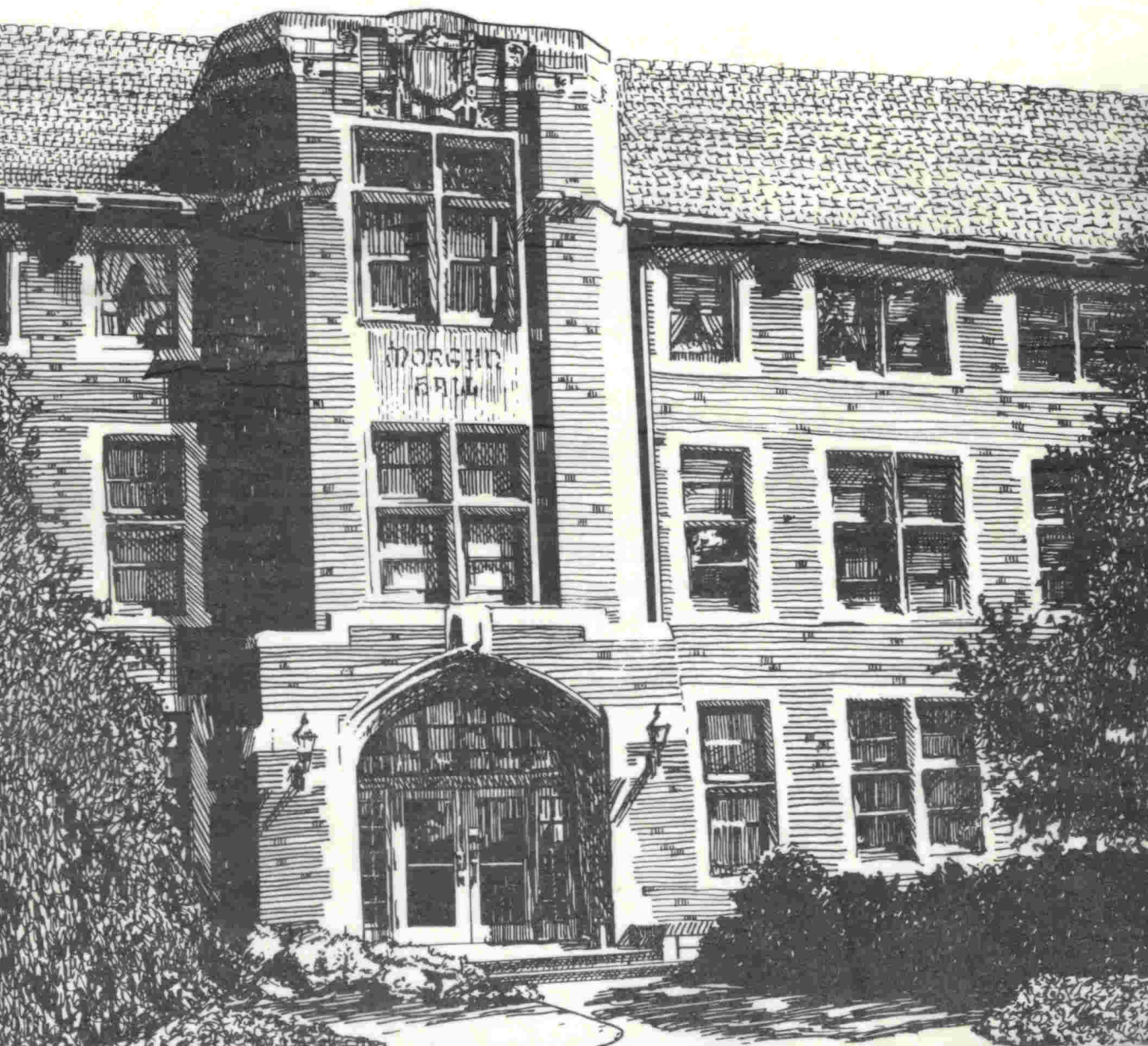


A History of the Tennessee Agricultural Experiment Station



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Thomas J. Whatley

With a Foreword by Don O. Richardson

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FOREWORD

As The University of Tennessee celebrates its 200th year, the Tennessee Agricultural Experiment Station contemplates its 115th year of service to Tennessee's agricultural industries and rural life. Pausing to review the roots and history of an organization such as the Tennessee Agricultural Experiment Station is a necessary step in a periodic reassessment of institutional mission and priorities. Although clichés such as, "if you fail to remember the past you must relive it" are generalizations, there is, in fact, a real "pearl" of wisdom in such an adage. One must understand not only the status of science in a particular era, but also the "social" climate of the times to understand the whys and wherefores of the Experiment Station's development and the public's expectation of the research program.

The Tennessee Agricultural Experiment Station is deeply indebted to Dr. Thomas J. Whatley, Associate Dean Emeritus, who served the Experiment Station in several capacities over 39 years. This period included service as a research project leader, head of the Department of Agricultural Economics and Rural Sociology, and as Associate Dean with major responsibilities in budgeting and program development. Dr. Whatley was active in administration during a period of budgetary and programmatic growth. In his various roles, he mentored many of the existing faculty and administrative team. Thus, he has

had a major role in shaping the recent Experiment Station history. With his tremendous insight, he was a natural scholar to take the lead in recapturing in written form some of the essence of the Experiment Station's history as a legacy to its current faculty and staff. Dr. Whatley received help from many others who have earned "Emeritus" titles and we are grateful for their many contributions professionally and to this history manuscript.

I believe as you read this manuscript on the History of the Tennessee Agricultural Experiment Station you will agree with me that Dr. Whatley has recorded a fascinating portrayal of our unit's development and service. This perspective should be invaluable in the Station's continuing service to its constituencies.

DON O. RICHARDSON
DEAN, TENNESSEE AGRICULTURAL EXPERIMENT STATION

PREFACE

From the beginning of the 19th century, a debate was underway in America on the best means to obtain an adequate and safe supply of food for an expanding population. The country's leaders recognized that individual farmers did not have the resources nor knowledge to conduct agricultural research, but it was in the public interest to improve agriculture. A consensus was developing among the population that higher education with specific emphasis on agriculture and the mechanical arts was needed because most existing colleges and universities were directed toward the classics with training primarily for the ministry, medicine, and law.

To broaden the country's educational base, in 1862 Congress passed, and President Lincoln signed, the Morrill Act to create a system of land-grant colleges and universities where agriculture and the mechanical arts would have a prominent role. This action was followed in 1887 by the passage of the Hatch Act authorizing the establishment of an agriculture experiment station in each state and territory as the research arm of land-grant colleges and/or universities. An annual appropriation of \$15,000 per station was forthcoming, and this represented the first national effort in the world to provide a research base in agriculture through the use of public funds. Under the Hatch Act, a procedure was established for coordinating federal and state efforts in planning

and implementing research, and getting research results to farmers, scientists, and administrators.

After the Civil War, in 1869, the state legislature designated East Tennessee University at Knoxville, which later became The University of Tennessee, as the state's land-grant university under the terms of the Morrill Act. The same year, the College of Agriculture was founded, and a 200-acre farm was purchased in support of the program. A limited number of field experiments and feeding trials with livestock on the farm attracted attention. This led to the Board of Trustees' of the University establishing the Tennessee Agricultural Experiment Station in 1882—five years before the passage of the Hatch Act. It became the fifth experiment station established in the country.

This report has been prepared to give the readers a brief history of the organization, resources, and some examples of accomplishments of the Tennessee Agricultural Experiment Station over the 108 years of its operation between 1882 and 1990. This time span has been divided into approximately four equal periods having very distinctive characteristics impacting program development.

The first period was known as "The Early Years—Establishing Identity (1882-1915)." Two directors, Charles W. Dabney and H. A. Morgan, were instrumental in guiding the new Tennessee

Agricultural Experiment Station toward national recognition. In 1887, after the state legislature accepted the terms of the Hatch Act, the Board of Trustees of the University selected Dabney as President of the University and Director of the Agricultural Experiment Station. Dabney, who held a doctorate in chemistry from the University of Goettingen in Germany, had served as director of the North Carolina Experiment Station for seven years. Within a year, Dabney established four divisions in the station including: (1) field and feeding experiments; (2) chemistry; (3) botany and horticulture; and (4) entomology. The heads of these divisions were agriculturists selected from colleges in Massachusetts, Maine, or New York where agricultural subjects were more established than in the southern states.

Early research by the divisions involved the identification of the principal crops, livestock, insects, diseases, soils, and climatic conditions influencing food production. Thousands of seed sources were available but had not been tested for performance by scientific methods. People across the state were encouraged to submit samples of diseased plants, insects, soils, commercial fertilizers, and other products for identification and analyses. Gradually information was accumulated on crop performance, disease and insect outbreaks, and the characteristics of soil and other resources affecting food production. The respective divisions prepared quarterly reports on their research, which were released through daily and weekly newspapers and favorably evaluated by their readers. This helped to develop the identity of the faculty across the state.

In 1904, H. A. Morgan, a professor of entomology and zoology at Louisiana State University, was named director of the Station. He recognized the importance of providing visibility of agricultural research to farmers across the state, and in 1907 the first branch station was established at Jackson, Tennessee. The land was purchased by officials of Madison County and given to the University. The research program for the new West Tennessee Experiment Station, as well as future locations outside of Knoxville, was

developed by scientists at headquarters in Knoxville. Outlying work testing crop performance at Columbia, Gallatin, McMinnville, and Clarksville was initiated. Additional federal funding under the Adams Act of 1906 supported this expansion. The size of the professional staff at Knoxville increased from eight in 1900 to 14 in 1915. Five additional professional workers had assigned duties at the new locations mentioned.

The second period in the Station's history has been characterized as "Adversity in Agriculture: Its Impact on Research (1916-1940)." Two severe depressions—one in the early 1920s and the other throughout the 1930s—reduced farmers' purchasing power, and impeded their adoption of new technologies. H. A. Morgan continued to serve as director of the Station until 1919, when he assumed the dual role of director of the Station and president of The University of Tennessee. Morgan encouraged research on erosion control through crop rotation and crop diversification, and supported the initiation of economic studies on farm credit and taxation. C. A. Mooers, a chemist who joined the staff in 1893, became director of the Station in 1923 and served throughout the remainder of this period. Mooers, by his own choice, served as both a scientist and an administrator and he was recognized nationally for his identification of soils of Tennessee and their properties.

Enabling legislation at the federal level, through the Purnell Act of 1925 and the Bankhead-Jones Act of 1935, intensified research in the physical and biological sciences and provided for new and expanded programs highlighting nutritional, economic, and social problems of people.

The professional staff expanded from 14 in 1915 to approximately 74 in 1940. More specialization was occurring in the staff and the divisions were reorganized into departments. By 1940, the departments consisted of agronomy, plant pathology, chemistry, animal husbandry, economics and sociology, engineering, physics, home economics, horticulture, bacteriology, entomology, and markets.

The continuing demand for branch stations

where farmers could observe experiments on crops and livestock led to the establishment of the Middle Tennessee Experiment Station at Columbia in 1917 and the Tobacco Experiment Station at Greeneville in 1931. Crop research at outlying locations near Murfreesboro, Clarksville, and Crossville continued.

A backlog of research results was accumulated on food production. New crop varieties were developed, especially hybrids, and those resistant to diseases, such as wilt. Better fertilizers for crops and control measures for common insects using fluosilicates were available. Notable improvement in breeding and nutrition offered faster and more efficient gains in the production of livestock and livestock products, such as milk, butter, and eggs. Since most farmers did not have dollars to invest in these new discoveries, they could only postpone their application during this period.

The third period in agricultural research, labeled "Science and Technology in Agriculture (1941-1965)," represented a major breakthrough in the substitution of capital for labor in agriculture. This transition used the previous backlog of developed research plus a steady stream being generated. Having improved their financial position during World War II, Tennessee farmers were mechanizing their operations and demanding more scientific information. Between 1940 and 1965 the number of tractors on farms in Tennessee increased from 10,000 to 108,000, while the farm population declined 15 percent, and the number of farms declined 46 percent.

C. A. Mooers retired as director in 1946 after 53 years of distinguished service in the Station. He was followed by F. S. Chance from 1946 through 1956, and John A. Ewing succeeded Chance. Ewing, who represented a generation of scientists and administrators trained after World War II, was instrumental in planning and guiding most aspects of the program after the early 1950s.

Funding of agricultural research at the federal level was enhanced by passage of the Research and Marketing Act of 1946, the Consolidated Funding Legislation in 1955, and the McIntire-Stennis Forestry Research Act of 1962.

Under the 1946 legislation more emphases were placed on marketing research, and at least 25 percent of the total funds were earmarked for regional research undertaken by two or more states on an important mutual problem. Regional research projects on such topics as livestock breeding, forest genetics, cotton marketing, and human nutrition often brought together leading scientists from 10 or more states to work on joint problems. Research activities on the station ranged from the details of biological or chemical control of insects, diseases, and weeds on a specific crop to artificial breeding or embryo transplants in livestock. At the farm level, financial management became an important element in survival of the business. Consumers became aware of new freezing, packaging, and/or merchandizing techniques for food products and accepted them with minor reservations concerning their safety.

A team of approximately 100 full-time highly trained scientists were working in agricultural research. In addition, the number of branch stations which served as field laboratories more than doubled during this period. The name, location and date started were as follows: Highland Rim Experiment Station, Springfield, 1943; Plateau Experiment Station, Crossville, 1943; Dairy Experiment Station, Lewisburg, 1948; Ames Plantation, Grand Junction, 1950; Milan Experiment Station, Milan, 1962; and, Martin Experiment Station, Martin, 1965. The Knoxville Experiment Station, which had supporting field research at headquarters since 1869, was reorganized and outlying work in forestry was undertaken for the first time.

The fourth period in agricultural research has been identified as "Science and the Environment (1966-1990)." The title of the chief administrative officer in the Tennessee Agricultural Experiment Station was changed from director to dean in 1968. Ewing continued to serve in this capacity until his retirement in 1976. He was succeeded by D. M. Gossett, who served until 1987, when he became Vice President of the Institute of Agriculture. Don O. Richardson became dean in 1988.

Both the farm population and number of

farms in Tennessee continued to decline, while total agricultural production remained rather stable as a result of the substitution of capital for labor.

Urban citizens seemed to take food and fiber availability more for granted and raised other questions. These related to the safety of the environment resulting from all the chemicals used in the form of pesticides, herbicides, and fertilizers in farm production. Too, food safety, human nutrition and protecting natural resources received more attention.

The first priority of agricultural research continued to be the production of an abundant safe supply of food and fiber for all consumers. Research was intensified on monitoring the level of movement of chemicals through the air, soil, and water to determine acceptable rates. Two new sources of federal funding, known as Special Grants and Competitive Grants, became available to Tennessee scientists during this period; however, the overall level of federal funds did not keep abreast of inflationary pressures.

In three relatively new departments—Forestry, Wildlife, and Fisheries; Ornamental Horticulture and Landscape Design; and Food Technology and Science—the research effort was expanded. Another branch station, the Forestry Experiment Station, was established in 1972 with headquarters at the arboretum.

Insufficient time has elapsed to evaluate the research accomplishments of the fourth period from 1965 to 1990. The complete pay-off from basic research conducted during this period may not be achieved until the 21st century.

The story of agriculture research through the Tennessee Agricultural Experiment Station represents a series of building stones with each new stone supported by a knowledge-base dating back to 1882. A network of stations in each state is joined together in a framework that formulates policies and coordinates the national effort. Even though it is difficult to measure the accomplishments of any one station like Tennessee's, national studies cited near the end of this report in the section entitled "Agricultural Research in Retrospect" indicate that the annual rate of return

on public funds invested in agriculture research often exceed 30 percent. This represents a very favorable rate of return since some failures are experienced in any research endeavor.

Some documentation of research organization, leadership, and accomplishments is shown in graphs and pictures in the appendixes. The author assumes full responsibility for any errors that may be noted.

ACKNOWLEDGMENTS

This study was made possible only through the cooperation and support of the administration and staff of the Agricultural Experiment Station, especially Dean Don O. Richardson and Associate Deans John I. Sewell and Thomas H. Klindt. Department Heads, Station Superintendents, and other members of the professional staff provided numerous documents and insights relating to this history. Three Emeritus Professors and/or Department Heads—Drs. Luther Keller, Tom Miles and Lloyd Seatz—read the manuscript and suggested valuable improvements. Assistance in selecting and compiling photographs was provided by Bonnie Riechert, Coordinator of Communications. The most difficult task was performed by Beverly Robinson, Administrative Services Assistant for the Dean, who spent days converting the author's rough draft manuscript into a more legible and organized document.

THOMAS J. WHATLEY
ASSOCIATE DEAN EMERITUS,
TENNESSEE AGRICULTURAL EXPERIMENT STATION

FORCES AT THE NATIONAL SCENE

The establishment and nurture of agricultural experiment stations were an out-growth of events and activities shaping a relatively new nation during the first six decades of the 19th century. An industrial revolution was underway, shaking the foundation of societies world-wide in terms of population, life style, and economic well-being.

At the beginning of this period, most of the citizens of the United States were one to three generations removed from the old countries of Western Europe. They came to this country to escape servitude because of bad debts, or archaic laws that restricted freedom of movement, speech, and religion, or they sought new adventures and sources of wealth. The United States had just added a vast new territory of 885,000 square miles known as the Louisiana Purchase of 1803. This was equivalent to the land area of 21 states the size of Tennessee and provided unimagined growth potential for a country with a population only equal to Ireland's. From the viewpoint of the old countries, the United States was practically ignored in world affairs. The leaders and citizens of this country believed that the new territory would accommodate 50 to 100 generations of population growth, and they concentrated on domestic affairs.

Little was it visualized that over the next 60 years this country would experience a population growth six times the world's average and at the

end of this period rank only behind France and Russia as the most populous country in the Western world with 32 million people.¹ Higher birth rates, lower death rates, and five million immigrants accounted for this phenomenon. The favorable ratio of land to people gave greater assurances of an adequate food supply and encouraged couples to marry earlier and have larger families. Even though epidemics were frequent, their toll was less in the rural environment—containing 80 percent of the people—than in denser more urban populated European countries.

Despite a doubling of the population and gross national product about every 25 years and 15 years, respectively, the rate of economic growth varied widely within the society. Farm families in remote rural communities, isolated from navigable waterways and dependent upon a crude road system consisting of trails and pathways, experienced little increase in wealth. In a self-sufficient agriculture where most of the products including clothing were made in the home, wealth increased in about the same proportion as population. Lack of transportation impeded progress. For example, the cost of transporting

¹Peter D. McClelland and Richard J. Zeckhauser, *Demographic Dimensions of the New Republic* (Cambridge, Massachusetts, 1982).

goods thirty miles inland from a port equalled the cost of transporting the same goods across the Atlantic Ocean. Small wonder then that foreign trade amounted to more than domestic commerce during the first three decades of the 19th century.²

A revolution in modes of transportation easily became a top priority at the national, state, and local level for a new country covering a vast territory. Substantial improvements in efficiency of water transportation were brought about by the invention of the steam boat. It was further enhanced by the construction of almost 4,000 miles of canals; however, many of the lakes, rivers, and canals were iced over during winter months and not dependable for trade purposes. In a matter of decades this system of transportation was surpassed in importance by the invention of the "iron horse" or railroad. By 1850 the United States led the world with 9,000 miles of rail line. One decade later the 30,000 miles of rail exceeded the combined total of all other countries.

The economic impact of the new rail system was immediately recognized between towns and cities along the routes. Goods could be delivered by trains traveling at 30 miles per hour in less than one-tenth of the time previously required, and comparable reductions in transportation costs were often experienced. Larger quantities of goods could be moved by rail requiring fewer employees per ton mile than other systems of transportation. Communication was enhanced among customers in towns and cities along railroads as large newspapers increased their circulation to attract more buyers and advertisers. Often newspapers were delivered within hours or a few days of printing rather than within weeks. Too, quicker mail delivery reduced the isolation previously experienced by many families. The invention of the telegraph with its instant communications over hundreds of miles provided further enlightenment for the population.

This revolution in transportation and communications did not appreciably affect a majority of the families in the country at that time, but it gave impetus to a new system of production based on specialization and comparative advantage. For

example, farmers along railroads or waterways in Illinois who specialized in growing corn, wheat, and hogs and who sold them on Eastern markets might produce these enterprises cheaper than other farmers and make higher profits than if they set a goal of being self-sufficient. Increased productivity through specialization in manufacturing items as variable as nuts, bolts, guns, rails for railroads, locomotives, wagons, and textile products provided a crude forerunner of the modern assembly line. Quasi shops and factories began to replace the home industries in cities and towns along the waterways and railroad hubs. In addition to the laborers needed to operate these shops and factories, a whole new array of skills was needed to operate the railroads, run the telegraph system, schedule the storage and delivery of goods from factories to consumers, and finance this new infrastructure.³

By the mid-19th century the economic growth rate in the United States exceeded that of the rest of the world, and many people gave credit for that to the educational system in the new country. With the exception of slaves, most citizens had received three or more years of education. Equally important with the emphasis on religious freedom was the number of church schools of higher education established in the states. These provided emphasis on the classics with training primarily for the ministry, medicine, and law. Even though some of the universities in Europe were judged to have higher standards, their enrollment was limited to the elite, and the masses of their people received their training through the apprenticeship system.

Despite the contributions made to the development of the new country by students from church schools and other institutions of higher learning, these schools made only slight adaptations in their curricula to meet the needs of a pioneer people outside of medicine, law, and

²Eugene S. Ferguson, "Technology as Knowledge," in *Technology and Social Change in America*, Edwin T. Layton Jr., ed. (New York, 1973).

³James M. McPherson, *Battle Cry of Freedom, The Civil War Era*, (New York, 1988), Chapter 1.

religion. Leaders became very vocal in expressing a need for a change by adding two areas of instruction—agriculture and the mechanical arts—to college training.

By 1850 farmers and ranchers occupied not only the territory obtained by the Louisiana Purchase of 1803, but spilled over into territory reaching as far west as the Pacific Ocean, including California and Oregon. These settlers faced myriad conditions including differences in soils, climate, and topography, which impeded their ability to survive as they moved westward. The adaptation of known crops to new regions was usually on a trial-and-error basis, and this often led to low yields, famine, and starvation for many settlers. Too, as the number of farmers and ranchers increased, outbreaks of new diseases or pests of both plants and animals frequently occurred. Agricultural societies sprang up in all states and most territories for the purposes of exchanging practical information on farming. These societies started exerting their influence on public officials to set up a mechanism for obtaining scientific data on agriculture through the educational system.

In the meantime, the “industrial classes” of people including engineers, bankers, and merchants were clamoring for a system of higher education that would enhance the industrial revolution under way and raise the standard of living of all people.

Congress debated the issue of providing colleges and universities to teach agriculture and mechanical arts through the administrations of Presidents Taylor, Fillmore, and Buchanan. Finally, in 1859 the Morrill Act was passed by both branches of the Congress to accomplish this purpose. It was immediately vetoed by President Buchanan based primarily on the grounds that it was a violation of the traditional policy of the federal government to leave control of education to the states. His position was strongly endorsed, especially by southern congressmen, and the veto was not overridden.

Three more years were to lapse before the Morrill Act, creating the system of Land-Grant Colleges of Agriculture and Mechanical Arts, was

passed by Congress and approved by President Lincoln on July 2, 1862. The secession of the southern states reduced the number of opponents to the bill, and the Civil War, with its stress on food supply, enhanced approval. It was the third agricultural act of far-reaching significance passed by Congress that year. The other two created the United States Department of Agriculture and the National Homestead Act, under which any citizen was entitled to 160 acres of the public domain by complying with certain regulations.

The Morrill Act granted to each of the states an amount of public land equal to 30,000 acres for each senator or representative it had in Congress, or the equivalent in land script. Proceeds were to be used for the endowment, support, and maintenance of at least one college where the leading subjects would be fields of learning relating to agriculture and the mechanical arts.⁴ This was hailed as the first nationwide attempt by any government to launch a higher education system available to the masses. Iowa was the first state to accept the grant, followed by Vermont and Connecticut in 1862. Fourteen states accepted it in 1863 and 36 states by 1870. Southern states were not eligible for the grants until after the Civil War.

One provision of the Morrill Act stated that the state legislatures would be responsible for accepting the land grants and selecting the locations of the colleges of agriculture. Controversy immediately developed as to whether these colleges should be institutions of “general culture” or “technical in nature.” The law was permissive in respect to *all* subjects taught; however, it was specific in stating the leading objective should be instruction in agriculture and mechanical arts. Across the country about one half of the states eventually offered the training through state universities, while the other half provided separate

⁴A. J. Sims, “History and Development of Land-Grant Colleges, Including the Organization, Development and Philosophy of the Three Branches of the State’s Colleges of Agriculture, Research, Resident Teaching and Extension,” Presentation at Tennessee Farm Bureau Conference, Columbia, Tennessee, June 18, 1947.

“The Hatch Act represented the first national effort in the world to provide a research base in agriculture through the use of public funds.”

and independent institutions for teaching agriculture and mechanical arts. Regardless of the type of institution selected, the reservoir of teachers available had limited experiences in agriculture. Available professors were trained in such areas as chemistry, physics, botany, and entomology. A few leading agriculturalists were added to faculties based on their practical experience and success in farming.

Seldom have professors in institutions been confronted with as many problems in teaching as those in agriculture in these early days. As indicated, the teachers lacked training in their subject matter, and to confound the problem, reliable textbook and course materials were nonexistent. Limited data from agricultural societies, a few trade journals, and newspaper articles were available based on reported practical experiences of people. Since the great majority of people at that time knew little about science or the application of scientific knowledge, new discoveries, inventions, and untried methods were confronted with superstition and skepticism. “Book learning” for farming was no exception. Nevertheless, the leaders of the country who observed shortages of food and fiber during the Civil War believed that the sustained and adequate production of these resources was essential in this country. Individual farmers and ranchers had neither the funds nor the knowledge to ensure an adequate and safe food supply. After more than a decade of debate, Congress, on March 3, 1887, passed the Hatch Act authorizing an appropriation of \$15,000 per state or territory to establish agricultural experiment stations associated with the land-grant colleges. The Hatch Act represented the first national effort in the world to provide a research base in agriculture through the use of public funds.

Under provisions of the Hatch Act, agricul-

tural experiment stations were to be established to aid in acquiring and disseminating among the people of the United States useful and practical information on agriculture and to promote scientific investigations and experiments respecting the principles and applications of agricultural sciences. These stations were to conduct original research to verify experiments on plants, animals, or other subjects bearing directly on the agricultural industry. The United States Commissioner of Agriculture was, as far as practical, to provide forms for the tabulation of results from experiments to secure, to the extent possible, uniformity of methods and results. An annual report was to be made by each station to the governor of the state or territory, with a copy going to both the Commissioner of Agriculture and the Secretary of the Treasury of the United States. Bulletins or reports of progress were to be published at each station at least quarterly, and one copy was to be sent to each newspaper in the state or territory in which it was located and, if funds permitted, to individuals engaged in farming who might request the same. Such bulletins and reports were to be transmitted free through the mail under regulations prescribed by the Postmaster General. Quarterly distributions were to be made of federal appropriations to authorized personnel. From the first annual appropriation an amount not exceeding 20 percent could be expended in the erection, enlargement, or repair of a building or buildings necessary for conducting research; and after the first year, an amount not exceeding five percent could be used for this purpose. (For more detailed provisions of the Hatch Act see Appendix A.)

The Hatch Act initiated a partnership in agricultural research between the federal and state governments that has continued for more than a century. Other legislation at both levels of government has been enacted to strengthen this joint endeavor. The struggles and accomplishments of the Tennessee Agricultural Experiment Station represent one land-grant university’s experiences in agricultural research.

FORCES AT THE TENNESSEE SCENE

Before reviewing the experiences of the Tennessee Agricultural Experiment Station, a look at a brief history of the people and the agricultural industry in the state—before the Station was established—seems in order. Tennessee was conceded to have a population exceeding the 60,000 free people necessary for statehood in 1796, and the Congress passed the enabling Act to make it the 16th state on June 1, 1796.

By 1850, the population had increased to 1,250,000 people. This still represented a sparsely settled state with only about six persons to every ten square miles. Nashville was the largest city with approximately 10,000 people, and the combined total population of Nashville, Memphis, Knoxville, Chattanooga, and Jackson was around 25,000.

At that time, the state had 72,735 farms averaging 261 acres per farm with only 27 percent of the land classified as improved. The number of states in the United States had increased to 31, and Tennessee ranked high in the production of many crops and livestock used to provide food and fiber for the young nation. For example, it ranked first in hog production, fourth in tobacco and honey, fifth in corn and cotton, seventh in oats, eighth in sheep, ninth in dairy cattle, 12th in cattle “other than dairy,” and 13th in wheat.⁵

Like farmers in other states, Tennessee farmers expressed an early interest in organizing

agricultural societies. These societies provided a mechanism for meeting other people as well as an opportunity to exchange ideas on how to improve agriculture. Usually the societies were organized on a county basis. Some of the earlier ones were formed in Washington, Greene, and Davidson counties around 1820 to 1830. Soon followed the county fairs where farmers and their families exhibited the products of the farm and home. Here might be shown a favorite dairy calf, a country ham, an ear of corn with straight rows of grain, a jar of preserves, or some handcraft. Competition led to the establishment of prizes for the best products shown at these fairs.

Governor James K. Polk, in an address before the Tennessee legislature in 1839, indicated that agriculture was a basic industry of the state and deserved the attention of that body of lawmakers. This led to the establishment of the first Standing Committee on Agriculture and Manufacturers in both the House of Representatives and the Senate. In 1842 an act was passed by them to incorporate the Tennessee State Agricultural Society. Slightly more than a decade later, during the administration of Governor Andrew Johnson,

⁵“A Century of Tennessee Agriculture 1854-1954,” *40th Biennial Report*, Tennessee Department of Agriculture. (Nashville, Tennessee, 1954).

“Dr. John M. McBryde . . . planned field experiments on the farm and . . . published the results of this work and attracted wide attention. This gave impetus to the establishing of an agricultural experiment station.”

the Tennessee State Agricultural Bureau was established on February 21, 1854. Under this act, emphasis was placed on the role of fairs in the improvement of agriculture and limited funds were made available to support prizes offered at these fairs.

The decades of the 1860s and the 1870s were overshadowed by the Civil War and the era of reconstruction. Political and social issues were magnified and foremost in the minds of the people who had few resources available to improve agriculture. While Tennessee was out of the Union, its citizens were not eligible for benefits from the newly-established U. S. Department of Agriculture, nor the land-grant college program. Nevertheless, agriculture continued to be the dominant industry in the state. The number of farms increased from 82,368 in 1860 to 118,141 in 1870, while the average farm decreased in size from 251 to 166 acres for the respective period.

