He returned to the University in 1950 and received an M.S. (1952) and a Ph.D. (1954) in field crops under Baldrige. At the time of his appointment as chairman (September 1, 1955), he was associated with Baldrige on the lespedeza project. Offutt possessed the qualities needed to make an excellent chairman and could have had a long tenure in the Department. However, due to family illnesses, he chose to resign after one year and transfer to the University of Arkansas where he became a forage breeder, working with lespedeza.

In the interim, Lloyd Cavanah was appointed acting chairman. Cavanah served in that position from September 1, 1956, to January 15, 1957. During these transition periods, the Department moved ahead steadily, even as the future seemed uncertain at times.

11. PINNELL'S REIGN AS CHAIRMAN, 1957-67

After Offutt resigned as chairman of Field Crops, Emmett L. Pinnell, an associate professor of agronomy at the University of Minnesota, was chosen to become professor of field crops and department chairman.

Emmett Louis Pinnell: The new chairman was a native of Oak Hill, Mo., and had received a B.S. degree at the University in 1940. During Pinnell's freshman year, Etheridge had reported that Clara Fuhr, the Seed Analyst, wanted a student to work in the Seed Laboratory. I was teaching the laboratory in Field Crops and occasionally gave Etheridge names of exceptional students whose work habits made them worthy for student employment. Pinnell's name was among those given him on this occasion. After observing Pinnell for a few class periods, Etheridge remarked to me, "That Pinnell boy would tickle Clara pink." The following summer, Pinnell worked on Stadler's corn genetics project and continued with Stadler until his graduation. Pinnell then went to Minnesota to study corn breeding under Professor H.K. Hayes, where he received the M.S. degree in 1942 and a Ph.D. in 1948. Pinnell became a member of the Minnesota faculty as a corn breeder at the Waseca Station and served there until his appointment at Missouri, except for two years, 1953 to 1954, that he spent as a hybrid corn specialist for the Yugoslav government.

Department policies changed under Pinnell, some slowly with due deliberation, others precipitously causing concern and uncertainty among the departmental faculty. But his accomplishments were many. He picked up loose ends from Etheridge's detached administration and developed a more structured department. He worked aggressively to increase staff and financial support for the plant genetics and breeding projects; increased the pathology staff within the Department to provide for research on field-crop plant diseases and pathological support for plant breeders and crops extension specialists; strongly supported the forage and weed-science research; and brought into the Department the first crop physiologist. He introduced a procedure for increase and distribution of crop varieties that conformed to procedures in practice at other North Central Experiment Stations. He developed firm budgets for research projects so that project leaders knew exactly the resources available to them. Cooperation with the U.S. Department of Agriculture continued to flourish.

New Field Crops Faculty Under Pinnell

When Pinnell became chairman of the Department on Jan. 15, 1957, the departmental teaching and research personnel included J.M.



Emmett Pinnell, chairman of the Department of Field Crops, 1957-67, discusses alfalfa research plots with farmers at a Southwest Missouri Research Center Field Day in 1965.

Poehlman, Viola Stanway, L.E. Cavanah, O.H. Fletchall, M.G. Neuffer, W.P. Sappenfield, and Marvin Whitehead; Dale T. Sechler, A.L. Matson, and C.F. Hayward as instructors and graduate students; J.R. Fleetwood, and W.J. Murphy, extension specialists; E.M. Brown, E.R. Sears, J.D. Baldrige, M.S. Zuber, L.F. Williams, C.O. Grogan, E.H. Coe Jr., and Elroy Peters from the U.S. Department of Agriculture; W.E. Aslin and F.E. Forsyth, associated with the Missouri Seed Improvement Association; and Norman Brown and Carl Hayward as superintendents of the Southeast and Southwest Experimental fields, respectively.

Pinnell departed from the Etheridge policy of filling positions from the ranks by bringing in graduates from other institutions to fill key positions. Several appointments were made shortly before the reorganization of the College Departments in 1967; their contributions to the Department of Field Crops before it became part of the Department of Agronomy were necessarily limited. Faculty who came in with Pinnell, or were recruited by Pinnell, included:

Gyorgy Pál Rédei (1955-†). Rédei's appointment had been arranged by Dean Longwell and Acting Chairman Cavanah before Pinnell arrived. Rédei was a native of Hungary and received the degrees B.S. (1948) at the Academy of Agriculture; M.S. (1949), University of Agricultural Sciences, Budapest, and Ph.D. (1956), Hungarian Academy of Science (Budapest). He joined the Field Crops Department in 1957 after he and Mrs. Rédei had fled Hungary during the 1956

uprising. Rédei studied the genetics of biochemical processes in *Arabidopsis*, a member of the Cruciferae family that has a short life cycle, making it possible to grow and observe several generations each year. Oscar Hugh Calvert (1958-‡). Calvert was born in Dallas, Tex. He received a B.S. in agriculture at Oklahoma State University in 1943, an M.S. and a Ph.D. in 1945 and 1948, respectively, at the University of Wisconsin. He subsequently was with the U.S. Department of Agriculture located at Texas A&M University, and consultant to a private landscape group, before coming to Missouri in 1958. At the University, he worked closely with the breeding projects and served as an information source on field-crop diseases to the agricultural extension staff and to farmers. He taught the course "Field Crop Diseases" after Whitehead left in 1960.

Joseph Hainline Scott, Jr. (1958-88). Scott was born in Sommerville, Tenn., and received a B.S. in agriculture at Mississippi State University in 1941. He served as an agricultural extension agent in Dunklin County, Mo., from 1945-58. In 1958, a position opened for a field crops extension specialist to serve the southeast Missouri area. In the Trotter and Paulling tradition, experience with cotton was desired, and Scott was a logical choice because he was a native of a cotton-producing state and had served successfully as extension agent in a leading Missouri cotton-producing county. Furthermore, he still retained some of his southern accent. Scott was the first field crops extension specialist to maintain his residence in southeast Missouri and devote full time to the area. Scott worked closely with Sappenfield, cotton breeder at the Delta Center, to promote short-season, early-maturing varieties combined with a production system designed to reduce production costs. He continued to serve as extension specialist in the new Agronomy Department until 1982 when he became Superintendent of the Delta Research Center, Portageville.

Thomas Dean Wylie (1960-‡). Wylie was born in Hinsdale, Ill., and received his B.S. degree at San Diego State College in California. He received an M.S. and a Ph.D. at the University of Minnesota. Wylie's research was with diseases of soybeans, particularly the root-knot nematode root-rotting pathogen relationship, and the ecology of soil-born pathogens. Wylie came to the Department following the departure of Whitehead. He helped develop and teach a course on "Insects in Relation to Plant Diseases."

Lotti Marie Steinitz-Sears (1962-67). Dr. Lotti Sears was born in Germany, attended Redding University in England, received a B.S. at Penn State University, and a Ph.D. (1942) at the University of

‡Continues active in the Department of Plant Pathology as of December, 1988.

California, Berkeley, in genetics. The wife of Dr. E.R. Sears, she collaborated with him on wheat genetic research. Prior to her appointment in the Department of Field Crops, she held an appointment from 1954 to 1962 as research associate in genetics.

Om Parkash Sehgal (1963-‡). Sehgal, a native of India and a specialist in viral diseases, received an M.Sc. (1953) at Lucknow University and a Ph.D. (1961) at the University of Wisconsin. After a couple of years at the University of Arizona, he came to the University of Missouri. He worked with the maize genetics and corn-breeding groups on viral diseases in corn.

Laurel Ethan Anderson (1965-85). Anderson was appointed extension professor of field crops in 1965 to provide guidance to area agronomists and farmers on weed-control practices. At that time, many commercial herbicides were becoming available. Anderson updated area agronomists on herbicide use, coordinated training programs for certification of commercial pesticide application, and prepared appropriate publications for the farm public. Anderson was born in Upsala, Minn., of Scandinavian parentage. He had received three degrees from the University of Minnesota, B.S. (1947), M.S. (1953), and Ph.D. (1955).

Kay Harris Asay (1965-74). Asay was a native of Lovell, Big Horn County, Wyo. He received B.S. (1957) and M.S. (1959) degrees from the University of Wyoming, and a Ph.D. (1965) from Iowa State University in plant breeding. Asay came to the Department as a forage breeder and initiated a breeding program with tall fescue. Tall fescue had been introduced to Missouri in the 1950s, and had become the backbone of the cow-calf industry in the Ozarks. Asay's first variety, Mo-96, supported 30 percent to 35 percent higher average daily gain than Kentucky 31, the standard, due to higher nutritive content.

Einar Wallace Palm (1965-‡). Palm was the first plant pathology extension specialist in the College. His appointment was in field crops, and most of his work involved field-crop diseases, but he also assisted extension agents with plant-disease problems in the horticultural area. Palm was born in Baudette, Minn., received a B.S. in agriculture from the University of Minnesota in 1952, and an M.S. in agricultural economics from the University of Connecticut, Storrs, in 1954. From 1954 to 1962, he taught vocational agriculture in Minnesota. He received a Ph.D. in plant pathology at North Dakota State University in 1965.

Leo Albert Duclos (1966-75). Duclos was appointed research geneticist to replace Arnold Matson as soybean breeder for southeast Missouri and was stationed at the Delta Research Center, Portageville. A native of Manila, Ark., Duclos received a B.S. (1958) at the University of Arkansas, and an M.S. (1964) and Ph.D. (1966) at Purdue University. Duclos also cooperated with the small-grains testing program at the

Delta Research Center. An expert on computer programs at the time computers were coming into use by researchers, Duclos developed programs for summarizing soybean and small-grains research data.

Rodney Dwain Horrocks (1967-78). Horrocks was born in Maeser, Utah, and received a B.S. (1962) from Brigham Young University, Provo, Utah, and an M.S. (1964) and a Ph.D. (1967) from Pennsylvania State University in Crop Physiology. At the University, he conducted outstate testing programs for corn, sorghum, and soybeans. Like Duclos, Horrocks was fascinated by the utility of computers for research and developed programs for rapid analysis of the test results and assisted graduate students in analyzing thesis data.

Curtis Jerome Nelson (1967-†). Nelson was a native of Mitchell County, Iowa, and received a B.S. (1961) in animal husbandry and nutrition and an M.S. (1963) in forage management, both at the University of Minnesota. His Ph.D. (1966) was at the University of Wisconsin in agricultural biochemistry and crop physiology. Nelson's appointment was another break with earlier policies because his assignment was to teach and conduct research in crop physiology. In prior years, the Botany Department, with physiologists such as B.M. Duggar, W.J. Robbins, or Jacob Levitt on their faculty, had been depended upon for teaching in plant physiology. Nelson arrived just two months before field crops became part of the Agronomy Department and remains active in that department. Nelson collaborated with Asay in studies of the genetic control of photosynthesis that served as a model for cooperative breeding-physiology research.

Frank Edward LeGrand (1967-68). LeGrand was employed as a field crops extension specialist to replace Fleetwood, who had retired in 1966. LeGrand was a native of Mayfield, Okla., had received a B.S. (1959) and a Ph.D. (1963) at Oklahoma State University, and had been employed there as an extension agronomist from 1963 to 1967. LeGrand arrived only a few weeks before the Department was changed in 1967 and remained only until February, 1968.

Harold Delbert Kerr (1967-†). After receiving B.S. (1955) and M.S. (1957) degrees in the Department of Field Crops in weed science, Kerr, a native of Gideon, Mo., obtained a Ph.D. at Washington State University in 1963. From 1962 to 1967, he was employed by the U.S. Department of Agriculture at Beltsville, Maryland, also in weed science. Pinnell arranged for the appointment of Kerr in the Department of Field Crops. He was to be located at the Delta Research Center, Portageville, and to conduct weed-science research in cotton and other southeast Missouri crops. Kerr reported for this position in September, 1967, after field crops had become part of the Agronomy Department.

Pinnell also arranged for the return of Dale T. Sechler to the University. Sechler had been appointed an instructor in field crops prior

to Etheridge's retirement. After receiving his Ph.D. in 1960, he joined the University of Florida. In June 1967, Sechler went to India on a two-year assignment as adviser on research for the University of Missouri India Program and associate professor in field crops. After returning to the Department, he worked on the small-grains breeding program.

Cooperation with the U.S. Department of Agriculture

The good relationship between the U.S. Department of Agriculture and the Department of Field Crops established under Etheridge continued to flourish during Pinnell's tenure as chairman. Additional federal scientists were sent to strengthen the research in maize breeding and genetics, in weed science, and as replacements in pasture research and soybean genetics. They included:

Elroy J. Peters (1956-85). Peters was born in Kauhauna, Wis., and received three degrees in agronomy from the University of Wisconsin, B.S. in agriculture (1952), M.S. (1953), and Ph.D. (1956). He came to the University in 1956 as a research agronomist for the U.S. Department of Agriculture replacing Dayton Klingman, who was transferred to Beltsville, Maryland. Peters' research was devoted to finding improved methods of controlling weeds in forages and grain crops. He identified an allelopathic agent in tall fescue that inhibits growth of other plants, suggesting the use of such agents in control of weeds. He invented a roller-applicator for applying herbicides onto weeds, reducing the amount of herbicide released into the environment and lowering costs of application.

Peter J. Loesch (1959-71). Loesch was a native of New York City who had received a B.S. (1953) at Kansas State University, and an M.S. (1955) at Cornell. He completed a Ph.D. at North Carolina State University in 1960. Loesch came to Missouri to assist Zuber with the corn-breeding project. He was later transferred to Iowa State University. Loesch taught the course, "Field Crops Improvement," for two years while Poehlman was on the University of Missouri/India Program.

Gregory G. Doyle (1960-†). Doyle was born in Lewiston, Idaho. He majored in botany, receiving a B.S. (1954) at the University of Washington, an M.S. (1956) at Washington State University, and a Ph.D. (1960) at the University of Illinois in cytogenetics and agronomy. He came to the University of Missouri in 1960 as a research geneticist for the U.S. Department of Agriculture to work in the maize genetics program. His research dealt with chromosome-pairing mechanisms and the cytogenetics of autotetraploid pairing in maize. Doyle assisted in teaching the plant cytogenetics course in the Department of Field Crops.

Arthur G. Matches (1961-82). Matches was a native of Portland, Oreg., and received B.S. (1952) and M.S. (1954) degrees at Oregon State University and a Ph.D. (1960) at Purdue University in forage management. He came to Missouri as a research agronomist for the U.S. Department of Agriculture, replacing E.M. Brown, who retired in 1961. Matches' research was in the broad field of forage management and included the growth responses of grasses to defoliation, seasonal use of pasture crops, and the production of warm-season grasses in Missouri.

Jack B. Beckett (1963-†). Beckett was born in Hutsonville, Ill. After receiving a B.S. in botany (1950) at the University of Washington, Seattle, and M.S. (1952) in horticulture and Ph.D. (1954) in genetics at the University of Wisconsin, Madison, he was appointed a maize geneticist for the U.S. Department of Agriculture located in the Agronomy Department at the University of Illinois. In 1963, he was transferred to the Department of Field Crops at the University of Missouri. He has identified different cytoplasmic sterility in maize in relation to cytoplasmic sterility in hybrid seed production, and developed a system that utilizes translocations to identify the contributions of individual chromosome arms to the development of the corn plant.

Russell L. Larson (1964-†). Larson was born in Bridgewater, S. Dak., and received B.S. in agriculture (1957) and an M.S. in chemistry (1959) from South Dakota State University. His Ph.D. was in biochemistry in the Dairy Science Department (1962) at the University of Illinois. After Postdoctoral study at Oregon State University (1962-64), Larson came to the University of Missouri to work in the maize-genetics program as a research chemist (biochemistry) for the U.S. Department of Agriculture. His research is in the genetic control of biochemical mechanisms affecting plant development and disease control. Larson assisted in teaching "Biochemistry" at the University.

Virgil Dean Luedders (1965-†). Luedders was born in Breman, Kans., and received a B.S. in agriculture (1958) from Kansas State University and an M.S. (1960) and a Ph.D. (1963) from Michigan State University. He then spent two years in a Postdoctoral position in genetics at the University of California (Davis). Luedders came to Missouri as a research agronomist for the U.S. Department of Agriculture in the soybean-breeding and genetics-research program after Leonard Williams' fatal automobile accident.

Administrative Appointees

Three administrative appointees during this period had academic ties to the Department of Field Crops:

Richard John Aldrich. Aldrich was appointed associate director of the Agricultural Experiment Station and professor of field crops in 1964. In 1967, he became associate dean for research. Aldrich, a native of

Fairgrove, Mich., had received a B.S. in agriculture (1948) from Michigan State University and a Ph.D. (1950) from Ohio State University. From 1950 to 1957, he had conducted weed research for the U.S. Department of Agriculture located at Rutgers University, and from 1957 to 1964 was assistant director of the Michigan Agricultural Experiment Station.

Norman Edward Justus. Justus, a native of Marionville, Mo., received his B.S. degree at the University of Arkansas in 1954, and his M.S. and Ph.D. from Oklahoma State University in 1955 and 1958, respectively. From 1958 to 1965, he was cotton geneticist for the U.S. Department of Agriculture at Knoxville, Tenn. In 1965, he was appointed superintendent of the Southwest Research Center in Mt. Vernon, Mo., and associate professor of field crops. Justus was the third field crops staff member to become a research center superintendent, following Carl Hayward at Mt. Vernon and Norman Brown at the Delta Research Center, Portageville. Like Marion Brown, Justus took great pride in the appearance of field-research plots and was unceasing in his efforts to make the Southwest Research Center a model research establishment.

Gary F. Krause. In 1965, Krause was appointed Agricultural Experiment Station statistician and associate professor of field crops. As a collegewide consultant to faculty and graduate students on the design of experiments and statistical analysis of experiential data, Krause's knowledge and assistance became a valuable and much-needed resource for the faculty and graduate students in agriculture. With a joint appointment in the Department of Statistics, he began teaching courses in "Statistical Analysis," "Analysis of Variance," and "Design of Experiments." These became standard courses in the graduate programs of field crops graduate students. Krause was born in Coffey, Kans., received B.S. in agriculture (1958) and M.S. (1959) degrees at Kansas State University and a Ph.D. (1963) in statistics, mathematics, and biology at Virginia Polytechnic Institute, Blacksburg, Virginia. From 1963 to 1965, he taught in the Department of Statistics at Kansas State University.

Visiting Professors and Postdoctorals

The genetics program in the Department attracted visiting professors and postdoctoral scientists, and visitors from around the world. Those present in the Department on appointment during the period 1957 to 1967 were:

Dr. Ernest Gustav Anderson was a Visiting Professor from 1962 to 1965, following his retirement as professor of genetics at the California Institute of Technology. A native of Nebraska with degrees from Nebraska (B.S.) and Cornell (Ph.D.), Dr. Anderson had an illustrious career as a maize geneticist.

Dr. Gordon Kimber, a wheat cytogeneticist from the Plant Breeding Institute, Cambridge, England, spent the year 1963-64 in the Department. Kimber became a faculty member in the new Department of Genetics, after reorganization of the agricultural college departments in 1967, and later in the Department of Agronomy.

Dr. Moshe Feldman, a wheat geneticist and professor, Weizmann Institute of Science, Rehovot, Israel, worked with Dr. Ernest R. Sears, 1964 to 1967. Together, they contributed to our knowledge of the wild species related to cultivated wheats.

Dr. Gerhard P. Röbbelen, professor, Institute of Plant Breeding, University of Göttingen, Göttingen, West Germany, also worked with Dr. Sears, 1966-67.

College Administration

In 1960, Longwell retired as dean, and Elmer R. Kiehl, chairman of agricultural economics, was appointed dean and director. Kiehl was a native of Saline county and had received B.S. (1942) and M.A. (1950) degrees from the University of Missouri, and a Ph.D. from Harvard in economics. As a youth on a crop and livestock farm, Kiehl had read many of the college farm bulletins and in this way became familiar with names of the field crops faculty. In his first year at the University, he enrolled in Etheridge's "Field Crops" and Helm's "Field Crop Management" courses. As dean, he was a strong supporter of field crops programs. He also became a strong supporter of international agriculture programs and later was instrumental in obtaining a grant from the U.S. Agency for International Development to train graduate students for international plant-breeding activities. It was during Kiehl's administration as dean that Field Crops and Soils Departments were joined to form an Agronomy Department.

International Agriculture Programs

During Pinnell's tenure as chairman of field crops, the Missouri College of Agriculture embarked on a program of technical assistance in the development of the Orissa (India) University of Agriculture and Technology funded by the United States Agency for International Development. Located at Bhubaneswar, Orissa State, India, the new university was to be developed along the lines of the U.S. landgrant university. Ida P. Trotter, field crops extension specialist at the University of Missouri from 1923 to 1936 and recently retired from Texas A&M University, served from 1959 to 1963 in getting the new university organized and inaugurated. J.M. Pohlman was adviser on research organization from 1963 to 1965; Emmett Pinnell on agronomy programs for two months in 1967; and Dale T. Sechler on research organization from 1967 to 1969. This was the beginning of an active

international program in the new Department of Agronomy after 1967. Etheridge had never looked with favor on his staff participating in overseas projects, but Pinnell endorsed them heartily. While on the Minnesota faculty, Pinnell had served two years on a hybrid corn development project in Yugoslavia and recognized the merit of assisting underdeveloped countries and thereby broadening the perspective of participating departmental faculty persons.

Pinnell's Administrative Style

Pinnell's departmental experience had been under H.K. Hayes, chairman of the Department of Agronomy and Plant Genetics in the University of Minnesota. Pinnell admired Hayes, who had established an unparalleled record as a teacher of plant breeding. Hayes was fiercely combative with his students and staff, a strategy designed to arouse their competitiveness. Pinnell sought to emulate Hayes in this technique but sometimes lacked the artful tact required to prevent arousing hostility. He had worked exceedingly hard to improve the department and thereby gained the respect and appreciation of the field crops faculty. But his aggressiveness in seeking ever greater financial support from the deans brought upon him the enmity of the college administration. Pinnell's position as department chairman became a casualty of the departmental reorganization implemented September 1, 1967. On October 30, 1967, he suffered a massive and fatal stroke.

12. THE GENETICS AREA PROGRAM

The genetics program emerged as a splinter group within the Department of Field Crops. In the beginning, its source of strength was Stadler; in later years, it rallied around Sears. The exceptional scientific attainments of these two scholars created an internationally renowned center for classical maize- and wheat-genetics research. This international image contrasted starkly with the local image carefully groomed by Etheridge of a department dedicated to serving Missouri agriculture.