After the Civil War and after Tennessee was readmitted to the Union, the state legislature in 1869 authorized the establishment of a land-grant university under the terms of the Morrill Act of 1862, mentioned earlier. East Tennessee University, located at Knoxville, was chosen as the land-grant university for the state. This institution had been founded as Blount College in 1794. Its name was changed to East Tennessee College in 1807, and to East Tennessee University in 1840. Ten years after the institution's designation as a land-grant university, the legislature would change the name again, from East Tennessee University, to The University of Tennessee.

In 1869, the same year that the University was designated as the states's land-grant university, the agricultural college was founded and the first farm purchased. The farm consisted of two

tracts known as the South Farm or “College Farm,” consisting of slightly more than 100 acres and the North Farm consisting of nearly 100 acres. The South Farm included the land where Morgan Hall is now located. The North Farm was mostly unimproved land covered with brush or trees.

At that time many people thought that instruction should focus on manual labor on the farm and the practical aspects of farming. Dr. John M. McBryde, one of the first professors in this school, thought otherwise, and immediately planned field experiments on the farm and developed feeding trials with animals. He published the results of this work and attracted wide attention. This gave impetus to the establishing of an agricultural experiment station.

TWO STAGES IN DEVELOPING THE TENNESSEE STATION⁶

STAGE ONE

On June 8, 1882, the Board of Trustees of The University of Tennessee—without the benefit of appropriated funds from either the state or national government—took bold action in creating and inaugurating an agricultural experiment station utilizing the College Farm. This Board of Trustees was the first to ever take such action to establish a station without any special endowment. By their action the Tennessee Agricultural Experiment Station became one of the first five established in the United States. A “Board of Control,” consisting of five members of the Board of Trustees of the University, was to be elected annually to supervise the Experiment Station. The work of the Station would be under the administration of a director who would be responsible for planning experiments, investigations, and the development of the Station subject to the approval of the Board of Control. It was further emphasized that the accounts of the Station for all experimental work were to be kept separate and distinct from the farm as far as practical. In addition to the director, a chemist was to be employed as an assistant whose primary responsibility would be for the chemical part of the work, especially the analysis.

The objective of the Station was to promote the agricultural interests by practical and scientific investigations. Analyses were to be conducted of

seeds, fertilizers, soils, minerals, drinking waters, and botanical determinations of benefit to the public under the following conditions:

- (1) No charges were to be made provided the samples were prepared according to written instructions;
- (2) The Station would be free to publish the results of any analysis;
- (3) No more work would be done by the Station than the means of the University would allow;
- (4) All analyses would be made in the order of the arrival of the samples;
- (5) Examinations and analyses for the benefit of private parties would be made on reasonable terms; and
- (6) Appropriations of funds for the Station would only be made by the Board of Trustees.

The first stage in the development of the Experiment Station covered five years from June 1882, through June 1887. One important precedent was established at this stage, that of administrators and faculty often sharing dual responsibilities in teaching and research. The first director of the Experiment Station was Professor John W.

⁶*First Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1888, (Knoxville, Tennessee, 1889).*

“On June 8, 1882, the Board of Trustees of The University of Tennessee . . . took bold action in creating and inaugurating an agricultural experiment station . . . By their action the Tennessee Agricultural Experiment Station became one of the first five established in the United States.”

Glenn, who succeeded Dr. McBryde as professor of agriculture, horticulture, and botany. The identity of the other person employed, the chemist, is not known.

During this five-year period, the main resources available in terms of office space, laboratories, equipment, land, and livestock were those previously provided the agricultural college. The General Assembly of the state did pass an act providing for fertilizer inspection and analysis and devoted a part of the license tax collected on this account to the support of the Experiment Station. This tax yielded only a small revenue varying from \$700 to \$1,000 per year. Since the Board of Trustees had very limited funds from other sources to devote to the Station, progress was severely limited during this period. Perhaps the major accomplishment in this stage was establishment of the administrative structure linking the Board of Trustees of the University and the Agricultural Experiment Station.

The General Assembly of the State of Tennessee on March 28, 1887, passed an act empowering the Treasurer of The University of Tennessee to accept funds under the Hatch Act, and these funds were to be committed to the Board of Trustees of the University (now in charge of the State Agricultural Experiment Station) to apply according to the law (see Appendix B).

STAGE TWO

The passage of the “Hatch Experiment Station Act” by the U. S. Congress on March 3, 1887, gave new life to the Tennessee Agricultural Experiment Station (Appendix A). First, it provided a source of funding in the amount of \$15,000 annually for state agricultural experiment stations established in association with the land-grant colleges or universities authorized in 1862. Second, it provided a mechanism for coordinating the planning and implementing of research and the dissemination of research results to farmers, scientists, and administrators across the nation.

THE EARLY YEARS— ESTABLISHING IDENTITY (1882-1915)

Once the General Assembly passed the enabling Act authorizing the Board of Trustees to establish a Tennessee Agricultural Experiment Station, the next step was to select a director and authorize selection of the faculty and staff who, in turn, would develop the program in accordance with the Federal Hatch Act. The success of this endeavor would depend on how the Station's clientele would evaluate its accomplishments. The principal clientele was viewed as the farmers of the state; however, governmental leaders recognized that all citizens would benefit if the new Station eventually led to assuring an increased supply of wholesome food and fiber for the population. Thus, the period 1882 through 1915 can be viewed as a time for establishing the identity of the Station.

The Board of Trustees acted quickly in electing Dr. Charles W. Dabney, Director of the North Carolina Station, as the Director of the Tennessee Agricultural Experiment Station with authority to propose a plan and nominate officers for the reorganization of the Station under the Hatch Act. He assumed his new role on July 24, 1887, and by September had organized the Station into four divisions and selected the leaders for these units as follows:

(1) *The Division of Field and Feeding Experiments*, Professor Charles S. Plumb, a

graduate of Massachusetts Agricultural College and, previously the assistant director of the New York Agricultural Experiment Station at Geneva;

(2) *The Division of Chemistry*, Dr. W. E. Stone, a graduate of the Massachusetts Agricultural College and the University at Goettingen in Germany, and, previously the assistant chemist and biologist of the Massachusetts Experiment Station;

(3) *The Division of Botany and Horticulture*, Professor Lamson Scribner, a graduate of Maine State College and, previously in charge of the Section of Vegetable Pathology of the Department of Agriculture, Washington, D.C.; and

(4) *The Division of Entomology*, Professor Henry E. Summers, a graduate and Fellow of Cornell University and, previously, instructor in veterinary science at Cornell University.

Mr. C. L. Newman, a graduate of the Agricultural and Mechanical College of Alabama, who had served as an assistant in its Experiment Station, was selected as general assistant in the Tennessee Experiment Station.

An interesting comment appeared in the First Annual Report of the Tennessee Agricultural Experiment Station for 1888 regarding organization and staffing:

Although other subjects of investigations might have been undertaken, it was found that these Divisions were the most important for Tennessee, and that it would be wiser to first provide well for these than to crowd the Station with numerous offices or divisions, some of which could not be adequately sustained.

Within 18 months after Dabney assumed his duties, plans for a new headquarters were developed and a building was erected, the new staff arrived, laboratories were being equipped, experiments were implemented, and the Annual National Convention of Agricultural Colleges and Experiment Stations was hosted in Knoxville in January 1889.

The University had undertaken to erect a building several years before for the new Agriculture College, but it was not entirely completed, even though it was occupied. It was a simple 30 × 60 feet, two-story brick building. After consulting with a number of leading scientists in the country, the administration decided to make an addition of two stories 40 × 60 feet over an ample basement for the Experiment Station. Plans for the building were drawn by Charles L. Carson of Baltimore, who was the architect of many Johns Hopkins University buildings and laboratories. Only \$3,000 of the first year's appropriation to the Experiment Station could be used for buildings, so the Board of Trustees of the University provided an additional \$3,800 to complete the headquarters building.

As indicated earlier, agricultural societies were organized, usually on a county basis, beginning around 1820, to promote agricultural interests in the state. Later the Tennessee Farmers' Association undertook this responsibility. Members of this association, while in session in Knoxville in May 1888, joined the President of the University in laying the cornerstone of this new building which was completed in November 1888.

Another interesting statement of philosophy appeared in the first Annual Report of 1888:

As in regard to the building, so in regard to apparatus and other equipment, your Board was determined to lay the foundation broad and strong for the great institution. Believing it to be a permanent one and

that the work must grow until it covers many of the agricultural interests of Tennessee, it was decided to build it on a liberal plan and to use a very large proportion of the first appropriation in providing scientific apparatus, books, furniture and other necessary facilities for the highest scientific work.

In pursuit of this goal, Dr. Stone, the chemist for the Station, spent the first month of his employment (August 1888) in Germany, where he selected and purchased chemicals and other apparatus and books for the Experiment Station. Among the items purchased were: a fine Sartorius balance, short-armed with aluminum beams, patent compensating hangers, and latest improvements; a Laurents polariscope, made by Schmidt and Haensch of Berlin; a Westphal's specific gravity balance; complete sets of apparatus for nitrogen determinations according to Kjeldahl, Will-Varrentrap, and the "absolute" method; a Bunsen combustion furnace; a Wiesnegg muffle; water blast lamp, according to Beutell; and full sets of reagent bottles with indestructible labels. According to the terms of purchase, all of this equipment was imported "duty free."

INITIAL PROGRAM

With the new office building erected, the laboratories at least partially equipped, and the division leaders on board, the agricultural experiment station staff undertook the awesome task of inventorying the resources then in use or potentially available to support agriculture in Tennessee. These resources included the food, fiber, and feed crops and livestock grown, and the topography, climate, soils, and insect and disease risks. Initial emphases were on increasing the quantity and quality of products produced with less attention to other economic considerations. This rationale made sense at that time.

A major screening process was undertaken to identify the characteristics of the principal food, fiber, and feed crops such as corn, wheat, oats, barley, cotton, cowpeas, vegetables, and fruits, through observations of plots grown on the two

experimental farms at Knoxville or by analyses of these products especially in the chemistry laboratory. The entomologist and botanist also observed the insect and disease problems associated with growing and storing these crops.

Reliable seed sources were unknown except as seed were passed down from year to year, and usually from one generation to the next based on farmers' observations of their performance. Seed corn was usually obtained from selections made in the field and/or in the corn crib by farmers. Within communities and through agricultural societies or farmers' conventions some exchange of seed stock was practiced. In the Division of Field Experiments, between 1888 and 1900, it was not unusual to screen 40 to 50 seed sources for individual crops such as wheat, corn, and cowpeas.

The first research on livestock involved two sets of feeding experiments. One involved six steers to show the influence of feed upon growth. One involved six milk cows to test the influence of feed upon milk production. The latter experiment used cottonseed meal and cottonseed hulls as a major part of the ration. Investigations on methods of dehorning cattle were reported in the first bulletin of the station.

In 1888, the Division of Horticulture and Botany prepared the hillside south of the Station building for an orchard consisting of 259 varieties of standard fruits consisting of the following:

Apples	50	Figs	3
Pears (Standard)	28	Almonds	2
Pears (dwarf)	22	Quinces	4
Peaches	42	Currants	12
Nectarines	3	Gooseberries	6
Apricots	25	Blackberries	6
Cherries	25	Raspberries	14
Plums	32		

In addition, many vegetable crops were grown in plots and the results were eagerly sought by farmers and their families who were very dependent upon homegrown vegetables, both fresh and for canning.

Limited investigations were started on many of the diseases of vegetable and fruit crops. These

included Irish and sweet potato rot, strawberry blight, anthracnose of the raspberry and bean, black rot of apples, grape leaf blight, and powdery mildew of the vine.

A "grass garden" of forage plants and grasses was started including orchardgrass, fescue, timothy, and red top. The private collection of grass of the botanist, which was considered one of the best in the country, was placed in the Station building.

The Division of Chemistry became operational in 1888 and drew attention statewide for its analysis of commercial fertilizers as required by law. For example, out of 35 samples sent in by the state inspector and analyzed that year, 14 were found deficient in one or more of the guaranteed constituents. A private party sent in a sample of Buffalo Bone Guano and complained that his wheat would not sprout where he had used this fertilizer. An analysis indicated that the fertilizer contained 7.1 percent free sulfuric acid. The division continued to analyze commercial fertilizers until July 1897, when the responsibility was transferred to the Tennessee State Agricultural Bureau, later known as the Tennessee Department of Agriculture. A number of so-called "waste products" such as cottonseed meal, hulls and ashes, lime, plaster, tannery tankage, and animal manures, were analyzed as possible sources of fertilizer. These results were published and followed with a great deal of interest by farmers.

The Division of Entomology started a collection of the insects of the state in the fall of 1888. To further its services, the division indicated that it was prepared to answer questions concerning the habit of, and, to give information regarding the best remedies to be applied for injurious insects, provided specimens were sent to the Station for examination.

The 1889 Annual Report of the Experiment Station indicated the reception that farmers manifested for research results. Nearly 5,000 Tennessee farmers requested to be placed on the permanent mailing list for publications. Within two months after publication of a bulletin on *Diseases of the Irish Potato*, 15,000 copies had been distributed. The demand for a bulletin on *Cottonseed Hulls and Meal as a Food for Livestock* resulted in four

separate editions being printed and 19,000 copies distributed. In addition, in accordance with the terms of the Hatch Act, large newspaper sheets called "supplements" were published by the Station and sent to newspapers in the state for distribution to their readers. These supplements treated in a brief and popular manner subjects on which farmers wanted information and which did not require extensive investigations and discussions. Three editions of the supplement were published in January, April, and July of 1889 and a total of 200,000 copies were distributed throughout the state by the following newspapers:

<i>The Public Ledger</i>	Memphis
<i>The American</i>	Nashville
<i>West Tennessee Whig</i>	Jackson
<i>Bolivar Bulletin</i>	Bolivar
<i>Hickman Pioneer</i>	Centerville
<i>The Leader</i>	Covington
<i>The Columbia Herald</i>	Columbia
<i>News-Gazette</i>	Dayton
<i>The Democrat</i>	Dickson
<i>Dyer County Times</i>	Dyersburg
<i>The Register</i>	Lebanon
<i>The Southern Standard</i>	McMinnville
<i>Jefferson County Visitor</i>	Mossy Creek
<i>Giles County Democrat</i>	Pulaski
<i>The Citizen</i>	Pulaski
<i>Ripley Enterprise</i>	Ripley
<i>Springfield Record</i>	Springfield
<i>Weekly News</i>	Sweetwater
<i>The Exchange</i>	Milan
<i>The Post-Intelligencer</i>	Park
<i>Bedford County Times</i>	Shelbyville
<i>Journal</i>	Knoxville
<i>Sentinel</i>	Knoxville

Starting in 1892 statements were entered on the inside cover of every annual report and bulletin of the Station indicating (1) the services available through the Station and (2) its location. The first statement read as follows:

The Station has facilities for analyzing and testing fertilizers, cattle foods, milk and dairy products; seeds with references to their purity or germinating power; for identifying grasses and weeds, and studying forage plants; for investigating the diseases of fruits and fruit trees, grains and other useful plants. The Station Bulletins and Reports will be sent free of charge, to any farmer in the state. Packages

by express, to receive attention, should be prepaid. All communications should be addressed to the Secretary of the Agricultural Experiment Station, Knoxville, Tennessee.⁷

This statement was used through 1908.

The wording on location of the Station was as follows:

The Experiment Station building containing its offices, laboratories and museum, and the plant-house and horticultural department are located on the University grounds, fifteen minutes walk from the Custom House in Knoxville. The Experimental farm, stables, milk laboratory, etc., are located one mile west of the University on the Kingston Pike. Farmers are cordially invited to visit the buildings and experimental grounds.

Even though modified somewhat, the statement on location continued to be used until World War II.

In 1890 the College Farm with its tools, livestock, and buildings was transferred to the Experiment Station. The professors and their classes were to have free access to all crops, livestock, and facilities of the farm. All sales of produce, including livestock, were to be deposited in an account with the Treasurer of the University. One half of these funds was available for operating the farm and providing buildings and improvements.

During the last decade of the 19th century, the Station continued to operate with the same four divisions established in 1888; however, additional support in the classifications of a librarian, stenographer, dairyman, and assistant for plot work were included. Too, the U. S. Department of Agriculture employed a meteorologist located at the Station.

The annual report for the year 1900 provided a history of the resources and accomplishments of the Station during its existence through the 19th

⁷*Fifth Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1892*, (Knoxville, Tennessee, 1893).

century.⁸ Some of the highlights not previously stated were as follows:

The Station buildings consisted of Morrill Hall on the University grounds, an office building at the farm, a cottage for the farm manager, two barns, a dairy building, a greenhouse, and a few small farm buildings. Morrill Hall had the laboratories for chemistry, botany, horticulture, and soil physics; as well as the museum, herbarium, library, two lecture rooms, four offices, and a photographic area. The two barns provided stables for horses, cattle, swine, and sheep, as well as storage facilities for feed and equipment. A new brick dairy building, completed in 1900, was fully equipped, including milk and cream vats, separators, sterilizers, pasteurizers, bottling machines, churns, and butter workers. The building had a refrigerator and cheese room and was heated throughout with steam and lighted by electricity. The greenhouse had both grafting and potting rooms. The office building at the farm contained work and seed rooms, an office, and some lodging rooms for assistants.

The Station owned 30 milk cows, 15 head of beef stock, six horses, and three mules. The total value of buildings, livestock, and equipment of the Station was \$44,650.

The College Farm was now used by the horticulturist and chemist for a fruit and experimental farm. The South Farm had 20 acres occupied by a series of 800 uniform test plots for experimental field work and 70 acres devoted to more extensive field tests.

The Division of Botany had an herbarium of 25,000 specimens including a fine collection of fungi, 500 lantern slides, and equipment for work in physiological botany. The Station also had a collection of over 5,000 insects and 400 bottles of alcoholic materials.

The separate Station library contained 2,300 volumes and 3,500 pamphlets in addition to 5,000 unbound bulletins and reports of other experiment stations and the U. S. Department of Agriculture.

A survey of the soils of Tennessee was started in 1891. A preliminary soil map was prepared, and many of the virgin soils were collected and analyzed both chemically and

“The Experiment Station made an exhibit illustrating its soil survey and its grass survey at the 1900 Paris, France, Exposition. Gold medals were awarded both portions of this exhibit.”

physically. Notes were made at each place about the geology, flora, fauna, agricultural methods, and products.

In a similar manner a thorough study was made of the grasses of Tennessee. Two reports were issued, one dealing with the botanical features and the other dealing with the agricultural features and uses of grasses and forage plants.

The Experiment Station made an exhibit illustrating its soil survey and its grass survey at the 1900 Paris, France, Exposition. Gold medals were awarded both portions of this exhibit.

Studies were made of both the feed and food value of crops including peanuts, cowpeas, sorghum, corn, potatoes, sugar beets, fruits, and grains. Comparisons were made of the average composition of southern feeding stuffs and American feeding stuffs in general.

A thorough study was made of the cotton plant from a chemical point of view. Analyses were made of all the different parts of the plant. The relative amounts of each of these parts were determined, and the fertilizer constituents contained in the average cotton plant were calculated.

The horticultural division made cultural and variety tests with small fruits, tomatoes, and vegetables grown both under glass and outside. A study was completed of the wild onion, a weed that had given much trouble throughout the state.

Lamson Scribner, professor and leader of the division of botany and horticulture, received both national and international recognition for his work

⁸*Thirteenth Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1900, (Knoxville, Tennessee, 1901).*

**“For these great discoveries,
now applied world-wide, Professor
Scribner was decorated
by the French government
with the Order of the Legion of Honor,
on January 1, 1888 . . .”**

BACKGROUND

The beginning of the 20th century found the young Tennessee Agricultural Experiment Station getting favorable responses from many farmers, but needing greater identity especially in Middle and West Tennessee. Research results were flowing primarily through the laboratories in chemistry, botany, and entomology or from the results of crops and livestock grown and studied on the two experimental farms in Knoxville. Farmers throughout the state were responding to the invitation to send in samples of materials such as soil, seed, weeds, insects, diseased plants, and fertilizer for analysis. The research staff devoted a great deal of time in analyzing these samples and corresponding with farmers concerning the results. This created good will with this clientele group, and better acquainted the faculty with agriculture across the entire state.

in cooperation with a French investigator, M. Viola, in determining the nature of the black rot of the grape, and writing the first official circular recommending the use of Bordeaux mixture in the United States. For these great discoveries, now applied world-wide, Professor Scribner was decorated by the French government with the Order of the Legion of Honor, on January 1, 1888, according to the First Annual Report of the Agricultural Experiment Station for 1888.

In the 13 years after the Hatch Act was passed, 59 bulletins and 13 annual reports were issued. More than 465,000 copies of these publications were distributed to farmers and agricultural leaders. When special reports issued through the press were included, more than 13,000,000 printed pages on agriculture and related subjects were made available. One of the bulletins relating to agriculture that received quite a bit of attention was entitled, *Points About Country Roads*, prepared by Professor W. W. Carson in Civil Engineering in the University. The director of the Station made the following comments on it in the Annual Report for 1890:

There are sections within our territory where the conditions of these roads is such as destroys all profits on farm produce which must be hauled over them to market. Anything that will help or lead to an improvement in our country roads will directly promote our agricultural development. The Bulletin in question points out the ways and means for accomplishing this.

In addition, the growth in farmers' institutes across the state provided a mechanism for acquainting farmers with agricultural research results. The State Department of Agriculture encouraged and promoted these institutes and estimated they had been held in 72 of the state's 95 counties by 1903.⁹ Total annual attendance at these conventions was about 30,000 to 40,000 people. Often these conventions were scheduled on consecutive days in adjoining counties. A common practice where railroads existed was for speakers to travel by rail from one convention site to another and give their discussions on agricultural topics. Faculty members of the research staff frequently participated, using this mode of transportation, and their involvement was well received by farmers.

The 25-year period ending in 1915 represented a significant change in the resources available and

⁹“A Century of Tennessee Agriculture 1854-1954,” *40th Biennial Report*, Tennessee Department of Agriculture, (Nashville, Tennessee, 1954).

used in Tennessee, especially in agriculture. The population increased by almost 500,000 with about one-fifth of these people added to the population of the state's four largest cities. The number of farms increased 43 percent; about 75,000 new farms were added to the 174,000 previously existing. The size of farms decreased from an average of 116 acres to about 80 acres.

Corn remained the principal crop in the state with about 3.4 million acres yielding an average of 22 bushels per acre. Hay acreage doubled from one-half million to one million, while both wheat and cotton decreased more than 100,000 acres each over the 25-year period to 780,000 and 692,000 acres, respectively. Wheat yields were 10 bushels per acre, while cotton averaged 212 pounds of lint per acre. All tobacco types increased 50 per cent to 98,000 acres by 1915 and yields increased 135 pounds per acre to 780 pounds. Sizeable acreages of fruit and vegetable crops were grown for home consumption as fresh, dried, or canned products, and some commercial sales became important, especially in West Tennessee. For example, the State Department of Agriculture in 1906 reported 509 carload shipments of tomatoes, 475 of strawberries, 80 of cabbage, and lesser amounts of apples, peas, beans, Irish potatoes, and sweet potatoes primarily from Gibson County and the surrounding area.

Management problems, broader than production aspects, were also recognized as indicated by H. A. Morgan, director of the Tennessee Agricultural Experiment Station in 1912:

Notwithstanding the fact that the results of experiment station work in this and other states have given ample evidence of the influence of single-cultivated-crop systems upon the soil, and that warnings concerning the disasters that may be expected have been sounded, corn, cotton and tobacco are still grown to the exclusion of other crops in certain sections of Tennessee. A study of census statistics for Tennessee shows a marked relationship between the one-crop system of farming and the number of renters. The man who rents a farm for one year only will naturally grow the crop that will give him the largest return without regard to the effect upon the farm and subsequent crops in which he has no interest. The renter is often in need of money, which

he can borrow at a high rate of interest on these particular crops more easily than on any others. To meet these obligations the crop, or a large part of it, must be sold at the earliest possible moment, often regardless of price, leaving the renter hardly enough to keep his family and the stock he must have for work until he can borrow again on the next crop.¹⁰

During the period 1890 through 1915 the number of cattle "other than dairy" remained almost constant at 670,000 head, while dairy cattle increased from 320,000 to 355,000. Horses increased 11 percent to 335,000, and mules increased 51 per cent to 294,000. The increase in horses and mules provided workstock on the new farms. Hog numbers declined 28 percent to 1,340,000. Sheep numbers declined by 87,000 to 413,000.

The first 15 years of the 20th century provided an environment for the expansion of agriculture and research supporting it. The population in both the United States and Tennessee was increasing rapidly, creating more demand for both food and fiber. A growing economy with greater price stability than before provided more employment in industries and a profitable era for U. S. agriculture. Later, during the depressed conditions of the 1920s and 1930s, farm legislation would establish a goal of returning agricultural prices and income to the "parity level" with industry that existed during this so-called "Golden Era of Agriculture."

ADAMS ACT OF 1906

Federal appropriations supporting agricultural experiment stations had remained at \$15,000 per state from the time the Hatch Act was passed in 1887 until 1906. State support either did not exist or was very erratic. Many leaders felt that additional funds were necessary to develop and

¹⁰*Twenty-Fifth Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1912*, (Knoxville, Tennessee, 1913).

“The cooperative effort at the federal and state level improved research methodology and enhanced individual scientists’ ability to keep abreast of developments within their own discipline both at the state and national level.”

sustain an innovative research program. After considerable debate, Congress in 1906 passed the Adams Act providing an additional \$15,000 annually to each state with certain restrictions. First, the new funds could only be used to conduct original research or experiments; and secondly, the funds could not be used by justifying all manner of teaching, demonstrations, and extension activities. The funds would be increased gradually with \$5,000 added the first year and \$2,000 each year thereafter until the Adams Act provided \$15,000 and the Hatch Act \$15,000 for a total of \$30,000 annually per state. The Adams Act also gave the Office of Experiment Stations in the U. S. Department of Agriculture the duty to certify annually each state’s eligibility for continued support in accordance with legislative requirements.

The Association of American Agricultural Colleges and Experiment Stations, recognizing the need for a true partnership with the Office of Experiment Stations, created the Experiment Station Committee on Organization and Policy (ESCOP) in 1905 to assist in formulating and implementing policies associated with existing research as well as research proposed under the Adams Act. This action proved to be very satisfactory. For the first time, state experiment stations were required to submit to the National Office of Experiment Stations a written plan of work with all activities grouped into specific projects. Each project would provide a statement of the problems to be attacked, the research approach to be applied, and an estimate of the cost of conducting the research.¹¹ The cooperative effort at the federal and state level improved research methodology

and enhanced individual scientists’ ability to keep abreast of developments within their own discipline both at the state and national level.

MORE DEPTH AND OUTREACH IN RESEARCH

The dawning of the 20th century found optimism on two fronts and a specter of pessimism on the third front for the young Tennessee Agricultural Experiment Station. Prospects for a doubling of federal funding materialized with the passage of the Adams Act, and citizens through local governmental units expressed an early interest in establishing branch stations, especially in West and Middle Tennessee. On the other hand, repeated efforts to obtain state funding on a regular basis for items such as new buildings and equipment not supported with federal funds met with failure.

Research continued to be dominated by the goal of increasing farm production of crops, livestock, and livestock products. However, the process of conducting this research began to move from the “observational or screening stage” to the “planned replicated stage.” Under the “observational or screening stage” individual farmers often provided researchers with samples of their recommended seed or plant source for crops such as corn, sorghum, cowpeas, cotton, tobacco, vegetables, and fruits. The researcher would plant each of these seed or plant sources in a plat or plot and observe its performance, compared with other seed or plant sources, over a period of two or more years. For example, 40 or 50 different seed sources of wheat might be planted in this manner, and after repeating this process for five years, the 5 to 10 seed sources that proved the most productive in terms of observation and measured yields would be moved to the “planned replicated stage.”

¹¹Norwood Allen Kerr, *The Legacy: A Centennial History of the State Agricultural Experiment Stations 1887-1987*, (Columbia, Missouri, 1987).

Similarly, livestock research started in the “observational or screening stage” because of the high costs of conducting livestock research, especially with cattle. Sizeable acreages of land were required to provide the pasture, hay, and concentrates necessary for growing and maintaining livestock. Competition for the land resource was also shared by horses and mules, the principal source of power on both farms and experiment stations. In addition, labor requirement in growing, maintaining, and utilizing livestock in research was considerably higher than for most other enterprises. Under these conditions most experiments involving livestock—for example, studying the effect of ration on weight gain in beef cattle or effect of ration on milk production of dairy cows—utilized few animals and belonged in the “observational or screening stage.”

Other scientists involving the disciplines of chemistry, botany, and entomology operated in the “observational or screening stage” for a number of years. Due to limited staff and travel funds, the scientists were highly dependent upon samples provided by farmers on crops, soils, diseases, and insects, especially from the middle and western parts of the state. It was difficult for the scientists to ascertain whether such samples were representative of conditions throughout the state.

EXPANSION AT HEADQUARTERS

Between 1890 and 1915 the resource base, in terms of livestock numbers, land area, and new facilities, was increased in Knoxville. The number of animals maintained for feeding trials and power (horses and mules) increased from 50 to more than 200, with the dairy and beef cattle herds utilizing most of the land base. Because of the critical need for additional land for research, the state legislature in 1903, for the first time in its history, provided a one-time appropriation of \$10,000 for purchase of land adjoining the existing experimental farm. Excluding the South Farm, the University farm now consisted of 145 acres bounded on one side by the Tennessee River and having a long

**“The development industrially,
agriculturally, and otherwise
in our country for the last forty years
has been wonderful.”**

**—Judge R. A Brown
of the Knox County Court, 1915.**

frontage on Kingston Pike. Four distinct kinds of soil useful for research purposes were identified on this farm as follows: (1) sandy, first bottom, which overflowed yearly; (2) loamy second bottom, which was formed in part by overflow of the Tennessee River, but in larger part by washings from the dolomite uplands; (3) a type of dolomite upland containing but little chert and resembling the Sweetwater Valley soil of East Tennessee; and (4) a cherty dolomite similar to the soils found on ridges like Blackoak and Crocketts and results obtained on this kind of soil, would be applicable to the barrens area.¹²

Slightly more than a decade later in 1915 Knox County Court and the citizens of Knoxville gave to the Agricultural Experiment Station, through the University and the State, the Cherokee tract of land consisting of 570 acres, which more than doubled its land holdings. The Cherokee tract, which adjoined other land of the Station on the Southeast, was purchased by the Knox County Court for \$140,000. The mood of the people at that time could be best characterized by a quotation from Judge R. A. Brown of the Knox County Court at the formal ceremony attended by the Governor of Tennessee, President of the University, Commissioner of Agriculture, Director of the Experiment Station, and other dignitaries when the property was officially transferred:

¹²*Eighteenth Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1905*, (Knoxville, Tennessee, 1906).