Stadler's early research in the Department was in field plot experimental technique and in crop-variety improvement. In 1919, W.H. Eyster had started an agricultural Experiment Station project on "A Genetic Analysis of Maize." Although Eyster was in the Botany Department, the research project was in field crops. When Eyster left the University in 1924, Stadler was given the project. Papers published by Stadler in 1925 and 1926 on linkage and crossing-over in maize

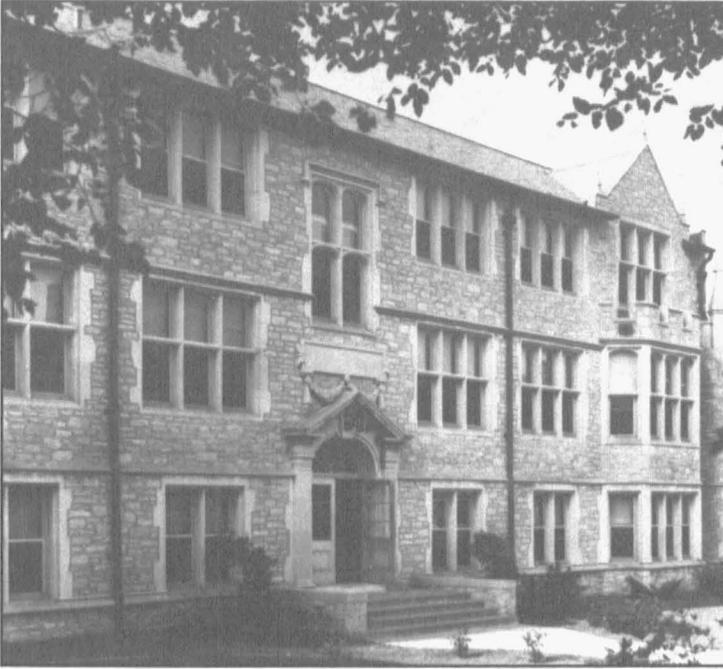
attracted widespread and favorable attention among maize geneticists. Stadler's stature as a geneticist was further enhanced by a series of publications starting in 1928 on the effects of radiation on mutation. As his genetic research efforts expanded during those years, the breeding projects were shifted to Kirkpatrick, Tascher, and King.

I first knew Stadler in the spring of 1929 as a student in his course in "Field Crop Improvement," and as a student laborer under him planting radiated barley seeds in the greenhouse and counting mutant plants. Theoretical genetics did not appeal to my practical outlook, so the next semester I transferred to work for Helm. At that time, field crops faculty and students not involved in genetic research projects tended to distance themselves from Stadler. With his fertile imagination and suave, persuasive manner, Stadler would invite their cooperation on genetic experiments that, to their later dismay, utilized their time and resources at the expense of their own research. His obliviousness to other departmental programs occasionally resulted in conflicts with Etheridge or other academic staff.

Distance between the genetic research group and the remainder of the Department became a reality when a grant from the Rockefeller Foundation in the late 1930s led to the construction of Curtis Hall to house the genetics program. Etheridge sanctioned the move of the genetics-related programs to Curtis to reduce internal friction and to relieve congestion in Waters Hall. By that time, additional U.S. Department of Agriculture scientists had arrived, E.R. Sears, J.G. O'Mara, and Luther Smith for genetic research on wheat; and George F. Sprague on the corn-breeding project. Maize cytogeneticists Barbara McClintock, Charles Burnham, and Bently Glass were collaborating with Stadler during summer periods. Office and laboratory space in Waters was woefully inadequate. In addition to Experiment Station and Department of Agriculture funding, the maize genetic research had attracted generous gifts from the Rockefeller Foundation, National Research Council, U.S. Department of Agriculture, and other funding agencies. With the move to Curtis Hall, the maize- and wheat-genetics research operated essentially as a quasi-official program within the Department of Field Crops.

After Stadler's death, John R. Laughnan was appointed professor of field crops and unofficial leader of the genetics program. Laughnan had completed a Ph.D. under Stadler in 1946. He stayed only one year before returning to the University of Illinois as chairman of the Botany Department. Leadership then went to Neuffer who had received his Ph.D. under Stadler in 1952.

Speculations about a Department of Genetics emerged from time to time. University policy specified that science departments be located in the College of Arts and Sciences, a move that would jeopardize



Built with a grant from the Rockefeller Foundation in the late 1930s, Curtis Hall housed the genetics program of the Department of Field Crops.

Experiment Station and Department of Agriculture funding for the maize-genetics research. An accommodation was reached in 1957 when genetics-oriented faculty in Departments of field crops, botany, radiation, and zoology organized a genetics program. The program received official sanction on April 10, 1958, when University of Missouri President, Elmer Ellis, addressed a letter to seven members of the four departments as follows:

“I am appointing the above-named persons to serve on a coordinating committee on genetics. I would like to have this committee function much as a department would in planning course offerings, graduate and undergraduate, that meet the overall needs of the University. Other functions of the committee may develop normally in connection with candidates for admission to the Graduate School and applicants for assistantships. It should plan the overall program in genetics here at the University of Missouri.”

The move appears to have lacked the support of some departmental chairmen or divisional deans, as implied by a letter of October 11, 1958, from Ellis to M.G. Neuffer, whom he had appointed chairman of the Genetics Coordinating Committee. The letter from Ellis states:

Myron G. Neuffer, a researcher in corn genetics, explains a genetics exhibit to a visitor on College Career Day in 1958.



“A Genetics Group which cuts across departmental and even divisional lines, as I am sure you realize, involves certain hazards. No one department chairman or even divisional dean has full responsibility for all of the work involved and, therefore, it is conceivable that the program might not secure the support it merits. I am writing this letter to assure you that the University as a whole is concerned with this program and wants to give you every encouragement possible.”

The Genetics Area Program weathered the criticism. It continued to function and was supported strongly by Pinnell, who succeeded Etheridge as chairman of field crops. The program served as a model for other area programs at the University. Leadership of the Genetics Coordinating Committee was rotated with Sears, Rédei, and Coe serving for periods as chairman.

Actually, graduate fellowships and degrees in genetics, and faculty appointments in genetics had been given from time to time. The University of Missouri Commencement Program for 1942 records that a Ph.D. in Genetics was received by Herschel Roman although no record of prior approval by the Board of Curators for a Genetics degree program could be found. Also, in 1954, Dr. Lotti M. Sears was appointed “Research Associate in Genetics” without assignment to any department.

13. TEACHING IN FIELD CROPS, 1914-67

The teaching programs in field crops have reflected the philosophies and professional interests of the different chairmen. Hutchison developed a basic undergraduate curriculum embodying the major aspects of crop production. That course program fit Etheridge's philosophy of teaching field crops broadly for the benefit of the largest number of undergraduates in agriculture rather than for a specialized few. As service courses for other departments, the enrollments were large and the classes filled with students from animal husbandry, dairy husbandry, agricultural engineering, agricultural extension, or agricultural education. Laboratory sections were sometimes eliminated to facilitate student scheduling. Graduate teaching was not stressed. The academic staff available for teaching was always limited because many research positions were filled with federal workers who could not teach on federal time and were required to take annual leave while in the classroom. Yet Brown, Baldrige, Coe, Doyle, Larson and others often taught or assisted in teaching particular courses. All federal workers received University appointments and advised graduate students.

When Farm Crops became a Department in 1914, the core courses in the curriculum continued to be taught through the 53-year life of the Department with changes that were largely cosmetic. "Farm Crops" was changed to "Field Crops" when the department name was changed; "Cereal Crops" became "Grain Crops", and both courses were reduced to three credit hours. "Grain Judging" was replaced with "Grain Grading and Marketing" and "Seed Analysis." Courses in "Forage Crops" and "Fiber Crops" were introduced. Stadler introduced two graduate level courses, "Advanced Field Crop Improvement" and "Crop Experimentation" in the 1920s, but they were rarely taught in the early years. A course, "Advanced Genetics," offered jointly with the Department of Botany and Zoology, was scheduled from 1929 through 1960, although not always taught. The Departments of Botany and Zoology were depended upon for instruction in biological sciences, introductory genetics, plant physiology, and plant pathology.

After Pinnell became chairman in 1957, the curriculum was rapidly expanded. Offutt had initiated discussions about the curriculum, but his tenure as chairman was too brief to effect substantive changes. However, it was with his blessing that Poehlman began teaching the "Crop Experimentation" course that had lain dormant for many years, and "Advanced Field Crops Improvement" in order to provide graduate level courses for students in the Department. There were several reasons for the curriculum expansion under Pinnell. Pinnell's graduate study at

Students work
diligently in a
field crops grain
grading
laboratory in
1941.



Minnesota was in genetics and plant breeding, and he desired to advance those areas of study in the Department. The genetics area program was newly established, and part of its mission was to improve genetics teaching. New disciplines, weed science and plant pathology, had been brought into the Department of Field Crops, and courses were not being offered in those areas. The number of graduate students had been increasing since World War II, and the teaching program of the Department needed expansion to accommodate this new dimension. Although the service aspect of teaching undergraduates from several departments was still important, it did not now fulfill the total need of the students.

The introductory course, "Field Crops," was generally taught by the department chairman. Etheridge, in 1928, had published an elementary text in field crops, and he continued to revise and update his "Studies in Field Crops," with the last edition in 1950. Pinnell relinquished the teaching of "Field Crops" after a few years to Charles Hayward, who subsequently assisted in development of the course "Plant Science" (later called "Crop Science"). The laboratories in "Field Crops" were the training ground in teaching for many graduate students and young faculty members.

"Field Crops Management" was Helm's course. Many students enrolled to gain exposure to his enthusiasm and practical knowledge. Helm liked to shock the students with unbelievable statements. When they challenged him, he had their attention to make his points. "Grain Crops," "Forage Crops," and "Fiber Crops" provided depth to the course program. All were taught by specialists in those fields; "Grain Crops" successively by King, Poehlman, Sappenfield, and Cavanah;

"Forage Crops" by E.M. Brown and Baldridge; "Fiber Crops" by King, Langford, Norman Brown, and Hicks. Cavanah taught the "Grain Grading," and Stanway the "Seed Analysis" courses. Stanway's manual for beginners in seed testing provided information on standard procedures. "Field Crops Improvement" became Poehlman's course when he took over the small-grains breeding projects and led to development of the textbook, "Breeding Field Crops." "Weed Science" was developed and taught by Fletchall because he developed that area of research in the Department, and "Field Crops Diseases" was developed and taught by Whitehead and Calvert. These latter courses were first listed in the University catalog in 1957-58. A course in "Seed Production and Processing" was introduced by Cavanah and "Advanced Seed Analysis" by Stanway in 1961-62.

The influence of the genetics area program was displayed through the increased offering of graduate-level courses. In 1957-58, Neuffer introduced the course "Gene Structure and Function." This was followed with "Genetic Techniques" by Coe, "Evolution of Genetic Concepts" by Rédei, and "Cytology" by Doyle. Larson assisted with teaching "Biochemistry." When Neuffer began teaching "Principles of Genetics," fulfilling a long need for an elementary genetics course, enrollment in it increased rapidly. New graduate-level courses in genetics were also introduced in the Department of Botany. Genetics and plant breeding became strong teaching areas in the Department and, along with weed science, became the major departmental areas for training graduate students.

The curricula in the College of Agriculture underwent several changes during these years that reflected the increase in specialization by students. When Farm Crops became a department, "Farm Crops" (later "Field Crops") and "Field Crop Management" were required courses for agricultural students, along with specified courses in some other departments. "Field Crops Improvement" was an alternate requirement; in the absence of a required course in "Genetics," students could select between "Field Crops Improvement," "Animal Breeding," or "Evolution of Horticultural Plants."

In 1934-35, a new curriculum was established that required agriculture students to complete an introductory course in each College of Agriculture Department. The status of "Field Crops Management" and "Field Crops Improvement" were not changed. With these curricula, the practical aspects of field crops production were broadly taught to many agricultural students. In addition, "Forage Crops" and "Grain Crops" became popular elective courses. Under this curriculum, specific courses in the sciences were required, including courses in both botany

Viola Stanway
instructs a
student in seed
testing
procedures in
1958. Stanway
was the seed
analyst in charge
of the field crops
seed testing
laboratory from
1945-79.



and zoology, but training in science generally received less emphasis than training in agriculture.

Curriculum changes were again made in 1944-45 that provided greater opportunity for specialization and placed less emphasis on general agriculture training. In the new curriculum, students were required to complete 60 hours of agricultural courses and 50 hours of subjects other than agriculture; of the latter, 25 hours were required in mathematics and science. Only "Agricultural Economics" among the agriculture courses and "General Chemistry," "Botany," or "Zoology," and one mathematics course, among the science and mathematics, were specific requirements. This curriculum required that greater attention be given to student advising because the student and the adviser were responsible for developing a course program to meet each student's specific career objective. From the initiation of this curriculum until 1963, I was responsible for the advising of undergraduate students in Field Crops and, in addition, many "general agriculture" students.

The new curriculum fulfilled the objective of enabling the advisor and student to tailor a course program to meet a student's career objective. As an adviser, I thought it had two weaknesses: 1) few students had a specific career objective or established one so late in their college career that an effective course program couldn't be planned, and 2) it further weakened the overall science training of agriculture students because the minimum requirements in science were construed to be the maximum necessary by students who found science courses to be difficult. The science component of the student's program, I felt, was further weakened with the introduction of the "Plant Science" course, with the provision that it could substitute for a biological science course in the student's program.

14. RESEARCH IN FIELD CROPS, 1914-67

Changes in Crop Production Practices

When the Department of Farm Crops was established in 1914, animal-agriculture dominated the Missouri uplands with cash-crop farming principally on the alluvial soils along the major rivers and in the large southeast Missouri Delta area. About 15 million acres were cultivated in Missouri, with about one-half that acreage being planted in corn, 1 to 2 million acres in oats, 2 to 3 million acres in wheat, and 3 to 4 million acres in hay. In addition, an unmeasurably large acreage was utilized as pasture. Some of it was cropland, but most was permanent grasslands or woodlands. A common crop rotation, where a systematic rotation was followed on the cropland, was corn-oats-wheat-clover and timothy. If this rotation didn't produce enough corn, an extra year of corn might be added, or corn would replace oats in the rotation, or even be grown continuously. On the uplands, where animal agriculture was practiced, the corn, oats, and hay were fed to fattening livestock, to milk cows, or to work animals, and the wheat sold as a cash crop. On the alluvial soils, which in Missouri were extensive, corn, except that fed to work animals, along with wheat and alfalfa hay, were largely grown as cash crops. In the Delta area, cotton was becoming established as a profitable cash crop. Barley, sorghum, rice, soybeans, and tobacco were often locally important, but were minor in the state's overall agricultural economy. Through the soil survey, the crops and soils experiment stations, and the farmer-cooperative experiments, the soil areas of Missouri and the crop species adapted in each soon became defined.

Crop production and production practices changed dramatically during the following 53-year period. Some of the changes were forced by catastrophic events or economic developments not within the individual farmer's control. These events included two world wars with emphasis on greater production during periods of farm-labor shortages; the Great Depression with overproduction and precipitous declines in prices of farm products beginning in 1929; two major droughts in the 1930s and again in the 1950s, which pointed up the vulnerability of a Missouri farm economy with crop production dependent upon corn and hay; and government farm policies that included acreage and price controls, farm subsidies, farm loans, and soil-conservation practices.

Extensive changes were brought about by agricultural research developments and their dissemination through agricultural-extension and farm-industry programs. None caused greater dislocations than the change from an animal-powered to a petroleum-powered agriculture. Utilization on the farm of oats and hay declined, freeing up acres previously used in their production for other crops. The technology available after World War II for producing nitrogen fertilizer in abundance reduced the critical need of a legume in the crop rotation, and improved soil-testing techniques changed fertilization practices. No longer was it necessary to adapt the crop species to the soil fertility level; now the soil fertility level could be altered to satisfy the needs of the crop species.

Crop yields increased rapidly in the 1950s and '60s as a result of the improved tillage and fertilization; new varieties and hybrids; and chemical pest control with herbicides, insecticides, and fungicides. Fewer acres were needed for production of grain and hay. By shortening the rotations, or by continuous cropping, highly productive crops such as corn could be kept on the more fertile soils, and cultivation of less fertile and more erosive soils could be reduced. The efficiency of shorter rotations had been demonstrated during the drought years with new crops like lespedeza and winter barley. Due to the increased demand by industry, soybeans became a major crop with a high market value and replaced the diminishing acreage of corn and oats. Production of grain sorghum increased as hybrids suitable for mechanized harvest were developed. By contrast, cotton was facing increased competition from synthetic fibers.

Agricultural research not only contributed to the changes in field-crop production during this period, but research endeavors were stimulated by the events of the period. Advancements in one field created the need for adjustments in related areas. New varieties or hybrids gave maximum performance only with optimum tillage, fertilization, and pest-control practices. Ready acceptance of new ideas

and practices accelerated throughout the period, and farmers eagerly awaited new research developments.

Vital agricultural research does not occur in isolation. The intertwining of research efforts by agricultural experiment stations, the U.S. Department of Agriculture, and agricultural industry often obscures the individual contributions of each. It is in this setting that the research of the Department of Field Crops is discussed.

Corn Variety and Hybrid Research

Traditionally, corn was Missouri's major cultivated crop. In 1916-17, about 7.5 million acres were grown; by 1966-67, the acreage had declined to just over 3 million acres. Since average grain yields of corn increased from 25 to more than 65 bushels per acre during that period, the total grain produced at the end was about the same. The yield increase (which later went much higher) resulted from planting corn only on the more fertile soils and greatly improved soil fertility programs, the change from open-pollinated varieties to hybrids, mechanization enabling practice of thorough and timely cultural procedures, and chemical control of weeds, insects, and plant diseases. The research leading to these changes was contributed through many disciplines at land-grant colleges throughout the Corn Belt and by private industry.

Testing of open-pollinated varieties of corn to determine their adaptation to the different soil areas of Missouri began in 1905 in outlying experiment fields and farmer-cooperative yield trials. Test results reported in AES Bulletins 143 (1916) and 181 (1921) fail to show the variety/soil type adaptation anticipated. Rather, the data show that highest yields were produced by varieties that most completely utilized the growing season. A late maturing variety, "Commercial White," was the highest-yielding variety over all areas but was recommended only for southern Missouri due to risk of injury by early frost in northern Missouri. "Reids Yellow Dent" was the highest-yielding yellow variety.

Corn cultural experiments were reported by Helm in AES Bulletin 185 (1921). Practices recommended were fall plowing on land not subject to erosion, thorough seedbed preparation as the first step in weed control, level planting instead of listing, and check-row planting to permit cross-cultivation. Crop rotation and use of barnyard manure to maintain soil organic matter were stressed. If commercial fertilizers were used, a rate not to exceed 75 to 100 pounds per acre applied in the hills or rows was recommended. This information formed the basis for classroom and extension teaching of corn-production methods for the next two to three decades.

Research on hybrid corn was started in Missouri about 1920. The AES Report for 1926 notes that strains from commercial varieties have now been inbred continuously for two to six generations. An AES project, "Corn Investigations," was first reported in 1927-28, with Stadler and Kirkpatrick as investigators. Two-hundred and fifty single-cross and double-cross combinations were assembled and preliminary field trials conducted at four locations in Missouri. During the following 10 to 15 years, the corn-breeding project encountered many problems due to unfavorable seasons and personnel changes. An unfavorable season in 1929 was followed by a severe drought in 1930; then disastrous droughts occurred in 1934, 1936, and 1937. In 1935, extensive rains precluded planting until late June. Kirkpatrick and Tascher, who were assisting Stadler on the corn-breeding project, were dismissed from the University in 1933 due to budget problems.

The U.S. Department of Agriculture transferred George Sprague to Missouri to conduct corn-breeding research in 1936, but in 1939, he was transferred to Ames, Iowa. Dean Anderson was placed in charge in 1939; in 1944, he resigned to join a private hybrid company. The first Missouri hybrids, Missouri No. 8 and Missouri No. 47, were released for commercial production during this period. Missouri lagged behind other Corn Belt states in the change from open-pollinated varieties to hybrids due to the set-backs in the College research program. Commercial hybrid-corn research programs in Missouri were similarly affected, so the hybrid companies sold hybrids to Missouri farmers that had been developed for Iowa or northern Illinois. Being early maturing and unadapted to Missouri, the hybrids sometimes scarcely exceeded yields of open-pollinated varieties.

Marcus S. Zuber, a research agronomist for the U.S. Department of Agriculture, took over the Missouri corn-breeding project in 1946. Under Zuber, the project prospered, and a productive research and graduate-student program emerged. In the late 1940s, open-pedigree corn hybrids developed by the state agricultural experiment stations and marketed through certified-seed programs were still grown extensively in Missouri, but adapted and productive closed-pedigree hybrids developed by private hybrid-corn companies were rapidly gaining in use. As research capabilities of the private companies improved, the state experiment stations gradually reduced research on development of new hybrids. In Missouri, testing of experimental combinations of single-, double-, and 3-way cross hybrids continued until the early 1960s (AES Bulletins 805 and 819, Special Reports 58 and 71). Open-pedigree hybrids MO 804, MO 843, and MO 880, were released in Missouri during this period.

A state-wide, corn-hybrid testing program was started by Zuber in

1949. The tests included experiment station open-pedigree, commercial closed-pedigree, and experimental hybrids. Testing of commercial hybrids was discontinued in 1951 but was resumed in 1953 with the hybrid companies paying a fee for each hybrid tested at each location. These hybrid corn trials are still continued with test results reported annually in experiment station publications, although recommendations for growing specific hybrids are no longer made.

As experiment station research on hybrid development was reduced, Zuber and his students gave increasing attention to a wide range of production problems. The research included studies on stalk characteristics that reduce lodging, resistance to corn earworm and to dwarf mosaic, screening for superior corn root systems, enhancement of lysine-rich protein and high-amylose starch, and date and rate of planting studies. Corn populations were generally developed that were improved in the characteristics under study, and improved inbreds derived from the populations were then made available for industrywide use. This research provided the foundation for the later release of inbred Mo17, which gave the program worldwide recognition. Another legacy of the corn hybrid research was the number and quality of the graduate students trained in corn breeding who, upon receiving degrees, became employed throughout the industry.