The development industrially, agriculturally, and otherwise in our country for the last forty years has been wonderful. May I give you an illustration? My own grandmother peddled milk in this city horseback. She had a long sack, opening in the side, and cans of milk were put in each end of the sack and strung over a horse, and she delivered milk that way. Her son delivered it in an open spring wagon, later a covered hack, finally in what we know as a milk wagon. His son is today delivering milk in this city in an up-to-date automobile, and he has the latest and most modern sanitary equipment in his dairy, which is located at the same old spring from which my grandmother delivered milk in her satchel, on horseback, 40 years ago. We are just beginning fairly to realize our possibilities, and what we shall be.¹³

Earlier, in 1907, the state legislature provided a one-time appropriation to improve the headquarters building, Morrill Hall. The amount of money provided is unknown; however, several comments in the 1908 Annual Report refer to the opening of the new Morrill Hall with its improved laboratories plus new office spaces for the expanded staff, made possible through the Adams Act. Another major facility, the Oliver Perry Temple Convention Hall, was funded by the East Tennessee Farmers' Convention and built on the Experiment Station farm in 1912. This hall provided suitable space for meetings of the convention and other groups, as well as an arena for use as livestock shows and sales.

BRANCH STATIONS AND OUTLYING WORK

Contact between farmers across the state and the professional staff in the Agricultural Experiment Station, especially outside of East Tennessee, was mainly limited to exchange of information on samples of soil, seed, insects, and diseases analyzed, discussions at farmers' conventions, or publications issued based on research conducted in Knoxville. Scientists recognized that differences in soils, climate, and physiographic conditions across the state especially influenced crop production and yields and that these differences should be studied. Too, farmers at the turn of the 20th century were still skeptical of "book learning" so having research conducted where they could see

the crops and livestock grown had an advantage. For example, what better way was there to demonstrate the importance of fertilizer on corn yield than to have a plot of corn not fertilized and producing 20 bushels per acre growing alongside a fertilized plot yielding 50 bushels per acre?

West Tennessee Experiment Station

A Commission was appointed under an Act of the 1907 General Assembly of Tennessee to select a location for a West Tennessee Experiment Station. The competition was keen among the West Tennessee counties for this branch station, but a site about one mile west of the city of Jackson in Madison County was chosen. The land, consisting of three tracts, was purchased by the governing body of Madison County and given to the University. The following statement characterized this decision:

These properties, comprising in all about 175 acres of land, are admirably suited for experimental work. The immediate location stretching between the Brownsville and Poplar Corners Pikes is of easy approach to local and visiting farmers. The soils upon these areas are sufficiently diversified to be representative of the soil areas of this division of the state. The worn-out condition of many of the fields offers ample opportunity for experiments in economical soil improvement for the various phases of activities for which West Tennessee is so well adapted. Since a large share of West Tennessee's agricultural interest is cotton, the Station will have a rare opportunity to suggest and encourage other profitable lines of agricultural effort before the arrival of the Mexican Cotton Boll Weevil which at its present rate of dispersion will reach the outlying western counties about 1912 or 1913.¹⁴

¹³Direct quotations from Judge R. A. Brown of Knox County Court when the Cherokee Tract was presented to The University of Tennessee in a ceremony in Knoxville, Tennessee, January 27, 1916. (Copy of official program and speech located in the Webster Pendergrass Library on the UT Agricultural Campus).

¹⁴*Twenty-First Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1908*, (Knoxville, Tennessee, 1909.)

During 1909, the heads of departments of the Experiment Station outlined the work of the West Tennessee Station. Experimental areas were selected and some buildings were erected. S. A. Roberts, former agriculturalist of the Murray State School of Agriculture in Oklahoma, became superintendent of the station on August 1, 1909. It was anticipated that the research program would relate to the crops adapted to West Tennessee, especially cotton, fruits, and vegetables, and to dairy and beef animals. Problems associated with crop rotation, fertility levels, and soil erosion received high priority.

Lack of state funds for buildings and equipment continued. Finally, in 1913, the General Assembly appropriated \$10,000 for equipment. In 1914 a superintendent's dwelling was built on the station. During the same year, following the example of the farmers of East Tennessee, those of West Tennessee erected upon the station an auditorium (known as the round building) with a seating capacity of 2,000 people and an innovative method of storing equipment underneath the seating area.

Outlying Work

As a result of the increased funding under the Adams Act, three individuals were employed and assigned to do cooperative work in the middle divisions of the state in 1907. J. E. Converse, formerly assistant in plot work at Knoxville, was assigned to Crossville; J. E. Hite, a graduate of The University of Tennessee, was located at Gallatin; and, W. N. Rudd, a practical farmer, was assigned at McMinnville. Each was given the title of assistant in cooperative experiments. After two years, Hite resigned to further his education and L. R. Neal was appointed as his replacement but was headquartered at Columbia in Maury County. Neal had graduated from the University in the Agricultural Department in 1908 and the following session was appointed a Fellow in the agricultural department.

The following plans of work for outlying

locations were outlined by the heads of the departments of the Station:

Extension and cooperative work in the middle division of the State has been arranged and is in actual operation in connection with varieties of crops, rotations, systems of culture, introduction of new crops, fertilizers and lime, and in the more special lines of tobacco, truck and fruit. The initial plans emphasize a study of the various soil types; crops and varieties adapted to them and their plant food requirements; the most suitable systems of rotation and culture; and insects and diseases, with possible preventives and remedies. Much attention will be given to the introduction of new crops and methods of farm management which will induce a more liberal support of livestock upon the farms of this section of the State.¹⁵

In cooperation with the Bureau of Plant Industry of the U. S. Department of Agriculture and the County of Montgomery, special field experiments and demonstrations in tobacco culture were started in 1913 at Clarksville in Montgomery County. R. H. Milton was listed in the 1914 Annual Report as the superintendent of the Tobacco Experiment Station at Clarksville.

ACCOMPLISHMENTS

Any attempt to describe fully the scope and comprehension of the total research program and its accomplishments during this period 1900 to 1915, or any other period, is beyond the capacity of this reviewer. Instead, it is hoped that the examples that follow will give the reader some sense of the historical importance of agricultural research in Tennessee.

¹⁵*Twentieth Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1907, (Knoxville, Tennessee, 1908).*

Variety Testing and Development

Near the turn of the century, three varieties of corn were recommended for different soils.

Hickory King was identified as best suited to upland soils of medium quality, while *Cocke's Prolific* fitted the better upland soils. *Huffman* was the choice for rich river and creek bottoms. A decade later, *Neal's Paymaster* became the number one corn variety in Tennessee being adapted to both upland and bottomland soils. This was a red-cob corn selected in the field for a number of years by W. H. Neal of Lebanon, Tennessee. The following quote was used to describe this variety:

Never seen a variety which tends more strongly than this to produce two ears per stalk. Red cob appeals to farmers.¹⁶

Under an agreement with the U.S. Department of Agriculture, the Experiment Station botanist worked on plots in Fayette County to improve native varieties of cotton for earliness, general improvement, and oil content of the seed. After four years of testing, a new variety of cotton came out of stock found in Chester County and was distributed under the name *Trice*. This variety had early maturity and medium large bolls. Cotton breeding was moved to the West Tennessee Experiment Station in 1909 and five years later, a new variety called *Cleveland Big Boll* was developed which had a higher yield, larger bolls and higher lint percentage than *Trice*.

A new variety of soybeans, called *Tokyo*, was developed and recommended as being much better for hay than the standard variety *Mammoth Yellow*.

Among the small grains, the wheat variety *Economist* was developed from seed received from A. W. Warfield of Columbia, Tennessee. This variety was characterized as able to stand up on rich soils with the production of high yields of grain of good quality. This variety appeared to be the same as *Fultze-Mediterranean*. Oat varieties recommended for fall seeding were *Virginia Gray* and *Culberson*, while *Burt* and *60-Day Russian* represented spring seeding stock. *Union* and

Tennessee were the leading varieties of winter barley and were especially adapted to rich soils.

Intensive testing of varieties of berries was noted with recommendations as follows:

Strawberries: Highest yield: *Pride of Cumberland*, *Clyde*, *Tennessee Prolific*; Best quality: *Bennett*, *Parson's Beauty*, *Brownie*; Latest berries: *Gandy*, *Hunn*, *Michigan*.

Raspberries: *Columbia*, *Sheffer's Colossal*.

Blackberries: *Snyder*, *Wilson*, *Rathbun*, *Lawton*.

Red and White Currants: No longer recommended for Tennessee because of little growth, dropped their leaves around August, and needed a cooler climate.

A new sorghum variety known as *Honey* or *Japanese Ribbon Cane* was developed at Jackson, and it was described as adapted to all but higher elevations in the state and gave higher yields and stood up better than other varieties.

The following statement characterized some of the research on grasses:

The results of four years' work with grasses teaches very plainly that too many grasses are recommended for cultivation. Out of 30 varieties tested separately and in many different mixtures not more than five or six can be recommended for cultivation, and some of these only on special classes of soil. The grasses that have succeeded are orchard grass, tall-oat, red-top, Kentucky Blue and Bermuda. On a very poor cherty soil there was no mixture of grasses superior to orchard grass, tall-oat or red-top seeded alone.¹⁷

Fertilizer Recommendations and Analysis of Soils

Throughout this period, the chemistry department conducted this work along two distinct lines. One line of work was in the field and represented

¹⁶*Twenty-Seventh Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1914*, (Knoxville, Tennessee, 1915).

¹⁷*Sixteenth Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1903*, (Knoxville, Tennessee, 1904).

fertilizer experiments on different soil types; the other involved laboratory analyses of the different soils. The first time the term agronomy was noted was in 1905. The first general fertilizer recommendations appeared in 1901, as follows:

Formula 1: Corn, sorghum, etc.	Total applic./acre
300 lbs. high-grade acid phosphate}	
25 lbs. muriate of potash}	200-400 lbs.
200 lbs. cottonseed meal}	
Formula 2: Cotton	
300 lbs. high-grade phosphate}	
25 lbs. muriate of potash}	200-400 lbs.
300 lbs. cottonseed meal}	
Formula 3: Potatoes (sweet & Irish)	
300 lbs. high-grade phosphate}	
50 lbs. muriate of potash}	500-1,000 lbs.
350 lbs. cottonseed meal}	
Formula 4: Wheat and other small grains	
300 lbs. high-grade phosphate}	
25 lbs. muriate of potash}	150-300 lbs.
350 lbs. cottonseed meal}	
Formula 5: Beans, peas, clovers, etc.	
300 lbs. high-grade phosphate}	
25 lbs. muriate of potash}	200-400 lbs.
Formula 6: Grass for lawns, etc.	
300 lbs. high-grade phosphate}	
50 lbs. muriate of potash}	300-1,500 lbs.
600 lbs. cottonseed meal}	

It was reported that cottonseed meal could not be drilled with safety for wheat but should be broadcast because of its injurious effects on germination. Too, it was recommended that larger proportions of cottonseed meal to acid phosphate be applied to soils in the central basin of middle Tennessee because these soils were better supplied with native phosphates.

It might be speculated that these general fertilizer recommendations were provided on crops because of pressure from farmers for the best information available. It should be remembered that the Agricultural Extension Service did not exist at that time. Nevertheless, by 1910 with more intensive research and better commercial fertilizers, specific recommendations were altered.

For example, side dressing of corn with nitrates was reported as beneficial if applied when the corn was ankle- to knee-high, but diminished in importance as the crop reached waist-high, and gave no benefits if applied at the tassel stage.

The second line of work by the chemistry department, involving laboratory analysis of soils, represented some very basic research of utmost importance, which has continued to influence crop production in the state. Soil samples were collected throughout the state, often by scientists attending farmers' conventions, and these samples were catalogued by location and then analyzed for chemical elements, humus and other materials. As early as 1902 samples were placed in galvanized pots and fertilizer experiments were conducted on crops grown in these soils. Over the next decade more elaborate lysimeter equipment was utilized to evaluate soil characteristics and their relationship to supporting plant growth. Gradually, guidelines were developed on the fertility level of soils, ranging from the high phosphatic soils in the central basin in Middle Tennessee to contrasting soils in East Tennessee.

Livestock

Dairy

Most of the research was concentrated on determining the substitution rate of different forages and grains in the ration of the predominately purebred herd of 25 Jersey cows at Knoxville and the importance of culling and controlling diseases, especially tuberculosis and milk fever, in raising milk production levels. Alfalfa, cowpeas, soybeans, and red and crimson clovers were the principal forage crops tested, while corn, small grains, and cottonseed meal were the concentrates used. By 1904 milk production in this herd averaged 6,000 pounds per cow with 353 pounds of butterfat. Dairy farmers in Knox and surrounding counties were organized and advised by specialists from the Experiment Station to follow prescribed recommended practices.

Two other activities at the Knoxville headquarters were highlighted during this period. In 1906 a new Burrell-Lawrence-Kennedy milking machine was tested. In 1915 a cooperative creamery was established for experimental study and investigations in dairy products and manufacture not available previously.

Two additional herds of dairy cattle were added to the resource base at the West Tennessee Station. A Holstein herd was purchased in 1911, followed by a Shorthorn herd in 1915. The Shorthorn cattle were viewed as dual purpose or suitable for both milk and meat production. A unique system was used for purchasing this herd and will be discussed later.

Beef Cattle

One-acre plots were planted to corn, cow-peas, and soybeans and then tested to see which one of these crops would provide the most feed for steers. Soybeans provided feed over the longest period and with the greatest gain. The manure was left on the plot and the soybean crops provided 12.5 percent more animal carrying capacity the third year than the first year.

Steer feeding was conducted at Jackson out in the open during the winter, compared with an enclosed building, and no differences were noted in performance of animals. In another experiment, steers of beef breeds out-gained dairy steers. Over a 90-day feeding period, feeder type steers, classified as very good, gained 18 pounds more than the next grade lower and 33 pounds more than steers medium to poor in type.

Other Food Animals

The first research on poultry in 1905 dealt with the test of eight breeds using the best sources of feed for both fowl and egg production. Incubators and brooders were used in producing the breeding stock. Different methods of preserving eggs also were undertaken.

Rations were tested for swine production

with emphasis on the use of corn and skim milk. Another ration consisting of four parts of corn meal to one part of cottonseed meal was successful, provided some iron compound such as copperas was fed with the meal at the rate of one pound for every 50 pounds of cottonseed meal fed. If the iron compound was omitted, death losses were high.

Sheep research dealt primarily with the importance of pasture rotation in controlling the stomach worm.

In 1908 it was reported that Dr. M. Jacob, the veterinarian, had developed a hog cholera immunization serum that was highly successful. He encouraged the state to produce the serum to stop the \$500,000 annual loss of swine due to cholera, but no action was taken. Several other prevalent livestock diseases that were identified included black leg, lumpy jaw, chronic bacterial dysentery, and cattle fever.

Disease and Insect Control

The fight against plant diseases can probably best be characterized by the "clover sickness" outbreak in red clover, which occurred around 1900 and continued for decades. This crop was widely grown throughout the state as both a major forage crop for livestock and as a restorer of poor, eroded soils. The crop usually began to die in the summer following late winter sowing. The trouble was popularly attributed by farmers to some supposed condition of the soil, and so termed "clover sickness" of the land. It was soon learned that the malady was independent of soil conditions and represented some fungus or bacterial disease, which was later identified as anthracnose. Scientists and farmers cooperated identifying and selecting anthracnose resistant clover. It was reported that W. P. Ridley of Columbia produced 200 bushels of such seed in 1912. Farmers were encouraged to rotate cropland as a further precaution. The introduction of Japanese clover (now called lespedeza), especially in West Tennessee, helped to alleviate part of the forage problems.

The solution of using resistant strains within crops was attempted in many instances such as apple and pea blight and fusarium wilt of tomatoes.

Insect identification was a major project of the entomologists with emphasis on insect life-cycle including breeding places, overwintering habitats, and feed habits. Those insects that attacked fruit and vegetable crops, such as the Mexican bean beetle, cabbage bug, and woolly aphids, received the most attention since all farm families were highly dependent on these home-grown crops. A list of county correspondents was used to report outbreaks of insects in the various counties included 168 correspondents in 1913.

Among the spray materials used to control insects and diseases was the self-boiled lime sulphur solution, the Bordeaux mixture, Paris green, and arsenate of lead.

Mechanical and Cultural Practices

Many modified and new mechanical pieces of equipment or cultural practices were researched during this period as indicated.

By the addition of a 2½ h.p. gasoline engine sprayer and a double-acting, horizontal-cylinder, lever sprayer, also a compressed-air sprayer, to our already nearly complete spray equipment, there is no feature in spraying that cannot be satisfactorily demonstrated. With 30 distinct types of spray mechanics, from the simple to the complex, we are able to show the kinds suited to the various demands of spraying.¹⁸

Four types of crude-petroleum burners and the coal-burning Ideal Orchard Heater were used in attempts to raise temperatures and prevent freeze damage in orchards. Sixty heaters were used per acre and the temperature was raised four degrees above what it was beyond the orchard limits. With superior coal costing \$4.00 per ton and crude oil 6 cents per gallon, the coal burners were more economical. Besides, the oil heaters left an unburned residue of one-half to one-third in each pot and they had a tendency to sputter out when rain or snow was falling.

Tests with the subsoil plow indicated its importance as a land-breaking implement because it gave a better seedbed, more complete weed control, and avoided "clod trouble" compared with conventional tools.

No-till corn received recognition.

One of the novel experimental results which is exciting interest at the Jackson Station, as well as elsewhere, is the good showing made by corn when left uncultivated except that the weeds were not allowed to grow but are scraped off the surface from time to time.¹⁹

Results indicated that yields often exceeded those in cultivated areas.

GIFTS, GRANTS, AND LOANS

The limitations on the use of federal funds and the failure to obtain state funds on a regular basis were offset to some extent by the generosity of farmers and businesses in the state. For example, the donations in 1914 were listed as a cultivator, a farm wagon with extra wheels and attachments, two car loads of crushed stone, and cement for two silos. The largest contribution during this period came from two businesses to establish the Percheron Breeding Foundation as indicated:

During the past year donations have been received from the Nashville, Chattanooga, and St. Louis Railway of Nashville and the Holston National Bank of Knoxville, for the purchase of a type of Percheron to be used in crossing upon saddle, roadster, and other types of native mares, the offspring of which is to be used, over a period of years, in determining the best crosses to be made for the production of mule mothers. The Foundation established by the Railway will be located at Jackson, and the one by the Bank

¹⁸Twenty-Fourth Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1911, (Knoxville, Tennessee, 1912).

¹⁹Twenty-Seventh Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1914, (Knoxville, Tennessee, 1915).

“The use of publications continued to be a mechanism employed by the Agricultural Experiment Station to establish and maintain its identity with farmers and other support groups.”

will be located at Knoxville. The Foundation money is a loan without interest; all purebred filly colts to remain the property of the University; the male purebreds to be sold to farmers at two years old for not more than \$500 with the money returned to the subscribers. The same is true of any males or females not suited for the project. Animals produced from the Railway Foundation are first offered to farmers along the lines of this company in Tennessee, then in the State, then on the open market. Those from the Bank Foundation must be offered to Knox County first, then to East Tennessee, then to the State, and then to the open market. Later on, when the crossbred fillies become available, it is the purpose of the Station authorities to arrange for carefully selected high-class registered jacks to be placed at each Station or in approved communities, in order that they may be crossed upon the approved off-spring of the Percheron crosses.²⁰

In 1915 the same railway financed the purchase of the Shorthorn herd of cattle at the Jackson Station using a method for financing similar to that of the Percheron Breeding Foundation.

PUBLICATIONS

The use of publications continued to be a mechanism employed by the Agricultural Experiment Station to establish and maintain its identity with farmers and other support groups. Two types of bulletins were in use.

The first type was known as the regular series bulletin which gave detailed research accomplishments, such as reported earlier. About four of these bulletins were published annually, with fairly equal representation from the different subject-matter areas. Titles of some of these bulletins were as follows: *Soils of Tennessee*,

Their Chemical Composition and Fertilizer Requirements; Selection for Disease-Resistant Clover; The Cattle Tick as Affected by Climate; and Home Grown Rations in Economical Production of Milk and Butter.

By 1912, almost 11,000 farmers were on the mailing list requesting these bulletins. Often these requests could not be met because of shortage of funds for printing. Pleas for state appropriations for publications fell on deaf ears.

The second type of bulletin was known as the press bulletin. The press bulletins were first mentioned around 1900, and it is believed that these took the place of the large newspaper sheets called “supplements” that were published by the Station and sent to newspapers in the state for distribution to their readers. The press bulletins were brief and covered popular topics such as: *Rates and Dates of Seeding; Advantages of Dairying; Formula for Spraying Mixes; and The Fertilizer Question.* More than 225 newspapers were on the mailing list to receive these press bulletins by 1912.

LEADERSHIP AND PERSONNEL

Few agricultural experiment stations experienced the continuity in strong leadership that existed at Tennessee between 1888 and 1915. Charles Dabney, Jr. was chosen by the Trustees of The University of Tennessee in 1887 to serve both as President of the University and director of the Agricultural Experiment Station. He served as president until 1904, and with the exception of five years, he was also director. During the period when Dabney was not the director, F. Lamson Scribner held the position between 1890 and 1892, and Andrew Soule from 1903 through 1904.

Director Dabney's leadership qualities were recognized at the national level when at the first meeting of the newly-organized Association of American Agricultural Colleges and Experiment

²⁰*Ibid.*

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Charles Dabney, Jr. was chosen by the Trustees of The University of Tennessee in 1887 to serve both as President of the University and director of the Agricultural Experiment Station. . . . Director Dabney’s leadership qualities were recognized at the national level . . . Director Morgan . . . recognized weaknesses in marketing credit and farm tenure that needed attention for agriculture to be viable.”

Stations in 1888, he was requested to head a committee on college-station relationships. The committee concluded that each station should be a distinct department with a single administrator devoting most of his time to the station work. The committee further suggested that the stations maintain separate accounts to better ensure that Hatch monies were spent in station research, rather than general college operations.²¹

In late 1893, President Grover Cleveland named Dabney Assistant Secretary of Agriculture, and he served in that capacity until 1897. During this period, he had a partial leave of absence from the University, but agreed to manage the affairs of the University to the fullest extent possible, and to be present on the campus at least four times per year.

Shortly after Dabney’s resignation in 1904 to become president of the University of Cincinnati, Director Soule resigned. H. A. Morgan, a professor of entomology and zoology at Louisiana State University was named director by the new president, Brown Ayres. Director Morgan provided strong leadership for research in the sciences relating to production agriculture, but he also recognized weaknesses in marketing credit and farm tenure that needed attention for agriculture to be viable. In 1913, the President of the United States, Woodrow Wilson, appointed Morgan to a seven-man commission that spent three months studying rural credit and cooperation in European countries. This experience seemed to have a major impact on his career.

The size of the professional staff increased from eight scientists in 1900 to 19 in 1915, while

workers in a supporting role increased from three to five over this period. Five of the additional professional workers were either superintendents of branch stations or engaged in outlying work across the state. The rapid turnover in staff and gradual emergence of new disciplines and titles associated with agricultural research was evident during these years. For example, Howard Sledd, editor of *The Industrious Hen*, was placed in charge of the poultry department in 1905, but he remained only one year, and the poultry department, as such, was no longer mentioned during this period. Samuel Barnes was employed in 1901 and carried the title field expert in dairying until he resigned in 1909. He was replaced by C. A. Wilson, who became the first animal husbandman. Charles A. Keffer, who was professor of botany, horticulture, and forestry at South Dakota State College, was appointed horticulturist in 1901 and in 1914 was appointed the first director of the newly-established Agricultural Extension Service in Tennessee. On the other hand, two other staff members, C. A. Mooers, a chemist, and F. H. Broome, a librarian, who joined the staff in 1893 and 1896, respectively, would later retire from the Agricultural Experiment Station with a service record of 53 and 52 years, respectively.

As the chemistry department grew from one person in 1901 to three in 1915, some specialization

²¹Norwood Allen Kerr, *The Legacy; A Centennial History of the State Agricultural Experiment Stations, 1887-1987*, (Columbia, Missouri, 1987).

was noted based on titles. One was designated as a chemist and agronomist while another carried the title soils chemist. Personnel representing new disciplines in 1915 were three entomologists, one bacteriologist and one animal husbandman. Two consultants, a veterinarian and a meteorologist, were on the staff in both 1901 and 1915.

ADVERSITY IN AGRICULTURE: ITS IMPACT ON RESEARCH (1916-1940)

BACKGROUND

Seldom in the history of agriculture have farmers experienced greater fluctuations in the prices they received for their products and the purchasing power of these products than during the 25-year period 1916-1940.

At the beginning of this period, American citizens and their government were responding to an increasing demand for food, fiber, and war materials from allies engaged in World War I. By 1917, the United States was involved in this war, and further emphasis was placed on food production for the country's own needs. Farmers reacted positively to this demand, and increased production and prosperity resulted throughout the war years and almost two years into the post-war period. By this time, European agriculture had recovered and suddenly the demand for U. S. farm products decreased appreciably. Unfortunately, American policy-makers had given little attention to the impact of decreasing foreign demand and exports on farm prices and incomes, and the results were disastrous. Between 1920 and 1921, the average price received for livestock and major cash crops dropped almost 50 percent. Using 1913 as a base year with a purchasing power index for agriculture of 100, a similar index for 1921 was 51; for 1922 it was 77; in 1923 it was 70; and in 1924 it was 83. Recovery in the industrial sector

of the economy led to a stronger domestic demand for food and fiber products between 1925 and 1929.

This was quickly followed by the Great Depression of the 1930s—the consequences of which were felt in all sectors of the economy. Prices of agricultural products declined to their lowest level of the 20th century, with cotton and tobacco selling from 5 to 7 cents per pound, corn 30 to 40 cents per bushel, wheat 60 cents per bushel, strawberries for \$1.25 per crate and cattle, and hogs and lambs from 3 to 5 cents per pound. Many farmers with land payments or other indebtedness were unable to produce a sufficient volume of produce at existing prices to meet their obligations, and foreclosures resulted. Equally serious was the lay-off of people in industrial employment, where no safety net such as unemployment compensation was available and their consumption of food decreased to subsistence levels. Many of these former industrial employees returned to the farm to live with relatives or friends and became sharecroppers or tenants. In some instances the only other choice for survival was dependency on soup kitchens in major cities across the country. Since this depression was world-wide, both foreign and domestic demand for agricultural products declined at existing prices, and despite the best efforts of the New Deal of the 1930s, agricultural and industrial

recovery was slow until the early years of World War II.

Economic conditions in Tennessee closely paralleled those in the nation during the 25-year period beginning in 1916. The farmer's plight during the early 1920s was characterized by George White, state veterinarian, as follows:

Numerous new and enthusiastic beginners were discouraged and financially handicapped in such a way that they were actually choked out of business. Even some of the best farmers retired during this calamitous depression period.²²

The decade of the 1920s represented the first decrease in numbers of farms in Tennessee history; however, with the arrival of the Great Depression of the 1930s, the numbers of farms increased to more than 28,000 between 1930 and 1935. This increase was attributed primarily to the return of agricultural workers released from industrial jobs. The pattern of crop and livestock production in the state remained basically the same, except for greater emphasis on fruit and vegetable production and self-sufficiency. Farmers often discovered that they could not implement new and profitable research findings because of lack of cash. For example, if two dollars invested in fertilizer for corn would generate six dollars in extra income, this would appear to be a profitable undertaking. However, for the farmer who did not have, and could not borrow, the two dollars for the fertilizer, the results were meaningless. Under these conditions, a backlog of research findings accumulated during this period and could not be implemented until economic recovery took place.

RESEARCH HORIZON BROADENED

The adverse economic conditions encountered in the 1920s and 1930s raised questions among leaders at the national level concerning funding for agricultural research for two reasons. First, more attention focused on the economic and social problems unique to farm life seemed warranted; and, second, the existing funding-base,

eroded by inflation since the Adams Act was passed in 1906, needed to be increased. Too, many legislators argued that states should be required to match federal funding using the pattern established in the Smith-Lever Act of 1914 for the Agricultural Extension Service. Legislation in both 1925 and 1935 addressed most of these concerns.

PURNELL ACT OF 1925

Representative Fred S. Purnell of Indiana introduced legislation during the 1921 recession to strengthen agricultural research, but it was not enacted until 1925. The Purnell Act provided annual appropriations amounting to \$20,000 for each state experiment station in 1926, with stepped increases of \$10,000 per year until the total reached \$60,000 per state in 1930. The goals and some of the reactions toward the new areas of research authorized were as follows:

In the process, the Purnell Act explicitly stated goals for the station: the establishment and maintenance of a permanent and efficient agricultural industry, and the development and improvement of the rural home and rural life. The first objective had been the implicit guide to investigations since the time of the Hatch Act. The second, which legitimized efforts to expand research programs to serve broader needs than only agricultural production, was entirely new to many stations. Many agricultural scientists, including directors, were reluctant to accord the proposed social scientists equal status. Home economists investigating nutrition perhaps fared best since their experiments were closest to those of traditional biological science, but even they had to overcome early challenges posed by college chemistry departments.²³

²²"A Century of Tennessee Agriculture 1854-1954," *40th Biennial Report*, Tennessee Department of Agriculture, (Nashville, Tennessee, 1954).

²³Norwood Allen Kerr, *The Legacy: A Centennial History of the State Agricultural Experiment Stations, 1887-1987*, (Columbia, Missouri, 1987).

BANKHEAD-JONES ACT OF 1935

A decade after the Purnell Act was passed and at a time when the country was in a major depression, Congress passed the Bankhead-Jones Act to strengthen agricultural research. The act called for an additional \$1 million in 1936, followed by incremental increases of \$1 million per year until the appropriation reached \$5 million. This act had some additional features not found in previous legislation. Only 60 percent of the new money was to go to the state experiment stations. The other 40 percent was set up as a "Special Research Fund" to be used at the discretion of the Secretary of Agriculture. He authorized the establishment of several new regional research laboratories. The new money distributed to the state experiment stations was not distributed equally, but was based on each state's proportion of the rural population of the United States and its territories. For example, the first year Texas received the largest share (\$37,341) and Alaska got the smallest (\$559). Tennessee's share the first year was \$18,696. Each state was required to match the federal contribution out of its own treasury. The purpose of this Act was as follows:

... research into laws and principles underlying basic problems of agriculture in the broadest aspects; research relating to the improvement of the quality of, and the development of, new and improved methods of production, distribution of, and new and extended uses and markets for, agricultural commodities ... and research relating to conservation, development, and use of land and water resources for agricultural purposes.²⁴

FUNDING THROUGH NEW DEAL ACTION AGENCIES

Starting in 1933 President Franklin D. Roosevelt recommended and Congress enacted a number of programs in soil conservation, flood control, price support, acreage and marketing allotments, farm credit, and rural electrification, designed to alleviate poverty in agriculture. These programs were part of Roosevelt's New Deal. The

newly created Tennessee Valley Authority (TVA) shared some of the responsibilities for administering some of these programs in the South along with the USDA. Shortages of reliable information for executing new programs often resulted in agencies contracting with the experiment station for supporting research. This especially enabled the Tennessee Station to broaden its financial base and programs, while state appropriations were severely restricted.