The stalk-quality studies were intensively researched and gained national prominence for the Missouri program, but the date-of-planting studies had the greatest effect on Missouri corn-production practices. From prior experience, May 10 to May 15 was considered the optimum date for planting corn in mid-Missouri. Studies by Zuber and Grogan showed that higher yields were obtained by planting from April 20 to May 1 in mid-Missouri and, similarly, with earlier planting dates than previously practiced at other latitudes in Missouri. The earlier-planted corn had less lodging, lower ear height, and less earworm and cornborer damage, all of which contributed to higher yields (AES Bulletins 832, 862, 868 and Research Bulletin 706). Many factors contributed to the success of early-planted corn: improved machinery that permitted rapid seed-bed preparation and precision planting, seed treatment, hybrids with greater seedling vigor and resistance to seedling diseases, and fertility programs that promoted rapid seedling growth. With earlier planting, now a common practice in Missouri, corn ripens before fall rains, a season more favorable for mechanized harvesting and permitting the timely seeding of winter cover crops.

Corn Genetics Investigations

An AES Field Crops research project, "A Genetic Investigation of Maize," was first reported for 1921-'22 (AES Bulletin 197). The research was conducted by W.H. Eyster, a member of the Botany

Lewis J. Stadler
examining corn
plants in the
University
greenhouse.



Department. When Eyster left the University in 1924, the project was turned over to L.J. Stadler in field crops. Under Stadler's guidance, the corn-genetics research brought national and international distinction to the Department. Many noted scientists came to the University and associated themselves with the project. These included G.F. Sprague, Barbara McClintock, C.R. Burnham, Bentley Glass, E.M. Uber, and E.G. Anderson. With Stadler's death in 1954, Dr. J.R. Laughnan, a student of Stadler's, was placed in charge of the corn-genetics project, then designated "Mechanism of Heredity in Corn," and Dr. E.H. Coe Jr. arrived to fill a U.S.D.A. position. Laughnan left in 1956, and Dr.

M.G. Neuffer, another Stadler student, was selected to succeed him. Neuffer and Coe continued the corn-genetic investigations that were in progress concerning mutations, controlling elements, biosynthetic pathways, and gene conversion. Later, the project was expanded by the U.S. Department of Agriculture adding to the staff Dr. Gregory Doyle (1960) and Dr. Jack Beckett (1963) to conduct research in corn cytogenetics, with interests in cytoplasmic inheritance, chromosome aberrations, and polyploidy; and Dr. R.L. Larson (1964) to study the biochemistry of anthocyanin pigments.

Stadler quickly demonstrated his skill in genetic research with studies on linkage and crossing-over in maize. He firmly established his fame and that of the Department with subsequent studies on the frequency of spontaneous mutations in maize and the effects of radiation on mutational events in plants (AES Bulletins 236, 244, 256, 272). These studies, conducted in the late 1920s, brought into focus two areas of basic investigation, (1) the structure of the gene, and (2) the nature of radiation-induced mutations in plants, that occupied the research efforts of the corn-genetic group through the next four decades. The investigations were carried out with assistance from a dedicated group of graduate students that included H. Roman, S. Fogel, J.R. Laughnan, M.G. Neuffer, M. Emmerling, J. Klinger, and G.M. Reddy (Appendix No. 2). The cytogenetic research was facilitated through a technique developed by collaborator Dr. Barbara McClintock (later a Nobel Prize recipient), that permitted the location of the position of specific genes on corn chromosomes as a consequence of chromosome breakage.

Subsequent contributions of Stadler and his successors included among others: development of the BA translocation procedure for locating genes of corn on specific chromosome arms; identification of allelic variations at the *R* locus, which permits precise identification of corn inbred lines; establishment of the compound nature of genes at the *R* and *A* loci, suggesting the existence of separately mutating elements within the entity regarded as a single gene; development of a gamete selection procedure for corn breeding; elucidation of the genetic control of mutation and the nature of controlling elements; identification of lines that increased the frequency of maternal haploids with the intent of producing doubled-haploids; discovery of a paraffin-oil technique to induce mutations in germ cells of pollen grains; and identification of the sequence of the steps in anthocyanin synthesis.

Early in his career, Stadler questioned the genetic nature of the mutations induced by ionizing radiations. He suggested that the inherent effects may be due to extra-genic alterations of various kinds, particularly short deficiencies (AES Bulletin 340). Research with non-ionizing ultra-violet radiations was intensified when it was learned

that germinal material in corn pollen (later designated DNA) absorbed the specific wavelengths of UV that induced mutagenic effects. Significant results bearing on the longstanding controversy concerning the ability of X-rays to induce gene mutations were later obtained. These results demonstrated that X-rays cause deficiencies and rearrangements of the genetic material but do not cause changes in the gene per se, whereas UV radiation induces mutants that in all respects resemble mutants occurring spontaneously or induced by hereditary agents (AES Bulletin 676).

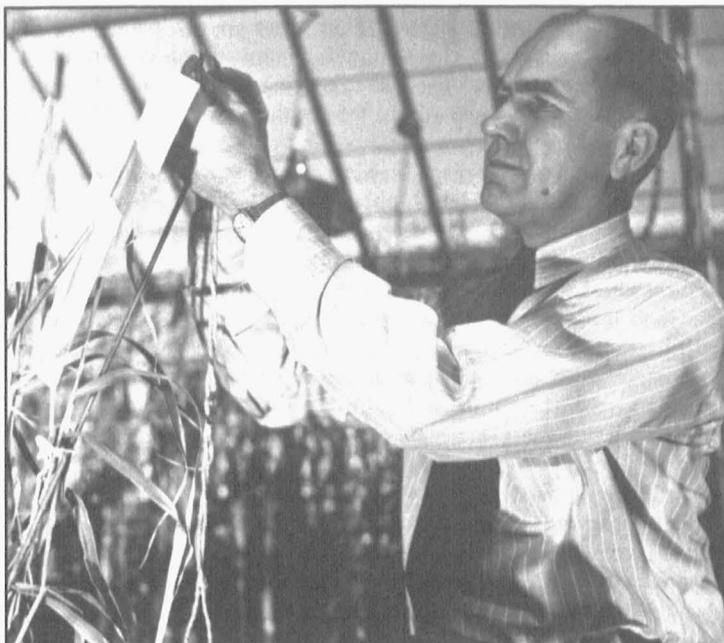
The corn genetic research program was supported generously through the years by the U.S. Department of Agriculture, National Science Foundation, American Cancer Society, Rockefeller Foundation, Atomic Energy Commission, National Institute of Health, and the hybrid corn industry in addition to agricultural experiment station funding.

Research with Small Grains (Wheat-Oats-Barley-Rice)

Wheat - Wheat was one of the earliest crops grown in Missouri by white settlers. The wheat was ground into flour on water-powered, stone-burred grist mills. By the late 1700s, a surplus of wheat was being produced around the villages of Sainte Genevieve, Saint Charles, Saint Louis, and New Madrid, and flour was being shipped down the river to New Orleans. Seed of the early wheats had been carried in by the early settlers and was of the soft red winter type. This market type, which continues to occupy the major portion of the Missouri acreage, is utilized in making excellent-quality cake and pastry flour. Spring-seeded wheat was never productive in Missouri, and only a fringe of the hard red winter type was grown in the northwestern border counties where it had greater survival during unfavorable winters.

Traditionally, wheat was the second-most important cultivated crop in Missouri after corn. In addition to supplying flour for the early settlers, or providing them with a high-value cash crop, it had practical utility in a crop rotation, facilitating the change from a cultivated crop to a hay crop. Acreage of wheat in Missouri from 1914 to 1967 was relatively stable, about 1.5 million acres. It rose sharply during World War I, however, reaching 4.5 million acres in 1916, and again following the drought years of the 1930s, reaching 3.3 million acres in 1937. But its second-place ranking in value was lost temporarily to cotton in the 1940s, and to soybeans, in both acreage and value, around 1950.

Testing of wheat varieties, initiated by the College in 1877, was expanded under Hutchison with the farmer-cooperative tests and the crops experiment fields. Responsibility for wheat-variety research,



J.M. Poehlman, small grains breeder crosses oats in a University greenhouse in 1953.

between 1916 and 1935, was shifted successively to McDonald, Stadler, Kirkpatrick, Tascher, Brown, and in 1935 to Poehlman, who continued in charge until 1969. Etheridge and Helm conducted early research on culture and production (AES Bulletin 188).

When I took over the wheat-breeding program, the leading varieties in Missouri were "Michigan Wonder," "Poole," "Fultz," "Harvest Queen," "Fulcaster" and "Mediterranean." Several of these varieties, or varieties essentially identical to these, had been included in Tracy's original wheat-variety trial begun in 1877. Changes had occurred within the varieties through the years, so pure-line selections had been made from several by Hutchison and Stadler, and crosses made among them. The field notebooks handed down to me from Stadler were filled with notes on minute morphological differences or color markings of the different lines, ostensibly useful for genetic studies but of little value for evaluation of breeding lines. My reaction was that a farmer was not interested in whether a wheat variety had white or purple glumes; he wanted a variety that would stand until harvest without shattering and that would produce a high yield of good-quality grain. So I began to identify features desirable in a Missouri wheat variety: winter hardiness, short-stiff straw, early maturity, disease resistance, soft wheat

milling and baking qualities. I taught these in my plant-breeding course, emphasizing that these should be considered by farmers in choosing a variety to grow. This led to writing the textbook "Breeding Field Crops" because none of the textbooks available at that time discussed breeding objectives, yet breeding objectives were the major conversation topics when plant breeders got together.

Someone, probably Helm, obtained seed of an early-maturing variety from a farmer in Platte County, which Etheridge named Missouri Early Premium. It fitted into their wheat-lespedeza rotation, the early wheat harvest advancing the growth of the lespedeza following. Cake flour made from Missouri Early Premium was of highest quality, and Mr. Kelley, owner of a flour mill in Boonville, hired one of our students, Wynard Aslin, for one summer to promote the variety with farmers on the river hills and bottom lands adjacent to his mill. However, as with most extremely early varieties, yields did not measure up to yields of normal maturing varieties, so the variety didn't become popular with farmers.

Short straw was an elusive character, also. Short wheats like early wheats normally produce less grain. Missouri wheat fields were filled with tall, high-yielding, winter hardy varieties like Clarkan and Vigo when the farmers changed from binder to combine harvesting. The large volume of straw passing through the combine slowed the harvest operations. The advantages of the dwarfing genes from the Japanese Noren wheat, which shortens straw and maintains or even increases yield, were then unknown to American breeders. When the utility of the "Noren 10" parent was later demonstrated in Washington State and the International Research Center in Mexico, I rechecked my field notes to find why I hadn't utilized the Noren strain in the Missouri program. I had received those lines from the USDA at the same time as Washington State. In Missouri, "Noren 10" was severely winterkilled. But a strain from France with related parentage and short stiff straw was utilized in crosses from which the variety "Hart" was selected.

The varieties "Lewis" and "Stadler," named for Dr. Lewis Stadler, originated in a thesis study on radiation-induced mutations in wheat by Charles Hayward. The Stadler variety had many excellent characteristics, winter-hardiness, high yield, leaf-rust resistance, and superior quality. I never have been convinced that all of these characteristics originated from radiation-induced mutations rather than fortuitous outcrossing. But Stadler was a tall wheat and never became popular for combine harvesting.

Quality became an important consideration in the breeding program when Mr. Dulle, the owner of a flour mill in Jefferson City, came to the University for help. He had milled "Kawvale" wheat purchased from the state prison farm, and the cake flour made from it was returned

by a St. Louis bakery as unsatisfactory. Kawvale had been developed in Kansas of hard wheat parentage. To evaluate the baking quality of soft red winter wheats in the breeding program, we established cooperative research with the Scott County Milling Company, Sikeston, who milled wheat samples from the variety test plots, and the Department of Home Economics, who evaluated the flours for cake-baking qualities. Later, Missouri and other soft-wheat-producing states cooperated with the USDA in development of a Regional Soft Wheat Testing Laboratory at Wooster, Ohio, for quality evaluation of wheat breeders' samples across the Eastern soft-wheat production area.

Oats - Oats was a major cultivated crop in the early years of the Department, with acreages frequently exceeding those of wheat as late as 1950. Because bushel value was low, high yields of oats were required to make the crop profitable. Oats usually followed corn in the rotation, and early planting of an early-maturing variety were essential practices for high yields. When tractors replaced horses and mules on the farm, the demand for oats as feed diminished. This change, combined with the low price of oats and the introduction of new short rotations in which oats was not a necessary component, resulted in the oat acreage in Missouri declining rapidly beginning in the early 1950s.

Oat variety tests were included in the farmer-cooperative experiments by Hutchison, and testing of oat varieties was continued by Etheridge, Helm, and Stadler. The variety Fulghum, first tested in 1919, was found to be well-adapted in Missouri. Fulghum was selected from the Red Rustproof family of varieties. These oats originated in the Mediterranean area of Europe and could withstand high early-summer temperatures better than varieties of white oats that were grown in Northern United States and that had originated in the cooler climates of northern Europe. Fulghum contained many off-type plants. One of these plants was selected and increased as the variety Columbia. During the hot and dry 1930s, Columbia became the leading variety in Missouri and the Central United States. It was used extensively in milling rolled oats by the Quaker Oats Company in their St. Joseph, Mo., plant.

I assumed responsibility for the oats-breeding program in 1939. Resistance to smuts and rusts had been combined into single varieties by USDA breeders at Ames, Iowa. My predecessor on the oats research project, B.M. King, had crossed Columbia oats to the disease-resistant varieties. From these and later crosses came Mo. 0-200, Mo. 0-205, Macon, Nodaway, Pettis, and Nodaway 70 varieties. During the 1950s, a new virus disease, barley yellow dwarf, attacked oats in the Southern corn belt. Mo. 0-205 and Pettis possessed genes conferring resistance to the virus. The genes were intensified through a Ph.D. thesis study by a student from Thailand, Praphase Weerapat. A virus-resistant selection

originating from that study was later distributed as a variety under the name Bates.

Barley - Barley acreage in Missouri has varied widely, from a few thousand acres in 1914 to more than one-half million acres planted in the fall of 1954. Tests of spring-seeded varieties were conducted until 1933, but yields were generally unsatisfactory. Fleetwood once said that "spring barley in Missouri has just enough element of success to keep a few farmers interested." Winter barleys were being grown locally in southern Missouri. The seed was carried in from Kentucky and Tennessee by early settlers. Hutchison, in 1914, noted that winter barleys are more promising than spring varieties in Missouri. He and McDonald selected plants that had survived the winter of 1913-14 from several varieties, but the lines increased from them were lost in the severe winter of 1916-17. Tests and farm observations of winter barley were made by Etheridge and Helm beginning about 1921. By 1931, they were strongly promoting winter barley, using for this purpose an early-maturing variety obtained from C.H.E. Walther, a certified seed grower farming near Boonville. Walther had purchased the seed from a St. Louis, Mo., seedhouse, but earlier origin could not be traced. Helm saw Walther's barley field in 1931 and noted its early maturity, two to three weeks ahead of wheat varieties grown then. The early maturity fitted the barley into rotations as a nurse crop ahead of lespedeza, or as an alternate crop in a one-year rotation with soybeans. Walther's barley field was rogued to remove some of the impurities, the seed increased rapidly, and the variety released with the name, Missouri Early Beardless.

The disastrous drought in the summer of 1934 decimated Missouri pastures, and farmers were being forced to market their livestock for lack of feed. Etheridge and Helm recognized that even with fall rains the pastures would not recover sufficiently to provide needed feed. Winter barley pasture seemed to be the best solution. Among the winter grains, winter barley seeded in August would make the most rapid vegetative growth and would provide the earliest and largest quantity of nutritious forage for fall grazing. With Missouri State Drought Relief Agency support, Helm and King traveled to Oklahoma and Tennessee, states with large acreages of winter barley, and purchased several carloads of seed, which were shipped to Missouri and made available to drought-stricken farmers for planting after the rains started in mid-August of 1934. In addition to the pasture, winter barley grain harvested the following spring provided a feed grain several months ahead of a crop of corn. By 1939, 200 thousand acres of winter barley were being harvested in Missouri. This lesson was not forgotten. When droughts struck again in the 1950s, the acreage of winter barley again increased, this time to one-half million acres in 1955. Beginning in

1960, the barley acreage declined rapidly. When the government started compensating farmers for reducing cultivated acreages, barley, which had a lower market value than corn, wheat, or soybeans, was the first crop to be reduced in acreage. Also, with the introduction of the combine, harvest losses were heavy due to lodging before the crop could be combined.

Missouri Early Beardless proved to be a poor variety for grain production, but crosses of it with hardy, bearded types led to the improved varieties Mo. B-400 and Mo. B-475. Selections from Missouri Early Beardless were found to be highly resistant to loose smut. Beginning in 1962, winter malting barley investigations were initiated, funded by Anheuser Busch, Inc., and a series of two-row, winter-hardy malting types were developed.

Rice - Between 1916 and 1967, rice acreage in Missouri never exceeded more than a few thousand acres, although there are 1.5 to 2 million acres of potential rice soils that could be planted in the crop. Rice soils, in addition to moderate fertility, have special requirements: a relatively impervious subsoil to hold water, level topography so that irrigation water may be evenly distributed, surface drainage to carry off water to permit seedbed preparation and harvest, and an available source of water for irrigation. The gray, second bottom soils between the Ozark uplands and the Crowley Ridge in the southeast lowlands, and the heavy 'gumbo' soils along the Mississippi and Missouri rivers and their tributaries meet these requirements.

In Missouri, rice was grown first in the southeast lowlands in Stoddard and Butler counties, beginning about 1916. In 1923, production was started north of St. Louis in Pike, Lincoln, and St. Charles counties. Here, the crop was highly successful for several years, reaching 10,000 acres in 1928. Afterward, the crop in that area was abandoned due to declining yields, poor quality, and falling prices.

A rice experiment field was established on heavy clay soils near Ellsberry, Lincoln county, in 1929-30, by the Field Crops Department in cooperation with the U.S. Department of Agriculture, to find methods for overcoming the declining yields. Professor B.M. King was appointed a federal cooperative agent and placed in charge. The cooperative research project had been under consideration for several years. On March 13, 1923, Etheridge had sent a list of rice growers to C.E. Chambliss, rice research scientist in the U.S.D.A., and offered to visit the growers with Chambliss. He suggested that the Department of Field Crops and the growers would accept an offer of cooperation from the U.S.D.A.

Research results conducted over a 7-year period (1930-36), demonstrated (1) the value of growing rice in a rotation if fertility was to be maintained and weeds effectively controlled, and (2) the need for an

early-maturing variety in northern Missouri to permit harvest before an early frost (AES Research Bulletin 254). A two-year rotation alternating rice with soybeans proved to be the most productive. Soybeans added nitrogen and improved the physical condition of the soil so that it could be returned to rice. Aquatic weeds did not thrive in dry soil during the growth of the soybean crop, and weeds common to soybean fields were eliminated when the rice was flooded.

In variety tests conducted at Elsberry, an early, short-grain rice variety, "Cody," was selected by King out of breeding lines received from California. After King's death, the rice-variety testing program was taken over by Cavanah and Poehlman and the trials moved to the J.L. Cook farm near Palmyra. Two early short-strawed varieties were developed, "Mo. R-500" and "Palmyra." In 1963, the rice research was discontinued due to lack of interest in rice by farmers in the area.

About 1950, farmers started to grow rice again in southeast Missouri and in 1967, 5,200 acres were planted, principally in Butler county, and acreage increased rapidly after that. Production technology used by the farmers was largely adapted from practices employed by southern rice growers.

Wheat Cytogenetics Studies

A wheat genetics investigation initiated in 1936, in cooperation with the U.S. Department of Agriculture, attained eminence for the originality of the research and gained national and international distinction for the Field Crops Department. The original goal of the research was to find means for duplicating the chromosome number in plants, thereby artificially creating polyploids. A polyploid plant is one with more than the normal two sets of chromosomes. Bread wheat (*Triticum aestivum*) is a naturally occurring polyploid with six sets of chromosomes, so it provided a good model for studying the phenomenon. Three young geneticists, all new Ph.D.'s, were engaged to conduct the study: Luther Smith, a student of Stadler's; Joseph O'Mara, a Bostonian by birth and a Harvard graduate; and Ernest Sears, a native of Oregon and also a Harvard graduate.

Smith, for his Ph.D. dissertation, had conducted cytogenetic studies with *Triticum monococcum* and *T. aegilopoides*, wild diploid species of wheat. The diploid species have two sets of chromosomes only. Smith continued the research with diploid species and through X-ray treatments obtained about 50 mutant genes suitable for use in genetic investigations. Because this research did not appear to be leading toward the original project goal, Smith's research, after he returned from military service in World War II, was switched to cytogenetic studies in barley, and in 1943 he was transferred by the USDA to Washington State University in Pullman.

O'Mara conducted research with rye, a related species, and produced the first triticale of the type now widely grown throughout the world as a substitute for wheat; namely, a doubled hybrid of durum (tetraploid) wheat and rye. After returning from a leave during which he worked on a USDA war-related project, O'Mara initiated cytogenetic research in oats, also a polyploid species. In 1950, he resigned to accept a position at Iowa State University.

Sears, after arriving in Columbia in 1936, embarked on the original objective of the research project, that of finding a means to induce the doubling of the chromosome number in plants. Following a lead that heat treatments might be effective in accomplishing this goal, he subjected pollinated embryos of wheat to heat, but without success. At that point, there appeared a journal article reporting that colchicine, an alkaloid extracted from seeds and corms of the autumn crocus, *Colchicum autumnale*, was an effective agent for doubling chromosome number in dividing cells. Because this solved the problem of polyploid induction, Sears began casting about for other areas of research.

The previous year he had made a wheat x rye cross. The wheat variety Chinese Spring was used because it was reported to cross readily with rye. From the cross, a haploid plant (having only one set of chromosomes) was obtained. When the haploid plant was pollinated with wheat, he obtained 14 seeds, 13 of which germinated. Of the 13 plants, 11 were monosomic (were short one chromosome) and two were trisomic (had one extra chromosome). This was the lead that Sears was looking for. It proved to be a fruitful area of research and occupied Sears' attention for the next 50 years.

Bread wheat has 42 chromosomes and evolved through the union of three diploid species, each with two sets of seven chromosomes. In wheat, customary methods of genetic analysis of plants are inefficient because the large chromosome number increases the difficulty of linkage studies, and duplicate genes on the chromosome sets of different origin mask recessive mutations. Sears reasoned that the loss of a single chromosome (monosomic), or loss of a single pair of chromosomes (nullisomic), would provide a simple means for genetic studies of the wheat plant because it would permit observation of the effects of a single chromosome, or pair of chromosomes, on the plant. Also, the addition of a single chromosome (trisomic), or substitution of an alien chromosome for the original (substitution line), would permit observations of the effect of the added chromosome.

A thorough genetic analysis of wheat utilizing these techniques would require recovery of the 21 possible monosomics, i.e. 21 plants, each monosomic for a different pair of chromosomes. To develop these became Sears' goal, which he patiently pursued. The most fruitful

source of monosomics and trisomics proved to be the Chinese Spring wheat x rye crosses and from partially asynaptic nullisomics arising from these crosses. Asynaptic chromosomes don't pair and tend to get lost or become duplicated. By the early 1950s, all of the possible monosomics and nullisomics had been obtained. These are described in AES Research Bulletin 572 (1954).

One of the earliest uses of the Chinese Spring monosomic lines was to identify the wheat chromosomes on which particular genes for stem-rust resistance were located. Since then, monosomic lines have been established in numerous wheat varieties, and the procedure has become the principal means for genetic studies in wheat-research laboratories around the world.

Other valuable research contributions from this research project have been the identification of a wild wheat species, *Aegilops squarrosa*, as one of the three diploid parents of the cultivated bread wheats; establishment of the identity of each of the 21 chromosomes in a haploid germ cell of bread wheat and their assignment into three sets of seven according to their diploid parent origin; and the transfer to bread wheat of a gene for leaf-rust resistance carried in an X-ray-induced chromosome segment from a diploid wild wheat species, *Aegilops umbellulata*.

Soybean Research

The soybean was introduced to the Missouri farmer around the turn of the century. Soybean-variety tests were being grown by the Agricultural Experiment Station by 1900, and the soybean was included along with cowpea in the Agronomy Department's farmer-cooperative testing program in 1914. In those years, cowpeas received more attention than soybeans, particularly in the early rotation studies on poor soils. They were also grown in association with corn for hogging down. Both were grown for hay on soils too low in calcium or too high in soil acidity to grow clovers or alfalfa. Hackleman reported that cowpeas were superior to soybeans for hay, but soybeans were superior for seed because they were more easily harvested and their seeds didn't crack as badly in threshing (AES Bulletin 117). Cultural experiments were conducted on row width and planting rate. But most farmers planted soybeans in 36-or 42-inch rows with a corn planter. Farmers planted them this way so that they could be cultivated like corn, and not necessarily because of any conclusive experimental data from the University. Planting with a grain drill might be used if grown for hay.

The practice in Missouri of growing soybeans principally as a hay crop continued until the 1940s. By 1921, soybeans had been shown by Helm to be superior to cowpeas for both hay and seed (AES Bulletin 197). My father grew an occasional soybean hay crop on his farm in Macon County in the early 1920s. Molding of the hay while curing and

loss of leaves in handling the hay were common problems encountered in harvesting. Because the soybean was a new crop in Missouri and the strains of *Rhizobium* needed for nodule formation were not present in the soil, cultures were obtained from the University in Columbia to inoculate the seed before planting. That task usually fell to me.

Soybean-variety research was intensified about 1920 by Etheridge and Helm. The varieties were tested for hay and seed production in Columbia and on crops experiment fields in Maryville, Warrensburg, Kirksville, Shelbina, Cuba, and other locations. The soybean varieties included in the variety tests had generally been introduced into the United States by the U.S. Department of Agriculture from China, or they were selections from introduced seed lots. A group of these introductions had been received by the Department of Agronomy in 1909. Varieties that emerged as productive in Missouri included "Virginia," "Wilson" and "Laredo" for hay, and "Morse," "Medium Yellow" (probably "Midwest"), and "Mikado" for seed. Varieties recommended for hay were typically tall, thin stemmed, and indeterminate in flowering habit, while seed varieties were short, stocky, with determinate flowering habit. Yellow seed color was desired in seed varieties, but seed color was unimportant in hay varieties.

Yields obtained in the variety tests indicated that "Virginia" was the most desirable variety on soils below average and "Morse" on soils above average in fertility. Two Ph.D. thesis studies were conducted in attempts to answer why this variety adaptation occurred. Mine was the first, and I compared the two varieties in a wide range of environmental conditions. Although no definitive answer was found to this complex problem, one lead uncovered on the relative yields of the varieties when grown with different levels of exchangeable bases was followed up by Denver Allen with cultures grown in varying nutrient solutions. His results indicated that with high nutrient levels, "Morse" used larger amounts of phosphorus, potassium, and sulphur for increased growth over "Virginia" (AES Research Bulletins 255 and 361). In another development, 134 systematic forms of soybeans were classified by Etheridge, Helm, and King on the basis of their morphological features (AES Research Bulletin 131). The study embraced most of the varieties then being grown by farmers in the United States.

King was given responsibility for the soybean project in the late 1920s. The soybean was still popular as a hay crop in Missouri, but soybean-processing plants were being built, and the market demand for the soybean was growing. One objective of King's breeding project was to produce a dual-purpose variety with the plant type of "Virginia," a brown-seeded variety, and yellow seeds with high oil content suitable for processing. Forty-two crosses among 23 parent varieties were made. One cross, Virginia x S.P.I. 37062, yielded lines that appeared to meet

his goal, a "yellow-seeded Virginia." After several years of selection and testing, seed increases were made of the superior lines, only to learn that they shattered easily and all of the lines had to be discarded. This ended efforts to develop a dual-purpose soybean variety. By that time, lespedeza had generally replaced the soybean as a hay crop and the seed varieties "Boone" and "S-100," developed by King, had been released. In 1942, the acreage of soybeans in Missouri harvested for seed made a rapid upturn and exceeded the acreage harvested for hay for the first time.

Rapid progress was made in soybean breeding after organization of a U.S.D.A. Regional Soybean Laboratory at Urbana, Ill., in 1936, in cooperation with North Central Agricultural Experiment Stations. Dr. L.F. Williams, breeder and geneticist located at Urbana, had the uncanny ability of making the right crosses. Selections from his crosses were tested in Missouri and other cooperating states, and as superior lines were identified, they were increased and distributed in the states where they were adapted. Graduate students Leon McHoney, Denver Allen, and Carl Feaster were employed by the USDA Regional Laboratory to assist King with variety testing. After King's death in 1947, Feaster conducted the soybean research until completion of his Ph.D. thesis in 1950. In 1951, Williams was transferred to Missouri. He remained in charge of the program until his death in an automobile accident in 1965. Varieties released cooperatively through the Regional Laboratory and grown in Missouri prior to 1967 included "Adams," "Chief," "Clark," "Clark 63," "Harasoy," "Harasoy 63," "Hawkeye," "Hill," "Kent," "Lincoln," "Perry," "Pickett," "Scott," "Shelby," "Wabash," and "Wayne." Williams had contributed in some measure to the development of all of them.

The soybean cyst nematode had spread into southeast Missouri by 1957, and it became a disastrous pest of soybeans in that area. "Peking," an introduction from China received in Missouri in 1909 from the U.S. Department of Agriculture, was highly resistant, but the resistance genes were tightly associated with genes for black seed coat. Williams and his graduate student, Arnold Matson, succeeded in breaking the tight linkage and transferring resistance to a yellow-seeded variety—a remarkable feat, indeed, since resistance was controlled by three recessive genes and one dominant gene. The latter was tightly linked to the seed-coat-color gene. In 1967, the Missouri Agricultural Experiment Station released the variety "Custer" with resistance to the cyst nematode from this source. After Matson completed his graduate degree, he transferred to southeast Missouri and developed a breeding program on the Delta Research Center in Portageville. He resigned in

1966 to accept a commercial position and was succeeded by Leo Duclos, a Purdue graduate.

Cotton Research

In Missouri, cotton is produced almost entirely in seven counties—Pemiscot, Dunklin, New Madrid, Mississippi, Scott, Stoddard, and Butler—all lying in the southeast Mississippi River Delta, or Bootheel, as the area is commonly called. The climate, soils, and topography of the area are well suited to cotton production, and the area's proximity to the Mississippi river offers cheap transportation to New Orleans and access to world markets. From 1914 to 1921, the cotton acreage averaged about 100,000 acres, small in comparison to the leading cotton-producing states. But acre yields were high, and for the five-year period 1917-21, Missouri ranked second only to North Carolina in production of lint. The cotton acreage expanded rapidly after 1921, reaching one-half million acres by 1925; from then until 1967, the annual acreage fluctuated between 300,000 and 600,000 acres. About 1940, cotton replaced wheat as the cash crop in Missouri with the highest value, but this distinction was lost to soybeans in the 1950s. The rapid increase in acreage of cotton after 1921 was the result of rising prices for cotton, the reclamation of highly fertile soils through the Little River Drainage District, and failure of the boll-weevil, a scourge to cotton production in the South, to become established in Missouri.

The rapid increase in the cotton acreage in Missouri after 1921, by growers inexperienced in cotton production, brought a deluge of requests to the College of Agriculture for information on cotton production practices. Because the area had production problems different from the deep South, it was clear that additional research was needed. Cotton had been included in the Agronomy Department's farmer-cooperative variety tests in 1913, and in 1914 a five-acre cotton experiment field had been established on light sandy loam soil near Kennett. In 1915, the Kennett field was enlarged; twelve varieties were tested and fertility trials conducted with treatments of cottonseed, acid phosphate, and manure (AES Bulletin 147). Etheridge and Helm continued cotton research on the Kennett field and in 1923 developed recommendations for cotton production in Missouri, although much of the information was an adaptation of research results from Southern states (Agricultural Extension Circular 122). So to bolster the cotton research effort, B.M. King, a 1922 graduate who was then employed on the Cotton Field Station, Greenville, Texas, was brought back to Missouri in 1924 to develop an expanded cotton research effort.

The cotton research program developed by King consisted in general of three lines of investigation, (1) variety adaptation to the different

William (Bill) P. Sappenfield, cotton breeder at the Delta Research Center; examines a new experimental strain developed in the Delta Center research plots.



soil types of southeast Missouri, (2) combinations and rates of fertilizer for cotton on the different soils, and (3) plant-spacing trials in cotton. In 1924, King located cotton experimental trials at Charleston, Bertrand, Sikeston, New Madrid, Caruthersville, and Holland, in addition to the Kennett field. These locations enabled the research to be conducted on soils with a wide range of fertility and physical conditions. Additional test locations were established from time to time as needed to answer specific production problems. In 1930, a Crops and Soils Experimental Field was established on a farm north of Sikeston. The Sikeston field, later moved to a site south of the city, served as the principal location for cotton research in southeast Missouri until the establishment of the Delta Research Center at Portageville in 1959.

The 1950s brought mechanization to cotton production, reducing dependency on hand labor to chop, hoe, and pick the cotton crop. With the change, there emerged a new group of problems related to seedbed preparation and fertilization, seeding rate with delinted seed, cross cultivation to eliminate hand chopping, flame cultivation and chemical weed control, supplemental irrigation, defoliation, and new short-season varieties suitable for once-over mechanical picking. W.R. Langford became cotton production specialist and superintendent of the

experiment field at Sikeston in 1948. When he left in 1951, he was succeeded by Norman Brown. Langford's and Brown's appointments marked a change in Department policy because they were the first crops experiment station superintendents with academic appointments in the Department.

In 1956, William P. Sappenfield started a breeding program with cotton. Sappenfield had received his Ph.D. from the University in 1952 and had subsequently been employed as a cotton breeder in New Mexico and California. In the initiation of the breeding program, Sappenfield recognized the high costs associated with mechanized cotton production and the need for varieties that would mesh with a profitable production system. He set as his goal the development of a rapid-fruited, short-season variety suitable for "once over" harvesting during favorable October weather with a spindle-picker or brush stripper; high lint yield and lint quality for wide end-uses; seed cotton suitable for food or oil and planting seed; and multi-disease and insect resistance. Germplasm from a wide range of genetic backgrounds were intercrossed. By using sequential inoculation techniques with different disease organisms, simultaneous selection for resistance to several diseases was facilitated. The research culminated in the release of the Delcot cotton germplasm.

Sorghum Investigations

Prior to 1955, sorghum was not a major crop in Missouri. During the period 1916-55, the area planted in sorghum averaged about 200,000 acres, but this included sorghum for all purposes: grain, silage, syrup, and forage. About one-fifth of the total acreage was harvested for grain, with three-fifths utilized for forage. Much of the latter would have been sudan grass utilized for supplemental summer pasture. Miller tested sudan grass extensively in the early crop-rotation studies, and Helm included sudan grass and sweet sorghums on the outlying crops experimental fields, particularly on poor, droughty Ozark soils such as that on the Cuba field.

Grain sorghum acreage expanded rapidly in Missouri after 1955, reaching 603,000 acres in 1958, with about 70 percent of the total being grain sorghum. The rapid expansion in the grain sorghum acreage followed a year of poor corn yields, in 1954, due to drought injury. Also, the early-maturing short-stalked varieties and hybrids of grain sorghum suitable for combine harvesting were just becoming available. Grain sorghum variety testing had been initiated in 1914 with the farmer-cooperative variety tests, and was continued by Helm on the outlying crops experiment fields at Cuba, Green Ridge, and Stark City. But an experiment station project on sorghum was not formulated until 1958, when Zuber began testing varieties and hybrids of grain sorghum developed by commercial companies on a paid entry-fee basis.

Hay, A Major Crop

Hay is a major crop in Missouri with annual harvest of about 3,000,000 acres. The acreage remained relatively stable from 1924 to 1965, but the mix of crops harvested for hay changed greatly as will be noted in the following table:

Crop	1924-'28	1942-'46	1962-'65
Clover/timothy	75	31	42
Alfalfa	5	9	24
Cowpeas/soybeans	6	4	-
Cereal grains	2	5	6
Lespedeza	-	42	13

The remainder of the acreage was native grasses or miscellaneous legumes. The value of the hay crop averaged 38 million dollars during 1924 to 1928, and 106 million dollars during 1962 to 1965.

In spite of the high value of the hay crop in Missouri, the Department of Field Crops never had a research project that focused specifically on hay. Clover/timothy was an important component in the early rotation studies, and timothy hay was prized by farmers as a roughage for feeding work animals, but its utility and importance declined with the introduction of the tractor as a source of power on the farm. Early alfalfa investigations focused on adaptation of the crop to specific soils, fertility treatments, or varieties. One of my earliest assignments when I started to work for Helm in the summer of 1930 was to harvest alfalfa-variety and fertilizer plots he had established on farms in Lafayette County. Alfalfa-variety trials were initiated again by Offutt and Pinnell in the 1950s, with focus on comparisons of new disease-resistant varieties. Meanwhile, the Soils Department had conducted numerous fertility studies with alfalfa. The substantial increase in alfalfa acreage reported for 1962 to 1965 above was made possible by growing the crop on adapted soils, with improved fertility practices, and using the new disease- and insect-resistant varieties.

Lespedeza was introduced to Missouri farmers by the Department of Field Crops about 1930. Its spectacular performance as a forage crop during the "dry" years of the 1930s was responsible for its rapid increase in acreage. Lespedeza was promoted both as a pasture crop and a hay crop. While widely used for hay, its ready acceptance was due more to its utility in rotation-pastures with small grains than for its hay production. The reduction in lespedeza acreage was due in part to the spread of disease that reduced stands, and also the increased yield and safety of the new disease-resistant alfalfa varieties when grown with improved fertility treatments.

Several early projects were designed to look at alternative crops for forage. A project, "Spring, Summer, and Fall Sown Crops for Forage" was started by Hackleman about 1912 and continued by Helm and Etheridge until 1920. A wide range of crops were studied—crimson clover, vetch, rape, Canada field pea, rye, oats, and millet. None became important in Missouri. Cowpea- and soybean-variety trials were usually harvested for both hay and seed, but the focus was always on the variety comparisons. Helm had a project on "Comparisons of Grain Sorghum and Corn for Grain and Forage Production." He reported yields of dry fodder of the leading varieties of each, but he was interested primarily in the grain production.

Pastures Research

The largest single use of Missouri farm land is for pasture, roughly 15.5 million acres. This compares with about 20 million acres classified as crop land. There is some overlapping here as about six million of the pasture acres are crop lands that are being pastured. The remaining pasture acres are about equally divided between permanent grassland pastures and woodland pastures. During the period 1925 to 1967, the pasture acreage increased by about two million acres due to shifting of cropland into permanent pastures, clearing of woodland, or renovation of wasteland.

Pasture research was not given a high priority in the early years of the Department. The prairie soils of Missouri were originally covered with a lush growth of bluestem grass that provided abundant grazing if left unplowed. The rolling hills of northern Missouri quickly became carpeted with bluegrass after the brush was cleared away. The greatest difficulty in establishing grass was encountered in the stony, Ozark uplands. Miller had recognized this problem and in 1907 initiated studies designed to learn the practices of the most successful farmers in the region (AES Bulletin 108). When Etheridge and Helm came into the Department in 1916, they concentrated their efforts on the cultivated crops, giving attention to cultural methods and adaptation of varieties. Crops suitable for supplementary grazing occasionally received minor attention. In 1924, Helm conducted a survey of grassland problems in the Ozark region similar to the 1907 study and developed recommendations for pasture establishment and maintenance for that region (AES Bulletin 234).

An experiment station project, "Systems of Grazing Bluegrass Pastures," was started in 1931 (AES Bulletin 328). The project was in cooperation with the Department of Animal Husbandry, the U.S. Department of Agriculture, and Sni-A-Bar Farms located at Grain Valley, Mo. E.M. Brown, who had just completed an M.S. degree in Field Crops, received an appointment with the newly established Forage

Crops Division of the U.S. Department of Agriculture, and was placed in charge of the project. Responsibility for the cattle grazing on the pastures was assigned to J.E. Comfort, Department of Animal Husbandry, and Marion Hazen, a U.S.D.A. animal scientist conducting cattle feeding experiments on Sni-A-Bar Farms. Sni-A-Bar Farms was owned by the estate of the late William Rockhill Nelson, founder of the *Kansas City Star*, and it had a worldwide reputation for the quality of its registered herd of the Shorthorn breed of beef cattle. The farm provided the pastures and the beef animals that grazed the pastures. From 1935 to 1939, I assisted Brown on this pasture project on a part-time U.S.D.A. appointment conducting the field research. When I changed to cereal-breeding research, Joe D. Baldrige became associated with the project on a U.S.D.A. appointment.

Pasture research, although neglected by the Department in the previous two decades, became a major area of departmental research in the 1930s. In Missouri, the most fertile farm land had generally been planted in cultivated crops; the areas too rough or too poor to cultivate were left for pasture. Or when production on the cultivated areas declined, due to erosion or fertility depletion, those acres, too, would be seeded in grass and pastured. Eventually the productivity of these grasslands would go down, fostering encroachment with tickle grass (*Aristida* spp.), broom sedge (*Andropogon virginicus*), lance-leaved ragweed (*Ambrosia bidentata*), or woody species without value for forage.

The decline in grassland productivity was hastened by overgrazing during a succession of droughts and climaxed by the disastrous heat and droughts of 1934 and 1936. I remember, in 1934, seeing trees chopped down in drought-stricken pastures between Columbia and Jefferson City, just so that cattle could feed on the green leaves. Farmers were still struggling to overcome the effects of the Great Depression brought on in part by overproduction of grain crops in the 1920s. Only then did the restoration of the grasslands begin receiving a high research priority. It is significant that the 1930s were alive with conservation-mindedness, that fostered the establishment of the U.S. Soil Erosion Service (later the Soil Conservation Service), the Missouri Conservation Service, and the National Forests in Missouri. The U.S. Department of Agriculture rapidly expanded its grassland research and provided generous support to the Department of Field Crops through cooperative research projects.

The best bluegrass pastures in Missouri were then found on the fertile Marshall soils in northwest Missouri. A thriving bluegrass-seed industry helped to keep the pastures profitable; otherwise, they might have been plowed and planted in corn. On the Sni-A-Bar Farms, the rolling hills were covered with a mantle of Summit silt loam, a more



Cattle graze lespedeza on the Sni-A-Bar supplemental pasture experiments, Grain Valley, in 1942.

droughty soil than the Marshall, and the bluegrass swards deteriorated there more quickly in the succession of dry years. In the Sni-A-Bar experiment, three grazing systems were established—continuous, rotation, and supplemental. Bluegrass made most of its annual growth in April and May. The cattle grazed it unevenly, overgrazing in some areas and undergrazing in other areas of the pasture. The forage remaining on the undergrazed areas soon became unpalatable, and stands of grass were reduced on the overgrazed areas. Rotation grazing maintained the most uniform stand, but largest cattle gains were obtained where they grazed the bluegrass heavily in early spring while it was most nutritious and were then given supplemental grazing on lespedeza in midsummer. A second peak in the growth of bluegrass occurred with the fall rains and was utilized after the lespedeza was grazed off.

Observations from the Sni-A-Bar experiments raised significant questions. Can an efficient pasture system be devised that will utilize bluegrass herbage when it is most palatable and nutritious? Can the pasture season be stretched out to provide additional months of grazing? Brown was conducting basic studies on the effects of temperature on the growth and chemical composition of pasture grasses, and the seasonal variation in growth and chemical composition of Kentucky bluegrass (AES Research Bulletins 299, 360). Helm had been conducting research with short rotations that would provide pasture and hay: wheat-lespedeza, winter barley-lespedeza, winter barley-soybean. Combining this information provided useful answers. The result was the development of the Missouri All-Year Pasture System. The essential components of the system were (1) bluegrass pasture in the late spring and again in late summer or winter, (2) lespedeza pasture in midsummer, and (3) winter barley pasture through the fall and wheat pasture in early spring before bluegrass was ready. Such a system would “practically double the length of the grazing season and triple the amount of feed

produced" (AES Bulletins 360, 486, 750; AES Circulars 175, 186, 193, 210, 285, 335).

Developments following World War II radically changed pasture management practices. The developments included the introduction of soil testing; increased availability of commercial fertilizers and limestone; development of power machinery for pasture renovation including fertilizer and limestone application; introduction of tall fescue, a highly competitive grass species that quickly replaced bluegrass as the dominant pasture species in Missouri; decline of lespedeza through disease and other factors as a productive pasture species; and a government program for pasture improvement in which costs of fertilizer and limestone were partially offset by the Agricultural Stabilization and Conservation Service.