A few months after the establishment of TVA, an agricultural program for improvement of the Tennessee Valley was prepared from the Tennessee Station's point of view, at the request of a member of the Board of TVA. Even though the board member was not identified, it is suspected that the request came from H. A. Morgan, chairman of the board of TVA and former president of The University of Tennessee, and former director of the Tennessee Station. Almost immediately TVA provided funds for the Department of Agronomy to conduct field experiments with new fertilizer combinations, and also for the Department of Chemistry to assist in the development of new processes in the production of phosphates suitable for fertilizers. The Department of Agricultural Economics also received substantial funding to study the use of demonstration and experimental farms for educational purposes. Later TVA was the principal provider of funds for the Station to undertake a long-range soil survey involving the identification, classification, and mapping of soils by counties in the state. For example, 15 men surveyed more than one million acres of land in 1939. This data base was and still is useful to farmers and others in planning land use, in both rural and urban areas. The Department of Agricultural Engineering also received funding from TVA for several studies relating to irrigation, tillage practices, terracing and other structural devices for controlling erosion, and the potential use of electrical power in performing farm tasks.

Even though a number of other New Deal

²⁴*Ibid.*

agencies provided funds for research, only one unusual project is discussed. In 1933 approximately \$100,000 was provided to the Department of Agricultural Economics by the Bureau of Agricultural Economics, USDA, to secure and analyze data in every county in the state on farm mortgages, farm foreclosures, and tax delinquencies. About 370 people were employed on the project. When the study was completed maps were made showing tax delinquencies not only by counties but by civil districts. Data were obtained comparing the tax assessment with the actual sale price on a large number of identical properties in each county. The results provided valuable information to both legislative and administrative officials for problem solving during a crisis.

ACTION AT HEADQUARTERS

The Tennessee Agricultural Experiment Station continued to organize research activities into subject-matter areas, known as departments, during the 1916-1940 period. From time to time departments would be abolished for a few years then reappear on the organizational charts. In general, the number of departments increased over this period. Furthermore, specialization within disciplines and departments became more evident. For example, within the Department of Animal Husbandry, one staff member might be identified as an authority in animal breeding while another person would be classified as an animal nutritionist. Broader enabling legislation, such as the Purnell and Bankhead-Jones Acts, encouraged this development.

Six years before the passage of the Purnell Act, which was the first federal legislation to place emphasis upon new social science disciplines, the Tennessee Station created the Department of Agricultural Economics with C. E. Allred as its head. In 1919, with the death of President Brown Ayres, H. A. Morgan was appointed President of the University but continued to serve as Director of the Agricultural Experiment Station with C. A. Mooers promoted to vice director.

Beginning in 1920 the Station was reorganized and practically every member of the staff was employed to devote full time to research. The number of departments was reduced to five, consisting of Agronomy, Soil Chemistry, Botany and Plant Pathology, Entomology, and Agricultural Economics.

In 1923, Mooers became director and by 1928 there were eight departments with their chief lines of work as follows:

1. *Agronomy*—varieties and culture of general farm crops, Tennessee soils, their crop adaptability, and fertilizer requirements.
2. *Animal Husbandry*—problems in feeding, diseases, breeds, and breeding.
3. *Botany*—plant improvement, especially general farm crops.
4. *Chemistry*—special problems concerning soils, liming, and action of fertilizers. Problems concerning foods and nutrition. Problems concerning insecticides.
5. *Economics*—problems concerning marketing, taxation, and social organizations.
6. *Entomology*—insects affecting farm, garden and orchard crops and livestock and their control.
7. *Horticulture*—truck crops, small fruits and orchard problems.
8. *Plant Pathology*—diseases affecting farm, garden, and orchard crops and their control.²⁵

Further growth in number of departments was noted by 1940 with the addition of five, including the Departments of Bacteriology, Engineering, Home Economics, Markets, and Physics. In addition, economics was broadened to include sociology.

²⁵*Forty-First Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1928*, (Knoxville, Tennessee, 1929).

The role of agriculture in research, teaching, and extension in the University, as well as across the state, was enhanced in 1921 by the completion of a new headquarters building, later to be named Morgan Hall. This facility was described as follows:

An important event of the year was the transfer of the Station library and chemical laboratories, and the offices of the Vice-Director, Secretary, Agricultural Economist, and Botanist to the new agricultural building at the University farm. There remains at the old building on the University campus only the laboratories and offices of the Station's Plant Pathologist and Entomologist. This change brings the staff in more immediate touch with the plot work and the lysimeter and cylinder experiments than has been possible in the past. Also the office and facilities are much in favor of the new location. The chemical laboratories are commodious and excellently arranged. The hope is expressed that it may soon be possible to bring the remaining members of the staff to the new building.²⁶

Other new facilities and buildings added near Morgan Hall included greenhouses in 1922; lysimeter plant in 1926-27; the USDA Cooperative Corn and Cotton Laboratory Building in 1936; and the agricultural engineering building in 1940.

BRANCH STATIONS AND OUTLYING WORK

Farmers, other agricultural leaders, and legislators continued to stress the need for branch stations within their specific area of the state. Differences in soil types, physiographic conditions, climate, and existing livestock and cropping patterns reinforced this argument. Too, the visibility and success of the first branch station in West Tennessee served as a real trump card in this endeavor. Additional branch stations were established during this period.

WEST TENNESSEE EXPERIMENT STATION

Intensive experimentation in crop rotations, cultural methods, soil fertility, and variety trials of both farm and garden crops was conducted. Since cotton was the number one cash crop in this section of the state, it received special attention through research on breeding and quality evaluations of both lint and seed.

Livestock research was viewed as a means of encouraging row crop farmers in West Tennessee to diversify their operations and increase income; however, the land resources on this station were inadequate to support both a crop and livestock research program. The Holstein dairy herd was transferred to the Knoxville Headquarters Station in 1921, and the dual-purpose Shorthorn herd was liquidated and replaced by a Jersey herd in 1927. Beef cattle research was restricted to winter feeding. Other animals available for research purposes included about 30 ewes and a ram, a purebred Berkshire boar and two or three brood sows, a few Barred Rock Chickens, and within the Percheron Foundation, four purebred mares and one purebred stallion. The 210 acres available on the Station in 1940 remained fully utilized.

Ben P. Hazlewood, who held both a B.S. and an M.S. degree from The University of Tennessee, was appointed superintendent of this station in 1929, replacing S. A. Roberts, who resigned.

MIDDLE TENNESSEE EXPERIMENT STATION

In 1917 the Legislature authorized the establishment of the Middle Tennessee Experiment Station with the location to be determined by a committee appointed by the governor. The county receiving the station was to provide the land and the state would provide an annual appropriation of \$10,000 for its operation. After

²⁶*Thirty-Fourth Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1921, (Knoxville, Tennessee, 1922).*

considerable investigation, the committee approved a tract lying between the Hampshire and Mt. Pleasant Pikes, just west of Columbia in Maury County. The area included 652 acres and cost approximately \$100,000. The soil resource was considered very typical of the Great Basin of Middle Tennessee.

The station was developed principally for livestock research with supporting field experiments with pastures, grasses, and legumes. Between 1917 and 1921, a beef barn was constructed to hold 75 cattle along with a horse barn for 15 horses and a dairy barn for 45 dairy cattle. A flock of 110 common ewes was purchased with four purebred rams representing the breeds of Southdown, Shropshire, Hampshire, and Oxford. In 1924, two herds of Jersey cattle were purchased for comparing Island Bred and native stock. It was noted that in that same year, a 12-acre field of kudzu was established as a promising pasture and soil improvement crop.

C. M. Hume served as acting superintendent of this new station from 1918 until 1922 when L. R. Neel became the superintendent.

An adjacent farm of 129 acres was added to the station in 1936 to accommodate a special Bankhead-Jones project on jack-stock. Another tract of 23 acres was added to the jack-stock farm in 1940.

TOBACCO EXPERIMENT STATION

In 1928, Clyde B. Austin, a well-known tobacco buyer, was joined by a number of buyers and growers in requesting the establishment of a Tobacco Station in East Tennessee at Greeneville. Burley tobacco had been grown in East Tennessee since about 1900, and the array of problems facing the successful grower included proper selection of soil, fertilizer use, variety selection, insect and disease control, harvesting methods, and curing and marketing techniques. Failure to give attention to this complete bundle of practices resulted in a low yield of tobacco and/or a poor quality product.

The legislature responded in 1930-31 by

appropriating \$25,000 for the purchase of land and improvements for the establishment of a Tobacco Station in cooperation with the Office of Tobacco and Plant Nutrition Investigations, Bureau of Plant Industry, U. S. Department of Agriculture. In the fall of 1931, a tract of 164 acres of land with buildings was purchased from F. C. Wilhoit for this station by a committee representing both the Tennessee Agricultural Experiment Station and the U. S. Department of Agriculture. It was thought that this station would be able to help solve problems relating to tobacco production and marketing not only in Tennessee but in adjoining states where burley was grown.²⁷

F. S. Chance, formerly on the agronomy staff of the Agriculture Extension Service, was appointed superintendent of the new station in 1932 as a joint employee of the Tennessee Agricultural Experiment Station and the U. S. Department of Agriculture. Over the next eight years, two additional tracts of land were purchased for grazing and pasture research, bringing the size of the station to 380 acres.

OUTLYING WORK

Leased land continued to be used to conduct research in Middle Tennessee near Murfreesboro and Clarksville and on the Cumberland Plateau near Crossville. Variety trials, fertilizer and lime requirements of crops, time of application of nitrate of soda on corn and cotton, dates and rates of planting small grains, and the value of new legumes, such as Ladino white clover, lotus, and sweet clover were evaluated.

Plot experiments and field demonstrations with reference to tobacco culture had been conducted at Clarksville since 1913. The results of this research so impressed Hunter M. Meriwether, a prominent citizen of Clarksville, that in the fall of 1926, he deeded his homeplace, "Mericourt" to

²⁷*Forty-Fourth Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1931, (Knoxville, Tennessee, 1932).*

the University for such purposes. Mericourt was a farm of 48 acres with about 30 acres of cultivated land. This farm played an important role in the research program for a number of years.

ACCOMPLISHMENTS

An umbrella of protection against disastrous disruptions in agricultural production, not related to weather conditions, began to develop during this 1916-1940 period. The number of young scientists graduating through land-grant colleges and universities was increasing and some specialization within disciplines was noted. The beginning of annual appropriations for agricultural research by the state legislature associated with higher levels of federal funding improved the base for staffing and adding branch stations and outlying locations to service the needs within Tennessee. A back-log of research data was being accumulated to solve both short- and long-term problems. For example, several years before the boll weevil migrated into the state and attacked the cotton crop, research was available on methods for minimizing its damage. In a similar manner, long-term research was underway on such problems as how to change the germplasm of plants to produce better varieties or how to alter the genetic composition of animals for higher productivity. Often these results become operational 20 or 30 years after research has been started. A few examples of research follow.

FLUOSILICATES AND INSECT CONTROL

Simon Marcovitch, who joined the staff in 1919 as an assistant entomologist, soon gained a national reputation for his development and use of fluosilicates as insecticides. Farmers and other consumers were seeking control of insects attacking crops and livestock without rendering these food products unsafe for human consumption. Fluosilicates were found to be effective against such insects as the cucumber beetle, Mexican bean beetle, flea beetle, cut worm, hornworm, roach,

and chicken lice. Marcovitch's studies indicated that the fluosilicates acted as both a contact and stomach poison for insects, and they were not as toxic as many of the arsenic compounds in use at that time. For example, he reported that in higher animals arsenicals were nine times more toxic than sodium fluosilicates, and 30 times more toxic than sodium fluoride.²⁸ During the 1930s large quantities of lead arsenate were used on tobacco to control hornworms and flea beetles and this sounded an alarm concerning the content of this compound in chewing tobacco and snuff. Marcovitch discovered that cryolite, another fluosilicate, was an effective and nonpoisonous insecticide for tobacco. Another advantage of the fluosilicates was their low cost, since they were a by-product in the manufacture of acid phosphate.²⁹

While studying insects and their control, Marcovitch made another important discovery in 1924. He found that day length affects the determination of sex and migration in aphids—a phenomenon known as photoperiodism.

CORN HYBRID PRODUCTION

For a number of years the Station conducted cooperative work with various Divisions of the U. S. Department of Agriculture. In 1922 an agreement was reached between the Station and the Division of Cereals, whereby a member of their scientific staff, L. S. Mayer, was appointed to the Station to have charge of corn breeding experiments. Seven years later inbreeding using self-pollination was being used with 10 commercial varieties including *Neal Paymaster*, *Delta Prolific*, *Jarvis Golden Prolific*, and *Tennessee Red Cob*. The number of strains included in inbred lines was more than 700, with one half of the number

²⁸Thirty-Eighth Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1925, (Knoxville, Tennessee, 1926).

²⁹Forty-Ninth Annual Report of the Agricultural Experiment Station of The University of Tennessee for 1936, (Knoxville, Tennessee, 1937).

confined to one variety, Neal Paymaster. By 1938 the production of double-cross hybrids of Neal Paymaster inbred lines had increased as a result of approximately 80 farmers across the state planting quarter-acre plots, which were inspected and passed by the Tennessee Crop Improvement Association. About 400 bushels of hybrid seed corn were obtained. The various recombinations permitted the making of 16 different hybrids, which were designated serially *Tennessee Hybrid No. 1* to *16*. These were tested at the branch stations and outlying locations in following years. In addition to his own work in developing hybrid corn, Mayer tested many hybrids developed in other states and reported on their adaptability to Tennessee conditions.

CROP RESPONSE TO COMMERCIAL FERTILIZATION

Agronomists and horticulturalists were conducting research on yield responses from commercial fertilizers used on principal row crops such as corn, cotton, tobacco, and vegetables, as well as some forage crops like alfalfa. Usually one or two rates of fertilization were used and the yield response at the higher rate was still increasing sharply. For example, in research on sweet potatoes, where no fertilizer was used on a check plot, the yield was 100 bushels per acre, while on a comparable plot, fertilized at the rate of 100 pounds of nitrate of soda, the yield was 200 bushels per acre. No other level of fertilization was used to establish the complete response curve of this crop. Nevertheless, it is assumed that the farmers who needed to produce 200 bushels of sweet potatoes for home consumption and/or sale could immediately visualize that if they had the money to purchase 100 pounds of nitrate of soda, they could produce this crop on one acre and not have to prepare the seed bed, plant and cultivate the second acre in potatoes, and could actually use the second acre for some other crop. This rationale concerning the use of commercial fertilizers seems appropriate to partially explain the rapid expansion in agricultural productivity after World War II.

DIET RESEARCH ON FAMILIES ON THE CUMBERLAND PLATEAU

The first project approved in Tennessee under the Bankhead-Jones Act was a study of the feasibility of producing almost 100 percent of a family food supply on small subsistence farms on the Cumberland Homesteads, a federal resettlement undertaking near Crossville and then relating the diets of these families to their general health. Due to the limited number of people involved, the study of the diet-health phase of the project was extended to 160 families representing 800 people on the plateau. Detailed supervised weekly records were obtained on food consumption of participants, and these data were compared with their general health standards as measured through complete physical examinations.

In general, the results of these physical examinations revealed that blood calcium and phosphorus, blood protein, vitamin C, and bone density were within a normal range. Since practically all plant and animal life on the plateau registered extreme symptoms of mineral deficiency, the above results with human beings, living largely on local products, was surprising. It was surmised that the chief source of protein and phosphorus came from the consumption of dried beans, which often reached 100 pounds annually per adult equivalent, and this offset the potential mineral deficiency. The preliminary data on bone density later led to more detailed studies on the importance of bone density, especially in older people.

SWINE NUTRITION

Corn has been the major ingredient in swine rations for generations. In producing swine for home consumption, farmers often used farm by-products or table scraps to supplement the corn in the ration, and this often resulted in poor diets and inefficient gains in swine. In a similar manner, commercial growers were continuously

seeking cheaper and better ingredients for swine rations.

Research in the 1920s on the main station in Knoxville highlighted the importance of adding proper supplements to corn in swine rations. Pigs that were litter mates of the same age and weight were divided into three groups, and each group was fed a different ration for 120 days. The results obtained were as follows:

	Group of Pigs		
	1	2	3
<i>Feed required per 100 lbs. gain</i>			
Corn (lbs)	1,494	366	333
Tankage (lbs)	-	18.7	18.9
Mineral Mixture (lbs)	-	-	.69
Pasture	-	-	at will
<i>Average gain per head (lbs)</i>	29	226	233
<i>Average cost per 100 lbs. gain</i>	\$30.64	\$8.25	\$7.43

The ingredients in the ration were valued as follows: corn, \$1.15 per bushel; tankage, \$50 per ton; and mineral mixture, one cent per pound. No value was assigned to pasture cost which represented a slight oversight. The contrast is obvious in comparing the results of the ration of the first group with the other two groups.

INDUSTRIALIZATION IN RURAL AREAS

Since this country was first settled, many studies have been conducted tracing the development of trading posts, cottage industries, manufacturing plants, and retail outlets, but little attention was given before 1925 to the impact of these developments upon the welfare of farmers and rural people within the area of these activities. One of the first studies along this line in this country was initiated by C. E. Allred in 1925 under a project entitled "effect of the development of manufacturing in an agricultural region on rural welfare." Four areas where manufacturing had developed were paired in the study with four adjoining areas with little manufacturing, and data were collected and analyzed. For example, Kingsport in Sullivan County, where extensive manufacturing had occurred, was

paired with Rogersville in Hawkins County. It was found that where industrial development had occurred it was helpful to the rural people by broadening the tax base within a county, resulting in better services such as roads, schools, and medical care. In many instances, it resulted in better markets, especially for fresh farm produce. On the other hand, industrialization often resulted in the rural people having fewer voices in political decision-making, including setting hired wage rates. The documentation of these experiences in industrialization helped other rural communities evaluate the impact of such changes in their area.

COMMUNICATIONS

Three outlets were used to disseminate information on research accomplishments. These were publications, special events, and radio programs.

Publications continued to be the primary media used by researchers to document their findings and discoveries. However, these publications and research results were disseminated in a different manner than previously used. With the establishment of the Agricultural Extension Service in 1914, and the location of County Farm and Home Agents in most counties across Tennessee, agents had the primary functions of working directly with farm families in educational programs. Legislation providing for the creation of vocational agriculture and home economics training in high schools also enhanced the use of research information. In addition, in the midst of the depression in the 1930s, many institutions and agencies were either modified or established to work on special problems of farmers. These included the Farm Credit System, the Farm Security Administration, the Soil Conservation Service, and the Agricultural Adjustment Administration. As a result of these changes, most of the publications of the Agricultural Experiment Station, including bulletins, circulars, and monographs, were

“Attendance of 10,000 or more people per year was not unusual at each of the [field day] sites of Knoxville, Columbia, and Jackson in the 1930s.”

mailed directly to the leaders of these agricultural agencies for their use in working with farm families, rather than mailing them directly to farmers. Occasionally the researchers would report their results through trade magazines. One other type of publication used to report research results was the professional journals, which were used to communicate scientific findings within specialties among scientists. In 1940, a total of 43 professional journals were reported available through the Agricultural Library of The University of Tennessee.

Special events, such as farmers' conventions or so-called "field days" held at the main station in Knoxville, or on branch stations or sites of outlying work, were very popular with farmers. Here, the farmer could actually see different varieties of crops, such as corn, cotton, soybeans, vegetables, and alfalfa, growing in the field and observe the response of these crops to fertilizer, or treatment for diseases and insect damage. Livestock experiments on breeds, rations, and growth rates were conducted and explained by researchers. New farm equipment was often demonstrated on these occasions. Since automobiles were becoming commonplace, farmers often traveled 100 miles or more to such events. Attendance of 10,000 or more people per year was not unusual at each of the sites of Knoxville, Columbia, and Jackson in the 1930s.

The radio provided a medium for carrying research stories, even though fewer than one third of farm families owned radios. They were especially useful when epidemics of disease or insect damage threatened either crops or animals. Often the scientist who discovered ways of alleviating losses could through either tapes or direct broadcasting communicate methods for obtaining suitable control.

LEADERSHIP AND PERSONNEL

H. A. Morgan served as Director of the station until 1919 when he assumed the dual role as Director of the Station and President of the University until 1923. C. A. Mooers became vice director of the Station in 1919 and Director in 1923. He was still serving as the Director in 1940.

The professional staff increased from 15 in 1915 to 74 in 1940; however, some of the 74 were serving in the dual role of research and teaching. It may be recalled that in 1920 practically all the staff was engaged in research full time, and it is not known when that policy was changed. The number of professional staff members by departments in 1940 was as follows: agronomy, 15; plant pathology, 10; chemistry, 8; animal husbandry, 7; economics and sociology, 7; engineering, 6; physics, 6; home economics, 5; horticulture, 5; bacteriology, 2; entomology, 2; and markets, 1.

Among those not previously identified who played an important role in research during this period were M. Jacob, a veterinarian and leader in animal husbandry; W. H. MacIntire in chemistry; M. A. Sharp in engineering; Florence L. MacLeod in home economics; K. L. Hertel in physics; and C. D. Sherbakoff in plant pathology.

SCIENCE AND TECHNOLOGY IN AGRICULTURE (1941-1965)

BACKGROUND

The years 1941 through 1965 are generally considered to represent the greatest development and the largest number of breakthroughs in the area of science and technology ever experienced in agriculture. The period can be divided into two segments—namely, the base, which consisted of the war years, followed by two decades of unprecedented growth and change.

When war broke out in Europe in 1939, the United States and most of the countries in the world had been involved in a severe depression for 10 years. The country had experienced high unemployment and underemployment, low consumer purchasing power, and major business failures in all sectors of the economy, including agriculture.

The stimulus to change this situation came quickly in three thrusts, two of which were generated by the governments of foreign countries, and a third that was generated internally by our own government. The first thrust came from Great Britain after Germany had overrun France in 1940 and left England isolated; the second thrust came from Russia after the attack in early 1941 by Germany; and the third thrust came internally after the attack by Japan at Pearl Harbor in December, 1941. Suddenly, within a two-year period, U. S. governmental policies were directed toward all-

out production of war materials, such as guns, munitions, ships and airplanes, along with food and fiber for our own needs, and those of our allies. Former labor surpluses at home became labor shortages as men and women moved into the armed forces and thousands of occupations supporting the war effort. Restrictions and rationing of goods and services for the civilian population were a common occurrence even though the total supply of food was adequate. For example, items like new houses, appliances, furniture, automobiles, tires, fuel, and machinery were scarce. With increased income and reduced opportunities for spending, families were able to reduce their indebtedness and/or increase their monetary gains or savings.

The impact of these war-time decisions and events was felt immediately in American agriculture. Thousands of family members who were laid-off from industrial employment during the depression and returned to farms as tenants or sharecroppers, now had opportunities to return to industry. Many farmers or members of their families enhanced their financial position by combining part-time farming with jobs in factories. The farm labor force was further reduced by the rapid expansion in the armed forces.

During and immediately after the war, commercial farmers were provided incentives for all-out production of food and fiber. First, the

stockpiles of products such as wheat, corn, cotton, and sugar, which had depressed prices more than a decade, were diminished to meet national and international demands. Secondly, government price supports of these and many other products were raised to encourage profitability throughout the war years and two years beyond so farmers could concentrate on increasing farm output. Thus, for a period of about six years, through good management, farmers were able to have reasonable profits for reducing indebtedness and accumulating capital. However, most of them were unable to further mechanize their operations because of rationing and the allocation of resources toward the military. Horses and mules remained the principal source of power, but this was to change rapidly with the end of the war and the conversion of industries toward peace time needs.

Having reviewed the government's lack of policies guiding the transition from war to peace after World War I and the ensuing depression that resulted, Congress and the Executive Branch of government took several steps to avoid a repetition of this economic description after World War II. First, a full employment policy was developed with a goal of providing 60 million jobs for the labor force. Unemployment compensation was available for those losing jobs in the conversion of factories from military to civilian production. Second, a broad range of legislation was enacted, providing retraining and other educational benefits for veterans returning to peace time endeavors.

The ending of the war left the nation facing conditions almost as ominous as during the conflict. Both consumers and businesses had postponed purchases of many goods and services for more than five years. The infrastructure within counties, states, and the nation needed changes, for example, in roads, airports, and schools. Too, the major task of providing food and capital for restructuring Germany and Japan, as well as many allied nations in Europe was assumed by the United States. The challenge was met without any major disruption or depression after the war.

Developments in agriculture played an important role in this agenda.

The increase in agricultural output per unit of labor in this country between 1940 and 1965 was greater than in all previously recorded history. Mechanization and the application of new technologies resulting from research were principal sources of increased labor efficiency. During this period, the total population of the United States increased from 132 million people to 194 million, while the farm population decreased from 30.5 million to 12.4 million. Job opportunities in old and new industries allowed workers to leave farms, while changes in agriculture resulted in maintaining and increasing food and fiber production. The investment and cash operating expenses on farms increased many fold, whether they represented capital expenditures like storage facilities, tractors, plows, cultivators, sprayers, and combines or operating costs such as fuel, seed, fertilizer, or chemicals. To contrast the change in cost, the investment in a 3-bottom plow alone in 1953 would have paid the cash operating expenses on an average U. S. farm in 1900 for three years.

Dramatic changes in resource use were also taking place in Tennessee. For example, workstock was the main source of power on farms in 1940, with the number of mules, horses, and colts totalling 451,000. Within 14 years, that number had declined to 210,000. Poultry and hogs were produced on most farms in 1940, but by 1965 these enterprises became specialties with large numbers on fewer farms. Soybeans became a major crop during this period, reaching 560,000 acres grown in 1965. Some other changes in resources and their use are shown in Table 1.

RESEARCH ROLE ENHANCED

Near the end of the war, agricultural leaders and legislators focused their attention on research as a means of providing greater stability to the agricultural industry during the post-war period. Three legislative acts that enhanced agricultural

Table 1. Comparison of Selected Resources in Tennessee in 1940 with 1965

TENNESSEE RESOURCES	1940	1965
	CENSUS PERIOD NUMBER	CENSUS PERIOD NUMBER
Total Population	2,915,800	3,567,100
Farm Population	1,272,000	452,000
Farms	247,617	133,446
Tenants	99,735	30,212
Tractors	10,967	108,319
Cattle/Calves	1,109,000	2,136,000
Corn Acreage	2,583,000	910,200
Cotton Acreage	679,000	497,000
Cotton Bales/Acre	436,100	641,300
Tobacco Acreage	118,200	68,600
Tobacco Pounds/Acre	1,020	1,885

Source: U. S. Census of Agriculture

research, over the next two decades at both the federal and state levels, were passed.³⁰

RESEARCH AND MARKETING ACT OF 1946

In 1946, Congressman John Flannagan of Virginia proposed legislation to expand the capacity of state experiment stations by increasing appropriations with a portion of the funds reserved for research on new markets and new uses of products. About the same time, Congressman Clifford R. Hope of Kansas proposed providing additional funds to USDA to promote research in marketing and distribution. These proposals were combined into a three-part package known as the Research and Marketing Act of 1946, representing an amendment to the Bankhead-Jones Act. While the stated intent of the Purnell Act had been to improve rural life, the new act indicated that a sound and prosperous agricultural and rural life was indispensable to the maintenance of maximum employment and national prosperity.

One part of the act authorized \$2.5 million in new funds in 1947, an equal amount in 1948 and "such additional funds as Congress deems neces-

sary" for future years. The funds would be allocated to the states as follows: 20 percent divided equally among them; 26 percent based on their relative rural population compared with the country; 26 percent based on their relative farm population compared with the country; 25 percent reserved for "Regional Research" undertaken by two or more states having regional significance; and 3 percent to the Office of Experiment Stations to administer the funds. Federal funds were to be matched by the states, and one dollar out of five was to be earmarked for "agricultural marketing projects" approved by the Department of Agriculture.

The act also provided funds for the USDA to establish laboratories to evaluate new and extended uses of agricultural products, and called for a national advisory committee to assist the USDA in developing a research agenda.

³⁰Norwood Allen Kerr, *The Legacy: A Centennial History of the State Agricultural Experiment Stations 1887-1987*, (Columbia, Missouri, 1987).

CONSOLIDATED FUNDING LEGISLATION

The next federal legislation affecting agricultural research occurred in 1955. This legislation provided for a consolidation of the previous provisions of the Hatch, Adams, Purnell, and Bankhead-Jones (including provisions of the Research and Marketing Act of 1946) into a new Hatch Act. The funds would be distributed to the states in accordance with the 1946 act. Each state was required to match all federal funds appropriated under the act excluding an initial \$90,000 and the money allocated for regional projects.

McINTIRE-STENNIS FORESTRY RESEARCH ACT OF 1962

Prior to the passage of the McIntire-Stennis Forestry Research Act of 1962, practically all research in forestry had been conducted by the Forest Service of the U. S. Department of Agriculture. By the mid-1930s the Forest Service had established 12 forestry experiment stations across the country.

Since the formula for distributing federal funds to state agricultural experiment stations was heavily weighted by farm and rural population, those states with considerable woodland and fewer people were limited in funds for forestry research. After over two decades of debate on how to remedy this situation, Congress passed the McIntire-Stennis Act in 1962, which took into consideration the nation's commercial forest land and value of timber cut in distributing money to the states. States were required to match federal funds on a dollar for dollar basis. An advisory board was established to determine detailed allocation procedures.

The first funds, amounting to \$1 million, were appropriated in 1964, and they were increased by a similar amount in 1965. The advisory committee allocated \$10,000 as a base to each state. The balance of the money was distributed as follows: 40 percent according to the state's proportion of the nation's total commercial forest

land; 40 percent according to the value of its timber cut annually; and 20 percent according to its contribution of state, gift, or grant dollars for forestry research. Research was authorized in such areas as reforestation, wood utilization, management, outdoor recreation, and wildlife habitat.

ACTION AT HEADQUARTERS

The administrators of the Tennessee Agricultural Experiment Station were confronted with as many challenges and problems during the period 1941 through 1965 as ever existed in agriculture. The period could be characterized by one word, "Change." With mechanization of the farms, farmers no longer produced most of the "inputs" needed in their operation, such as the corn and hay for the workstock that provided the power. Instead, tractors replaced workstock as a source of power and tractors, along with fuel, became a cash outlay. To be successful, farmers had to view their operations not only as a way of life, but increasingly as a complex business.