Changes in the pasture-research program were being made by Brown by the late 1940s. A wheat-lepedeza pasture at Lathrop that in 1948 produced 163 pounds of cattle gains-per-acre on the lepedeza produced only 71 pounds gain in 1949. The decline was attributed to disease infection of the lepedeza with bacterial wilt in a season with high rainfall. Phosphate and lime were being applied to bluegrass pastures to stimulate growth of legumes. But bluegrass at Lathrop fertilized and seeded with lepedeza did not produce cattle gains larger than those obtained on an unfertilized bluegrass pasture. It appeared that if bluegrass was to be profitably fertilized, some legume other than lepedeza must be seeded in the grass (AES Bulletin 556).

Brown continued the search for forage legume species compatible with bluegrass and the management practices that would maintain stands of the legume in the bluegrass (AES Bulletins 739, 750, and 768). When Brown retired in 1961, the pasture-management research was continued by Arthur Matches. By then, tall fescue had become the leading pasture grass, and its aggressiveness interfered with the growth of associated legume species. Matches investigated alternative sources of summer forage, including warm season grasses and the harvesting of excess herbage and stockpiling it for use during the summer season.

The Lespedeza Story - "It Filled a Need"

No development in the history of Missouri's Field Crops Department has been more remarkable than the lepedeza story. It began in the fall of 1921 when two ounces of seed of Korean lepedeza (*Lespedeza stipulacea*) were received by Etheridge from Dr. A.J. Pieters of the U.S. Department of Agriculture. The Department had received the species originally from Dr. Ralph Mills, a medical missionary in Seoul, Korea, who had collected it from a salt marsh along the Yellow Sea. A related but less productive form of lepedeza, *Lespedeza striata*, had spread over

the Ozarks, where it had been introduced probably during Civil War days, and was grazed in unimproved pastures along with native legumes and grasses. But no attempt had been made to cultivate the Japan clover, as it was called locally.

Etheridge and Helm planted the Korean lespedeza on the Crops Experimental Field south of Rothwell Gymnasium, where student dormitories and the University Medical Center are now located. The lespedeza, a low-growing annual legume, made an excellent growth and produced a heavy seed yield that first season. The following spring, a thick volunteer stand of lespedeza seedlings emerged that continued to make a vigorous growth during the hot summer months when bluegrass pastures were unproductive. The lespedeza plots were enlarged and fenced. Animals brought in to graze on the lespedeza thrived and made remarkably good gains.

The performance of the lespedeza was so promising that seed was increased rapidly, and in the winter of 1927, 30 five-pound seed lots were distributed to Missouri farmers. The farmers' response was enthusiastic, so additional seed lots were distributed in 1928 and 1929; by 1930, seed was available from commercial seedsmen. Two years later, one-half million acres of Missouri land were covered with lespedeza. Just what the peak-acreage of lespedeza may have been is difficult to estimate. Figures of 10 million acres were used loosely, but these may have been inflated. Lespedeza reseeds itself, even with close grazing or early-cut hay; uncultivated land once planted in lespedeza would maintain a stand for several years. Much of the acreage was interseeded with a small grain, which might either have been cut for grain or pastured. But one observation was certain: the spread of lespedeza for pasture and hay was phenomenal.

Why did Korean lespedeza become such an important and valuable crop in that short period? The most obvious answer is that it "filled a need." Farmers were going through a critical economic period spawned by a serious depression in farm prices, soils depleted by high production during World War I, and the disastrous droughts in 1934 and 1936. Interest and taxes were going unpaid. How lespedeza "filled a need" and gave hope to Missouri farmers is eloquently described by Etheridge (AES Bulletin 619):

"The full significance of so vast an increase in the state's acreage of legumes in so short a time is difficult to grasp. Lespedeza's entrance upon the scene was the more dramatic because of desperate problems arising from soil depletion, financial distress, and frequent summer droughts. Here, suddenly, was a legume easily and cheaply established, reseeding itself, resistant to drought, producing forage at the season of greatest

need, tolerant of low fertility but responsive to soil treatments. And it provided good soil cover, a starter of soil improvement, and a key crop in quick turnover crop rotations. Here was a legume adapted for pasture, for hay, or for seed; adapted for growing in small grain stubble, in meadows, in permanent pastures, or in short-term pastures. Here was a crop with a variety of uses and with the ability to thrive in a variety of situations. Lespedeza wrought a profound change in the whole forage production system of Missouri.”

A demonstration of how Korean lespedeza could “fill a need” was made on the University’s South Farms. Some land was acquired that most recently had been cropped with corn producing a 15-bushel-per-acre yield. The soil was badly eroded, with subsoil exposed on the slopes and small gullies in the natural waterways. A wheat-lespedeza rotation was established on the field with moderate annual fertilizer applications; both wheat and lespedeza were pastured. Soon the field was producing 250 pounds of beef per acre, with continuous grazing from April until October, at a production cost of \$5 per acre according to prices then prevailing. Similar experiences were being reported by animal husbandry and dairy farmers on thousands of farms throughout the state.

Lespedeza had some critics. I remember receiving a lecture from Dr. Albrecht on how lespedeza was “mining the soil.” The rationale was that lespedeza, capable of extracting nutrients for production of forage on poor soils, was reducing the level of essential nutrients in those soils even lower. In reality, with the limited applications of fertilizer then practiced, all crops were mining the soil to the extent that nutrients removed in grain or hay, or by grazing animals, were not being replaced. Unfortunately, the economic conditions of the farmer wouldn’t have permitted utilization of fertilizers in quantity at that time even if they had been available.

The question asked frequently now is, “What happened to the lespedeza acreage in Missouri?” Decimation of lespedeza stands by bacterial wilt, incited by *Xanthomonas lespedezae*, is generally cited as the primary cause, but the reason is more complex. Radical changes in the way crops were being produced occurred following World War II, as the result of the introduction of soil testing to measure fertility needs and changing fertilization practices; reduction in corn acreages as yields increased, thereby freeing fertile lands on which alfalfa could be grown; renovation of pasture lands with massive fertility treatments, brush control, and seeding of a range of legume species with partial defrayment of costs through government payments; introduction of tall fescue, a highly competitive grass, into the pastures; and chemical weed-control practices. While forage yields of lespedeza were increased with fertilization, the increase was largely in stems of low nutritive



Joe D. Baldrige lectures in a lespedeza plot during a 1968 field day.

value rather than the highly nutritive leaves. A wilt-resistant variety of Korean lespedeza was later developed by Baldrige and Offutt, but it came too late to save the lespedeza crop. Forage-legume breeding research in the Department was then shifted to birdsfoot trefoil.

Weed Science, A New Field of Research

The development of a growth-regulating chemical, 2, 4-D, during World War II, ushered in a new era in chemical weed control. Helm had experimented with some chemicals such as common salt or sodium chlorate for control of weeds, but their use had been limited to specific situations and presented other problems. Information on the herbicidal properties of 2, 4-D was released after the war, but it was still necessary to demonstrate how and where it could be used. The first research plots in the University using 2, 4-D were established by Helm, but data were not recorded.

Leonard M. Stahler, a scientist with the U.S. Department of Agriculture was stationed in the Field Crops Department during 1952 to conduct research with 2, 4-D on control of weeds in pastures and meadows, but that was a very dry year, and results were not conclusive. Dayton Klingman replaced Stahler in 1953, and experiments with 2, 4-D were continued in cooperation with Helm and assistance from Hale Fletchall. Fletchall had returned from military service and was finishing his Ph.D. thesis. Etheridge wanted Klingman to expand his research to include corn, but Klingman did not have the resources or the time to

Hale Fletchall's weed science research changed field crops production practices and opened up new areas of agronomic research.



develop an expanded program. Etheridge then turned to Fletchall and asked him to develop a weed-control research project within the Field Crops Department.

Synthesis of new herbicides was being undertaken by agricultural chemical companies. Once the basic molecule of a substance having selective herbicidal properties was established, alterations could be made to the molecule and the new compounds tested on a wide range of plant species to determine their herbicidal properties. This was extremely expensive research and beyond the resources of an experiment station project. The cost prevented universities from conducting research to develop new herbicides.

In developing the weed research project, Fletchall proceeded on the premise that universities could play an important role as an impartial link between the agricultural chemical companies and the farmers. Recommendations on the use of specific herbicides, he concluded, were the responsibility of the chemical company manufacturing the herbicide. However, by accurately testing the herbicides and presenting unbiased test results, the university could have an influence on how the industry made the recommendations.

Objectives established for the project were (1) to evaluate the selective effects of herbicides developed by industry on individual weed species and on crop species, (2) to test new and standard herbicides as pre-emergence, post-emergence, and direct sprays, and (3) to compare various combinations of chemical and cultural weed-control practices.

As a result of the close cooperation established by Fletchall with industry, numerous industry grants were received and utilized in support of a strong graduate student program. Many of the students later held important positions in industry and at other universities.

Some accomplishments of the weed control research were: (1) pioneering use of triazines as herbicides for control of weeds in corn, (2) establishment of the preemergent use of specific herbicides, (3) development of bark treatment to kill woody plants, and (4) integration of the management aspects of crop production into the weed-control practices. Helm and W.B. Drew, Professor of Botany, published a bulletin in 1941 entitled, "Representative weeds and their control" (AES Bulletin 433). The bulletin contained descriptions and excellent illustrations of 135 common weed species.

Klingman was transferred from the University in 1956. He was replaced by Elroy Peters, a graduate of the University of Wisconsin. Peters continued the research on weed control in pastures and meadows.

The chemical herbicides often gave nearly 100 percent weed control. Along with the development of improved fertility programs and hybrid corn, chemical herbicides became a major contributor to modern, high-yield, farming practices. They significantly changed the farm implements utilized in crop production, eliminated a high proportion of crop cultivation, altered crop-rotation patterns, affected fertilizer use, influenced variety adaptation and made possible the practice of no-till farming. It was no longer necessary to practice crop rotation to control most weed species.

Field Crop Disease Investigation

A study of the diseases attacking major field crops in Missouri was started by Marvin Whitehead when he joined the Department in 1955. Prior to this research project, disease control was always a consideration in the field crop-production projects, but research on crop diseases per se had been done in the Department of Botany. The objectives of the research project were to identify the diseases of economic importance to Missouri's field crops, to estimate crop disease losses, to study the environmental factors affecting disease incidence in Missouri's field crops, to evaluate genetic resistance in breeding lines, and to evaluate newly developed chemicals and antibiotics for disease control. Studies on the *Diplodia* stalk rot and *Helminthosporium* leaf blights of corn were initiated by Oscar Calvert, who had been brought into the department in 1958 to assist Whitehead. The corn-disease research was conducted in cooperation with Marcus Zuber, the corn breeder. When Whitehead left in 1960, he was replaced by Thomas Wylie, who initiated investigations on soybean diseases. Om P. Sehgal, a virologist, joined the Department in 1963 and conducted research on viral diseases of corn.

Mutation Studies in *Arabidopsis*

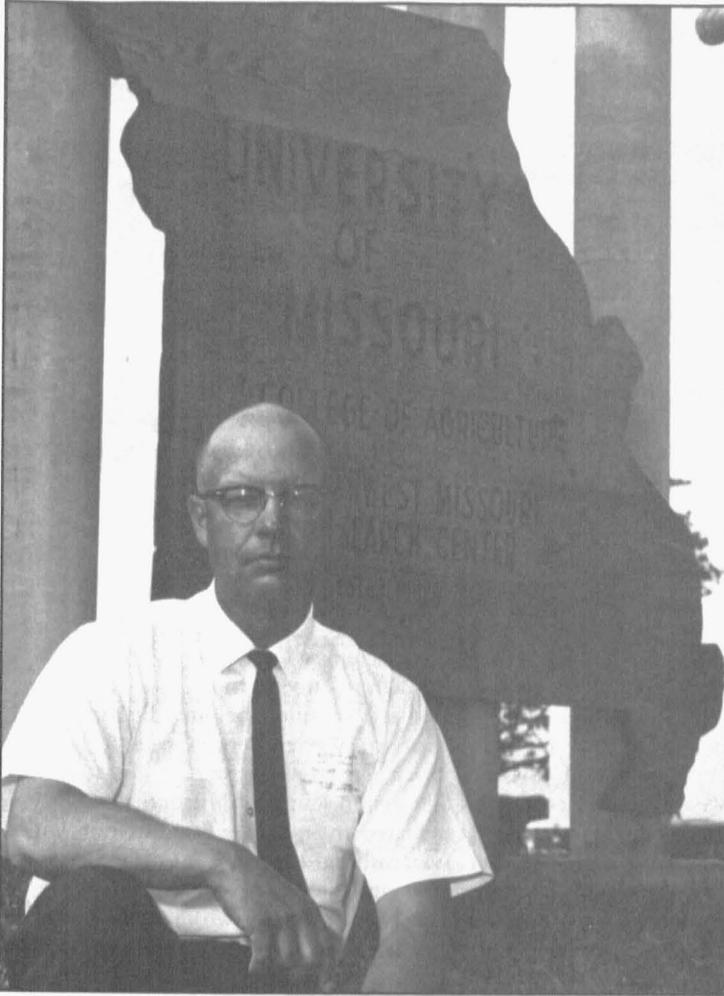
Life cycles of agricultural plants normally require several months, so not more than one or two generations may be grown in a year. Because basic genetic investigations usually require that observations be made over several generations, it may take several years to complete an experiment. When Gyorgy Rédei, from Hungary, joined the Field Crops Department in 1957, he chose to conduct genetic research with *Arabidopsis thaliana*, a small plant that completes its life cycle in 30 to 40 days. Additionally, the small size of the plant permitted growing large populations in a small space. Rédei's research with this miniature plant has contributed to knowledge about genetic control of flowering and various metabolic pathways. By studying specific mutants that inhibit the synthesis of essential substances in plants, an analysis could be made of the genes affecting successive metabolic steps.

15. FIELD RESEARCH FACILITIES AND EXPERIMENTAL PROCEDURES

Research in Columbia

Field research has been conducted by the Farm Crops/Field Crops Department at three primary locations in or near Columbia, each in cooperation with the Department of Soils. Additional University or private land was utilized for special studies at times. An early crops experiment field was located south of Rothwell Gymnasium and Rollins Field, bounded by Hillcrest Avenue (now Hitt Street) on the east, Maryland Avenue on the west, and a golf course on the west and south. On this field were conducted the early small grains and soybean varietal trials, the original lespedeza plots, and Stadler's early genetic studies with corn. Much of the area was taken over for veteran's housing after World War II and is now occupied by student dormitories; the University Medical Center and Crowder Hall. The only vestige remaining from the early research field is the Soil Erosion Experiment plot now designated a National Landmark.

In 1930, the College purchased the Beazley Farm, consisting of more than 300 acres, located southeast of Columbia. This tract, now part of the University South Farms, was the major crops experiment field until 1965. On this field Helm demonstrated the utility of the small grains-lespedeza one-year rotations, Brown conducted studies on forage grasses, and the early breeding research on small grains and



**Norman Justis,
the
superintendent
of the Southwest
Missouri
Research Center,
Mt. Vernon, in
1966.**

soybeans was conducted. For many years, this farm was the site of the Annual Crops and Soils Field Days. In later years, the farm became the headquarters of the Missouri Seed Improvement Association and the Foundation Seed Program. When the corn genetics research area on the campus was lost to the University's building program in the 1950s, a Genetics Research Farm was established south of Columbia adjacent to the Beasley Farm.

The 524-acre Bradford Farm, now designated Agronomy Research Center (Bradford Farm), was received as a gift from Mary Estelle

Field day at the
crops experiment
field, Cuba,
Missouri, in
1920.



Bradford in 1959. In 1965 the small grains, soybean and birdsfoot trefoil breeding research; hybrid corn variety trials; and pasture utilization experiments were moved to this site. In addition, a large segment of the farm was devoted to research in weed science.

Outlying Experimental Fields and Research Centers

Soils and Crops Experimental fields were first established in the Department of Agronomy in 1905. Six "Crops Experiment Fields" were being operated when Farm Crops became a Department. The sites of the experiment fields were changed from time to time, but through the years, major fields were located at Maryville, Shelbina, Elsberry, Paris, and Lathrop in northern Missouri; Warrensburg, Green Ridge, and Cuba in central Missouri; Stark City and Pierce City in southwest Missouri; and Kennett and Sikeston in southeast Missouri. In addition, pasture experiments were conducted on Sni-A-Bar Farms, Grain Valley, Mo. The Maryville and Warrensburg experimental fields were on state-owned land; the Lathrop and Sni-A-Bar experiments were on private land made available to the University without cost; and the remaining experimental fields were on private land leased by the University.

During the Mumford and Miller administrations, it was the policy to lease land for outlying experimental fields rather than purchase it. The outlying experimental field program had been started by Miller to obtain information about adaptation of crops and cropping practices on different soil areas. After the desired information was obtained, the lease could be terminated and the resources utilized in other areas of the state. With University ownership of the land, pressure from local groups makes termination of an experimental field difficult.

The policy changed under the administration of Dean Longwell. Large blocks of land were acquired through gifts or purchase in various



The Fall Field Day at the University South Farms was well attended in 1958.

areas of the state, and permanent Research Centers developed. The major centers established prior to 1967 and the Field Crops research conducted on each were:

North Missouri Center (Thompson Farm), Spickard. This 1600-acre farm was a gift to the University in 1956. Field Crops research was limited to small-grain-variety and hybrid-corn and sorghum trials.

Southwest Missouri Center, Mt. Vernon. This 987-acre site was purchased by the University in 1959 and replaced the Pierce City experimental field. Small-grain, soybean, and pasture research was moved from Pierce City to Mt. Vernon, and the pasture research was expanded considerably. The Center's first two resident superintendents, Carl Hayward and Norman Justus, held academic appointments in the Department of Field Crops.

Delta Center, Portageville. The Delta Center was established with the gift of a 1,024-acre tract to the University in 1959. The Crops Experimental Field at Sikeston was then discontinued. A cotton breeder and a soybean breeder, both Field Crops faculty members, were stationed at the Center. In addition, the center's first superintendent, Norman Brown, was a member of the Field Crops faculty.

Forage Systems Research Center (Cornett Farm), Linneus. This center was established in 1965 when the University began leasing land from the Cornett family. Research on the evaluation of forage production systems have been conducted there.

The system of permanent research centers has advantages over the leased experimental fields formerly used. It permits the construction of laboratories and greenhouses needed for efficient conduct of research programs. For breeding and other research programs, continuity in

E.M. Brown's grass breeding plots on University South Farms in 1942 were a model of field research perfection.



access to uniform soil areas is necessary for the experimenter to design the most efficient experiments. On the other hand, overhead costs and maintenance of the Centers utilize a significant portion of the Agricultural Experiment Stations total research budget, thus reducing funds available for allotment to specific research projects.

Experimental Procedures

The early crop-rotation experiments and farmer-cooperative variety tests were conducted without replication or randomization. Sanborn laid out the rotation plots in 1887 with a single plot for each rotation. With a four-year rotation, only one crop was grown each year, so that four years were required to complete the rotation cycle. Although 100 years of data are available, it represents only 25 years of data for each crop in a four-year rotation. Miller improved the experimental procedure in the rotation studies on the Soils and Crops Experiment Fields by setting up four series of plots for a four-year rotation and growing each crop each year. This pattern of experimentation was generally followed by Helm and King on the outlying Crops Experimental Fields through the 1930s. In the farmer-cooperative variety experiments, the varieties were usually planted in narrow strips across a farmer's field without replication.

Concern for improving field-plot procedures to obtain more accuracy in the data became widespread among agronomists as field research expanded. In Missouri, this led to a series of thesis studies on experimental techniques under Hutchison (Day, 1916; McGee, 1916) and Etheridge (Letson, 1921; Stadler, 1922; Hale, 1927). In these studies, size and shape of field plots, replication, border effects,

intervarietal competition, and systematic errors were all given consideration as means for improving data accuracy. But it was the development of a statistical tool by Sir Roland Fisher at the Rothamsted Experiment Station in England, the analysis of variance, that ushered in modern field-plot technique. This was followed by development of experimental designs such as the randomized-block, Latin-square, split-plot, and various lattice designs, appropriate for statistical evaluation by the analysis of variance. Although originally designed for field plot experimentation, the analysis of variance has become a standard statistical procedure for analyzing many kinds of scientific experiments.

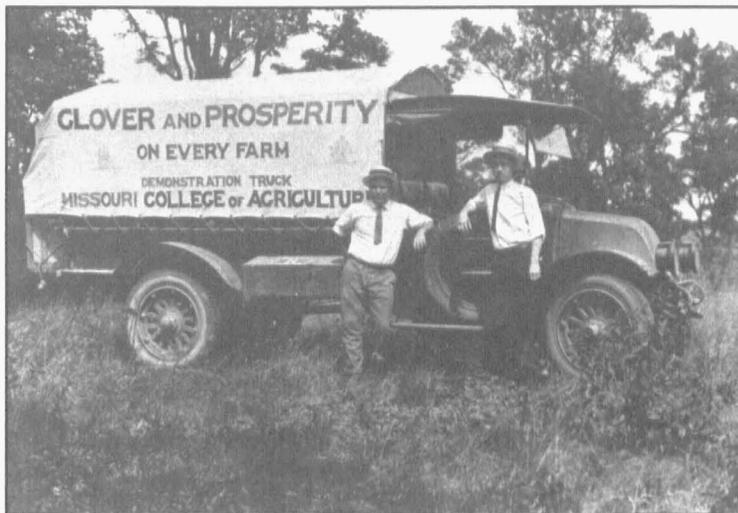
The analysis of variance procedure statistically divides the variation of an experiment into components due to controlled causes, treatments and replications, for example, and an uncontrolled component or error which may be used to evaluate the significance of the experimental results based on probability tables. The analysis of variance technique was first used in the Department by Poehlman in 1935. Zuber introduced the use of the lattice designs in the corn-variety tests in 1947. Zuber and Poehlman began putting data from corn- and wheat-variety tests on IBM cards in 1948 that were then processed on IBM machines in the University Business Office. Subsequent developments with computers in the 1960s made these procedures obsolete.

In 1924, Stadler introduced the course, "Field Crops Experimentation," which was taught intermittently until 1931. Poehlman revived the course in 1956 and taught it until 1963. The only course in statistics applicable to agricultural problems during that period was taught in the Department of Agricultural Economics. In 1964, Dr. Gary F. Krause came to the campus as Agricultural Statistician, attached to the Dean's Office but with Field Crops as his academic home. He began teaching three courses, "Statistics," "Analysis of Variance," and "Design of Experiments." For the first time, a comprehensive course offering in statistics applicable to field crops research became available for our students.