Agricultural businesses were formed or expanded to provide the farmers with inputs, or to serve as middlemen in moving farm production from the farm gate to facilities for storage, processing, and distribution to wholesalers, retailers, or consumers. As noted earlier, the consolidated Hatch Act and the McIntire-Stennis Act outlined new responsibilities for experiment stations relating to marketing of agricultural products and pursuing research at the regional level. Thus, the goals of state agricultural experiment stations were expanded from primarily farm production issues to the broader aspects of agriculture as well, involving the agricultural business sector, the rural setting, and quality considerations relating to foods.

Administrative Changes

The administration of the Tennessee Agricultural Experiment Station followed three stages during this period. Dr. C. A. Mooers, who became

director in 1923, continued in this role throughout World War II and retired in 1946 after 53 years of service with The University of Tennessee. Director Mooers, by his own choice, served both as a scientist and administrator. This was possible since the staff was small and the administrative paperwork was low. He was recognized nationally for his identification of soils of Tennessee and their physical and chemical properties. In 1943, F. S. Chance, who had served as Extension agronomist before becoming superintendent of the Tobacco Station at Greeneville, was appointed assistant director of the station and moved to Knoxville. During the war the faculty in the experiment station declined from 74 in 1941 to 60 in 1945. Despite this reduction in workforce, research results enhanced food and fiber production in the state.

The second stage in administration of the station spanned the 10 years 1946 through 1956, with F. S. Chance serving as vice director. Upon the retirement of Dr. Mooers, Dr. C. E. Brehm, who had been Dean of the College of Agriculture since 1943, became the first person appointed to coordinate all units in agriculture as the Dean of the College of Agriculture and Director of both the Agricultural Experiment Station and the Agricultural Extension Service. Dr. J. H. McLeod became his successor in this capacity in 1948 when Dr. Brehm became President of The University of Tennessee. F. S. Chance continued in a leadership role as vice director of the Station.

John A. Ewing, who was serving as superintendent of the Middle Tennessee Experiment Station at Columbia, was appointed assistant director of the Tennessee Agricultural Experiment Station in 1950. Shortly thereafter, he took leave to pursue graduate studies at Harvard University. Upon his return, Ewing assumed a major role in the expansion of the research program with emphasis on faculty recruitment, improvement of facilities at headquarters, strengthening the branch station activities and program planning, especially involving the new concept of regional research. He was delegated responsibility for developing two unique programs in the Station, which will be

discussed in detail later. One involved coordination of the resources of the Hobart Ames Foundation, including the Ames Plantation, into a meaningful field research laboratory in West Tennessee; the second dealt with the strengthening of a cooperative program with the Atomic Energy Commission at Oak Ridge, Tennessee, initially known as the Atomic Radiation Program. The latter endeavor brought national and international attention to the station because of the uncertainty and concerns associated with atomic radiation upon the animal and plant food chain, as well as upon human lives.

Dr. Eric Winters, who became head of the Department of Agronomy in 1946, joined the team as associate director of the Station in 1955.

The third stage in administration during this period covered the years 1957 through 1965. Vice director F. S. Chance retired in December, 1956, and Dean and Director J. H. McLeod retired in February, 1957. Dr. Webster Pendergrass was appointed Dean of Agriculture, a new title, and John A. Ewing was appointed Director of the Agricultural Experiment Station in 1957. The professional staff in the station more than doubled between 1945 and 1965, with most of the members holding doctoral degrees by the end of the period.

The combined task of program planning and execution, along with budget preparation represented a challenge to the director and his staff. Since federal legislation required state matching of research funds, support was sought throughout the state for this endeavor, especially by farmers, farm organizations, and agricultural businesses. State budgets for agricultural research were prepared by the director and submitted through the Dean of Agriculture and the President of the University to the governor and the state legislature. Hearings were held by the agricultural committee of the state legislature with the director and his staff on budget requests. During this period state funds were appropriated and "earmarked" for the Tennessee Agricultural Experiment Station. In addition, budget requests were submitted through the Cooperative State Research Service, for federal appropriations.

Table 2. Growth in Federal and State Appropriations for the Tennessee Agricultural Experiment Station 1940 through 1965

Year	Appropriations		
	Federal	State	Total
1940	\$164,800	\$74,800	\$239,600
1945	167,100	184,300	351,400
1950	281,800	565,900	847,700
1955	458,900	809,600	1,268,500
1960	864,600	1,118,700	1,983,300
1965	1,276,500	2,012,700	3,289,200

Increased Funding and Regional Research

The growth in state and federal support for agricultural research, excluding grants, capital improvements for major buildings, laboratories, and branch stations in Tennessee, are shown in Table 2.

The passage of the Research and Marketing Act of 1946 added a new dimension to the duties of the Director of Agricultural Experiment Station relating to regional research. The country was divided into four regions consisting of the South, North East, North Central, and West. Tennessee was part of the Southern region along with 12 other states reaching from Virginia to Texas and including Puerto Rico. Topics proposed for regional research could be initiated by a professional staff member, department head, or a director.

An example of an early topic that led to one of the first southern regional projects was beef cattle breeding. Since beef cattle were an important enterprise in all southern states, one or more scientists in each state was engaged in beef cattle breeding research. Once the topic was identified and approved for a potential project by the Southern Directors Association, each director then designated a scientist from his staff who had an interest in working on developing the project

proposal. One director was selected to serve as an administrative advisor and to facilitate bringing the scientists together to develop a project. A counterpart at the federal level, representing the Cooperative State Research Service, USDA, was appointed to participate in the endeavor. Important components of such a project included: a review of literature, justification, objective(s), procedures (including resources provided and commitment by each participating state), and the duration of the project, which usually ranged from three to five years. Once the project was developed, other states, both in the region and outside the region, were given an opportunity to commit the necessary resources and to participate.

Professional development was enhanced by bringing together a number of scientists to implement a regional project, and the total resource base devoted to a given problem was increased appreciably. For example, in the case previously mentioned, if individual states could only supply 100 beef cows in a breeding project, but 10 states pooling their cattle could provide 1,000 head for a regional project, the results obtained should be more tenable and reduce duplication of effort. Providing proper coordination and individual recognition for contributions for regional research was more difficult than on state projects. Despite higher administrative costs for regional research, it

was viewed favorably, and by 1965 the Tennessee Station was participating in 10 regional projects.

Departmental Changes

Department heads provided a vital link between individual staff members and the Experiment Station director. Their functions included staff recruitment, budget preparation, and coordination in the development of research priorities, projects, and reports supporting the research program. Their responsibilities grew with the expansion of the research staff representing more subdisciplines within many subject matter areas after World War II.

Numerous changes were made in the departmental structure during this period. In 1947, the Department of Animal Husbandry was divided into three departments consisting of animal husbandry, dairy, and poultry. In 1953 the name of the Department of Animal Husbandry was changed to Department of Animal Husbandry and Veterinary Science. Considerable shifting of personnel occurred in 1959 with the creation of the Department of Food Technology and the discontinuation of the chemistry department. Even though two to three staff members were conducting research in forestry through this period, the Department of Forestry was not officially organized until 1964. During this same year, personnel formerly listed in the Departments of Entomology and Plant Pathology were brought together in a new Department of Agricultural Biology.

Home economics was listed as a separate unit through 1961 with Florence L. MacLeod serving as assistant director for Home Economics Research. In 1962 research was sponsored by the Agricultural Experiment Station in five departments in the College of Home Economics as follows: Child Development and Family Relations; Foods; Home Management; Equipment and Family Economics; Nutrition; and Textiles and Clothing.

The following list includes the name of the

departments and the department heads serving during the period 1941 through 1965:

AGRONOMY

C. A. Mooers (1941-45)
Eric Winters (1946-54)
L. N. Skold (1955-60)
L. F. Seatz (1961-XX)*

ANIMAL HUSBANDRY

M. Jacob (1941-42)
J. C. Miller (1943-46)
C. S. Hobbs (1947-XX)*

DAIRY

C. E. Wylie (1947-59)
J. T. Miles (1960-XX)*

POULTRY

O. E. Goff (1947-XX)*

AGR ECON & RURAL SOC.

C. E. Allred (1941-49)
E. J. Long (1950-55)
D. M. Thorpe, Acting (1956-57)
T.J. Whatley (1958-XX)*

HORTICULTURE

B. D. Drain (1941-46)
N. D. Peacock (1947-49)
B. S. Pickett (1950-XX)*

ENTOMOLOGY

S. Marcovitch (1941-58)

PLANT PATHOLOGY

C. D. Sherbakoff (1941-49)
J. O. Andes (1950-64)

CHEMISTRY

W. H. MacIntire (1941-54)
G. A. Schuey (1955-58)

* XX indicate period continuing beyond 1965.

PHYSICS

K. L. Hertel (1941-XX)*

BOTANY

N. I. Hancock (1947-1962)

FOOD TECHNOLOGY

M. J. Johnston (1957-XX)*

AGR ENGINEERING

M. A. Sharp (1941-1955)

C. W. Brown, Acting (1956)

C. W. Bockhop (1957-1959)

J. H. Anderson (1960)

J. J. McDow (1962-XX)*

FORESTRY

J. W. Barrett (1964-XX)*

AGR BIOLOGY

S. E. Bennett (19XX)*

INFORMATION

A. J. Sims (1943-1959)

R. L. Hamilton (1960-XX)*

HOME ECONOMICS

Florence L. MacLeod (1947-1961)

(Asst. Dir. for Home Ec. Research)

CHILD DEVELOPMENT AND FAMILY RELATIONS

Ruth A. Highberger (1962-XX)*

FOODS

Bernadine Myers (1962-1964)

Grayce E. Goertz** (19XX)

HOME MANAGEMENT, EQUIPMENT & FAMILY ECONOMICS

Myra L. Bishop (1962-XX)*

NUTRITION

Mary Rose Gram (1964-XX)*

TEXTILES & CLOTHING

Anna Jean Treece(1962-XX)*

Between 1945 and 1965 the number of full-time equivalent research scientists doubled, increasing from about 50 to 100, excluding those financed by grants or contracts. This resulted in a tremendous demand for office space for the new scientists and their supporting staff, as well as laboratories embracing modern technologies. Most professional workers were joint employees of the College of Agriculture's Resident Instruction section and the Agricultural Experiment Station. A fairly typical assignment was 25 percent teaching and 75 percent research. Thus, 100 of these employees would represent 25 full-time equivalent teachers and 75 full-time equivalent researchers. In 1965, the 100 full-time equivalents in research actually involved 136 different scientists.

Facilities Added

The severe shortage of facilities between 1945 and 1948 was partially overcome by moving surplus army barracks on campus and converting them into office and laboratory spaces. This remedy for the space problem was not unique to Tennessee but was widespread on college and university campuses throughout the country at that time.

In retrospect, the greatest increase in office space and research laboratories in the history of the College of Agriculture or the Agricultural Experiment Station occurred between 1949 and 1959. The administration was successful in obtaining state funding for four new buildings, which practically doubled the facilities on the agricultural campus.

The first major facility constructed was McCord Hall, named after former Governor Jim McCord and completed in 1949. It was known as the dairy building and initially housed personnel from the Departments of Dairy and Poultry, as well

* XX indicate period continuing beyond 1965.

**Name of Department changed to Food Science and Institutional Management.

as some staff members in animal husbandry and food technology. In 1950 the Dairy Products Building was completed. This was followed in 1951 by the completion of a new facility for personnel trained in Food Technology. This building was later named McLeod Hall in honor of former Dean and Director J. H. McLeod of the College of Agriculture. The last major facility completed during this period was Brehm Hall, completed in 1959 and occupied by personnel in the Department of Animal Husbandry. This building was named after C. E. Brehm, former Dean and Director of the College of Agriculture and President of The University of Tennessee. This building program on the agricultural campus represented a part of a massive planning program underway throughout The University of Tennessee.

Role of Graduate Research Students

Near the end of World War II, what was commonly called the "G. I. Bill" was enacted by Congress and approved by the Executive Branch to provide an incentive for veterans to upgrade their civilian job skills upon release from military service. The response of veterans to this opportunity, especially at the undergraduate and graduate level in colleges and universities, was overwhelming. These students were provided a stipend (primarily for food and lodging) and coverage for books, fees, and tuition.

The immediate impact of this program was an increase in demand for teachers and for those students enrolled in graduate studies, a demand for researchers to provide guidance in supervision of theses and dissertations research. As indicated earlier, in most instances in agriculture, the teacher was also a joint employee of the Agricultural Experiment Station with on-going research projects. This provided an opportunity for students and faculty to work together on research projects of common interest and satisfy the needs of both parties. Many of these graduate students became teachers or researchers upon completion of their

degrees, and they fulfilled the need for additional staffing in these areas.

Before the time of the G. I. Bill, a limited number of graduate students had been funded through the Tennessee Agricultural Experiment Station using monies generated by gifts, grants, and contracts. Such students agreed to conduct research in areas of interest being funded, and the research became the basis of their theses or dissertations.

As graduate students used up their eligibility under the G. I. Bill, it became evident that, if the pool of scientific personnel needed in research and other fields in the future was to be met, the state experiment stations had to assume a greater role in their training. This led to the setting up of graduate research assistantships in the Tennessee Agricultural Experiment Station, which were funded through the use of federal and state sources. Under the assistantship, the student was provided an annual stipend and the Agricultural Experiment Station paid the student's fees and tuition. Graduate research assistantships were allotted to the various departments based on a number of factors, including the amount of total funds appropriated, size of the departmental faculty, graduate programs available, and job opportunities available to graduates. The total package of benefits for graduate research assistants was designed to make them competitive with other forms of financial aid available for graduate students.

Holders of graduate research assistantships were obligated to work on a funded research project for their theses or dissertations. They were encouraged to publish their research findings through bulletins, scientific journals, or other media sources. This served the dual role of expanding the scope of agricultural research while enhancing the student's competitive position with prospective employers. By 1965 more than 75 graduate research assistantships were financed annually through the Agricultural Experiment Station and this represented more than one half of the total students pursuing graduate degrees in agricultural programs.

Coordination through Work Plans

The increase in the number of research scientists and branch stations during this period created new problems in coordination of research and delineation of responsibilities of personnel. The research faculty was assigned to departments in Knoxville and more than 90 percent were located at headquarters, with the others located at branch stations. Both the department heads and the superintendents of branch stations were provided budgets to facilitate research. Through the combined efforts of the faculty, department heads, superintendents and administration, a document was developed known as the "Work Plan" for coordination of research.

For example, a scientist developed a five-year project to evaluate the effectiveness of two or more herbicides in controlling weeds and grasses in corn, cotton, and soybeans. As project leader, the scientist discussed the project with all superintendents who expressed an interest in conducting the experiments on corn and soybeans, while those located in the cotton growing area agreed to include cotton. The project leader initiated one or more Work Plans with each of the participating superintendents indicating what the station would provide, such as land, labor, and equipment for planting and growing the crop, herbicides to be used and quantity used, observations to be made, and data collected on the experiments. The project leader's inputs in designing the experiment, observing the experiments, and analyzing the data would be specified. Each Work Plan was signed by the project leader, superintendent, department head, and a representative of the director's office. Copies were distributed to each of the parties. Under this procedure, if problems developed in conducting an experiment, which were very rarely, the limitation could be identified. Project leaders were encouraged to prepare annual preliminary reports so superintendents and others could see comparisons of results of experiments across the state.

The Work Plans provided an effective tool for station superintendents to measure how fully

their resources, such as land, labor, and livestock, were utilized in research. In general, there had to be some rationing of resources rather than an underutilization.

BRANCH STATIONS AND OUTLYING WORK

The growth in research programs at headquarters during the period 1941 through 1965 was matched by an increase of research field laboratories across the state known as branch stations and field stations. In retrospect, it seemed that influential groups within the different physiographic or types of farming areas of the state believed that having one of these units within easy traveling distance of users of agricultural research results would speed up mechanization on farms and the adoption of new technologies. A good argument can be made that this occurred. Since the field stations mentioned during these years were later changed in name to branch stations, the following discussion treats all of these units as branch stations.

West Tennessee Experiment Station

The West Tennessee Experiment Station, established in 1907 and consisting of 175 acres, was viewed by many people in West Tennessee as too small to engage in the wide range of crop and livestock research needed in the area. Fortunately, in 1941 the owners of a 415-acre tract adjoining the station offered to sell their land to the West Tennessee Experiment Station and accept future crop receipts from the land as payment. The University of Tennessee Board of Trustees, upon the recommendation of its Agricultural Committee, approved this transaction and the land was purchased in January 1942. The tract included about 150 acres of South Fork, Forked Deer River bottom land, typical of many soils in west Tennessee. The additional land purchased extended the station's boundary to the Forked Deer River on the west, the G. M. & O. Railroad on the north,

and some privately owned bottom timberland on the northwest. It was agreed that the new land would not be used for research until it was debt-free.³¹

In July 1943, the attendance at the Farmers' and Homemakers' Institute held at the station was the largest in 10 years. The main speaker was Governor Prentice Cooper. J. B. Tigrett, a Trustee of the University, in an introduction announced that the Governor had provided \$48,000 from the state's General Fund to pay the indebtedness that had been incurred for the enlargement of the station during the past three years. "Governor Cooper's response was an outstanding address."³² In 1944, a few additional acres were purchased bringing the total size to 653 acres.

Since cotton was the principal cash crop in West Tennessee, research was concentrated on this crop and related to variety testing, breeding, fertility, and insect and disease control. With the advent of mechanization, weed control, and mechanical harvesting, research on cotton offered possibilities of reducing labor needs to about one-fourth previous levels. Research on horticultural crops adapted to the area was intensified, and with the additional land resources, corn, small grains, soybeans, pasture, and forage crops received more attention. A large herd of Jersey cattle, as well as more swine for research, were added.

Middle Tennessee Experiment Station

The Middle Tennessee Experiment Station, which was established in 1917, continued to serve in evaluating and improving of forage crops adapted to the area that could support a viable livestock industry.

Due to the demand for land near Columbia in both the public and private sector, in 1950 the Board of Trustees of The University of Tennessee approved the purchase of a 593-acre farm from W. A. Haynes for \$295 per acre to replace the old Middle Tennessee Experiment Station. The new station was located seven miles north of Columbia on U. S. Highway 31. The purchased farm was in

a very productive stage with many good buildings, improved fencing, and adequate water, and soil types were considered more typical of the region than those on the old station. During the same year the Board of Trustees approved the sale of 45 acres from the old station to Maury County for \$75,000 for a hospital site.

During 1951, rapid progress was made in developing facilities and other resources needed in transferring research from the old to the new station. An office building with an auditorium, a superintendent's residence, a foreman's dwelling plus four other houses for employees, and a modern pit-type milking parlor were constructed. A herd of Holstein cattle was purchased, as well as 200 ewes for research, while plans were implemented to transfer the Jersey cattle to the West Tennessee Experiment Station. An additional 95 acres of the old station were sold to the Maury County Farmers Cooperative for \$58,000.

Two other land transfers occurred during this period. In 1954 a 285-acre tract known as the "Reclamation Farm" was obtained through Monsanto Chemical Company, and in 1959 an adjoining farm of 275 acres was added. These additions provided space for further expansion of the dairy herd as well as beef cattle research. To emphasize the importance of forages and grasses in the research program, the Second National Grassland Conference and Field Day was held on this Station in June 1965. This event was attended by more than 30,000 people from throughout Tennessee and the United States.

Four changes occurred in the leadership role of this station during this period. J. A. Ewing, who held a master's degree in agriculture with a major in agronomy and was an employee of the Agricultural Extension Service, was appointed assistant superintendent in 1944. When L. R. Neal retired

³¹*Fifty-Fourth Annual Report for 1940*, Agricultural Experiment Station, The University of Tennessee, (Knoxville, Tennessee, 1941).

³²*Fifty-Sixth Annual Report for 1942*, Agricultural Experiment Station, The University of Tennessee, (Knoxville, Tennessee, 1943).

as superintendent in 1946, Ewing took that position. In 1950 when Ewing became assistant director of the Tennessee Agricultural Experiment Station in Knoxville, E. J. Chapman, who held a master's degree in agriculture with a major in agronomy and who was serving as an assistant agronomist at the West Tennessee Station, became the superintendent. In 1964 when Chapman was appointed assistant dean of agriculture in Knoxville, J. W. High, Jr., who held a doctorate with a major in animal science, became the superintendent.

Tobacco Experiment Station

The Tobacco Experiment Station, which was established in 1932, was increased to 483 total acres in 1941 by the purchase of a tract of 103 acres. The land was paid for out of crop sales made from the new land. The burley tobacco breeding and disease program continued to receive major attention in the cooperative effort with the USDA. Through the research of many scientists, the station became known throughout the world for the development and release of outstanding burley tobacco varieties including *Burley 1*, *Burley 2*, *Burley 11A*, *Burley 11B*, *Burley 21*, *Burley 37*, *Burley 49*, and *Burley 64*. Many tobacco breeders state that the majority of the burley tobacco varieties in use today have some genetic material of *Burley 21* in their parentage.

In addition to the work on tobacco, other crop variety trials such as corn, soybeans, and forages, as well as crop rotation studies, were conducted here along with research on beef cattle.

In 1943 F. S. Chance was appointed assistant director of the Tennessee Agricultural Experiment Station in Knoxville. He was succeeded as superintendent of the Tobacco Experiment Station by J. Hugh Felts, who held a bachelor's degree with a major in agriculture from The University of Tennessee, and was County Agricultural Extension Agent in Greene County before assuming the new position.

Many improvements were made in roads, fencing, and buildings on the station especially

those relating to tobacco storage, curing, and preparation for marketing. The F. S. Chance Administration Building was completed in 1949, providing office and laboratory spaces.

A human interest story on the mechanization of burley tobacco was passed on by current personnel at the station. Felts, the superintendent in 1952, saw an advertisement for a mechanical transplanter used for vegetable crops. He invited the manufacturer, Holland Transplanter, Holland, Michigan, to have a representative bring a unit to the station for a demonstration with tobacco. Present at that demonstration was Ed Masoner, the local Ford tractor dealer. After seeing the machine set tobacco, Masoner asked if he could place an order. The representative asked him how many units Masoner needed. He replied, "Two hundred." The representative was amazed. He could only provide 20 units. The 20 units were sent and sold in a few days. That is how the mechanical tobacco setter was introduced to East Tennessee.

Highland Rim Experiment Station

In 1943 the General Assembly of the Tennessee Legislature responded to the urgent request of representatives of the 30,000 farmers on the Highland Rim for an Agricultural Experiment Station and appropriated \$15,000 to purchase land in Robertson County for this purpose. A 191-acre tract, located three miles southeast of Springfield on the Nashville-Springfield Highway, was purchased from Martin W. Simmons. Two former citizens of Robertson County, J. H. and J. W. Dean, provided a cash gift of \$5,000 to be used without restrictions on the new station.³³ The following year part of the Mericourt tract in Clarksville was sold, and the proceeds used to purchase an additional 136 acres adjoining the new station.³⁴ Three years later the rest of the

³³*Ibid.*

³⁴*Fifty-Seventh Annual Report for 1943*, Agricultural Experiment Station, The University of Tennessee, (Knoxville, Tennessee, 1944).

Mericourt tract was sold and 100 more acres were added.³⁵ Other tracts purchased in 1954, 1961, and 1964, brought the station's size to 600 acres.

The major cash crop of the Highland Rim was tobacco, consisting of dark fire cured, dark air cured, and burley. Tobacco research was concentrated on breeding, variety testing, fertilization, spacing, and disease control. In addition, general crops such as corn, sorghum, small grain, and forages were evaluated for adaptability in the region. A beef cattle herd was involved in research utilizing many of these crops.

Between 1944 and 1951, different scientists working at either Mericourt or the new station at Springfield, coordinated the activities with the administration in Knoxville. In 1952, Lawson Safley, an assistant agent, Agricultural Extension Service, who had a bachelor's degree in agriculture, was appointed superintendent of the Highland Rim Experiment Station.

Plateau Experiment Station

The following statement by Director Mooers introduced the 1942 Annual Report of the Tennessee Agricultural Experiment Station:

The Cumberland Plateau is a tableland 30 to 50 miles wide, extending across the State from Kentucky to Georgia and Alabama. It comprises about 4,500 square miles. The average elevation is not far from 1,800 feet, and nearly 1,000 feet above the Great Valley of East Tennessee on one side and the Highland Rim of Middle Tennessee on the other. It is a large and little developed section, the possibilities of which, and the value to the State, have long been underestimated. For a number of years, the Station has made researches in this area, with particular reference to crop adaptability, fertilizer and lime requirements of the soils and certain features of livestock production. The results warrant the belief that the Plateau could become a rich agricultural section contributing greatly to the welfare of the State. Its suitability to white potatoes and various truck and fruit crops, and to certain kinds of animal husbandry is well established. Only a small percentage of the area is cleared. Perhaps only one-third would justify clearing for cultivation, leaving nearly two-thirds for forest and range. Up to

the present time no land on the Plateau has been owned by the Institution but through cooperation with farmers, and with the aid of rental land, a large amount of research has been done by the Station. The time has come, however, when this kind of work will have to be curtailed or provisions made for a substation where crop improvement and adaptability studies on various important soil types can be made and answers found to numerous land clearing, range and livestock problems.³⁶

One year later a number of prominent citizens from Cumberland County expressed to Governor Prentice Cooper and members of the legislature a desire to establish a permanent location for agricultural research on the Cumberland Plateau. This resulted in an appropriation of \$30,000 to be spent over a two-year period, beginning in 1943, for buildings and general operating expenses, but not for land. In April 1943, the Cumberland County Court appropriated \$10,000 for the purchase of 588 acres of the Borer Tract, eight miles northwest of Crossville on U. S. Highway 70. The property fronted over a mile on the highway, had a Tennessee Central rail siding and spur track, and contained about 260 acres of cleared land representing most of the important soils of the Plateau.³⁷ A gift of an adjoining tract of 87 acres by G. E. Harrison increased the size of the station to 675 acres.

In 1947, an outlying portion of the Cumberland Homesteads, consisting of 1,380 acres, was transferred to the station through a grant of surplus property by the War Assets Administration. This tract included the Garwood Farm of 160 acres, commonly known as the "Mineral Deficiency Farm," which had been under lease for cattle research since 1939.

³⁵*Sixtieth Annual Report for 1946*, Agricultural Experiment Station, The University of Tennessee, (Knoxville, Tennessee, 1947).

³⁶*Fifty-Fifth Annual Report for 1941*, Agricultural Experiment Station, The University of Tennessee, (Knoxville, Tennessee, 1942).

³⁷*Fifty-Sixth Annual Report for 1942*, Agricultural Experiment Station, The University of Tennessee, (Knoxville, Tennessee, 1943).

Approximately 150 acres of the Homesteads tract was cleared land, and the remainder was forest land with poor quality timber. This tract became known as the "Grassland Farm" and is located eight miles southeast of Crossville.³⁸

In 1948, The University of Tennessee was given 194 acres used during World War II as a Prisoner of War Camp for the internment of 1,371 German and slightly fewer Italian officers. The land was obtained as a grant from the federal government for educational purposes. Of this 194 acres, 160 acres were assigned to the station for research and the remainder was to be used for the Clyde York 4-H Training Center. The total acreage of the station then became 2,215.

Due to the low state of productivity of both the original tract and the so-called Grassland Farm, the first decade at each of these locations was devoted to selecting and upgrading the condition of the land so it could be used for experiments with fruit and vegetable crops, corn, forage, and pasture crops. Stones had to be hauled off many of the open fields before crops could be planted and cultivated. Other priority improvements included fencing, building roads, digging wells and ponds, and remodeling existing dwellings and storage facilities. Gradually a systematic plan of land clearing and utilization was developed.

One of the first projects moved from rented land to the new station was a cooperative endeavor with the U. S. Department of Agriculture in potato breeding for the southeastern area. Other aspects of potato research included fertilizer tests, disease-control, and storage problems. In the 1960s, the development of the snapbean industry on the Plateau was greatly enhanced by research at the station.

At the same time that the station was clearing land and bringing it into productivity through research, farmers across the Plateau were clearing additional acreages. The research on adaptability of crops to the area, along with the lime and fertility requirements of the soils, was of great interest. As the Grassland Farm was developed, beef cattle experiments were introduced.

In 1947, John A. Odom, who held a

bachelor's degree in agricultural education and had been serving as county agent with the Agricultural Extension Service in Cumberland County, was appointed superintendent of the Plateau Experiment Station.

Dairy Experiment Station

This station, located at Lewisburg, Tennessee, was established in 1929 and operated by the Bureau of Dairy Industry, U. S. Department of Agriculture, for conducting research in breeding, feeding, and management of dairy cattle 19 years before becoming affiliated with the University. In 1948, The University of Tennessee Agricultural Experiment Station became a cooperative agency under a Memorandum of Understanding with the USDA. Under this agreement, the work at the station was planned and conducted by a committee of five, consisting of two members of the Agricultural Experiment Station's Dairy Department, two members of the Bureau of Dairy Industry, and the station superintendent.³⁹

The station originally consisted of 480 acres with more than 300 acres cleared and used for field crops and pasture. In 1955, an additional 135 acres adjoining the station were purchased. At that time the purebred Jersey herd consisted of more than 100 cows and about an equal number of young heifers. The principal objective of the research program was the improvement of dairy management techniques using Jersey cattle.

A. G. Van Horn, who held a bachelor's degree in agriculture with a major in animal husbandry from Kansas State University, was superintendent of this station from 1939 through 1958. He was succeeded by John R. Owen, who held a master's degree in agriculture with a major

³⁸*Sixtieth Annual Report for 1946*, Agricultural Experiment Station, The University of Tennessee, (Knoxville, Tennessee, 1947).

³⁹*Sixty-Second Annual Report for 1948*, Agricultural Experiment Station, The University of Tennessee, (Knoxville, Tennessee, 1949).

in dairying from Mississippi State University. The superintendent became a joint employee of the Tennessee Agricultural Experiment Station and the USDA under the cooperative program described.

Ames Plantation

The history of the Ames Plantation and its role in the Tennessee Agricultural Experiment Station is unique compared with other branch stations.

Located in the Brown Loam area in West Tennessee near Grand Junction, it is about 60 miles east of Memphis and 10 miles north of the Tennessee-Mississippi boundary in Fayette and Hardeman Counties. In 1950, it consisted of 18,540 acres lying approximately 10 miles east and west and eight miles north and south. The property was purchased by tracts between 1903 and 1937 by the late Hobart Ames of North Easton, Massachusetts, whose main interests were those of a sportsman, rather than those of a commercial farmer. He emphasized the importance of providing a favorable environment for quail production on the Plantation, as well as the raising and training of bird dogs. In 1915 the National Field Trials, which are held in February each year, were moved to this location. About this same time, he purchased a herd of Purebred Aberdeen Angus cattle and became associated with several officials of The University of Tennessee College of Agriculture, especially M. Jacob and C. E. Brehm, who provided assistance for improving the herd. Sharecroppers and tenants operated the rest of the open land, primarily in cotton production under typical plantation systems that prevailed in the area.

The Ames Plantation was probably better known outside the State of Tennessee than within because of the history of the Ames family, the National Field Trials, and the reputation of the Purebred Aberdeen Angus herd gained through shows throughout the country.

Hobart Ames died in 1945, and his wife,

Julia C. Ames, established the Hobart Ames Foundation in accordance with her Will dated April 25, 1949.⁴⁰ She died in 1950. The Seventh heading of this Will under Section (a), states:

The trust herein created and the entire trust fund and all securities and property at any time therein, real and personal, shall be a permanent foundation as a memorial to my said husband, Hobart Ames, and shall be created, held and operated exclusively for scientific and educational purposes in the manner herein set out and shall be known as the Hobart Ames Foundation.

The facilities of said Plantation shall be available to the College of Agriculture of the University of Tennessee for such scientific and educational purposes as said College of Agriculture is or may be authorized to pursue, including the carrying on of experiments and investigations in or related to any such purposes . . .

Under terms of the Will, William A. Parker of Easton, Massachusetts, and Old Colony Trust Company of Boston, Massachusetts, were designated as Trustees with provisions for their successors under the perpetual trust. It should be noted that The University of Tennessee does not own and cannot own the properties and securities of the Hobart Ames Foundation.

The first meeting of representatives of The University of Tennessee and the Will Trustees in October 1950, was devoted to a discussion of the terms of Mrs. Ames' Will and its implementation. The central theme of the meeting dealt with program development and management of resources. The University Administration indicated that they had always had the responsibility for developing programs and allocating funds in support of such endeavors. The Will Trustees indicated that under the terms of the Will, they had sole authority for managing the resources of the Hobart Ames Foundation and could not shirk this responsibility. By mutual agreement it was decided to authorize Ruben H. Scott, the manager,

⁴⁰Mrs. Julia C. Ames' Will, (Boston, 1949), Section 7. Copy of Will in file at Ames Plantation, Grand Junction, Tennessee.

to employ an assistant manager, and the University would undertake the task of developing a soil map and a cruise of the timber on the Plantation. Both parties would exchange ideas on program development over the next year.

When John A. Ewing became assistant director of the Agricultural Experiment Station, he was delegated authority by Dean J. H. McLeod to develop program proposals for the Ames Plantation in cooperation with the Will Trustees. Within a short period, Ewing was pursuing graduate studies at Harvard University and his major professor, J. D. Black, an internationally known economist, recommended that his dissertation be devoted to program development on the Ames Plantation. Since the Will Trustees were located in or near Boston, it was easy to consult with them during this process.

In the meantime, further inventory of the resources of the Ames Plantation indicated that the Plantation population consisted of 91 families or 481 persons, with 86 percent being black. The 91 families included 54 sharecroppers and tenants, while the other families provided wage hands and management personnel. The sharecropper and tenant units averaged 25 acres in size with 12.7 acres of cotton producing a yearly gross income of about \$1,700. Only 12 of the 54 operators were under 44 years of age. Many of the young people of working age had already left the area for employment in industries outside the state.

In the 1953 fall meeting of the Will Trustees and University representatives, Ewing presented four alternative programs for the Ames Plantation. The most extensive plan would utilize the woodlands in forestry and the open land in beef cattle research. This plan was not recommended. The recommended plan would include forestry and beef cattle research, but would include development of model farms including tenant units on land formerly operated by tenants and sharecroppers. Such a program of model farms would provide research information for the region on steps involved in moving from a workstock-cotton economy to a mechanized modern system of farming utilizing cotton, as well as other crops

combined with livestock. Ewing also proposed that the program be developed on a project basis with annual work plans and budgets, approved by both the Will Trustees and University Administration. These recommendations were approved by both parties with the understanding that the National Field Trials would continue to be held at the Plantation.⁴¹

The next task was to determine the current land-use pattern on the Plantation, and to follow this with a proposed long-range land-use plan. Aerial photographs obtained through the USDA, plus site visits, were used to establish the location of families and the utilization of the land area. Not surprisingly, with emphasis upon quail production, and sharecroppers and tenants using workstock, most of the open land was in small fields or patches. For example, the 640-acre cotton allotment was grown in about 1,000 patches. The current land-use pattern combined with the soil map and timber cruise data were used in developing the long-range land-use plan. The first step was the separation of land between forestry and other uses. Once the long-range plan was developed, two bulldozers were used almost full-time over a two-year period in converting patches into big fields suitable for mechanized operations.

The first project developed was forestry in 1954. The objective was to improve the existing stand of trees and plant loblolly pines and other species on several thousand acres of eroded cotton fields. The receipts from harvesting mature stands of timber were to be used to finance this project. A small sawmill was installed, and a professional forester employed.

The second project was a pilot or demonstration farm established in 1955 as a model for converting a "run-down" cotton farm into a modern cotton hog-beef-forestry farm of 370 acres. This operation was supervised by the assistant manager

⁴¹John Arthur Ewing, "Planning the Ames Plantation Project," A Dissertation in Partial Fulfillment of the Requirements for the Degree of Doctor of Public Administration, (Harvard University, Cambridge, Massachusetts, June, 1956).

of the Plantation. The results indicated that the operator's wages were twice the gross income of the average farmer in the area and the farm indebtedness could be retired in 40 years or less.

The third project was the central unit, established in 1955 on that part of the Plantation utilizing wage hands. It consisted of about 3,000 acres of open land and included the Purebred Aberdeen Angus cattle, some grade cattle, more than 100 acres of cotton, 400 acres of corn, and a proposed herd of 170 brood sows. The cattle and swine were to be involved in production testing programs and other research activities. Several departments, including Agronomy, Entomology, and Agricultural Engineering, conducted research within this unit.

The fourth project was farm management involving tenants using modern systems of farming and leasing arrangements. Five tenants were selected to participate, using various crops such as cotton, corn, strawberries, field peas, and livestock including dairy, beef, hogs, and sheep. Most of the rental arrangements were established on a one-third/two-thirds basis, with the Plantation paying one-third of the expenses and receiving one-third of the gross income. At the end of the first year, these five tenants paid the Plantation more rent than 30 tenants working under the old rental arrangements, and their net incomes increased in about the same proportion. These tenants were supervised by a farm management specialist.

The impact of the change in farming on one of the tenant operators was demonstrated as follows: The first year, while planning his operation, it was proposed that he use \$2,000 worth of fertilizer on his crops. He stated that this was upsetting since he never had gross farm sales above \$2,000 in a year. He reluctantly agreed to apply it, and the results were excellent. In planning the second year, this tenant immediately stated that he wanted to double his fertilizer use. Then it became difficult to explain to him how this might be excessive or uneconomical.

Ruben H. Scott, who obtained a degree in business from Union University in 1914, was employed as manager of the Ames Plantation by

Hobart Ames in 1932. In 1951, Scott appointed J. M. Bryan, who had a bachelor's degree with a major in agricultural education, as assistant manager. Both Scott and Bryan were direct employees of the Will Trustees rather than joint employees with The University of Tennessee. In 1953, T. J. Whatley, an agricultural economist, was authorized to coordinate the task of developing the land-use plan and new projects with the assistance of the manager and assistant manager of the Plantation, as well as University personnel selected for involvement. Whatley lived at the Plantation and served as a joint employee of the Will Trustees and the University from 1956 until 1958 with the title of program director. In 1958, he returned to Knoxville as acting head of the Department of Agricultural Economics and Rural Sociology, but continued to coordinate the development of work plans and budgets on projects at the Plantation.

Milan Experiment Station

After considerable negotiation, in 1962 The University of Tennessee Agricultural Experiment Station received, (as surplus property) from the U. S. Department of Health, Education, and Welfare, 488 acres of land on which the Milan Station was established. The land was acquired through the Milan Army Ammunition Plant and the U. S. Army Corps of Engineers, subject to the requirements of 20 years' utilization, for research purposes. Located in northwest Tennessee, this site was ideal for research in farm mechanization.

The research implemented on this station was directed toward improving the principal crops of corn, cotton, soybean, grain sorghum, and wheat. Soil erosion was a major problem in the area where these predominately row crops were grown. Experimental crops were often grown in fields rather than plots on the station, and the productivity of the crop and the degree of soil erosion were observed and/or measured. Different farm implements such as sub-soilers, disk harrows, planters, herbicide and pesticide applicators, cultivators, and harvesters were evaluated using these two

criteria. Studies relating to varieties, date of planting, rate of fertilization, and methods of disease and insect control of the principal crops strengthened the research efforts.

Tom C. McCutchen, a former Agriculture Extension Agent in Gibson County, who held a master's degree in agriculture with a major in agricultural extension education, was appointed manager of this station in 1962.

Martin Experiment Station

In 1965, The University of Tennessee's Martin Campus became affiliated with the Tennessee Agricultural Experiment Station through mutual agreement. Prior to that time, the farm, owned and operated as part of the UT Martin Campus, had served as a laboratory used to grow crops and livestock associated with the teaching program in agriculture. Establishing the branch station allowed the teaching faculty to engage in research and offered farmers and other agricultural leaders in Northwest Tennessee an opportunity to benefit from these results.

The land base consisted of 657 acres. Early research dealt with variety trials on corn, soybeans, wheat, alfalfa, and some winter cover crops like vetch and crimson clover used to reduce soil erosion. Different roughages were evaluated in feeding trials using the dairy herd. Plans were considered to add research on beef cattle and swine as soon as possible.

O. G. Hall, who held a doctorate in animal husbandry from Iowa State University, was listed as head of department, Martin Branch, in 1965.

Knoxville Experiment Station

The professional staff of the Agricultural Experiment Station located at headquarters in Knoxville has been highly dependent upon land nearby to grow and maintain many of the crops and livestock needed for their research. The

Knoxville Experiment Station was established on land purchased by the University in 1869. In the early years, the College Farm and South Farm, each consisting of about 100 acres, were used for research, and the Cherokee Farm of 570 acres was added in 1915. Two events in the 1941-1965 period changed the land base available and needed for research. First, a considerable acreage of the existing farms was absorbed by the new UT Memorial Hospital, buildings on the agricultural campus, parking lots and improvements in the road system involving Neyland Drive, Alcoa Highway and Kingston Pike. Second, the increase in the research faculty after World War II exerted additional pressure to increase the land base beyond its original size. Several steps were taken to resolve these issues.

Between 1942 and 1946 the Blount Farm, consisting of 511 acres, located about eight miles south of the agricultural campus in Blount County, was purchased through four transactions. Funds used to purchase the land were obtained from payments made by TVA for flood easements on the Cherokee Farm. Beef cattle, swine, and sheep used in research were transferred from the Cherokee Farm to Blount Farm.

In 1954 a lease contract was developed with the Aluminum Company of America whereby 1,450 acres of land and a herd of beef cattle belonging to the company were made available for research. The Experiment Station operated the unit, located about 10 miles from the agricultural campus, according to an annual budget funded by the company. Major areas of research included: fluorine in beef cattle; cow/calf management and production; bull production for breeding purposes; and beef production utilizing grass forage rations.

A new Plant Science Farm was purchased in 1963 from J. H. Anderson of Knoxville. It is located five miles south of the agricultural campus between Highway 129 and the Tennessee River. The farm contained both bottom and upland soils and this facility provided for the centralization of much of the field research that formerly was conducted at several locations by the Departments

of Agronomy, Horticulture, Forestry, Entomology, and Plant Pathology.⁴²

Following the purchases and lease of the properties described, the principal field research conducted on the Cherokee Farm was related to dairy and poultry.

Prior to 1943, there was no indication of any individual who had the responsibility for coordinating the field facilities on the Knoxville Station. In 1943, W. A. Campbell was listed as farm superintendent. In 1945, J. N. Odom, who held a master's degree in agriculture, was appointed superintendent of farms. After 1957, the Knoxville Station was identified as the Main Station.

Outlying Work—Forestry

A tract of 8,000 acres located in Morgan and Scott counties, and known as the Cumberland Forest, was transferred to The University of Tennessee in 1936. The tract had been extensively logged and strip-mined for coal before this event took place. In 1947, the land was transferred to the Tennessee Agricultural Experiment Station. James S. Kring was employed as the forester and, over the next decade, most of his time was spent in cruising timber, establishing legal boundaries, developing some timber and coal sales, and providing fire protection.

In 1947 the 680-acre Friendship Forest was established in Hamilton County on property owned by TVA but leased to the Tennessee Agricultural Experiment Station for forestry research.

A third tract, consisting of 860 acres known as the Highland Rim Forest, was established in Franklin county in 1964 in an area known as the "barrens."

Utilization of these three tracts for forestry research between the period 1947 and 1965 was limited to approximately two full-time scientists.

UT-AEC AGRICULTURAL RESEARCH PROGRAM

This program originated in 1948 when A. H. Holland, Chief, Office of Research and Medicine, Oak Ridge Operations, U. S. Atomic Energy Commission, contacted C. E. Brehm, President of The University of Tennessee, and requested the services of technical personnel as consultants to aid in developing a management program for the cattle that had been accidentally exposed to the effects of the first atomic bomb explosion in July 1945 near Alamogordo, New Mexico. C. S. Hobbs, head of the Department of Animal Husbandry, was appointed by Vice Director Chance to assist him in developing a proposal. Within five months, a contract was developed and executed between The University of Tennessee through the Agricultural Experiment Station and the Atomic Energy Commission to establish a cooperative program at the Oak Ridge site. The urgency and need for this endeavor were as follows:⁴³

(1) The availability of the herd of cattle that was exposed to the first atomic bomb test, represented a valuable resource from the point of view of biological effects of radiation, and it was in the national interest to provide for such work;

(2) No facilities existed in the United States for using atomic energy techniques with large animals. Thus, the effects of radiation and the feasibility of improved health through radioisotope studies were being neglected;

(3) These facilities and studies would be invaluable should future national emergencies result in widespread dispersement of radioactive materials;

(4) Location of the facilities within the Oak Ridge area would allow the use of short-lived radioisotopes, pile irradiation techniques, and

⁴²*Seventy-Sixth Annual Report for 1962*, Agricultural Experiment Station, The University of Tennessee, (Knoxville, Tennessee, 1963).

⁴³*Sixty-Second Annual Report for 1948*, Agricultural Experiment Station, The University of Tennessee, (Knoxville, Tennessee, 1949).

existing radioactive waste disposal systems, and exclude the public from the premises based on existing policies; and

(5) It would provide opportunities for qualified scientists and graduate students to study atomic energy problems relating to agriculture.

Within two years, land and facilities were obtained and improvements were begun. Scientific personnel were selected, technicians were trained, and research was implemented in several subject matter areas. On the 5,000 acres set aside for this project, some of the first tasks were to install fencing and improve pastures, dig wells and ponds, build silos, barns, machinery sheds, shops, and other facilities needed to maintain and produce the difference species of livestock envisioned for this project.

The Scarboro school building located within the Oak Ridge control area was designated for conversion into laboratories and offices. Facilities included rooms or laboratories for autopsy of animals, tissue dissection, preparation of samples for radioassay, Geiger counting, radio-chemical, and radio-biological research. Radioisotopes of elements such as calcium, phosphorus, cobalt, iodine, zinc, sulfur, and iron were obtained and used to establish counting procedures. Radiation-monitoring equipment was calibrated, and health physics procedures were established for the building.

The impact of the exposure of animals and plants in the food chain to radioactive materials received a great deal of consideration. Too, extrapolations were made from animal experiments to expected human behavioral and health conditions based on similar exposure to radioactive materials. Among the species studied were beef and dairy cattle, burros, sheep, swine, poultry, rabbits, and mice. Under the contract, certain animal and laboratory facilities were made available to the medical division of the Oak Ridge Institute of Nuclear Studies.

Two projects under the contract involved direct use of the Hereford cattle that were exposed, accidentally, in the test bombing at Alamogordo, NM. One project dealt with a study

of the general health, growth, breeding efficiency, and fertility of these cattle and their offspring, while the other related to the retention of radioactivity in their tissues and organs. Two projects on calcium metabolism in animals were developed with one concentrating on its absorption and internal distribution, and the second on its interrelationship with minerals, vitamins, and hormones. Three other projects used radioisotopes to study the physiology of milk secretion, poultry nutrition, and reproductive functions in farm animals. Later a project investigated the impact of sub-lethal amounts of external radiation on animal performance.

In the soils and plant areas projects also were developed. The introduction of both radioactive calcium and phosphate into different soil types was studied. A laboratory was developed for irradiation of seed for purposes of later measuring the impact on germination and crop improvement.

C. L. Comar, a biophysicist, was appointed laboratory and research coordinator for this program initially and J. Merrill Bird was named superintendent of the farm phase. In 1955, Homer Patrick, a poultry nutritionist, was appointed laboratory director succeeding Comar, and two years later Nathan S. Hall, an agronomist, replaced Patrick as the laboratory director. By 1965 the staff of scientists and graduate students had increased to 38 at this laboratory.

ACCOMPLISHMENTS

Director C. A. Mooers, in discussing station policy and outlook in 1945 under the heading: "The Specialist as a Key Man in Research," stated as follows:

Farmers, of course, present numerous problems to the Station for solution. Most of them are of a simple nature. Many of the more difficult ones are old problems on which investigators of the U. S. Department of Agriculture and of this and other states have labored more or less successfully. The originality of a research worker and the special value of his labors are often outside the farmer's experience, but at time give rise to very valuable accomplishments. The production of hybrid seed corn, for

example, with yield increases at this time of 10 percent or more over the best open-pollinated varieties was the discovery of an agricultural scientist. Two outstanding soybean varieties, Ogden and Volstate with high yields and an oil content of near 20 percent were developed by H. P. Ogden at Tennessee. Cryolite and certain other fluorine compounds were introduced by an entomologist, S. Marcovitch, of the Tennessee Station and have proved to be very valuable insecticides against certain truck-crop and orchard insects. Superphosphate as a valuable fertilizer was the discovery of a chemist. . . . These are examples of a great number of discoveries which are in daily use as a result of scientific research.⁴⁴

After World War II, with farm mechanization at the forefront and many of the previous tasks such as assembling, processing, and distributing farm products moving outside the farm gate, a whole new set of research problems confronted the scientists. A broad research base involving many disciplines was required to answer a series of questions raised by farmers considering mechanizing their operations. Some of these questions were: What type of equipment would be best for plowing, planting, cultivating, controlling weeds, and harvesting? Would current varieties of crops, such as snapbeans, soybeans, and cotton mature so once-over harvest would be satisfactory? Would mechanical harvesters adversely affect the quality of products? Should artificial breeding of livestock be implemented? What labor-saving technique could be introduced in dairying, as well as confinement operations with poultry and swine? Under what conditions should credit be used? What gross and net income could be expected under different systems of farming?

Then, as agricultural products moved out the farm gates, other questions arose such as: How efficient was the marketing system as products move through channels to the consumer? How safe was our food supply? From a policy point of view, how could an efficient and strong agricultural sector be maintained in our society?

Individual researchers working on projects involving questions like those raised here have occasionally achieved outstanding results similar to Director Mooers' examples. On the other hand,

continuous improvements in agriculture have resulted more often from two or more scientists working on a common problem where their individual contributions could not be isolated. The following examples represent accomplishments under these varying conditions.

Identity and Measurement of Physical Properties of Cotton

K. L. Hertel, a physicist with the Agricultural Experiment Station, devoted his research effort toward identifying and measuring the physical properties of cotton fiber. As early as 1941, his laboratory analyzed about 3,800 cotton-fiber samples with about one-half of these provided by the staff of agricultural experiment stations, and the others provided by farmers, ginners, or private cotton companies. This indicated that the rapid methods developed in the laboratory for measuring fiber length, strength, and fineness were desired by the industry. At least three groups, the cotton breeders, farmers, and cotton manufacturers recognized that these qualities would affect the value of their product to compete in the market place, and this was especially true with the development of man-made fibers.

The three major instruments in the Fiber Research Laboratory were the Fibergraph to measure length, the Arealometer to measure fineness and the Pressley to measure fiber strength. The Pressley instrument was developed by E. H. Pressley of the Arizona Experiment Station. The Arealometer was developed at the Knoxville Laboratory. Later it was modified to measure another property of cotton, immaturity. Another new instrument developed at Knoxville was the Stelometer, which gave a very rapid measurement of strength, tenacity, and elongation of cotton, especially useful in cotton mills. New features were added to both the Fibergraph and

⁴⁴*Fifty-Eighth Annual Report for 1944*, Agricultural Experiment Station, The University of Tennessee, (Knoxville, Tennessee, 1945).

“They recommended the purchase of a mechanical harvester, which could be tested and modified as part of a project on the needs of the snapbean industry. . . . A consolidated progress report was issued annually on this project. The results had a major impact in maintaining the industry on the Cumberland Plateau.”

Pressley instruments over time to give greater precision to their measurements. The lint percenter or lint fraction balance, which gave a reading on the percent of lint in a specific amount of seed cotton, represented another one of many developments made within this laboratory.

This Fiber Research Laboratory, under the direction of K. Hertel, gained national and international recognition for its achievements in development of new or modified instruments for measuring cotton fiber qualities and in providing actual measurements of these qualities to users within the industry.

Mechanization of Snapbean Harvesting

The Cumberland Plateau became known for its production of high quality snapbeans for the fresh, canned, and frozen markets in the late 1940s and 1950s. By 1960 this industry was declining because labor was becoming scarce for hand-harvesting. After representatives of the industry consulted with Director Ewing, he brought specialists together from four different subject areas—an engineer, horticulturalist, food technologist and economist—to research this problem. They recommended the purchase of a mechanical harvester, which could be tested and modified as part of a project on the needs of the snapbean industry. Director Ewing approved this purchase.

For four years each of those specialists obtained information he needed within his discipline while coordinating his efforts with other

members of the team in addressing the problems. For example, the engineer addressed the total machinery and equipment needed in growing and harvesting the crop and how to make modifications for greater efficiency. Some of the mutual concerns of the engineer and horticulturalist were: row spacing, the spacing of plants within the row, the range in height of bean plants and whether the pods set at different heights could be harvested, and how existing and new varieties differed in time of maturity for once-over harvesting. The food technologist focused on the quality of the product as measured by the amount of trash and breakage of beans at the time of harvest as well as time saved by mechanical harvesting in moving the product from the field to the market. The economist compared labor saved and costs associated with different methods of growing and harvesting snapbeans from the standpoint of both the growers with a few acres of snapbeans and the ones with larger acreages.

Snapbean growers and processors were consulted. A consolidated progress report was issued annually on this project. The results had a major impact in maintaining the industry on the Cumberland Plateau.

Use of Atomic Radiation in Agriculture

The cooperative program of the Tennessee Agricultural Experiment Station and the Atomic Energy Commission at the Oak Ridge laboratory involving basic research resulted in a storehouse of information for current and future generations. Radiation was used to determine its effects upon the reproduction and physiology of farm animals, burros, and laboratory animals, and to measure whether different dosages had both short-time and/or latent effects. Radiation effects were studied based on both rate and frequency of exposure using 19 sources of radiation, all from cobalt-60. This work was aimed at gaining a better understanding of the development, growth, and fertility of animals. Only a few brief highlights are discussed here.

Researchers determined from these studies the exact time in pregnancy that different parts of the calf embryo were developed. For example, cows irradiated during the fourth week of gestation had calves with deformed legs and feet. If irradiated before the third week or after the fifth week their calves were normal. In addition, radiation did not always cause sterility. Mature bulls that received this treatment recovered fertility within six months, while cows showed no evidence of lower fertility even as long as six years after exposure. Bulls that received irradiation during their mothers' gestation period produced few sperm and were expected to be sterile, while females under the same conditions showed no evidence of lower fertility or damage to reproductive organs.

The use of radiation on plants or seed was designed to produce more mutations than normally occurs in nature. Even though most mutations are harmful rather than beneficial, by increasing the number occurring, some useful traits may be captured. Advanced generations from irradiated seed of cotton, soybeans, and two forage grasses—fescue and orchardgrass—have been produced on a field scale.

This laboratory, the first in this country to study the force of atomic energy on the animal and plant food chain, has brought national and international recognition to the Tennessee Agricultural Experiment Station and many of its scientists.

Impact of Fluorine Upon Livestock

Animal scientists and agricultural chemists spent almost two decades, starting around 1947, identifying sources and levels of fluorine and its influence on the livestock industry. This problem was reported more frequently by farmers in Middle Tennessee around Columbia and in East Tennessee near Alcoa.

It was known that fluorine appeared naturally in most soils, but was very concentrated in large quantities in high phosphate soils. In addition,

industrial plants used in the production of such products as phosphorus, aluminum, or where coal was used as a source of heat or power, emitted fluorine in the form of gases or dust. It was found that within such areas, livestock grazing forage crops ingested large quantities of fluorine from deposits made on plants as a result of splashing during rains or dust particles moved by the wind. Accumulations of calcium fluoride in the soil exerted no harmful effects upon plant growth, and where soils were adequately supplied with calcium, there was little uptake of fluorine by most grasses and legumes.

Some of the most common symptoms of chronic fluorosis in cattle and sheep reported included discolored and uneven teeth, stunted growth, rough hair coat, low milk production, and lameness.

Cattle grazing pasture having high fluoride soil levels matured at weights 5 to 7 percent lower than those grazing pastures with low levels. A low nutrition diet combined with grazing pastures with high-fluoride soil levels resulted in even lower mature weights for cattle. The fluorine content in pasture forages was higher during the winter than in the summer. The amount of fluorine concentrated in the bones of cattle grazing pastures on soils with high fluoride levels was about 70 percent higher than the fluoride in the bones of cattle grazing on soils with low levels. Similar differences were noted in newborn calves from cows grazed under the above conditions. The most notable feature of cattle ingesting high levels of fluorides was the deterioration of teeth, especially between the second and fourth year of age.

The results of these studies had two broad beneficial effects. First, they identified desirable management practices that farmers should follow to minimize damage to livestock in high fluorosis areas. Second, many industrial concerns took action to reduce the emission of fluorides and other chemicals from their plants.

Table 3. Estimated Labor and Costs Associated with Different Levels of Mechanization on Corn and Cotton in 1965

Levels of Mechanization	Hours of Labor per Acre	Costs	
		Variable	Total
Workstock: Corn, handpicked	35	\$21	\$34
Tractor: Cornsnapper, chemical weed control	9	37	46
Tractor: Corn, combine, chemical weed control	8	42	50
Workstock: Cotton, handpicked	160	34	35
Tractor: Cotton, chemical weed control, handpicked	69	65	74
Tractor: Cotton, chemical weed control, mechanical picker	13	77	111

Marketing

When Congress passed the Research and Marketing Act of 1946, one of its objectives was to encourage scientists to delineate the channels of trade through which agricultural commodities moved between the farm gate and the consumer while identifying both technical and economic efficiencies along the pathways. Changes in the transportation system, especially the new interstate highway complex, had a major impact on marketing channels and product movement.

Marketing studies were initiated for commodities such as milk, eggs, broilers, livestock, grain, cotton, fruits and vegetables, and ornamentals. As studies progressed, it became evident that the volume of business available in many markets such as some auction barns for livestock, dairy processing plants, slaughter houses for livestock and poultry, cotton gins, and grain elevators was too low to be economical. It became evident that practices such as home delivery of milk and dairy products often by two or more processors within the same city block on the same day were extremely costly.

Major changes in the marketing system were set in motion by changes in farm production, including the introduction of soybeans as a major crop in Tennessee, as well as the development of confinement raising of broilers, laying flocks,

swine, beef cattle, and dairy cows. Often new processing and distribution systems were established based on the latest research data on changes in farm production. Equally important were the new technologies being developed relating to food and product safety, extended shelf life, freezing techniques employed, new products, and distribution through supermarkets and chain-stores.

Economics of Farm Adjustments

This period 1941 through 1965 was characterized by a step-by-step shift from the use of workstock to tractors. Initially most farmers used tractors primarily for land preparation with a one- or two-bottom plow and/or a disk harrow and cultipacker, while workstock was used for application of fertilizer, seeding, and cultivation. Within a few years tractor-drawn fertilizer drills, planters, and cultivators were adopted. This was followed by a substitution of chemical weed control for hand labor and cultivation operations. Later, as the farm population declined, the combine and mechanical pickers replaced hand labor used in harvesting corn and cotton as illustrated in Table 3 where yields per acre average 75 bushels and 600 pounds of lint for the respective crop.

Labor savings comparable with those shown in the previous example were not experienced in

growing many other crops or with livestock; however, it was not uncommon for farmers to reduce labor as much as 50 percent by mechanizing operations. Often a doubling of costs was associated with this mechanization and the tractors, equipment and labor were underutilized unless the volume of business was expanded. A limited number of farm owners and tenants were able to establish economic farm units by leasing or buying land from farm families moving to industrial employment.

Guidelines for establishing economic farm units were provided through model farms such as those developed at the Ames Plantation, and through the Rapid Adjustment Program cosponsored with TVA. Too, model rental leases were developed for tenants and landlords to use under different systems of farming.

Engineering Science

Engineers played a prominent role in the design and/or modification of farm buildings, machinery, equipment, and instruments used to substitute for human labor. Performance evaluations were as varied as comparing the new man-made concrete block with wood, brick, or stone in the construction of farm buildings, or the new tractor-drawn equipment with horse-drawn equipment in producing and harvesting crops, or handling materials such as fertilizer and feeds.

With the growth in confinement operations, especially in poultry and swine, engineers spent a great deal of time with livestock researchers on the design of buildings for those animals. Among the items receiving special attention were air circulation, cooling, heating, waste disposal, and methods for handling feed storage and distribution.

Three examples of new, more efficient technologies developed during this period were observed. Farm ponds were being developed at a rapid rate as a good source of water for livestock; however, many ponds had a tendency to leak. Researchers discovered that by mixing certain sodium compounds in the bottom of ponds as they

were being built, this leakage was prevented. After tractors became commonplace on farms, the ground equipment used to apply pesticides on crops required large quantities of water per acre in the mixture. An engineer took a spray nozzle that applied as little as one pint per acre by airplane and adapted it to ground equipment for spraying. H. A. Arnold of Tennessee developed one of the first hose pumps to be used for farm operations. It was particularly well adapted to handle corrosive materials like liquid fertilizers.