16. FIELD CROPS EXTENSION, 1917-67

The University of Missouri began hiring "farm advisers" in 1912. With the 1914 passage of the Smith-Lever Act by Congress, the Agricultural Extension Service was officially organized in Missouri with Federal/State cooperation. In those days, the agronomy faculty members were also

This Clover and Prosperity demonstration truck carried extension exhibits to 12 counties in 1922. C.E. Carter (left) and Paul Schowengerdt, extension specialists, started the program in that year.



engaged in extension-type activities such as sponsorship of the State Corn Show and Boys' Corn Growing Contests; lectures in agricultural institutes, farm demonstration trains, and Farmers Week meetings; and teaching summer classes for rural school teachers.

In 1917, J.C. Hackleman became the first crops extension specialist. His duties were to interpret new crops research and keep county agents and farmers current with research results. J.C. Hackleman also served as Secretary of the Missouri Corn Growers' Association from 1917-19. When Hackleman went to the University of Illinois in 1919 in a similar position, he was replaced by C.E. Carter, who served from 1920 to 1934. Other crops extension specialists were R.T. Kirkpatrick (1921-23), K.G. Harmon (1923-32), I.P. Trotter (1923-36), J.R. Fleetwood (1936-66), J.R. Paulling (1937-49), W.J. Murphy (1949-81), J.H. Scott, Jr. (1958-82), L.E. Anderson (1965-85), and E.W. Palm (1965-67). Trotter, Paulling and Scott were selected for their special knowledge in cotton production; Anderson as a weed science specialist, and Palm for plant-disease control. B.B. Branstetter had a six-month appointment in Crops Extension in 1927 on a special assignment; C.A. Helm had a three-month appointment in 1934 to assist with a special drought-relief seed program; and Parker Rodgers served as a field crops pesticide specialist for three months in 1966. F.E. LeGrand was appointed crops extension specialist in 1967, but he served less than one month before the organization of the Agronomy Department.

Close cooperation among the soils and crops specialists developed

according to a plan put forward in 1925 as described in the "Report of the Combined Soils and Field Crops Extension Projects for 1932":

"The state was divided into sections and a specialist assigned to each section. It is the duty of this specialist to have general charge of all the soils and crops work in that section and to keep in touch with all demonstration work in that section. In addition, each specialist accepts the responsibility of making a special study of some particular phase of either soils or crops which has a general application in the field. Thus it is hoped that the whole group can keep abreast of the latest information." Although the plan of dividing responsibilities of the specialists according to areas of the state was modified in later years, close cooperation continued between the soils and crops programs.

A significant program was developed in 1922 when Paul Schowengerdt, soils extension specialist, in cooperation with Carter organized a "Clover and Prosperity" campaign. This extension program emphasized the use of lime and legumes, chiefly red clover and sweetclover, for soil improvement and increased crop production. In 1922, a two-ton truck was utilized to haul exhibit material for farmer's meetings in 12 counties. I enjoyed the privilege of driving the "Clover and Prosperity" truck in the summer of 1929. By that time, a Dodge panel truck had been acquired to carry the exhibit materials, and a home economics specialist accompanied the soils and crops specialists on the tour. Two full-day meetings were held in each of 10 south-central Missouri counties in that year on farms where the county agent had arranged for demonstration plots that would show the benefits of lime and clover. The men visited the demonstration plots in the morning while the women set out the carry-in "dinner". After dinner, the group settled down for lectures to the men by the soils and crops specialists and to the women by the home economics specialist.

The Clover and Prosperity program soon evolved from a summer tour of a few counties to a scheduled winter conference. By 1933, Clover and Prosperity Conferences were being held in 96 counties with a total attendance of 10,700 persons. Fifty-six of those conferences were held in counties with county agents and 40 in non-agent counties. The conference programs changed through the years to adapt to changing agricultural conditions. The early focus was on legumes, lime, and fertilizers. Pasture improvement was added in 1931. With the increase in popularity of lespedeza in the 1930s and '40s, clover became a minor part of the legume acreage in Missouri. To reflect the changes in the program, the name was changed to Soils and Crops Conferences. In 1950, Soils and Crops Conferences were held in 114 counties with a total attendance of more than 28,000. In that year, in addition, 4990 persons attended Soils and Crops Field Days sponsored by the Extension

Service on the research plots in Columbia, Lathrop, and Sikeston. In later years, the annual conferences held in each county were planned jointly but conducted alternately by a soils or crops specialist.

In addition to the Soils and Crops Conferences, the specialists developed projects in cooperation with the county agents, focusing on specific problems. For the crops specialists these included projects on topics such as pure seed, pasture improvement, one-variety cotton communities, cereal varieties and production practices, and plant-disease control. In cooperation with the Missouri Seed Improvement Association, assistance was given to the promotion and use of high-quality seed of adapted varieties. With appointment of a weed-control specialist in 1965, demonstrations were conducted on weed-control practices and short courses planned for pesticide applicators. Crop diseases were monitored and control practices demonstrated by the plant pathology specialist. Special programs were developed for rice and tobacco growers. As soybeans became more popular, they received increased attention.

The field crops specialists played a special role in the promotion of short rotations for efficiency in production and reduction in soil erosion. Development of a productive cropping system was a necessary component in a "Balanced-Farming" farm plan. The goal was to bring about the adoption of such cropping practices as would insure the most economical production, increase soil fertility, and prevent soil erosion.

Some friction developed between the programs of the Missouri Agricultural Extension Service and the U.S. Soil Conservation Service. The Soil Conservation Service program initially planned to establish Soil Conservation Districts in Missouri along water-shed lines. These would cross county lines transcending jurisdiction of local government agents, including the county agent, and would form a district that dealt directly with the U.S. Government. This led to passage of the Missouri Soil District Law in 1943 that established Soil Districts along county lines. The law was written largely by W.C. Etheridge, chairman of the department of field crops, whose political influence was also instrumental in obtaining its passage by the Missouri State Legislature.

One of the differences that arose between the Missouri Agricultural Extension Service and the Soil Conservation Service was in the design of cropping systems. In the Balanced-Farming program sponsored by the Extension Service, the cropping system was designed around each farmer's principal activity, whether animal agriculture or cash-crop production. Short rotations had been proven adapted to Missouri's variable climatic pattern and were used extensively to provide maximum soil conservation and farm production. The National Soil Conservation did not adopt the short-rotation concept and planned its cropping systems around long rotations that provided soil conservation

but did not include the broader management and total farm production aspects inherent in the Balanced Farming Program. The conflicts between the agencies diminished beginning in 1962 with changes in leadership of the Missouri Extension Service and subsequent action of the Board of Curators (Headley, 1985). How serious the conflict was at the local level is not entirely clear since a soil conservation agronomist active during that period has assured me that he experienced few difficulties in working with most county agents.

17. SERVICE TO MISSOURI AGRICULTURE

The Department of Field Crops served Missouri agriculture through many activities other than the teaching, research, and extension functions. Faculty were called upon to visit farms, judge county fairs, conduct judging contests for farm youth, and give talks at agricultural institutes. Another service was answering correspondence. In the early years of the Department, before agricultural extension programs were established in all counties, many letters were received from farmers with questions about crop production practices. In 1922, L.A. Dalton developed a master's thesis in which he classified practical field-crop problems as identified from 5944 letters received from Missouri farmers during the period 1914 to 1921. Other important service activities in the Department were the testing of seeds, the seed certification program, and the production of foundation seed.

Seed Testing Laboratory

A Seed Testing Laboratory was established in the Department of Agronomy in 1908 in cooperation with the U.S. Department of Agriculture. Professor M.F. Miller was instrumental in getting the laboratory started and maintained a keen interest in its welfare. The seed laboratory provided free testing of seeds for germination and purity to Missouri farmers and seedsmen. As a Federal Seed Testing Laboratory, "Custom House" samples from commercial lots of grass and legume seeds entering the United States were sent to the Laboratory for germination or purity tests. In addition, "referee" samples were received from other federal seed laboratories when differences arose over test reports. The Laboratory also tested samples collected in the seed certification program of the Missouri Corn Growers' Association, later named the Missouri Seed Improvement Association, until the association established its own laboratory in 1978.

The Field Crops Seed Laboratory staff in 1941 were from left: Clara Fuhr, Vera Drake, Rose Poehlman, Grace Ernst Miller, Dr. Elva Norris, and Edgar Sundermeyer. Grace Ernst (Mrs. M.F. Miller) was the seed analyst when the seed laboratory was started in 1908.



In 1914, the year that the Farm Crops Department was established, the Laboratory received 875 seed samples from farmers and 645 samples from seedsmen. During World War I, a campaign was mounted through county agents to get farm seeds tested. In 1917, the number of samples received rose to 4409. By 1926, the number had reached 6139, of which 5537 were from Missouri, 60 were "custom house" and 40 "referee" samples. In that year, the largest crop represented was cotton with 1885 samples tested, followed by corn with 900 samples, and soybeans with 559 samples. Receipt of the samples were seasonal, placing a tremendous work load on the laboratory during busy seasons. Students were recruited to assist in the laboratory during those periods. When I was a student working for Helm during 1929 to 1931, he often sent me to the laboratory to help during rush periods. My job was counting sprouted seeds. I never qualified for making purity evaluations, which required long experience and close supervision by the seed analyst in charge.

The U.S. Department of Agriculture sent a succession of highly competent seed analysts to direct the operation of the laboratory. They included Flora Grace Ernst, Etta O. Gilbert, Rachael E. Holmes, Bertha Hite, Pearl Drummond, Regina Schulte, Maxine Wilks, and Clara Fuhr. Clara Fuhr was the "Dean" of the seed analysts, serving in the Missouri Laboratory from 1924 until 1945. A graduate in botany from the University of Illinois, she was thoroughly dedicated to the service of the laboratory and the integrity of the test results reported;

not a single analysis was completed in the laboratory that was not checked personally by her. Fuhr's appearance was distinctive. She was tall, walked with a determined gait, and talked with a high-pitched voice that became louder when she became excited, often to the amusement of students in an adjacent classroom.

In 1941, the Grain and Seed Division of the U.S. Department of Agriculture, Agricultural Marketing Service, opened an office in the Field Crops Department in Waters Hall. Walter R. Crispin, a 1917 graduate of the College of Agriculture, was placed in charge. The office was moved to Kansas City, Mo., in 1945, and a new Federal Seed Testing Laboratory was established there. Fuhr was transferred to the Kansas City Laboratory, ending 37 years of cooperation between the U.S. Department of Agriculture and the University of Missouri.

The Department of Field Crops continued to operate a Seed Testing Laboratory until 1979, with Viola Stanway, who had been trained by Fuhr, as the Seed Analyst. The Laboratory tested seeds for farmers, seedsmen, and the Missouri Seed Improvement Association's seed certification program. In 1950, tests were performed on more than 4,000 lots of farm seeds with an estimated value in excess of one-half million dollars. About one-fourth of those samples were from the seed certification program. Following passage of the Missouri Seed Law in 1957, the State Board of Agriculture developed a Seed Testing Laboratory in Jefferson City in conjunction with the regulatory activities imposed by the new law. But the number of samples received by the Department laboratory did not diminish perceptibly, due to increases in the seed certification program.

Stanway had bachelor's and master's degrees in botany, from the University, and received an academic appointment in the Department. In addition to her duties as seed analyst, she taught courses in seed analysis and counseled students.

Seed Certification Program

The seed certification program in Missouri was initiated by the Missouri Corn Growers' Association in 1916-17. In order to reflect the organization's broader role in certification of wheat, soybeans, cotton, and other crop seeds, as well as corn, the name was changed to the Missouri Seed Improvement Association in 1943.

Organization of a Corn Growers' Association was first proposed to students in the Missouri College of Agriculture in 1902. Preliminary approval was given for formation of the association by the student agricultural club in 1903. After consultations with faculty members, the secretary of the State Board of Agriculture, and Missouri corn growers, a constitution and by-laws was drawn up, pledged memberships secured, and final approval obtained for organization of the

Wynard Aslin
inspects a field
of wheat for the
Missouri Seed
Improvement
Association. He
was Executive-
Secretary of the
association from
1962-87 with a
Research
Associate
appointment in
the Department
of Field crops.



Missouri Corn Growers' Association in 1904. The objective was broad: improvement of seed corn and corn culture in Missouri. The principal activities in the early years were a corn school and corn show held as a part of the Farmer's Week program of the College of Agriculture.

During this period, a movement was growing to give greater emphasis to the production, distribution, and use of good seed. The idea of conducting field inspections had been pioneered in Canada since 1904, and was adopted by the Missouri Corn Growers' Association in 1916. The following year, they began bin inspections of wheat for seed quality and freedom from disease, performed germination tests on seed samples collected, and issued tags to growers to place on bags of "approved" seeds. Similar programs were being developed in other states, but lack of uniformity in the standards established in the different states for granting approval for the seed created a problem in interstate seed transactions. This led to the organization of the International Crop Improvement Association in 1919, and it became the unifying agency for seed-improvement organizations in the United

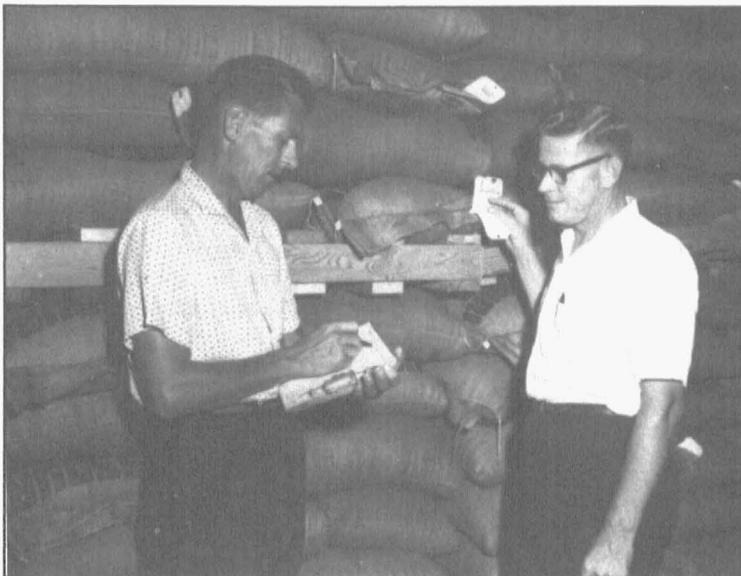
States and Canada. Through its efforts over the years, there have been established uniform minimum standards for certification: a uniform system of labeling with the local seed association issuing official tags to be fastened on the bags of certified seed, interagency certification, and limited-generation seed increases in states other than the state of final increase.

The executive officer of the Missouri Corn Growers' Association was the secretary. George M. Tucker, an instructor in the College of Agriculture, was elected the first secretary by the association members, and he served from 1903 to 1905. Successive secretaries were M.F. Miller (1906-08), S.M. Jordan, (1908-09), C.B. Hutchison (1910-12), T.R. Douglas (1913), C.B. Hutchison (1914-16), J.C. Hackleman (1917-19), C.E. Carter (1920-22), W.C. Etheridge (1923), Roy T. Kirkpatrick (1924-29), C.A. Helm (1930-55), L.E. Cavanah (1955-62), W.E. Aslin (1962-87). Except for Samuel M. Jordan who was affiliated with the Missouri State Board of Agriculture, all of the association secretaries have had appointments in the University, forging a substantive link between the association and the College of Agriculture. The link gained legal status with the Missouri Seed Law that became effective August 29, 1957, which states that "certification of seed in the State of Missouri shall be carried out by an agency or organization designated annually by the Director of the Missouri Agricultural Experiment Station." The Missouri Seed Improvement Association has since been designated as that agency.

Changes in the organization's constitution and by-laws in 1923 provided for a Board of Directors who would appoint an executive secretary-treasurer, rather than having one elected by members at the annual meeting. Use of the term "Certified Seed" instead of "Approved Seed," institution of field inspections in addition to bin inspections, and marketing of seed in bags printed with the association name and logo were all adopted prior to 1930. In 1930, the seed show, which had been open to any seed grower in previous years, was restricted to producers of certified seed. All exhibits were tested for purity and germination and the germinating sprouts exhibited with the sample. Disfavor with the seed show was growing because criterion for judging grain exhibited did not focus on genetic potential or genetic purity. The utility of the seed show declined further with the advent of hybrid corn, and in the 1950s, it was discontinued.

Professor C.A. Helm served as executive secretary-treasurer from 1930 until 1955. Under his dynamic leadership, the association flourished and established a sound financial structure; his long tenure gave the organization stability. Lloyd Cavanah, then assistant secretary-treasurer, succeeded Helm as executive secretary-treasurer. Both Helm and Cavanah held tenured academic positions in the Department of

Lloyd Cavanah (left) and Charles Hayward record the 1964 contents of the Foundation Seed Storage Building. Cavanah was manager of the Foundation Seed program from 1962-85. Hayward taught "Field Crops" and assisted with the wheat breeding program.



Field Crops and handled the administrative responsibilities of the organization in addition to their normal teaching and research duties. A change in policy of the College of Agriculture prohibited this dual role for faculty members. Rather than relinquishing his tenured faculty appointment, Cavanah resigned as executive secretary-treasurer to become manager of the Foundation Seed Program. Wynard Aslin, an assistant secretary-treasurer, was appointed in 1962 by the association Board of Directors to succeed Cavanah on a full-time basis. Aslin served in this position until 1987, with the title of "Research Associate" in the Department of Field Crops.

Foundation Seed Program

As hybrid corn came into production, seed of hybrids originating from agricultural experiment stations were generally produced by certified seed growers. Normally, they purchased seed of the inbred lines and produced certified single-cross and double-cross seed. Because an adequate supply of pure seed of the inbred lines was not always available, a Foundation Seed Stocks program to maintain and increase the seed of the inbred lines was implemented by the Missouri Seed Improvement Association in 1944 under the direction of Leon McHoney, an assistant professor in the Department of Field Crops. When McHoney resigned in 1946, he was succeeded by Wynard Aslin. As the

crop-breeding programs in the Department progressed, it became necessary for the association to increase foundation seed stocks of wheat, soybeans, cotton, and other crops, in addition to the corn inbreds, in order to supply nucleus seed to certified seed growers.

In many states, the Foundation Seed Stocks program was an activity of the college department rather than the Seed Improvement Association. This arrangement provided close liaison with the breeders and resolved a quasi-legal question caused by the Association inspecting and certifying foundation seed it produced. This arrangement was adopted in Missouri, and in February, 1962, the Association transferred the Foundation Seed Stocks program to the Board of Curators of the University. The transfer included funds, seed stocks, equipment, and outstanding seed contracts. In a concurrent move, Cavanah relinquished the position of executive secretary-treasurer of the Missouri Seed Improvement Association to Wynard Aslin and became manager of the Seed Stocks Project in order to maintain tenure in the Department.

18. ALUMNI AND FACULTY HONORS, 1914-67

Honorary Degrees

Three native Missourians and former graduates in Field Crops have been honored with honorary degrees by the University of Missouri:

Claude Burton Hutchison (B.S. 1908), first chairman of the Department of Farm Crops in the University of Missouri, was honored with an Honorary Doctor of Laws degree in 1937. At that time he was vice-president for agriculture at the University of California-Berkeley.

Frederick David Richey (B.S. 1909), a corn breeder and geneticist for the U.S. Department of Agriculture, who became chief of the Bureau of Plant Industry, U.S. Department of Agriculture, was awarded the Honorary Doctor of Science degree by the University of Missouri in 1949.

Fred N. Briggs (B.S. 1918), wheat breeder and geneticist, professor of agronomy, and later dean and director, College of Agriculture, University of California, Davis, received the Honorary Doctor of Science degree in 1963. Briggs, a native of Center, Mo., was a nephew of Henry Jackson Waters, former dean of the Missouri College of Agriculture.

National Academy of Sciences

Two faculty members in the Department of Field Crops were elected to the National Academy of Sciences:

Lewis J. Stadler (1938)

Ernest R. Sears (1964)

Stadler and Sears were the first faculty members from the University of Missouri to receive this honor.

American Academy of Arts and Sciences

Lewis J. Stadler

Ernest R. Sears (1953)

American Society of Agronomy Fellows

L.J. Stadler (1936)

W.C. Etheridge (1950)

E.M. Brown (1951)

J.M. Poehlman (1955)

E.R. Sears (1956)

M.S. Zuber (1963)

Stephenson Award in Crop Science

Luther Smith (1950)

E.R. Sears (1951)

Indian Society of Genetics and Plant Breeding

Distinguished Fellow: E.R. Sears (1966)

Fellow: J.M. Poehlman (1967)

Miscellaneous

W.C. Etheridge was an Honorary Colonel on the staffs of Governor Phil M. Donnelly (1944-49) and Governor Forrest Smith (1949-53).

E.R. Sears received the Hoblitzelle National Award in Agricultural Sciences (1958).

19. DEPARTMENTAL RESTRUCTURING

On September 1, 1967, portions of the Department of Field Crops were combined with portions of the Soils Department to form a Department of Agronomy. The action of the Board of Curators to restructure departments in the College of Agriculture is reported in the minutes of their May 5, 1967, meeting as follows:

“Upon the recommendation of Dean Kiehl, approved by Chancellor Schwada and President Weaver, and upon motion of Mr. Smith,

seconded by Mr. Brady and unanimously carried, the following action was approved:

BE IT RESOLVED that beginning September 1, 1967, the College of Agriculture be restructured to provide for the formation of five new departments as follows:

Genetics
Plant Pathology
Atmospheric Science
Food Science and Nutrition
Agronomy

and that administration be authorized to take such steps as may be necessary or desirable to implement the five new departments."

The Board paper submitted to the Chancellor by Dean Elmer Kiehl, dated December 21, 1966, included these statements:

"Agronomy, when restructured as recommended, will include the Soils Department minus Atmospheric Science and the Field Crops Department minus Genetics and Pathology."

"This restructuring will more accurately identify the College of Agriculture with the subjects with which it has faculty with outstanding ability and stature. It will recognize the increasingly basic subject matter upon which research and teaching is being done by College of Agriculture faculty. Also, it will coincide more nearly with the disciplines with which public institutions and research institutions identify."