Arthur Morgan of Tennessee developed and patented a "Strawberry Capper" that would mechanically remove the calyx from strawberries at processing plants. Previously the procedure had been to use hand labor to pick the berries and remove the calyx or cap, and this often led to a deterioration or spoilage before the berries reached the processing plant. The strawberry capper only worked successfully on varieties in which the calyx was not recessed into the top of the berry. The capper was made commercially for a period, but was not widely used because of this limitation. Nevertheless, it served as a stimulus for other researchers to develop better models.

Animal Breeding and Nutrition

The joint thrust in animal breeding and nutrition research on swine, beef cattle, and dairy cattle had very positive results. One of the objectives was to reduce the fat content in both pork and beef. A rotational cross-breeding program with swine at the Ames Plantation resulted in larger litters of pigs that gained weight faster than with conventional breeding programs. Pork production per litter increased 20 percent or more with considerable reductions in back-fat.

Artificial breeding of dairy and beef cattle, using sires whose progeny performed well, offered a procedure for quicker herd improvement than conventional breeding methods, and regional research projects provided a mechanism for identifying such sires over a greater geographic area. In general, with good management practices,

it was found that sires whose progeny performed well in one environment would be expected to produce progeny that would perform well in other environments. Emphasis on selection in beef cattle breeding was on rate of gain after correction for fat accumulation so leaner meats would meet consumer preferences.

An evaluation of pastures consisting of bluegrass, orchard grass, or tall fescue alone and in combination with clover for cattle, indicated a close correlation between clover composition in the pasture mixture with livestock performance. Performance improved as the clover content increased up to 40 or 50 percent of the mixture.

As milk production levels increased in dairy herds, higher quality forage crops became essential. A combination of low-moisture alfalfa or grass silage combined with corn silage was preferable if these crops were harvested before the late stage of maturity. Energy requirements were met more efficiently by feeding forage crops free choice, supplemented by concentrates, rather than restricting forage intake to obtain greater concentrate consumption.

The maintenance in high-producing dairy cows is dependent upon a constant flow of replacement heifers into these herds. Eric Swanson of Tennessee attracted national attention to his use of identical twin dairy heifers in evaluating feeding practices for replacements. He found that very liberal feeding of one identical twin often resulted in poor development of the mammary glands because of fatty tissue deposits compared with the other identical twin being fed and grown at a more moderate rate. Besides being more expensive to produce, the fatter heifer produced less milk than the other one during the first two lactation periods.

Corn and Cotton Breeding

Few research endeavors could match the accomplishments of the corn breeding program between 1941 and 1965. This cooperative effort between the USDA and the Tennessee Agricultural Experiment Station staff resulted in the

Table 4. Name and Year of Release of 16 Corn Hybrids in Tennessee 1941-1965

Name	Year Released
Tennessee 10	1941
Tennessee 14	1941
Tennessee 15	1941
Dixie 17	1946
Dixie 44	1947
Tennessee 602	1948
Dixie 22	1949
Dixie 33	1949
Tennessee 90	1955
Dixie 29	1956
Tennessee 501	1957
Dixie 77	1959
Tennessee 503	1960
Tennessee 604	1961

release of 16 corn hybrids, 37 inbred lines, one sweet corn, and 14 sweet corn lines over this period.

Two methods were developed for releasing corn hybrids. The directors of southern agricultural experiment stations recognized the importance of establishing uniformity in those hybrids adapted across the region, and they authorized corn breeders to meet, set standards, and approve such hybrids. Corn hybrids meeting their criteria were assigned the prefix "Dixie" and given a number when released. The other method for releasing new corn hybrids were assigned the "Tennessee" prefix and given a number.

Corn inbred lines released represented corn that was self-pollinated and grown over a number of years until it was "pure," or consistent in its characteristics. For example, when the corn picker was invented, one of the major concerns of the

corn breeder was to develop a variety where the ear of corn was set at the proper height on the stalk to minimize harvesting loss. Available corn inbred lines with this characteristic were sought in the breeding program for this purpose.

Four cotton varieties were developed and released in Tennessee between 1941 and 1957. N. I. Hancock, a botanist, developed new varieties including *Tennessee 241*, which was released in 1948. Through the cooperative program with USDA, D. M. Simpson developed two varieties—namely *Cobal*, released in the early 1950s, and *Pope*, released in 1956.

Foods and Human Nutrition

Several research highlights are worthy of note in the food and nutrition area.

In studying the factors affecting mineral requirements of children and adults it was found that the level of any one mineral needed to maintain physiological balance depended upon the protein in the diet, the level of other minerals, and the age group.

Several methods were developed for removing radioactive materials from milk without disturbing its nutritive value. These methods could be implemented commercially if the need were to arise.

Using taste panels, J. W. Cole evaluated the eating quality of meat from steers representing eight breeds and breed crosses from British, Zebu, and dairy types of cattle. Few differences were found in the quality of meat from Angus, Hereford, or Jersey steers, despite less marbling in the meat from the Jerseys. Meat from Zebu parentage was significantly less tender than from other breeds. The results attracted a great deal of attention at a conference of the World Association of Animal Production.

METHODS OF COMMUNICATION

Before the Department of Information was established in 1943 with A. J. Sims as its head, the

“These publications varied in content from very basic research results that might lead to a scientific breakthrough in developing a new variety of soybeans in two or three decades, to a publication giving applied results on the adaptability of known soybean varieties to different geographic areas of Tennessee.”

Tennessee Agricultural Experiment Station had operated with one editor. Thereafter, the full-time equivalent professional workers varied from 1.1 to approximately 3.0 through the 1960s.

The Department of Information played an important role in working with administrators, scientists, and members of the press, radio, and television stations in disseminating the agricultural research story.

During the period reaching from about World War I to World War II, the principal outlets for getting research accomplishments into the hands of the ultimate users of this information were publications, special events, and radio. Television became an additional outlet around 1950.

Publications continued to represent the main source used to document research accomplishments. By 1965 a staff of about 100 full-time researchers were producing around 150 bulletins, professional journal articles, and reports per year. These publications varied in content from very basic research results that might lead to a scientific breakthrough in developing a new variety of soybeans in two or three decades, to a publication giving applied results on the adaptability of known soybean varieties to different geographic areas of Tennessee. In 1952 a new quarterly magazine, *Tennessee Farm and Home Science*, was initiated to provide progress reports on research underway. Most research projects required three to five years to complete. Each year the scientists provided a brief summary of their accomplishments to date on the project. If the results looked promising but were not conclusive, they might be reported in

Tennessee Farm and Home Science. For example, if the scientist was testing a new soybean, which for two years had been resistant to a strain of nematodes that was reducing yields, Tennessee soybean farmers would be aware of this potential improvement. The annual report of the Tennessee Agricultural Experiment Station continued to be the principal reference publication providing information on the administrative organization, research projects, publications, research personnel by departments, funding sources, and amounts.

Among the special events, the field days scheduled annually at the main and branch stations attracted widespread attention among farmers. The increased number of branch stations established across the state meant that one or more of these stations was located within a short driving time of most producers. The importance of seeing experiments underway was emphasized to this author by a farmer attending a field day in 1956 where the program indicated that cotton was being grown without hoeing or cultivation. After listening to the researcher explain how chemicals were used to control the weeds the farmer commented, "I wouldn't believe it if I hadn't seen it."

The widespread use of radio and television by farm families and most consumers provided a rapid communication system for research results. The researchers, together with personnel in the Agricultural Extension Service, used these media sources. They were especially effective to report outbreaks of diseases, insects and/or food safety problems and their solutions.

SCIENCE AND THE ENVIRONMENT

(1966-1990)

BACKGROUND

The substitution of farm inputs such as fertilizers, chemical, and machines for farm labor continued unabated during this period. A study conducted in 1973 indicated that despite the change in farm-input mix, the total resources used in agricultural production had held about constant since 1950.⁴⁵ Since total farm production increased about two percent annually, this amount represented increased efficiency or productivity. However, the population growth in the country and increased exports of farm products often failed to absorb the full increase in farm production. This resulted in depressed agricultural prices over most of this period.

A commercial farmer operating in this environment recognized that he had little control of the prices received for products, so searching for one or more "enriched inputs" to substitute for an "existing input" seemed the best solution. Usually the Agricultural Experiment Station became the source of "enriched inputs" or new technologies. For example, substitution of a new feed mixture or supplement for an old one, or a new crop variety for one previously used, might increase productivity by 5 to 10 percent. On a larger scale the substitution of 4-row equipment for 2-row equipment might allow the operator to utilize an additional 100 acres of rented land and

lower unit cost of production. The consumer was the chief beneficiary of this system that provided abundant food at relatively low prices compared with other countries.

Over this 25-year period total population in this country increased almost 55 million while the total farm population declined from 12.4 million to 4.8 million. Total farm population represented 6.4 percent of the total population at the beginning of the period but only 1.9 percent at the end of the period. This decline was brought about by retirements, job opportunities outside of agriculture, and farm business failures. However, despite the decry of many politicians, the family farm, which became larger in size, remained the principal ownership pattern. For example, of the 2,087,759 farms in 1987, 1,809,324 were individually owned; 199,559 represented partnerships; 60,771 were family-held corporations; and of the other 18,105 held as corporations, only 1,172 had 10 shareholders or more. By 1987 only 55 percent of farm operators listed farming as their principal occupation. Thus, 45 percent of the operators were part-time farmers depending upon industrial employment or other sources of

⁴⁵Willard W. Cochrane and Mary E. Ryan, *American Farm Policy 1948-1973*, (University of Minnesota Press, 1976).

income for most of their livelihood.

Significant changes also occurred in agriculture on the Tennessee scene. There was a significant decline in number of farms between 1965 and 1990. Of the remaining 89,000 farms only 39 percent of the operators listed farming as their principal occupation. Most of the decline in numbers occurred within small farms, while those commercial farms with 260 acres or more increased in numbers.

Total resources used in agriculture in Tennessee remained about the same over the 25-year period with "enriched inputs" such as fertilizers, varieties, chemicals, rations, and breeding stock replacing labor. Of the major commodities, soybeans experienced the greatest fluctuation in acreage, increasing from 560,000 in 1965 to 2,100,000 in 1982, and dipping to 1,160,000 in 1987. High price expectations in the late 1970s and early 1980s resulted in conversion of marginal row-crop and pasture lands into production, but lower prices led to a reduction in acreage. Most of the increase in soybean acreage between 1965 and 1982 was offset by a decrease of acres in corn grown and a diversion of pastureland to soybeans.

RESEARCH ROLE MODIFIED

The continuing urbanization of America during this period was reflected in the changing agenda in agricultural research at the national level. Food and fiber availability seemed to be taken more for granted, and a whole new set of diverse problems surfaced. Citizens were questioning the safety of the environment resulting from all the chemicals in the form of pesticides, herbicides, and fertilizers used in agricultural production. Too, food safety, human nutrition, protecting natural resources, and rural development were of special interest to the general population. Research was already underway through agricultural experiments on most of the problems. It should be noted that most industries, including mining, manufacturing, and power generating facilities, were undergoing the same kind of public

scrutiny that occurred in agriculture, especially as it related to environmental protection.

Two initiatives were undertaken in the mid-1960s to strengthen agricultural research. The first, through legislative action, involved the establishment of a long-range planning process for research at the national level including setting of goals, priorities, estimated manpower, and costs associated with implementing priorities, and a tentative timetable for executing such research. A part of this planning gave attention to the existing research program in terms of identifying excessive duplication of effort and elimination of low priority endeavors. The task was conducted by personnel representing agricultural experiment stations, USDA research units, and industries. Despite differences of opinion that surfaced, the planning process was viewed favorably.

The second initiative was the development of a system for coding and classifying all agricultural research projects into a national network. This process, known as "Current Research Information System" or "CRIS," had many good features. All existing and proposed projects involving use of federal funds were required to be entered into CRIS, and most state experiment stations included all projects regardless of source of funding. Since most research projects had a duration of three to five years, annual and final reports were submitted to CRIS and these provided data on results, funding costs, and manpower use. A scientist developing a new project proposal could retrieve data from CRIS on existing research nationwide within his or her area of interest and avoid duplication or strengthen the research proposed. Annual reports distributed by CRIS personnel were very valuable for administrators and researchers.

Funding at the national level did not match the needs of long-range research planning, either in terms of amounts or continuity. Even though legislative authorizations in many instances were adequate, actual appropriations were at lower levels or were not made at all.

The principal source of federal funds continued to be generated under the Hatch and McIntire-Stennis Acts previously mentioned; however, the

increase in these funds between 1966 and 1990 failed to keep up with inflationary rates. In 1977, animal health and disease formula funding and grants were authorized at a substantial level, but actual appropriations were low over time.

Two other sources of funding identified as Special Grants and Competitive Grants were introduced during this period. Special Grants were authorized in 1966 for projects submitted in six areas: cotton and soybean production cost reductions, water resource development, new product uses, human nutrition, air pollution, and cooperative marketing. Only \$1.6 million was appropriated for these grants the first year, but by 1986, the funding level for Special Grants reached \$28 million. Competitive Grants were authorized in 1978, and the main feature that separated them from Special Grants was that all colleges and universities, other research organizations, both public and private, as well as individuals, were eligible to apply for them. These funds increased from \$15 million in 1978 to \$44 million in 1986.⁴⁶

In 1965 the Research Facilities Act was passed with the objective of providing federal funds for upgrading facilities in agricultural experiment stations. Even though sizeable sums of money were mentioned in the authorization, only \$10 million was appropriated nationwide over five years, and then funding stopped. A somewhat similar experience occurred relating to the Rural Development Act of 1972. In addition, some Hatch Formula Funds were earmarked for a short period of time for pesticide and environmental protection research in the late 1960s. In 1974 the National Science Foundation provided limited support using "pass through grants" for research on solar energy application to agriculture especially for drying, greenhouses, and food processing. The EPA, between 1973 and 1978, also provided some grants for research on rehabilitation of strip mine land.

The historic federal-state partnership in supporting agricultural research was weakened during this period as a major portion of the load was shifted toward the states.

ACTION AT HEADQUARTERS

Two reorganizations of The University of Tennessee that occurred during this period had a direct impact on agriculture. Andrew D. Holt, who served as a vice president during C. E. Brehm's tenure as President, became President of the University in 1959. The rapid growth in enrollment and physical facilities on the five campuses located at Knoxville, Nashville, Chattanooga, Martin, and Memphis, plus the demands for research and public service, led President Holt to recommend to the Board of Trustees a reorganization of the University in 1968. Under his plan, which was approved by the Trustees, the President and vice presidents in such areas of responsibility as academic affairs, finance, and development, would conduct the overall operation of the University System. Each of the campuses was to be administered by a chancellor and a number of vice chancellors, having somewhat comparable responsibilities at the campus level to those of the vice presidents.

Before this reorganization, the chief administrator in agriculture, Webster Pendergrass, who held a doctorate degree from Harvard University, held the title of Dean of Agriculture. The three divisions within agriculture with the administrators and titles were: Agricultural Experiment Station, John A. Ewing, Director; Agricultural Extension Service, Vernon E. Darter, Director; and Resident Instruction, Neal D. Peacock, Dean.

With the change, the agricultural units became the Institute of Agriculture, administered by Vice Chancellor Pendergrass, who reported to Chancellor Charles Weaver of the Knoxville Campus. The title of administrators of each of the three divisions within the Institute of Agriculture became Dean, and the Division of Resident Instruction was changed to College of Agriculture.

In 1970, President Holt retired and Edward J. Boling, who had been vice president for development, became the new President of the University.

⁴⁶Norwood Allen Kerr, *The Legacy: A Centennial History of the State Agricultural Experiment Stations 1887-1987*, (Columbia, Missouri, 1987).

He recommended that the Institute of Agriculture be administered by a vice president who reported directly to the President of the University. This change was approved by the Board of Trustees, and Pendergrass was appointed to this position. This action seemed very appropriate since the program of both the Agricultural Experiment Station and the Agricultural Extension Service was statewide, and appropriations were earmarked for these divisions. The College of Agriculture was to maintain a functional relationship with the Knoxville Campus since teaching was involved; however, it was administratively responsible to the Vice President for Agriculture.

Another significant change occurred in the Institute of Agriculture in 1974. Since World War II there had been a continuing debate over the need to establish a College of Veterinary Medicine in Tennessee. In 1974 the Tennessee Legislature overwhelmingly approved, with the support of Governor Winfield Dunn, the establishment of such a college in Knoxville as a part of The University of Tennessee and within the Institute of Agriculture. W. W. Armistead, Dean of the College of Veterinary Medicine at Michigan State University and the former Dean of the College of Veterinary Medicine at Texas A & M University, was chosen as a consultant in planning the new college. Armistead held the degree of Doctor of Veterinary Medicine from Texas A & M University and a doctorate from the University of Minnesota (1955). When the time arrived to select a dean for the new College of Veterinary Medicine, Armistead was approached and accepted the position in 1974. Thus, the College of Veterinary Medicine became the fourth division within the Institute of Agriculture, and its establishment added an important dimension to animal research in Tennessee.

Vice President Pendergrass, who devoted more than 40 years of service to agriculture through The University of Tennessee, retired in June 1979. W. W. Armistead, who was serving as dean of the College of Veterinary Medicine, was appointed the Vice President for Agriculture and served until June 1987, when he retired.

D. M. Gossett was appointed vice president for agriculture in 1987. He had obtained a doctorate with a major in crop physiology from North Carolina State University and following graduation he was employed by that institution and was located at Waynesville in a joint extension/research capacity to work on tobacco. In 1965 he returned to his native state as an assistant agronomist with the Agricultural Extension Service. Five years later he was appointed superintendent of the West Tennessee Experiment Station at Jackson. In 1972, he became assistant dean of the Tennessee Agricultural Experiment Station and, in 1976, its Dean.

Administrative Changes in Research

The chief administrative officer of the Agricultural Experiment Station was the Director, whose title after 1969 was changed to Dean, as indicated previously. The first administrative change in the Dean's staff occurred in August, 1972, when Associate Dean Eric Winters retired. After reviewing the workload in the office resulting from the rapid growth in professional and supporting personnel as well as facilities in departments and on branch stations throughout the state, Dean Ewing appointed T. J. Whatley and D. M. Gossett as assistant deans on September 1, 1972.

Whatley, who held a doctorate in agricultural economics from Purdue University, was head of the Department of Agricultural Economics and Rural Sociology and became the first Distinguished Professor in agriculture in 1964. As an assistant dean, he was delegated responsibility for working with department heads and their faculty in developing priorities and projects and implementing their research program including expenditure of funds. In addition, he was responsible for preparing the overall budget of the Agricultural Experiment Station.

Gossett, who was superintendent of the West Tennessee Experiment Station, was delegated responsibility for working with superintendents of Branch Stations in executing research at their

locations, recruiting personnel, planning changes in facilities and equipment, and proposing and authorizing expenditures. He was also responsible for coordinating Field Day activities at the stations.

A station statistician was added to the administrative staff in 1972. W. L. Sanders, who held a doctorate degree with a double major in animal science and statistics and who had served as a statistician in the UT-AEC program at Oak Ridge, was appointed to this position. His primary function was to serve in an advisory role with the faculty and administration in the design of projects, work plans, and research reports using the latest statistical techniques to obtain valid results. He also assisted in the transition from principal use of the main frame computer to more dependency on personal computers for data analysis. Equally important was the establishing of lines from each of the branch stations so data could be transmitted directly to scientists in Knoxville.

The first major change in administration during this period occurred in 1976 when Dean John A. Ewing retired. Gossett, who had served as assistant dean since 1972, was appointed Dean of the Agricultural Experiment Station, and Whatley was promoted from assistant to associate dean. John I. Sewell, a professor in the Department of Agricultural Engineering who obtained his doctorate from North Carolina State with a major in agricultural engineering, was appointed assistant dean in 1977 with the responsibilities for working with the station superintendents as previously described. He was promoted to associate dean in July, 1986. In June, 1986, Whatley retired and T. H. Klindt, who obtained his doctorate at the

University of Kentucky with a major in agricultural economics, was appointed as assistant dean with responsibilities similar to Whatley's. Klindt was serving as a professor in the Department of Agricultural Economics and Rural Sociology and had served part-time as assistant or associate dean of graduate studies from 1982 until 1985 on the Knoxville Campus of The University of Tennessee. He was promoted to associate dean in 1990.

The second major change in administration occurred when Gossett was appointed vice president in 1987 and a new dean of the Agricultural Experiment Station was sought. John I. Sewell served as interim dean until February 1988, when Don O. Richardson was appointed dean. Richardson held a doctorate with a major in dairy science from Ohio State University. He joined the faculty in the Department of Dairying as an assistant professor in 1963 and served as professor and department head in the renamed Department of Animal Science from 1982 until 1988.

Increased Funding

Even though funds increased at both the federal and state level between 1966 and 1990, the proportion of federal funding declined from about 38 percent of the total to 22 percent. The amount of Special and Competitive Grants money received varied considerably from year to year, depending on the total federal funds appropriated and how successful the staff was in obtaining these grants.

Some indication of the changes in funding is indicated in the table below.

FUNDING			
Year	Federal	State & Other	Total
1970	\$1,709,900	\$3,707,600	\$5,417,500
1975	2,337,700	5,733,100	8,070,800
1980	6,096,400	8,967,500	15,063,900
1985	4,876,400	14,088,200	18,964,600

Establishing Research Priorities

Long-range research planning was implemented at both the national and Tennessee levels in the late 1960s. A group of scientists at Tennessee was asked by Vice President Pendergrass to project the characteristics of the population and agriculture through 1985 and then until the end of the 20th century. They pictured agriculture as consisting of almost 50 percent fewer farmers, with part-time farmers comprising more than half of the total and most commercial farms increasing appreciatively in acreage. Soybean acreage would increase at the expense of corn and some tobacco production. Beef cattle would expand in numbers on most farms while dairy, swine, and poultry would be concentrated in greater numbers on fewer farms. Industrial employment would be encouraged especially in rural areas and, if personal incomes continued to rise, quality-of-life issues would be at the forefront.

In view of the broader image projected for Tennessee agriculture near the 21st century, each department spent months reevaluating its priorities in research to accomplish the desired goals. Plant and animal breeding remained a high priority to sustain agricultural production with fewer farmers. Equally important was the feasibility of incorporating biological controls for insects and diseases and obtaining plants which could utilize nitrogen from the air and require less chemical fertilizer use. Two plant breeding programs were especially identified that needed strengthening because of their long-term benefits. One in tree breeding would upgrade the quality of forest products growing on millions of acres owned both privately and publicly. The other program was in developing new pasture grasses adapted to Tennessee conditions for supporting the livestock industry.

An estimated 75 percent of all scientists in the late 1960s were engaged in research on food and fiber production and marketing and in evaluating the needs of the farm sector. Many refinements were still needed in crop adaptation to mechanization so harvesting losses could be minimized. In animal production, new problems

with diseases and stress became evident with confinement rearing. Also, problems of waste disposal required new solutions to prevent pollution of soil, water, and atmosphere. On a broader scale, a high priority was to maintain a strong infrastructure within rural areas in terms of schools, roads, medical and financial institutions, and markets to support farm families.

The other 25 percent of scientists engaged in research were seeking solutions for a growing category of agricultural problems which might be identified as "People Problems." Each new generation in our country has fewer people familiar with the agricultural processes used in providing food and fiber. These people have been raising more and more questions such as: How safe is our food supply? What is the shelf life of different products? Can food be preserved by irradiation? Food scientists have been pursuing answers to these and similar questions. In addition, changing dietary needs have been identified with the shift of workers from manual labor to white-collar jobs. The relationship of human nutrition to human health has received the attention of researchers, for example, in such areas as reducing the fat content of pork and beef products. New technologies for reconstituting food products such as dairy and meats to meet dietary needs became a high priority area of research.

Urban dwellers expressed an increased demand for improvement in other aspects relating to the quality of their lives. This included more consideration of the uses of grasses, flowers, and ornamental plants in landscaping both private and public lands. Tennessee has had a strong and expanding agricultural base to produce flowers and ornamental plants. Another part of the demand was for recreational opportunities for hunting, fishing, hiking, and tourists in rural settings where wildlife abound. Research priorities in these and many other areas continue to be appraised as conditions change.

Departmental Changes

Three notable changes in departmental organizations or involvement in research occurred during this period. The first represented a restructuring of departments, which reflected a realignment of subdisciplines and disciplines within agriculture. The second change was an expansion of the research effort in the relatively new Departments of Forestry, Wildlife, and Fisheries; Ornamental Horticulture and Landscape Design; and Food Technology and Science. The third change represented the contributions of departments within the new College of Veterinary Medicine using competitive grants, special grants, and limited formula funding in the solution of animal health problems.

In 1972, the Department of Agronomy and the Department of Horticulture were realigned primarily into the Department of Plant and Soil Science and the Department of Ornamental Horticulture and Landscape Design. Personnel involved in the breeding and/or production of fruit and vegetable crops were moved from the horticultural department into the new plant and soil science department while former agronomists with a background in ornamental horticulture and landscape design were assigned to that new department.

During the same year, the four departments of animal husbandry and veterinary science, dairying, food technology, and poultry were combined into two new departments—Animal Science, and Food Technology and Science. Those personnel with a background in meats and dairy manufacturing were assigned to the Department of Food Technology and Science, while personnel with training in animal production were placed in the Department of Animal Science. Even though research on forest tree breeding and forest management had been underway on a limited basis for over a decade in Tennessee, the establishment of the Department of Forestry, Wildlife, and Fisheries strengthened these programs. Especially noticeable was the increased effort to improve the quality of species such as

pinus and poplars as well as the Christmas tree industry. Habitat and life cycle studies of wildlife and fish were followed with a great deal of interest by landowners, hunters, fishers, and tourists.

The growing ornamental nursery industry in Tennessee with markets throughout the country was enhanced by the research within the Department of Ornamental Horticulture and Landscape Design on breeding and production of these products. Other floral landscape businesses, along with consumers with interest in improving the aesthetic values of life, benefitted from research on flowers, turf grasses, and landscaping techniques and designs.

The research program in the Department of Food Technology and Science was strengthened in the areas of food safety, food quality, and new product development and evaluation. An example of the role played by the department in research in food safety occurred in 1977 when a severe outbreak of aflatoxin caused severe grain losses and animal deaths in the southeastern states. Previous research findings led to methods for preventing grain contamination and the detoxification of contaminated feeds.

After the College of Veterinary Medicine was established, personnel in five of the six departments obtained some funding for animal health research. Those departments represented animal science (veterinary component), environmental practice, microbiology, pathobiology, and rural practice.

Several departments underwent name changes during this period. Agricultural biology became entomology and plant pathology; child development and family relations became child and family studies; nutrition became food science, nutrition and food systems administration; information became agricultural communications; and, textiles and clothing became textiles and fashion merchandizing. Two other departmental names were deleted including physics and food science and institutional management, with their personnel moved into other units.

The names of departments and department heads serving during the period 1966 through

1990 where the total research science year exceeded one full-time worker are indicated.

AGRONOMY

L. F. Seatz (XX-1972)*

HORTICULTURE

B. S. Pickett (XX-1972)

PLANT & SOIL SCIENCE

L. F. Seatz (1972-84)

J. E. Foss (1985-XX)**

ORNAMENTAL HORTICULTURE & LANDSCAPE DESIGN

D. B. Williams (1972-81)

G. D. Crater (1982-XX)

ANIMAL HUSBANDRY

C. S. Hobbs (XX-1971)

DAIRY

J. T. Miles (XX-1971)

POULTRY

O. E. Goff (XX-1971)

ANIMAL SCIENCE

S. L. Hansard (1972-73)

R. R. Johnson (1974-81)

D. O. Richardson (1982-88)

K. R. Robbins (1989-XX)

AGRICULTURAL BIOLOGY

S. E. Bennett (XX-1974)

C. J. Southards (1974-79)

ENTOMOLOGY & PLANT PATHOLOGY

C. J. Southards (1980-XX)

AGRICULTURAL ECONOMICS & RURAL SOCIOLOGY

T. J. Whatley (XX-1972)

J. A. Martin (1972-88)

Handy Williamson, Jr. (1988-XX)

FOOD TECHNOLOGY & SCIENCE

M. J. Johnston (XX-1971)

J. T. Miles (1972-85)

H. O. Jaynes (1985-XX)

AGRICULTURAL ENGINEERING

J. J. McDow (XX-1973)

D. H. Luttrell (1973-91)

F. D. Tompkins (1991-XX)

FORESTRY, WILDLIFE, & FISHERIES

J. W. Barrett (XX-1977)

Gary Schneider (1977-85)

G. T. Weaver (1986-XX)

FOOD SCIENCE & INSTITUTIONAL MANAGEMENT

G. E. Goertz (XX-1973)

NUTRITION

Mary Rose Gram (XX-1973)

FOOD SCIENCE, NUTRITION, & FOOD SYSTEMS ADMIN.

Mary Rose Gram (1974-76)

R. E. Beauchene (1977-81)

B. R. Carruth (1981-88)

INFORMATION

R. L. Hamilton (XX-1969)

AGRICULTURAL COMMUNICATIONS

R. L. Hamilton (1970-72)

Fletcher Sweet (1973-74)

G.W.F. Cavender (1975-81)

B. J. Reed (1982-83)

B. P. Riechert (1985-XX) (TAES)

Between 1966 and 1990 the number of full-time equivalent (FTE) scientists fluctuated between 100 and 110, depending primarily upon retirements and general funding levels. In recruiting

*XX- indicates period prior to 1966.

**XX indicates period after 1990.

new staff members, special attention was given to filling positions within subject-matter areas having a high priority in research. Approximately 30 technicians were added during this period to support the scientists' research endeavors, and most of these individuals held either an undergraduate or master's degree. Upgrading of support personnel at all levels was encouraged.

Facilities Added

Three major buildings were added to what is commonly called the "Agricultural Campus" during this period.

The first facility completed was the Plant Sciences Building, later named the Ellington Plant Sciences Building in honor of former Governor Buford Ellington. Completed in 1968, this building provided most of the office space, laboratories and class rooms for four departments—namely, Plant and Soil Science; Entomology and Plant Pathology; Ornamental Horticulture and Landscape Design; and Forestry, Wildlife, and Fisheries.

The largest facility, which was completed in 1976, was for the new College of Veterinary Medicine. This facility included space for housing the Institute of Agriculture Library, which was later named the Pendergrass Library in honor of the late Webster Pendergrass who served the University in many capacities.

The Agricultural Engineering Building, completed in 1981, represented the last major facility constructed before 1990. It provided modern laboratories and class rooms for that department.

BRANCH STATIONS

During the period 1966 through 1990, one additional station, the Forestry Experiment Station, joined the previously described 10 stations across the state in serving Tennesseans. Research at each of these stations was concentrated primarily upon the crop and livestock enterprises either

grown within or believed adapted to the geographic area they represented. Upgrading of buildings and facilities, laboratories, and instruments continued to be a major goal. Brochures were developed outlining the principal research activities underway at each of these stations.