Events Leading to Restructuring

Discussions on realignment of departments had been initiated by Dean John H. Longwell with appointment of a committee to study the problem. Later, Longwell reviewed the departmental structure of agronomic teaching and research in the land-grant universities in the early 1960s. Longwell was concerned that "sharp disagreements developed between the two departments (Field Crops and Soils), which reduced effectiveness of the work and caused some adverse criticism among people in the state" (AES Bulletin 883). In a letter to Dr. Albert J. Dyer, chairman of the College of Agriculture Operations Committee, dated February 15, 1967, Longwell stated that the proposals made by Dean Kiehl for reorganization were of considerable interest to him. "I did not believe the time was right before my retirement as dean, but the changes in agriculture have now progressed to the stage where I think reorganization is necessary."

Prior discussion or planning for the reorganization within the Field Crops Department had not been carried out. As a Field Crops faculty member, I was aware that considerations were being given to departmental reorganization with the possibility that the Departments of Field

Crops and Soils might be combined into an Agronomy Department, but I did not learn about the details until the action of the Board of Curators in approving the reorganization was published in a local newspaper. Dean Kiehl had appointed a committee in 1962 composed of departmental chairmen to study departmental structures. That committee continued in existence until 1965. Sometime in 1966, Dean Kiehl discussed departmental interfaces and structures in a Field Crops faculty meeting, but the discussion was in general terms only.

Kiehl's proposed plan of reorganization of departments did not move through the University administration quickly. On January 19, 1967, Chancellor Schwada wrote to Kiehl that a few farm bureau people had hinted to him of "considerable concern among chairmen and members of the faculty with respect to this move." Schwada proposed to Kiehl that he "run it through the process again there to be sure that everyone is aware of the nature of the changes and the material supporting it." On February 13, Schwada again wrote to Kiehl stating that Dr. Unklesbay, vice-president for academic affairs, had requested information on steps gone through to secure faculty understanding and support. "Could you sketch out for me," Schwada wrote, "the departments that will hopefully exist completing the reorganization and those that will be parcelled out into new departments. I think we can keep this information very much among us, but I think this would be needed to move the information forward."

In his reply on Feb. 15, Kiehl reported that the ideas for reorganization extended back for 20 to 30 years and were supported by his predecessors. In referring to the new Agronomy Department, Kiehl stated: "It is obvious that the bulk of the prospective realignments and program identification falls heavily on the departments of Soils and Field Crops."

"A review of how the areas encompassed by these departments were organized on other campuses was made by Dean Longwell in 1963 as a special study project. There have been scores of conversations and consultations with leaders in each field, the relevant professional societies, and administrators at similar institutions.

"The evidence is clear that effective research, teaching, and extension programs in soils and field crops can be accomplished in a department entitled Agronomy. In fact, in forty (40) states the program is so organized. It is also evident that the degree of excellence of either soils or crops programs is dependent on factors other than whether or not they are combined or in separate departments."

Two days earlier (Feb. 13, 1967), Kiehl had met with the College of Agriculture Operations Committee to present "more detail (on) the restructuring and program identification matter." The subject had been

discussed in the Operations Committee, whose membership consisted of department chairmen, in two previous meetings. In comments prepared for presentation to the committee members, Kiehl wrote:

"All of the program identification(s) had interfaces and connections with other divisions. Some contacts were made informally with several heads of these divisions and at times with the Graduate School. At no time was full inter-divisional discussions encouraged or recommended." But the details of the restructuring already presented for the Board of Curator's approval were not revealed in his comments.

The Field Crops faculty involved in the genetics area program were more fully informed regarding the proposed changes than other Field Crops faculty. The genetics group were in the process of requesting a grant to supplement University appropriations for expansion of Curtis Hall. Contacts with granting agencies had replied that the chances would be enhanced by formation of a genetics department. In April, 1966, a formal proposal for a Department of Genetics in the College of Agriculture was prepared that would include Field Crops staff members then engaged in genetic research and members of Botany and other departments who have similar interests. The group became impatient of the delays for a new department, and on February 22, 1967, M.G. Neuffer, chairman of the Genetics Coordinating Committee, wrote to Chancellor Schwada expressing disappointment at the "series of frustrating situations culminating in the recent oscillations on a proposal for a department of genetics." He cited the need for program identity to strengthen the grant application for building funds. The recommendation to the Board of Curators had requested that the Department of Genetics be established Feb. 1, 1967, earlier than the other departments, but since Board approval was not received until May 5, implementation of the change was not made until Sept. 1, the same as for the other departmental changes.

How fully the Field Crops faculty members who were plant pathologists were informed about potential formation of a Department of Plant Pathology is not clear. However, Dean Kiehl in the comments prepared for the Operations Committee, stated that the matter of program identification for plant pathology came to his attention in 1960. During the preceding three years, he noted, several statements of justification had been prepared, including a statement of the relationships of similar groups on other campuses.

With the implementation on Sept. 1, 1967, of the Board action approving the departmental restructuring, the Departments of Field Crops and Soils ceased to exist. The Field Crops programs in crop breeding, forage management, seed investigations, weed science, and crops extension were transferred to the new Department of Agronomy;

the genetic programs on corn, wheat, and arabidopsis were transferred to the new Department of Genetics; and the pathology programs in corn, cotton, soybeans, and extension were transferred to the new Department of Plant Pathology.

Restructuring in Retrospect

In the 1961 college bulletin, "Missouri College of Agriculture Through Half a Century" (AES Bulletin 769), Dean Emeritus Miller discusses the 1914 division of the Agronomy Department to form departments of Soils and Farm Crops. Miller was the chairman of the Agronomy Department before it was divided, and afterwards he became chairman of the new Department of Soils. Miller's protégé, C.B. Hutchison, became chairman of farm crops. Miller writes:

"Whether this division into two departments was wise, it is difficult to say. I have never been entirely sure of it. However, I believe that, in Missouri, more has been accomplished through the two departments than would have taken place through one. I think the total allotment of funds for the two departments has been larger than it would have been under a single department. The men have worked harmoniously, about as well, I think, as the two groups would have worked under a single type of administration."

It has now been 21 years since the two departments, Field Crops and Soils, were reunited into a Department of Agronomy. Paraphrasing Miller, one may ask, "Has more been accomplished through one department than would have been accomplished through two?" A definitive answer cannot be given, for the situation is more complex than the question implies. Actually, four new departments were formed in the move. Also, speculations must take into consideration the professional goals of the concerned faculty, the changed budget situation, and changes that have occurred in the academic environment.

Benefits of restructuring to the new departments varied. The plant pathology component from field crops (and the atmospheric science component from soils) prospered in new departments and gained name recognition in their disciplines. This professional goal was sought for the genetics program and was temporarily acquired. But the nemesis that stymied earlier visions of a genetics department in the College of Agriculture, the University policy of positioning science units in the College of Arts and Science, arose again. With formation of the Biological Sciences Division in 1972 that included genetics, the College of Agriculture department was terminated, and the genetics program formerly in Field Crops became a part of the Department of Agronomy. The crops and soils components in the new Agronomy Department also

acquired name recognition corresponding to their professional society, the American Society of Agronomy. The agronomy image is somewhat flawed in that the agronomy society itself is fractured into crop science and soil science societies. Perhaps "agronomy" connotes a more professional image, but it may be less widely understood by the public than "Crop Science" or "Soil Science."

From the beginning, farm crops and soils were treated as separate subjects in the teaching program of the College of Agriculture. This continues today. When the Agronomy Department was established in 1904, the rotation experiments on Soils Experiment Fields developed by Miller to study crop production in the different soil areas was a combined soils and crops research effort. But specialization soon developed. The soil survey and soil-fertility studies were conducted by the soils research teams, and the farmer-cooperative testing of crop varieties and variety-selection experiments by crops research personnel. Specialization continued in the separate departments of soils and field crops. In the soils department, research was conducted on measurement of soil erosion; physical and colloidal properties of soils; soil nitrogen, limestone, and forms of phosphorous; nodulation of legumes in relation to soil elements; soil tests and their calibration; and reduced tillage. Field Crops research was concentrated on crop cultural practices; genetic improvement of corn, wheat, oats, soybeans, cotton, and forages; new crops such as winter barley, soybeans, and lespedeza; pasture improvement; seed improvement; weed science; and genetic studies of corn and wheat. The extension specialists served to coordinate and interpret the research. Combining Field Crops and Soils has not changed this pattern of specialization; if any change has occurred, the specialization has become more intense as faculty have been forced to seek outside funding to supplement declining University research budgets.

Former Dean Longwell was a strong advocate for combining the departments of Crops and Soils. In his 1970 Centennial Report (AES Bulletin 883), he quotes a committee report on departmental re-organization:

"Many of the problems involved in crop production are closely related to both the plants being produced and the soil in which they grow. The research involved should be closely related and coordinated. A team of extension specialists speaking for the total area instead of two teams of specialists speaking for parts of it separately would be much more effective. In addition the information presented would not be discordant or, as is sometimes now the case, in disagreement."

The detail with which the extension specialists documented their efforts to coordinate recommendations in their "combined annual reports" don't support the implications of discordant recommendations.

Neither are they supported by crops and soils specialists who served in the separate departments and later in the Agronomy Department after the departments were combined. Certainly, discordant philosophies were expressed, sometimes forcefully, by individual faculty in the separate departments, particularly, Etheridge and Helm in Field Crops and Albrecht and Klemme in Soils. However, by the time the departments were united in 1967, all of these persons had passed from the scene.

Etheridge once stated his feeling that Miller was disappointed when the two departments were not reunited after Hutchison left in 1916. This may have contributed to Etheridge's sensitivity to the overlapping areas of responsibility in the two departments as expressed in a 1920 letter to M.M. Beeler. Beeler, editor of the magazine, *Farmer and Stockman*, had requested Etheridge to write a cover-page story on "Advantages of Early Preparation of Wheat Land." Etheridge replied:

"I would be pleased to prepare an article for you, but the subject of preparing land belongs rather in the Department of Soils. That is, the general field of agronomy is divided between us in such a way that soil treatments in general are handled by the Department of Soils. While we of this department discuss soil treatments in our classes and in correspondence, we would not like to write publicly on the matter as a special topic."

Etheridge's reticence had diminished by 1924 when A.J. Meyers, Director of the Agricultural Extension Service, requested approval from the soils department before publishing a circular submitted by Etheridge. Etheridge pointed out to Meyers that the circular contained five general subjects, "all nominally within the practical field of field crops," yet two may be technically classified in the field of soils, two in botany, and one in entomology. "Approval of these departments," Etheridge continued, "is equally as important as approval by the Department of Soils. The responsibility would then be equally and particularly fixed in all details. This would relieve the Department of Field Crops of any responsibility, a condition not altogether undesirable, in view of the vague understanding of the responsibility for subject matter in extension circulars, which is now apparent." Perhaps the largest disagreement between the departments was over Etheridge's and Helm's espousal of lespedeza, which Albrecht viewed as mining the soil. There was also hesitancy by crops faculty of accepting the high rates of fertilization when first recommended by soils researchers.

Programs were being restructured in many agricultural colleges in the early 1960s. This was a period of growth and relative prosperity in public universities. The agricultural industry was undergoing massive structural changes, and the colleges of agriculture were modifying

traditional lines of research to emphasize new programs. Combining Crops and Soils was viewed as the opportunity to approach agronomic problems with a united force. Unfortunately, perceptible advances in meeting this goal have not materialized. Progress has been made in crop physiology teaching and research, but this has been offset by a decline in the crop-breeding programs.

Progress in the new Agronomy Department was hampered by the declining fiscal situation. Rising costs of teaching and research exceeded increases in state and federal appropriations, once the mainstay of research funding. The shortfalls were met from attrition of positions and programs; reallocation of funds, largely from research budgets; and new funds from external donors. Returning to Hutchison's argument in 1914 that two departments would receive more funding and accomplish more than one, certainly, a case could be made that two chairmen pressing for University and federal funds might have had more impact than one during this period of fiscal difficulties. A major problem was inherent in the size and diversity of the new department, making effective management by a single chairman difficult. Greater unity in the new department might have been achieved if it could have been physically united instead of each former unit being housed separately as before.

Comparisons of achievements in the old and new departments are difficult to make due to the changed financial and academic environment. To augment dwindling research funds from traditional public sources, faculty were compelled to seek grants from public or private granting agencies or from agricultural industry. This change in funding source was accompanied by subtle changes in the nature of the research and the clientele for whom the research was designed to serve. Field research with benefits that could be demonstrated in a farmer's field, typical of the Etheridge and Pinnell era, has been largely supplanted by laboratory studies. Benefits of the latter are generally long-term, at best, and often are related to the grantor's goals rather than predetermined departmental goals based on solving agriculture's problems. The system permits the faculty to produce publications, an essential ingredient in the present academic environment. Many of these changes have been brought about by external forces; they are not necessarily related to departmental structures.

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Appendix No. 1

College of Agriculture Academic Staff that Conducted Teaching, Research, or Extension in Field Crops, 1870-1967

Name	Date of employment	Position(s) to 1967
1870-1903 (College of Agriculture)		
Swallow, George C.	1870-82	Professor of Agriculture, Dean
Schweitzer, Paul	1873-1906	Professor of Agricultural Chemistry, Dean and Director
Sanborn, Jeremiah W.	1882-89	Professor of Agriculture, Dean and Director
Waters, Henry J.	1891	Assistant
	1895-1909	Professor of Agriculture, Dean and Director
Conner, Charles M.	1893-97	Assistant
Quick, Walter J.	1893-95	Professor of Agriculture
Mumford, Frederick B.	1895-1938	Professor of Agriculture, Professor of Animal Husbandry, Dean and Director
Mairs, Thomas I.	1897-1902	Assistant
May, David M.	1897	Assistant
Shaw, E. L.	1902-03	Assistant
Tucker, George M.	1902-04	Instructor
1904 - 1913 (Department of Agronomy)		
Miller, Merrit F.	1904-45	Professor; Chairman, Agronomy; Chairman, Soils; Dean and Director
Grantham, Arthur E.	1905-07	Instructor
Hughes, Harold D.	1907-10	Instructor, Assistant Professor
Demaree, Frank H.	1908-11	Assistant, Instructor, Assistant Professor
Hutchison, Claude B.	1908-16	Assistant; Instructor; Assistant Professor; Professor; Chairman, Farm Crops
Hackleman, Jay C.	1910-19	Assistant, Instructor, Assistant Professor, Extension Assistant Professor
Hendrix, W.J.	1910-12	Assistant
Douglas, Thomas R.	1911-14	Assistant, Instructor, Assistant Professor

Name	Date of employment	Position(s) to 1967
Evans, A. Ray	1912-16	Assistant, Instructor
Bentley, Franklin L.	1913-14	**Assistant
1914-1919 (Department of Farm Crops)		
Moomaw, Leroy	1914-15	**Assistant
Neff, Clarence E.	1914-16	Assistant
McDonald, Elmer M.	1915-20	Assistant Professor
Etheridge, William C.	1916-55	Professor, Chairman, Farm Crops/Field Crops
Helm, Charles A.	1916-55	Assistant Professor, Associate Professor, Professor
Smith, John B.	1916-17	Assistant
Stadler, Lewis J.	1917-54	*Research Scholar, Assistant Instructor, Assistant Professor, Associate Professor, Professor
1920-1929 (Department of Field Crops)		
Carter, Clarence E.	1920-34	Extension Assistant Professor, Extension Associate Professor
Letson, Orren W.	1920-25	Assistant, Instructor
Pollock, E.O.	1920-21	Assistant
Branstetter, Basil B.	1921-27	Instructor, Extension Assistant Professor
Eyster, W.H.	1921-24	Assistant (summer appointment only)
Frear, D.W.	1921-25	Extension Associate Professor
Hill, A.C.	1921-22	Assistant
King, Bascom M.	1921-22, 1924-47	*Field Assistant, Instructor (Cotton Specialist), Assistant Professor, Associate Professor
Kirkpatrick, Roy T.	1921-33	**Extension Instructor, Extension Assistant Professor, Instructor, Assistant Professor
Harman, Kenyon G.	1923-32	Instructor, Extension Assistant Professor
Trotter, Ide P.	1923-36	Extension Assistant Professor
Stephens, Joseph C.	1924-25	Research Scholar
Eddins, Arthur H.	1925-26	Assistant Instructor
Keller, Eugene L.	1925-27	Assistant Instructor, Research Fellow
Tascher, Wendell R.	1927-33	Research Fellow, Assistant Professor
Goodsell, Samuel F.	1928-31	Research Fellow, Assistant
Brown, Eliphalet Marion	1929-61	*Research Fellow, Assistant Instructor, Instructor, Assistant Professor, Associate Professor, Professor

Name	Date of employment	Position(s) to 1967
1930-1939 (Department of Field Crops)		
Poehlman, John M.	1934, 1936-†	*Instructor, Assistant Professor, Associate Professor, Professor, Research Adviser (India Program)
Fleetwood, J. Ross	1936-66	Extension Associate Professor, Extension Professor
O'Mara, Joseph G.	1936-43, 1945-50	*Research Associate
Sears, Ernest R.	1936-†	*Research Associate, Professor
Smith, Luther	1936-43	*Research Associate
Sprague, George F.	1936-39	*Assistant Professor
Paulling, John R. Jr.	1937-49	Extension Assistant Professor, Extension Associate Professor, Extension Professor
Allen, Denver I.	1939-43	Instructor
Anderson, Dean G.	1939-44	*Research Associate
Hoegemeyer, Leonard C.	1939-42	Research Fellow
1940-1949 (Department of Field Crops)		
McHoney, Leon L.	1940, 1944-46	**Assistant, Instructor
Baldrige, Joe D.	1941-†	*Assistant, Instructor, Assistant Professor, Associate Professor, Professor
Stanway, Viola May	1941-†	Assistant Seed Analyst, Seed Analyst, Instructor, Assistant Professor
Li, Chung Hsiung	1944-45	Assistant
Liang, T.J.	1944-45	Assistant
Alley, William L.	1946-48	Assistant Instructor
Cloninger, Charles K.	1946-50 1952-54	Assistant Instructor, Instructor Assistant Professor, Administrative Assistant to Dean and Director
Gundy, Larry J.	1946-50, 1953	Research Fellow, Assistant Professor
Whitt, Darnall	1946-55	*Research Associate
Zuber, Marcus	1946-†	*Research Associate, Professor
Aslin, Wynard	1947-†	**Assistant, Instructor, Assistant Professor, Research Associate
Peek, John M.	1947-48	Assistant
Cavanah, Lloyd E.	1948-†	**Assistant Instructor, Instructor, Assistant Professor, Associate Professor, Professor, Acting Chairman

Name	Date of employment	Position(s) to 1967
Feaster, Carl V.	1948-50	*Research Associate
Fletchall, O. Hale	1948-†	Assistant Instructor, Instructor, Assistant Professor, Associate Professor, Professor
Langford, Walter R.	1948-51	Assistant, Instructor, Assistant Professor, Associate Professor, Professor
Nuffer/Neuffer, Myron G.	1948-†	Assistant, Assistant Professor, Associate Professor, Professor
Sappenfield, William P.	1948-51	Assistant Instructor
	1956-†	Associate Professor, Professor
Grogan, Clarence O.	1949-51	Assistant Instructor
	1954-59	*Research Associate
Murphy, William J.	1949-†	Extension Assistant Professor, Extension Associate Professor, Extension Professor, Adviser on Seed Production, India Program
1950-1954 (Department of Field Crops)		
Brown, Norman	1951-†	Instructor, Assistant Professor, Superintendent Delta Center
Emmerling, Margaret H.	1951-55	Assistant Instructor, Assistant Professor
Offutt, Marion S.	1951-56	Assistant Instructor, Assistant Professor, Associate Professor, Professor, Chairman Field Crops
Stahler, Leonard M.	1951-53	Research Associate
Strothmann, Harvey F.	1951-52	Assistant Instructor
Williams, Leonard F.	1951-65	*Research Associate, Associate Professor
Epperson, James F.	1952-53	Assistant Instructor
Foy, Chester T.	1952-53	Assistant Instructor
Klingner (Stadler), Joan	1952-54	Assistant Instructor
Koehler, Carl	1952-54	Assistant Instructor, Assistant
Beard, Benjamin H.	1953-54	Instructor
Hayward, Carl C.	1953-†	Instructor, Assistant Professor
Klingman, Dayton L.	1953-56	*Research Associate
Laughnan, John R.	1954-55	Professor
Longwell, John H. Jr.	1954-58	Assistant

Name	Date of employment	Position(s) to 1967
1955-1959 (Department of Field Crops)		
Coe, Edward H. Jr.	1955-†	*Research Associate, Associate Professor, Professor
Forsyth, Frederick E.	1955-†	**Assistant, Research Associate
Hayward, Charles F.	1955-66	Assistant, Instructor, Assistant Professor
Matson, Arnold L.	1955-65	Instructor
Sechler, Dale T.	1955-60	Assistant, Instructor
	1967-†	Associate Professor, Research Adviser (India Program)
Whitehead, Marvin	1955-60	Associate Professor
Muramatsu, Mikio	1956-63	Assistant, Instructor
Okamoto, Masasuke	1956-57	Research Associate
	1959-61	Instructor
Swearingen, Marvin L.	1956-57	Assistant
Hicks, Raymond	1957-66	Instructor, Assistant Professor
Hsu, Kuang S.	1957-60,	Assistant, Assistant Professor
	1964	
Kerr, Harold D.	1957-58	*Research Associate
	1967-†	Assistant Professor
Peters, Elroy J.	1956-†	*Research Associate, Assistant Professor, Associate Professor
Pinnell, Emmett L.	1957-†	Professor, Chairman Field Crops
Rédei, Gyorgy P.	1957-†	Assistant Professor, Associate Professor
Singleton, O.V.	1957-65	Instructor
Yabuno, Tomasabura	1957-58	Instructor
Calvert, Oscar H.	1958-†	Assistant Professor
Davis, Frank S.	1958-61	*Research Associate
Ferguson, Virgil	1958-66	*Research Associate, Assistant Professor
McBride, Alexander C.	1958-62	Assistant, Instructor
Talbert, Ronald E.	1958-63	Assistant, Instructor
Thomas, John P.	1958-62	Instructor
Scott, Joseph H.	1958-†	Extension Assistant Professor, Extension Associate Professor
Green, Detroy	1959-64	Assistant, Instructor
Loesch, Peter J.	1959-†	*Research Associate, Assistant Professor
Reddy, Gurgal M.	1959-62	Assistant

Name	Date of employment	Position(s) to 1967
1960-64 (Department of Field Crops)		
Brown, George E.	1960-61	Assistant
Doyle, Gregory G.	1960-†	*Research Associate, Assistant Professor
Hirono, Yoshihiko	1960-65	Assistant, Assistant Professor
Schnake, L.D.	1960	Assistant
Wylie, Thomas	1960-†	Assistant Professor, Associate Professor
Acosta C, Aristeo	1961-62	Instructor
Aycock, William D.	1961-62	Assistant
Ficsor, Gyula	1961-65	Assistant
Hooks, James A.	1961-62	Assistant
Hoskins, Paul H.	1961-66	Assistant
Matches, Arthur G.	1961-†	*Research Associate, Assistant Professor, Associate Professor
Pettit, Robert E.	1961-66	Instructor
Stritzke, Jimmie F.	1961-66	*Research Associate
Anderson E.G.	1962-65	Visiting Professor
Driscoll, Colin J.	1962-63	Instructor
Fine, Richard F.	1962-64	Assistant
Lumsden, Donald	1962-†	**Research Associate
Sarkar, Kamud R.	1962-65	Assistant
Sears, Lotti M.	1962-†	Research Associate, Assistant Professor
Singh, Tribhuvan P.	1962-65	Assistant
Swader, Jeff A.	1962-64	Assistant
Beckett, Jack B.	1963-†	*Research Associate, Assistant Professor
Helm, James L.	1963-67	Instructor
Kimber, Gordon	1963-64	Research Associate
Sehgal, Om P.	1963-†	Assistant Professor
Aldrich, Richard	1964-†	Professor, Associate Director Agricultural Experiment Station
Feldman, Moshe	1964-67	Instructor, Assistant Professor
Fink, Rodney F.	1964-66	Instructor
Goldman, Stephen L.	1964-67	Assistant

Name	Date of employment	Position(s) to 1967
Larson, Russell L.	1964-†	*Assistant Professor, Associate Professor
Posler, Gerry L.	1964-65	Assistant
Watson, Vance H.	1964-66	Assistant
1965-1967 (Department of Field Crops)		
Anderson, Laurel E.	1965-†	Assistant Professor
Asay, Kay H.	1965-†	Assistant Professor
Foland, Edward	1965-66	Assistant
Justus, Norman	1965-†	Associate Professor, Superintendent Southwest Research Center
Krause, Gary F.	1965-†	Associate Professor, Agricultural Experiment Station Statistician
Luedders, Virgil F.	1965-†	*Research Associate
Miller, John Wesley	1965-†	*Assistant Professor
Palm, Einar W.	1965-†	Assistant Professor, Extension Plant Pathologist
Sampayo, Truston Mello	1965-66	Research Associate
Stark, Clarence	1965-†	Research Associate
Chang, Young Huei	1966-67	Assistant
Duclos, Leo A.	1966-†	Research Geneticist, Assistant Professor
Lopez, Restituto	1966-67	Assistant
Palm, Harlan L.	1966-†	Assistant
Röbbelen, Gerhard P.	1966-67	Visiting Professor
Horrocks, R. Dwain	1967-†	Assistant Professor
LeGrand, Frank E.	1967-†	Extension Associate Professor
Nelson, Curtis J.	1967-†	Assistant Professor
Nishikowa, Kozu	1967-†	Research Associate
Wilson, Roland D.	1967-†	Assistant

*Cooperative for part or all of their careers with U.S. Department of Agriculture

**Cooperative for part or all of their careers with Missouri Corn Growers' Association/Missouri Seed Improvement Association

†University of Missouri appointment continued beyond 1967

Appendix No. 2

Graduate Degrees awarded in Field Crops and Genetics Doctor of Philosophy - Field Crops (1922-1967)

Year	Name	Major Advisor	Dissertation Title
1922	Lewis J. Stadler	W.C. Etheridge	Experiments in Field Plot Technique for the Preliminary Determination of Comparative Yields in Small Grains Corn Root Rot Studies
1927	B.B. Bransetter	*W.J. Robbins/ W.C. Etheridge	Effects of X-ray Treatments on the Seed of Certain Crop Plants
1929	Wendel R. Tascher	L.J. Stadler	A Study of Varietal Adaptation in Soybeans
1936	John M. Poehlman	*W.J. Robbins/ W.C. Etheridge	Cytogenetic Studies in <i>Triticum monococcum</i> and <i>Triticum aegilopoides</i>
1936	Luther Smith	L.J. Stadler	Effects of Temperature on the Growth and Chemical Composition of Certain Pasture Grasses
1938	E. Marion Brown	*W.J. Robbins/ W.C. Etheridge	Differential Growth Response of Varieties of Soybeans in Varied Nutrient Conditions
1942	Denver I. Allen	*P. Burkholder/ W.C. Etheridge	Growth Interaction Between Kentucky Bluegrass (<i>Poa pratensis</i>) and Korean Lespedeza (<i>Lespedeza stipulacea</i>) Under Different Environmental Conditions
1946	Joe D. Baldrige	*P. Burkholder/ E.M. Brown	The Morphological Aspects of Self-Sterility in <i>Lotus corniculatus</i> L.
1949	William L. Giles	*D.S. Van Fleet/ W.C. Etheridge	Inheritance of Resistance to <i>Xanthomonas phaseoli</i> var. <i>sojense</i> Hedges in Soybeans
1950	Carl V. Feaster	J.M. Poehlman	

Year	Name	Major Advisor	Dissertation Title
1950	Walter R. Langford	E.M. Brown	Studies in the Establishment and Management of Birdsfoot Trefoil (<i>Lotus corniculatus</i>) in Missouri
1951	Charles K. Cloninger	J.M. Poehlman	Reaction of Winter Barley Varieties To Collections of <i>Ustilago nuda</i>
1951	Clarence O. Grogan	M.Z. Zuber	A Comparative Study of Top Cross Tester Parents in Maize
1952	William P. Sappenfield	J.M. Poehlman	The Inheritance of Earliness Among Six Common Varieties of <i>Avena</i>
1952	Darnell M. Whitt	W.C. Etheridge	An Evaluation of the Production and Economic Return from Pastures on a Midwestern Claypan Soil
1954	O. Hale Fletchall	E.M. Brown	Studies in the Establishment and Management of Ladino Clover
1954	Marion S. Offutt	J.D. Baldrige	Inoculation Studies as Related to Breeding for Resistance to Bacterial Wilt in Lespedeza
1960	Dale T. Sechler	J.M. Poehlman	A Study of Some Plant Characters Associated With Resistance to Root Lodging in Oats
1961	Charles F. Hayward	J.M. Poehlman	X-Ray and Thermal Neutron Irradiation of Soft Red Winter Wheat, <i>Triticum aestivum</i>
1961	Arnold L. Matson	L.F. Williams	Factors Affecting Response of Soybeans to Irrigation
1961	Nihar R. Panigrahi	J.M. Poehlman	Heritability, Dominance and Genetic Advance in Wheat
1961	Damadar P. Shrivastava	E.L. Pinnell	Germination Studies in Grain Sorghum
1963	Dhirendra N. Borthakur	J.M. Poehlman	Inheritance of Seed Size in Two-Row Barley Crosses
1963	Charles E. Caviness	L.F. Williams	A Physiologic and Genetic Study of Shattering in the Soybean

<u>Year</u>	<u>Name</u>	<u>Major Advisor</u>	<u>Dissertation Title</u>
1963	Raymond D. Hicks	O.H. Fletchall	Cotton Defoliation in Missouri as Affected by Temperature, Variety and Chemical Defoliant
1963	Ronald E. Talbert	O.H. Fletchall	Studies of the Behavior of Some Triazine Herbicides in Soils
1964	Virgil Ferguson	M.S. Zuber	Inheritance of Diplodia Stalk Rot Resistance and the Interrelation of Ear and Stalk Rot in Maize
1964	N.M. Patel	J.D. Baldrige/ J.M. Poehlman	Growth Indices of Normal and "Uzu" Barley Varieties and Recombinant Lines
1965	Detroy E. Green	L.F. Williams	Inheritance of Soybean Seed Quality Characters
1965	Lawrence F. Gundy	M.S. Zuber	Multiple-Marker Genetic Method for the Location of Desirable Chromosome Segments in Corn
1965	Tribhuwan P. Singh	M.S. Zuber	Relationship Between Stalk Characters and Yield in Maize
1966	Manuel C. Torregroza	M.S. Zuber	Effect of Method of Maintaining Six Open-Pollinated Varieties of Corn on the Genetic Stability of Agronomic Characters
1966	Rodney J. Fink	O.H. Fletchall	The Effects of Atrazine or Simozine-Nitrogen Fertilizer Combinations on Corn and on Succeeding Crops
1966	Robert E. Pettit	O.H. Calvert	Host-Parasite Relations in Legumes: Study of Fungi Associated with the Rhizosphere and Root Disease of Birdsfoot Trefoil
1967	Paul H. Hoskins	J.M. Poehlman	Inheritance of Spike-Density and "Uzu" Genes in Barley
1967	Hemanta K. Mohanty	P.J. Loesch Jr.	Agronomic and Genetic Studies in Prolific and Non-Prolific Corn Hybrids with Special Reference to Stability of Yield.

<u>Year</u>	<u>Name</u>	<u>Major Advisor</u>	<u>Dissertation Title</u>
1967	Jimmie F. Stritzke	E.J. Peters	Physiological and Anatomical Studies of Bulbs of Wild Garlic (<i>Allium vineal</i> L.)

*Joint thesis study between Departments of Botany and Field Crops. Degree was awarded in the Department of Botany.

Master of Arts or Master of Science in Agronomy (1908-'14),
Farm Crops (1914-'20), or Field Crops (1920-'67)

<u>Year</u>	<u>Name</u>	<u>Advisor</u>	<u>Thesis Title</u>
1908	Harold D. Hughes	M.F. Miller	I. Studies with Red Clover Seed as Related to Color. II. Studies with the Impurities Found in Red Clover and Alfalfa Seed
1908	J. William Read	M.F. Miller	Some Factors Influencing the Germination of Corn
1909	Edgar A. Cockefair	M.F. Miller	Varietal Characteristics of Wheat Grown in Missouri
1911	Frank H. Demaree	M.F. Miller	Study of the Phenomenon of Barrenness in Corn
1912	Jay C. Hackleman	M.F. Miller	A Study of Conformation and the Correlation of Parts in Ears of Maize
1915	Clarence E. Neff	C.B. Hutchison	Some Correlation Studies in Maize
1916	James W. Day	C.B. Hutchison	The Relation of Size, Shape and Number of Replications of Plots to Probable Error in Field Experiments
1916	Clive R. Megee	C.B. Hutchison	The Relation of the Size of Seed to the Character of Plant Produced
1916	John B. Smith	C.B. Hutchison	Variations and Correlations in Wheat

<u>Year</u>	<u>Name</u>	<u>Advisor</u>	<u>Thesis Title</u>
1917	Harlan R. Sumner	W.C. Etheridge	Studies in the Winterkilling of Cereals
1918	Lewis J. Stadler	W.C. Etheridge	The Associated Growth of Legumes and Non-Legumes
1921	Orrin W. Letson	W.C. Etheridge	The Degree of Error in Plot Trials Due to Variation of Moisture Content in Crops
1921	E.O. Pollock	L.J. Stadler	The Effect of Seed Treatment on the Germination and Growth of Oats
1922	L.A. Dalton	W.C. Etheridge	A Survey and Classification of Practical Problems of Field Crops in Missouri
1922	Bascom M. King	W.C. Etheridge	Introduction of Drought Resistant Crops into the Ozark Region of Missouri
1924	James W. Graham	L.J. Stadler	Experimental Study of Variation and Correlation in Midwest Soybeans
1924	Roy T. Kirkpatrick	W.C. Etheridge	Some Growth and Storage Factors Affecting the Germination of Soybeans
1925	Ensley E. Morris	W.C. Etheridge	The Extent to Which Teachers in the Secondary Schools of Missouri are Finding Assistance from the Missouri College of Agriculture
1925	Joseph C. Stephens	L.J. Stadler	Germinal Study of Correlations in Midwest Soybeans
1926	Arthur H. Eddins	L.J. Stadler	Isolation of Selfed Lines, F ₁ Crosses and Varieties of Corn that Differ in Their Susceptibility to Corn Smut
1927	George H. Hale Jr.	W.C. Etheridge/ L.J. Stadler	Plot Competition and Yield Adjustment
1930	E. Marion Brown	L.J. Stadler	(No thesis)
1933	Floyd S. Ingersoll	L.J. Stadler	(No thesis)
1941	Harold J. Dumont	D.C. Anderson/ C.M. Tucker	Experiments in Seed Treatment of Corn
1941	Leon L. McHoney	C.A. Helm	(No thesis)

Year	Name	Advisor	Thesis Title
1947	Carl V. Feaster	J.M. Poehlman	A Study of Varietal Resistance of the Soybean to Infection by <i>Xanthomonas phaseoli</i> var. <i>sojense</i>
1947	Lawrence J. Gundy	M.S. Zuber	(No thesis)
1947	William C. Hansel	M.S. Zuber	(No thesis)
1948	John M. Peek	J.M. Poehlman	A Study of Milling Quality in Oats
1949	Clarence O. Grogan	M.S. Zuber	(No thesis)
1950	Lloyd E. Cavanah	W.C. Etheridge	A Study of Continuous Land Usage by Crop Succession
1950	Robert W. Mason	M.S. Zuber	A Statistical Study of Corn Yields in Missouri
1952	Benjamin H. Beard	J.M. Poehlman	A Study of Quality as Measured by the Pearling Test in Crosses Between Hard and Soft Wheats
1952	Donald D. Terhune	J.M. Poehlman	Resistance of Winter Barley to Three Smut Diseases
1953	Chester L. Foy	E.M. Brown	The Comparative Effectiveness of Isopropyl N-(3-Chlorophenyl) Carbamate as a Selective Herbicide in Cotton
1954	Carl L. Koehler	J.M. Poehlman	Some Root Characteristics and Their Relation to Lodging in Oats
1956	Norman E. Risner	J.M. Poehlman	(No thesis)
1957	Harold D. Kerr	D.L. Klingman	Weed Control Studies in Seedling Birdsfoot Trefoil (<i>Lotus corniculatus</i>)
1958	Patrick Chinwuba	M.S. Zuber	Detasseling Responses of Fertile and Male Sterile Maize Hybrids
1958	Marvin L. Swearingin	J.D. Baldrige	A Study of Legume Establishment in Wide Row Corn
1959	Humberto Castro	E.L. Pinnell	The Influence of Dates and Rates of Planting Upon Certain Agronomic Characters of Two Grain Sorghum Varieties

Year	Name	Advisor	Thesis Title
1959	Khan Badar Khan	C.O. Grogan/ M.S. Zuber	The Inheritance of Plant-Ear Height Ratios in Maize
1959	Hossein M. Nouri	M.D. Whitehead	Development of a Cold Testing Technique for Cotton
1959	Ram Prakash	M.G. Neuffer	Cytological Studies of Pearl Millet (<i>Pennisetum typhoidum</i> Rich.)
1960	Frank S. Davis	E.J. Peters	Studies of the Life History, Control, and Dormancy in Wild Garlic
1960	Virgil L. Ferguson	M.S. Zuber	Environmental Effects on Amylose Content of Maize
1960	Eric D. Kerr	J.M. Poehlman	Effect of Phorate on the Yields of Wheat
1960	Alexander C. McBride	M.S. Zuber	The Effects of Generation and Plant Density on Yield Components of Grain Sorghum
1960	Mahavir S. Rana	J.M. Poehlman	Inheritance of Head Density and its Relation to Height in Barley
1960	Damador Srivastava	E.L. Pinnell	Germination Studies in Grain Sorghum
1960	Ronald E. Talbert	O.H. Fletchall	Pre-Emergence Weed Control in Grain Sorghum
1961	Badan C. Barthakur	J.M. Poehlman	Response of Normal and "Uzu" Varieties of Barley to Fertility Level and Breeding Method
1961	George E. Brown	J.M. Poehlman	Heritability of Barley Yellow Dwarf Virus in Oats
1961	Detroy E. Green	E.L. Pinnell	Factors Affecting Soybean Seed Quality
1962	Prabodh K. Chatterjee	E.J. Peters	Response of Soybeans to Various Concentrations of Amiben
1962	Rodney J. Fink	O.H. Fletchall	Effect of Trizazine Residues in Soil on Establishment of Several Forage Crops
1962	Md. F. Haque	L.F. Williams	Linkage Relations Between Resistance to Phytophthora Root Rot and Plant and Seed Characteristics in the Soybean

<u>Year</u>	<u>Name</u>	<u>Advisor</u>	<u>Thesis Title</u>
1962	James A. Hooks	M.S. Zuber	Storage and Chemical Treatment Effects on Germination of Seed Corn
1962	Paul H. Hoskins	J.M. Poehlman	Effect of Spike-Density and "Uzu" Genes on Plant Characters in a Barley Cross
1962	M.H. Shahani	J.D. Baldrige	Stand Loss Studies in Birdsfoot Trefoil (<i>Lotus corniculatus</i> Linn.)
1963	Tribhuwan P. Singh	M.S. Zuber	A Study of Certain Morphological and Agronomic Characters Related to Field Stalk-Lodging in Maize
1964	Richard R. Fine	O.H. Fletchall	Studies on the Nature of Corn-Weed Competition
1964	William J. Murphy	O.H. Fletchall	Controlling Weeds in Seedling Grasses with Phenoxy Compounds
1964	Jeff A. Swader Jr.	O.H. Fletchall	Effects of Herbicide Residues in the Soil on the Growth of Several Forage Crops
1965	Restituto R. Lopez	A.G. Matches/ J.D. Baldrige	The Vegetative Development, Food Reserves, and Forage Yield of Tall Fescue
1966	Joseph F. Adams	O.H. Fletchall	Effect of Herbicides on the Growth and Development of Soybeans
1966	Jerry D. Caulder	O.H. Fletchall	Effect of Shading on the Establishment of Johnsongrass Seedlings
1966	Edward L. Foland	O.H. Fletchall	Effects of Some Triazine Herbicides on the Growth and Nitrogen Content of Young Corn Plants
1966	Gerry L. Posler	J.M. Poehlman	Response of Soft Red Winter Wheat Varieties to Fertilizer and Seeding Rates
1966	Vance H. Watson	A.G. Matches/ E.J. Peters	The Establishment of Birdsfoot Trefoil
1967	Donald H. Brewer	J.M. Poehlman	Fertilization and Harvesting Procedures to Improve Malting Quality of Winter Barley

Year	Name	Advisor	Thesis Title
1967	Harlan L. Palm	O.H. Fletchall	Responses of Soybeans to Trifluralin at Various Soil Temperatures
1967	Arun K. Rohatgi	O.H. Calvert	Effect of Varying Amylose : Amylopectin Starch Ratios on Corn Germination and on Growth of Three Fungi
1967	Ronald D. Wilson	O.H. Fletchall	Response of Selected Soybean Varieties to Amiben

Doctor of Philosophy in Genetics 1942-1967

Year	Name	Advisor	Dissertation Title
1942	Herschel Roman	L.J. Stadler	Translocations Involving B Chromosomes in Maize
1946	Seymour Fogel	L.J. Stadler	The Allelic Variability and Action of the Gene <i>R</i> in Maize
1946	John R. Laughnan	L.J. Stadler	The Action of Allelic Forms of the Gene <i>A</i> ₁ in Maize
1950	Katerina Zarudnaya (Kingston)	L.J. Stadler	A Chromatographic Study of Anthocyanins and Related Substances in Various Genotypes of Maize
1952	Ruby I. Larson	E.R. Sears	Aneuploid Analysis of the Inheritance of Stem Solidness in Common Wheat
1952	Myron G. Nuffer	L.J. Stadler	A Study of a Mutable Allele of <i>A</i> ₁ and Certain Related Modifiers of Mutation in Maize
1954	Margaret Emmerling (Thorp)	L.J. Stadler	An Analysis of Ultraviolet and X-Ray Radiation on Chromosomes of <i>Zea mays</i>
1955	Joan Klinger (Stadler)	L.J. Stadler	An Analysis of Instability at the <i>R</i> Locus in Maize
1957	Arlene Crosby (Longwell)	E.R. Sears	Nucleolar Behavior of Aneuploids of <i>Triticum aestivum</i>

<u>Year</u>	<u>Name</u>	<u>Advisor</u>	<u>Dissertation Title</u>
1960	Kuang Hsu	M.G. Neuffer	The Effect of the Dissociation-Activator System on Mutation in Maize
1961	Aristeo Acosta C.	E.R. Sears	A Transfer of Stem Rust Resistance From Rye to Wheat
1961	Mikio Muramatsu	E.R. Sears	The Nature of the Spelta Gene <i>q1</i> of Hexaploid Wheat and its Duplicators <i>q2</i> and <i>q3</i> on the Homologous Chromosomes
1961	Masasuke Okamoto	E.R. Sears	Studies on the Relationships Among the Chromosomes of Hexaploid Wheat
1962	Gurjal M. Reddy	E.H. Coe	Gene Action Sequence and Some Chemical Studies in Anthocyanin Synthesis in Maize
1964	Yoshihiko Hirono	G.P. Rédei	Mitotic Exchange of Linked Markers in <i>Arabidopsis</i>
1965	Gyula Ficsor	G.F. Neuffer	Chemical Mutagenesis in <i>Zea mays</i>
1965	Kumud R. Sarkar	E.H. Coe	Genetic Analysis of Fertilization Anomalies in Maize

Master of Arts or Master of Science in Genetics, 1947-1967

<u>Year</u>	<u>Name</u>	<u>Advisor</u>	<u>Thesis Title</u>
1947	Francisco S. Soto	L.J. Stadler	(No Thesis)
1948	J.A.F. Monge	L.J. Stadler	(No Thesis)
1948	Myron G. Nuffer	L.J. Stadler	(No Thesis)
1948	Jesus Velez-Fortuño	L.J. Stadler	Studies on Haploidy in <i>Zea mays</i>
1967	Young-Huei Chang	E.H. Coe	Some Studies of Media for Pollen Suspension Before Pollination in Corn
1967	Stephen Goldman	E.H. Coe	An Analysis of the Relationship Between Recombination Frequency and Coincidence in Maize
1967	Ilene Montgomery	E.H. Coe	(No Thesis)

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