West Tennessee Experiment Station

A staff of about 10 professional scientists representing the Departments of Plant and Soil Science, Entomology and Plant Pathology, and Agricultural Engineering were located at this station in Jackson, Tennessee, which was established in 1907, and continued research on production of major crops such as cotton, soybeans, and vegetables. The increased acreage of soybeans grown in the area focused attention on development of cyst nematode resistant varieties. Methods for controlling insects, diseases, and weeds in crops while protecting the environment received attention. The dairy herd was discontinued in the late 1980s with that area of research shifted to other existing stations with dairy cattle. This allowed for a greater concentration on crop research at Jackson.

The building of a new major facility known as the West Tennessee Center for Agricultural Research, Extension, and Public Service on the station in the late 1980s added a new dimension to the research program.

Ben P. Hazlewood, who had served as superintendent of this station since 1929, retired in 1970. He was succeeded by D. M. Gossett, who had served as an assistant agronomist with the Agricultural Extension Service. In 1972, Gossett was appointed assistant dean of the Agricultural Experiment Station and moved to Knoxville. Haywood W. Luck, who held a master's degree with a major in agronomy and who was an associate professor in plant and soil science, with the Agricultural Extension Service, Jackson, was appointed superintendent of the station to succeed Gossett. In 1977, Luck returned to the Agricultural Extension Service as district supervisor and

James F. Brown, who was an assistant professor in the Department of Plant and Soil Science and who held a doctorate with a major in horticulture, was appointed superintendent.

Middle Tennessee Experiment Station

Evaluation of different forage crops, production and breeding programs on both beef and dairy cattle, and the production and management of fruit and vegetable crops highlighted the research at this station located at Spring Hill near Columbia, Tennessee. One of the first studies on the use of shelled corn in fattening cattle was conducted at this location. About 2,000 peach trees, including four varieties using different spacing, trellis, and sprinkling systems, were planted to determine the adaptability of this crop in the Central Basin of Tennessee. Other fruit and vegetable crops being studied are grapes, apples, strawberries, raspberries, blackberries, tomatoes, cantaloupes, watermelons, and pumpkins.

Superintendent Joe High says the station gained status in the 1980s by having a new nationally-known neighbor arrive—the new Saturn Automobile Plant.

Tobacco Experiment Station

The Tobacco Experiment Station has been known since its establishment in 1932 for pioneering research on breeding and development of disease resistant burley tobacco varieties. In 1986, the variety *Tennessee 86* was released. It was recognized as the only commercial burley variety in the world with resistance to the PVY group of tobacco virus diseases. Screening of burley tobacco breeding lines for resistance to black shank and other diseases represented a major effort at the station. Studies conducted between 1966 and 1990 on increasing production and marketing efficiencies with tobacco resulted in an estimated 40 percent decrease in labor required to produce an acre of tobacco. Other research conducted on

major crops grown in Upper East Tennessee included variety testing; disease, pest, and weed control procedures; and cultural methods used.

Animal research was directed toward improving the reproductive ability of the Hereford cattle as well as evaluating different sources and stages of maturity of silages used as feed in beef production. Grazing tests were also conducted on endophyte-free Kentucky 31 fescue.

Three changes were made in superintendents at this station during this period. Hugh Felts retired in 1974 and Donald D. Howard, who held a doctorate from Auburn University with a major in soil chemistry and who was an associate professor in plant and soil science with the Agricultural Extension Service, was appointed to this position. In 1981, Howard transferred as a faculty member in plant and soil science to the West Tennessee Experiment Station and Philip P. Hunter, who held a doctorate from Virginia Polytechnic Institute and State University with a major in plant pathology and who was an assistant professor in entomology and plant pathology, became superintendent.

Highland Rim Experiment Station

The Highland Rim Experiment Station continued to be known for its research in the breeding and production of dark tobacco and the production of beef using the cow-calf system.

Several new varieties of dark-fired tobacco were released as a result of the work done at this station—*DF-300* in 1967, *DF-911* in 1976, and *DF-485* in 1985. These new varieties were more resistant to black shank and/or black root rot than many of the older varieties grown in the region. Both conventional and tissue culture techniques of breeding were used.

The use of higher quality forages such as endophyte-free fescue for grazing and cost effective storage of large round bale packages of hay was emphasized in studies. Several problems of grass tetany developed with cattle, and preventive and treatment techniques were used.

Research on the adaption of annual and perennial flower varieties and lawn turfgrass species received considerable attention.

Lawson Safley, the superintendent of this station since 1952, retired in 1986. Dennis Onks, who held a doctorate with a major in animal science and who was the superintendent of an agricultural experiment station in Missouri, was appointed the new superintendent in 1986.

The moment in history that will be remembered most vividly by those living on the station at the time was April 27, 1970, at 3:19 p.m. when a tornado devastated the landscape. Fortunately, no lives were lost, but property damage was estimated at \$255,000.

Plateau Experiment Station

The Plateau Experiment Station, established in 1943, continued to be known for its research on fruit and vegetable crops, especially green beans, apples, blueberries, grapes, tomatoes, and cabbage.

This station became a site for measuring water quality. Studies were conducted to monitor and measure run-off of fertilizer and pesticides using different tillage and cultural practices on crops grown.

With the development of the "Grassland Farm" beef cattle production utilizing high quality forage crops became a major research activity.

A swine feeding research facility was added to the station during this period. Tennessee, and especially the Cumberland Plateau, had long been known for its many farmers who produced feeder pigs, usually in small numbers, and shipped them out of the state for feeding to slaughter weights. The purposes of the new facility were to purchase feeder pigs from many of the growers and study the problems of diseases, nutrition, and growth-rate as the pigs matured toward slaughter weights. The results of this work were expected to encourage more farmers to produce market hogs rather than feeder pigs.

J. A. Odom served as superintendent until

1972 when he retired, and Robert D. Freeland, who was serving as an associate professor in the Agricultural Extension Service and held a doctorate in plant and soil science, was appointed superintendent.

Dairy Experiment Station

This station has been known for its dairy management research program. The station has one of the largest and highest milk-producing Jersey herds in the world involved in research.

Experiments in management have highlighted the importance of high quality forages in rations, dairy cattle breeding, heifer replacement, and controlling mastitis and other health problems.

Management of dairy waste as it affects water quality has received major attention at the station.

John R. Owen, who served as superintendent, retired in 1987 after serving 29 years. He was succeeded in 1988 by Henry H. Dowlen, who held a master's degree with a major in dairying and who was an assistant professor in animal science located at this site at Lewisburg.

Ames Plantation

The Ames Plantation, consisting of more than 18,000 acres, represented most of the major soil types in West Tennessee and offered a unique opportunity to conduct experiments from plot size to large field size and often involving large numbers of animals. For example, three systems of swine production were evaluated including: farrowing in portable houses in small pastures and finishing animals on pasture; farrowing in central house and finishing animals on pasture; and total confinement in environmentally controlled buildings. Some of the factors evaluated were breeding, nutrition, stress, and profitability.

Intensive cattle grazing experiments were conducted over a 25-year period in 45 specially equipped 3-acre pastures where both forage crops and the response of cattle were studied.

Forestry research included hardwood forest regeneration and evaluation of superior hardwood and pine seed orchards, while thousands of acres of loblolly pine stands established on eroded cotton fields in the 1950s and 1960s could be observed.

Studies on the compatibility of no-till commercial agriculture and wildlife seemed appropriate at the location where the National Field Trials have been held since 1915. Among the wildlife studied were bobwhite quail, white tail deer, and beavers.

Equally as important have been the crop variety and fertility trials, herbicide performance evaluations, and quality measures of both surface and groundwater.

The performance of the model farms program involving a pilot farm and several tenant-operated farms was observed, recorded, and published for use by other farmers where appropriate, and this work was terminated after about 10 years in operation.

Ruben H. Scott served as manager of the Ames Plantation from 1933 through 1965. During this time he served as secretary of the National Field Trial Association from 1933 until 1964 when he was elevated to its presidency, and he guided the Ames Plantation through its transition as a part of the Hobart Ames Foundation. James M. Bryan, the assistant manager, became manager in 1966. In 1972 his title was changed to superintendent as a joint employee of the Will Trustee and The University of Tennessee. In 1976, James M. Anderson, who was on the staff as an agricultural economist with Mississippi State University and who held a doctorate in agricultural economics, was appointed associate superintendent. When Bryan retired, Anderson was appointed superintendent in 1979. R. J. Carlisle, who held a doctorate with a major in plant and soil science, was appointed assistant superintendent in 1982 and promoted to associate superintendent in 1991.

Milan Experiment Station

In 1975 the Milan Experiment Station received an additional 25 acres of land, which were declared surplus by the Milan Army Ammunition Plant subject to the same conditions that existed in obtaining the original tract. A clear title to the original tract of 488 acres was obtained in 1982, and a lease was obtained on an adjoining tract of 200 acres of crop land for research purposes.

Row crops including corn, cotton, soybeans, and wheat were studied on such components as row width, plant population, seed treatments, dates of planting, fertilizer rates, insect and disease control, and plant growth regulators. In the area of soil conservation, experiments were conducted on rates of erosion associated with different cropping systems following minimum and no-tillage operations. In studies relating to environmental quality, studies were conducted on use of low-volume sprayers, no-till planters and drills, fertilizer placement with no-till crops, and pesticide movement near the soil surface and into shallow groundwater.

One of the major events on this station for a number of years has been the Milan No-Till Field Day, regularly attended by 3,000 to 6,000 people.

The untimely death of Tom McCutchen, the superintendent, occurred in 1983. John F. Bradley, who held a master's degree with a major in extension education and who was an associate extension agent and leader in Lake County, was appointed superintendent in 1983.

Martin Experiment Station

Between 1966 and 1990 about 130 acres of the station were absorbed into the expanded campus at Martin. Three tracts of land were added to the station, resulting in a net gain of 43 acres for a total of 700 acres in 1990.

Research was conducted on row crops and forage production systems within northwest Tennessee. Livestock research in dairy nutrition,

cow-calf management systems for beef cattle with emphasis on reproduction efficiency, and swine farrow-to-finish systems were evaluated.

O. G. Hall, who returned to the Knoxville Campus as Dean of Resident Instruction in the College of Agriculture, was replaced as head of the department at Martin in 1967 by Harold J. Smith, who held a doctorate with a major in animal husbandry and was a professor in the animal husbandry and veterinary science department in Knoxville. In 1969 Smith's title was changed to Dean when the name of the Department of Agriculture was changed to the School of Agriculture at the Martin Campus. In 1981 Harry A. Henderson, who held a master's degree in agricultural economics from UT Knoxville, was appointed superintendent of this station when this position was separated from that of the dean of the UTM School of Agriculture.

Knoxville Experiment Station

Previously the various tracts of land included in this station during the 1941 through 1965 period were described under a similar heading. Since that time two additional tracts were added. The first, identified as the Small Grain Unit, was obtained in 1973 as surplus property from the United States Department of Agriculture and consisted of 92 acres. This site was utilized for small grain breeding and variety evaluations. Herbicide interaction and management in small grain production was also observed and studied. The isolation of this tract enhanced some breeding studies for both corn and soybeans. The second tract, known as the Holston Unit, was acquired in 1974 as surplus property from the state and consisted of 425 acres. Most of this land was used in a cross-breeding program on beef cattle where grasses comprised the complete nutrition base. A phase of this work was devoted to grass tetany management and prevention in beef cattle.

Including the Small Grain and Holston Units, a total of 3,131 acres of land located in Knox and Blount counties served as a laboratory for most of

the research scientists working on agricultural problems at headquarters in Knoxville. These scientists, especially those engaged in basic research, prefer to conduct the work near their headquarters where they can observe the experiments frequently. This basic research may be directed toward changing the composition of plants and/or animals to satisfy consumer needs, but may require 10 years or more to achieve this goal. These changes may represent increasing the protein content of a plant one or two percent or decreasing the fat content of red meats by 10 percent. Experiments directed toward bringing about such changes require sophisticated equipment and management in breeding, producing, and monitoring changes as they occur. The resources on the Knoxville Station are dedicated to these purposes.

The superintendent, J. N. Odom, retired in 1975 and John Hodges III, who held a doctorate with a major in animal science, was appointed assistant superintendent in April 1975, and superintendent in October 1975.

Forestry Experiment Station

The Forestry Experiment Station was officially established and organized on the same basis as other stations in 1972 with headquarters at the arboretum located on the 2,260-acre Oak Ridge Forest in Oak Ridge, Tennessee. The arboretum consists of 250 acres featuring nature trails and a collection of more than 2,500 native and exotic woody plant specimens. It attracts more than 20,000 visitors annually.

Four Forestry Field Units in East and Middle Tennessee with a total of approximately 12,000 acres comprise the Forestry Experiment Station and serve as a laboratory for research in forestry and wildlife. In addition to the Oak Ridge Forest, the other three tracts include the Cumberland Forest consisting of 8,000 acres in Morgan and Scott Counties and established in 1947; the Friendship Forest established in 1947 on 680 acres of land leased from TVA and located near Chatta-

nooga; and the 860-acre Highland Rim Forest established in 1964 in Franklin County.

After the Cumberland Forest tract was transferred to the Agricultural Experiment Station, projects were initiated on strip-mine reclamation and the conversion of many sites to improved hardwood or pine plantations. In a similar manner, the Highland Rim Forest is located in a region known as the "barrens" where timber productivity is low. Here research is directed toward identifying tree species, sites, and silviculture systems to enhance forest productivity.

With the exception of the Friendship Forest, all other forest locations have a staff of two to four people available for implementing research activities as developed by project leaders in forestry and wildlife.

Richard M. Evans, who held a master's degree in forestry, was appointed superintendent of this station in 1972.

UT-AEC AGRICULTURAL RESEARCH PROGRAMS

The broad objectives of this program, when it was established in 1948 as previously described, continued until it was terminated in 1980. In 1973 Nathan S. Hall, director of the program, transferred to the Department of Agricultural Biology as a professor and Harry E. Walburg, who served as a scientist in the program and who held a degree in veterinary medicine, was appointed director. The title of the program was changed to UT-AEC Comparative Animal Research Laboratory (CARL) at that time. Later, officials of the U.S. Department of Energy, the primary agency funding the Laboratory, indicated that their national mission was shifting toward other priorities. By mutual consent, the Atomic Energy Commission and The University of Tennessee phased out the operation.

This unique program, which existed from 1948 through 1980, should be viewed as highly successful. Hundreds of scientists visited and/or worked at this laboratory and gained new insights

into the role of atomic energy both in war and peace upon the animal and plant food chain necessary for human survival. The scientists involved were prolific writers, and their work is well documented in scientific publications. Many of these scientists were on leave from federal establishments or universities while pursuing studies at the Oak Ridge laboratory, and they returned to their home bases to continue similar activities. Because of their capabilities some of these individuals were contacted for advice by the Russian Government when the melt down occurred in a major nuclear reactor in Chernobyl in 1986 and contaminated a large agricultural area.

ACCOMPLISHMENTS

Each new generation of scientists in the Tennessee Agricultural Experiment Station seems to be more highly trained than the previous generation. Some evidence of this during the 1966 through 1990 period is reflected by the increased productivity of the state's agriculture as measured by increased yields of crop and livestock enterprises. Other measures such as net farm income or standard of living of farm families may not be as reflective of this increased productivity since many of the benefits of research flow to consumers in general rather than producers.

Measuring the accomplishments of an individual scientist is difficult. Often his or her achievements prove fruitful several decades after science oriented or basic research proves valuable in solving a problem. Under these conditions, no examples of accomplishments have been listed for this period nor has recognition been given here to any scientist who is still living in 1990.

AGRICULTURAL RESEARCH IN RETROSPECT

The Tennessee Agricultural Experiment Station represents only one of the stations developed in each state in the country, as well as Puerto Rico, Virgin Islands, and Guam as an outgrowth of the establishment of the land grant college system with its research component more than a century ago. This joint venture between the federal and state government provides about one billion dollars funded annually by the public sector for agricultural research.

There are several good reasons for public funding of this research. First, there are approximately two million farmers in the country, and they do not have the capabilities nor the funds for this endeavor. Second, the demand for food is relatively inelastic, and when a breakthrough in research brings forth a big increase in food supply, the consumer often reaps more benefits than the producers. Third, agricultural research is becoming more science oriented or more basic in nature, and the costs are high while benefits may occur two or more decades in the future.

There are two characteristics of agricultural research that should be recognized, namely, its "spillover effects" and its "maintenance costs."⁴⁷

The results of research may be applicable only at the location where they were developed or they may be applied on a regional, national, or international scale. The application of research

results beyond the location where developed has been defined as "spillover effects." For example, the spillover effects of a new vaccine to control a livestock disease could be very broad and have national or international significance. Research accomplishments on livestock usually spread quicker and over a greater geographic area than for crops. Crops are more dependent upon soils, rainfall, temperature, and other climatic conditions than livestock and discoveries like new varieties are more restrictive in adaptability. The spillover effects from basic research are usually much greater than from applied research.

One of the characteristics of agricultural research is the "maintenance costs" associated with keeping current levels of productivity. For example, the costs of sustaining corn yields of 90 bushels per acre or milk production of 20,000 pounds per year for a dairy cow are entirely different than they were for 20 bushels per acre for corn and 5,000 pounds of milk per cow. The biological character of agriculture leads to a deterioration in productivity unless remedial action is taken. Both crop and livestock breeding

⁴⁷"Economic Evaluation of Agricultural Research," IR-6 Information Report No. 90-1, Department of Agricultural and Applied Economics, (University of Minnesota, May, 1990).

**“Few public investments of funds
can match the rate of return
from agricultural research.”**

have been directed toward selecting those traits which provide resistance to pests and diseases while maintaining or improving productivity, where possible. Other research activities have been directed toward the development of insecticides, herbicides, and cultural methods for suppressing pests. Breeding programs and new suppressants may alter the environment for pests, and their numbers may decrease, but usually new generations of pests will survive and increase, and the cycle for new controls must be repeated.

Maintenance costs for research have an impact on most areas of research in agriculture. The biological aspects of agriculture influence economic efficiency of food and fiber production at both the farm and national level. Agricultural policies must continuously be reviewed to assure consumers that the environment, as well as the food supply, is protected and safe.

“Research maintenance costs” are estimated to represent one-third to one-half of the total annual costs of conducting agricultural research.

After all this discussion about agricultural research, one final question seems appropriate: What has been the pay-off for this public investment?

Since 1950, more than 20 studies have been conducted, designed to estimate the annual rate of return on this investment. In the 1980s an interregional research project, identified as IR-6, was developed by many nationally- and internationally-known scientists. They reviewed the findings of these previous studies as part of their evaluation of public research in agriculture. Many of the participants had been involved in the earlier studies. The time span covered in these studies varied from a single year to several decades, while the annual rate of return on investment was calculated for some specific commodities, and also for particular types of research such as sci-

ence oriented (basic research), and technology oriented (applied research), and for different regions of the country. Since the Agricultural Extension Service is the educational arm responsible for delivering research results to the agricultural community, and it also is supported by public funds, the rate of return in the aggregate in most of these studies represented both the contribution of research and extension. It can be noted in Table 1 that most of these studies indicated an annual rate of return between 30 percent and 60 percent with a few exceeding 100 percent.⁴⁸

A strong publicly supported research program has aided in providing an abundant supply of food and fiber and in removing drudgery from agriculture in releasing millions of farm workers to pursue other occupations, which raised standard of living for most citizens. Few public investments of funds can match the rate of return from agricultural research.

⁴⁸“Public Research in Agriculture, Forestry and Home Economics, Its Role, Its Benefits and Selected Issues,” IR-6 Information Report No. 87-3, Department of Agriculture and Applied Economics, (University of Minnesota, November, 1987).

Table 1. Summary of Agricultural Research and Extension Productivity Studies for the U.S.

Study	Commodity	Time Period	Annual Internal Rate of Return (%)
Griliches, 1958	Hybrid Corn	1940-55	35-40
Griliches, 1958	Hybrid Sorghum	1940-57	20
Griliches, 1964	Aggregate	1949-59	35-40 (research & extension)
Latimer, 1964	Aggregate	1949-59	not. sig.
Peterson, 1967	Poultry	1915-1960	21-25
Evenson, 1968	Aggregate	1949-59	47
Schmitz and Seckler, 1970	Tomato Harvester	1958-69	16-28
Cline, 1975	Aggregate	1939-48	41-50 (research & extension)
(Revised by Knutson and Tweeten, 1979)		1949-58	39-47 (research & extension)
		1959-68	32-39 (research & extension)
		1969-72	28-35
Bredahl and Peterson, 1976	Poultry	1969	37
	Dairy	1969	43
	Livestock	1969	47
	Cash Grains	1969	36
Peterson and Fitzharris, 1977	Aggregate	1937-42	50
		1947-52	51
		1957-62	49
		1967-72	34
Evenson, 1979	Aggregate	1868-1926	65
	Technology Oriented	1927-50	
	Science Oriented	1927-50	95
	Science Oriented	1948-71	45
	Technology Oriented (South)	1943-71	130
	Technology Oriented (North)	1948-71	93
	Technology Oriented (West)	1948-71	95
	Farm Management and Agr. Extension	1948-71	110 (research & extension)
Davis, 1979	Aggregate	1949-59	66-100
		1964-74	37
White and Havlicek, 1979	Aggregate, South	1929-72	20 (research & extension)
White, Havlicek, and Otto, 1979	Aggregate	1929-41	54.7
		1942-57	48.3
		1958-77	41.7
Norton, 1981	Cash Grains	1968	31-57
	Dairy	1969	27-50
	Poultry	1969	30-56
	Livestock	1969	56-111
	Cash Grains	1974	44-85
	Dairy	1974	33-62
	Livestock	1974	66-132
Smith, Norton, and Havlicek, 1983	Cash Grains	1978	202
	Dairy	1978	25
	Poultry	1978	61
	Livestock	1978	22
White and Havlicek	Aggregate	1977-81	48
	By Region	1977-81	23-74
Braha and Tweeten	Aggregate	1959-82	47 (research & extension)

Source: "Economic Evaluation of Agricultural Research, IR-6, Information Report No. 90-1" Department of Agricultural and Applied Economics, (University of Minnesota, May, 1990). See next page for references.

References for Studies in Table 1:

- Braha, and L. Tweeten. Evaluating Past and Prospective Future Payoffs from Public Investment to Increase Agricultural Productivity." Technical Bulletin T-163, Agr. Exp. Sta., Oklahoma State University, September 1988.
- Bredahl, M. and W. Peterson. "The Productivity and Allocation of Research: U.S. Agricultural Experiment Stations." *Amer. J. Agr. Econ.* 58(November 1976), pp. 684-92.
- Cline, Philip L. "Sources of Productivity Change in the United States Agriculture." (Ph.D. dissertation, Oklahoma State University, 1979).
- Davis, Jeffrey S. "Stability of the Research Production Coefficient for U.S. Agriculture." (Ph.D. dissertation, University of Minnesota, 1979).
- Evenson, R. "The Contribution of Agricultural Research and Extension to Agricultural Production." (Ph.D. dissertation, University of Chicago, 1968).
- Evenson, Robert E., Paul E. Waggoner, and Vernon W. Ruttan. "Economic Benefits from Research: An Example from Agriculture." *Science*, 205(September 14, 1979), pp. 1101-7.
- Griliches, Z. "Research Costs and Social Returns: Hybrid Corn and Related Innovations." *J. of Pol. Econ.*, 66(1958) pp. 419-31.
- Griliches, Z. "Research Expenditures, Education and the Aggregate Agricultural Production Function." *Amer. Econ. Rev.* 54(December 1964), pp. 961-74.
- Latimer, R. "Some Economic Aspects of Agricultural Research and Extension in the U.S." Ph.D. dissertation, Purdue University, 1964).
- Norton, G.W. "The Productivity and Allocation of Research: U.S. Agricultural Experiment Stations, Revisited." *North Central J. Agr. Econ.* 3(January 1981): 1-12.
- Peterson, W.L. "Return to Poultry Research in the United States." *J. Farm Econ.*, 49(August 1967), pp. 656-69.
- Peterson, W.L. and J.C. Fitzharris. "The Organization and Productivity of the Federal State Research Systems in the United States," in *Resource Allocation and Productivity in National and International Agricultural Research*, Thomas M. Arndt, Dana G. Dalrymple, and Vernon W. Ruttan, Eds. (Minneapolis: University of Minnesota Press, 1977), pp. 60-85.
- Schmitz, A. and D. Seckler. "Mechanized Agriculture and Social Welfare: The Case of the Tomato Harvester." *Amer. J. Agr. Econ.*, 52 (November 1970). pp. 569-77.
- Smith, B., G. Norton, and J. Havlicek, Jr. "Impacts of Public Research Expenditures on Agricultural Value-Added in the U.S. and the Northeast." *J. of the Northeastern Agr. Econ. Council*, 12 (Fall 1983): 109-114.
- White, F. and J. Havlicek, Jr. "Rates of Return to Agricultural Research and Extension in the Southern Region." Staff Paper 79-2. Department of Agricultural Economics, VPI&SU, 1979.
- White, F. and J. Havlicek, Jr. "Optimal Expenditures for Agricultural Research and Extension: Implications of Underfunding." *Amer. J. Agr. Econ.*, 64(1982): 47-55.
- White, F., J. Havlicek, Jr. and D. Otto. "Fifty Years of Technical Change in American Agriculture," paper presented at the International Conference of Agricultural Economists, Banff Canada, September 3-12, 1979.

APPENDIXES

APPENDIX A:

THE HATCH EXPERIMENT STATION ACT

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science, there shall be established, under the direction of the college or colleges, or agricultural department of colleges, in each State or Territory established, or which may hereafter be established, in accordance with the provisions of an act approved July 2, 1862, entitled, "An act donating public lands to the several States and Territories which may provide colleges for the benefit agriculture and the mechanic arts," or any of the supplements to said act, a department to be known and designated as an "Agricultural Experiment Station;" *Provided,* That in any State or Territory in which two said colleges have been or may be so established the appropriation hereinafter made to such State or Territory shall be equally divided between such colleges, unless the legislature of such State or Territory shall otherwise direct.

SEC. 2. That it shall be the object and duty of said Experiment Stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotating cropping as pursued under a varying series of crops, the

capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories.

SEC. 3. That in order to secure, as far as practicable, uniformity of methods and results in the work of said Stations, it shall be the duty of the United States Commissioner of Agriculture to furnish forms, as far as practicable, for the tabulation of results of investigation or experiments; to indicate, from time to time, such lines of inquiry as to him shall seem most important; and, in general, to furnish such advice and assistance as will best promote the purposes of this act. It shall be the duty of each of said Stations, annually, on or before the first day of February, to make to the Governor of the State or Territory in which it is located, a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said Stations, to the said Commissioner of Agriculture, and to the Secretary of the Treasury of the United States.

SEC. 4. That bulletins or reports of progress shall be published at said Stations at least once in

three months, one copy of which shall be sent to each newspaper in the States or Territories in which they are respectively located, and to such individuals actually engaged in farming as may request the same, and as far as the means of the Station will permit. Such bulletins or reports and the annual reports of said Stations shall be transmitted in the mails of the United States free of charge for postage, under such regulations as the Postmaster General may from time to time prescribe.

SEC. 5. That for the purpose of paying the necessary expenses of conducting investigations and experiments, and printing and distributing the results, as hereinbefore prescribed, the sum of fifteen thousand dollars per annum is hereby appropriated to each State, to be especially provided for by Congress in the appropriations from year to year, and to each Territory entitled under the provisions of section eight of this act, out of any money in the Treasury proceeding from the sales of public lands, to be paid in quarterly payments, on the first day of January, April, July and October in each year, to the treasurer or other officer duly appointed by the governing boards of said college to receive the same, the first payment to be made on the first day of October eighteen hundred and eighty-seven; *Provided, however,* That out of the first annual appropriation so received by any station an amount not exceeding one-fifth may be expended in the erection, enlargement or repair of a building or buildings necessary for carrying on the work of such station; and thereafter an amount not exceeding five per centum of such annual appropriation may be so expended.

SEC. 6. That whenever it shall appear to the Secretary of the Treasury, from the annual statement of receipts and expenditures of any of said stations, that a portion of the preceding annual appropriation remains unexpended, such amount shall be deducted from the next succeeding annual appropriation to such station, in order that the amount of money appropriated to any station shall not exceed the amount actually and necessarily required for its maintenance and support.

SEC. 7. That nothing in this act shall be construed to impair or modify the legal relation existing between any of the said colleges and the government of the States and Territories in which they are respectively located.

SEC. 8. That in States having colleges entitled under this section to the benefits of this act, and having also Agricultural Experiment Stations established by law, separate from said colleges, such States shall be authorized to apply such benefits to experiments at Stations so established by such States; and in case any State shall have established, under the provisions of said act of July 2d aforesaid, an Agricultural Department or Experimental Station, in connection with any University, College, or institution not distinctively an agricultural college or school, and such State shall have established or shall hereafter establish a separate agricultural college or school, which shall have connected therewith an experimental farm or station, the legislature may apply, in whole or in part, the appropriation by this act made to such separate agricultural college or school; and no legislature shall by contract express or implied disable itself from so doing.

SEC. 9. That the grants of money authorized by this act are made subject to the legislative assents of the several States and Territories to the purposes of said grants; *Provided,* that payments of such installments of the appropriation herein made as shall become due to any State before the adjournment of the regular session of its legislature meeting next after the passage of this act, shall be made upon the assent of the Governor thereof, duly certified to the Secretary of the Treasury.

SEC. 10. Nothing in this act shall be held or construed as binding the United States to continue any payments from the Treasury to any or all States or institutions mentioned in this act, but Congress may at any time amend, suspend, or repeal any or all the provisions of this act.

APPENDIX B:

LAWS OF TENNESSEE, 1887

AN ACT empowering the Treasurer of the University of Tennessee to accept and apply certain grants of money authorized by an Act of the United States Congress, approved March 3d, 1887, and entitled, "An Act to establish Agricultural Experiment Stations in connection with the Colleges established in the several States under the provisions of an Act approved July 2d, 1862, and of acts supplementary thereto."

SEC. 1. *Be it enacted by the General Assembly of the State of Tennessee*, That the State of Tennessee hereby assents to the condition of An Act of the United States Congress, approved March 3d, 1887, entitled "An Act to establish Agricultural Experiment Stations in connection with the Colleges established in the several States under the provisions of An Act approved July 2d, 1862, and of Acts supplementary thereto," and authorizes the Treasurer of the University of Tennessee to accept any grants of money authorized by that Act in the State of Tennessee, and to give his official receipt for the same.

SEC. 2. *Be it further enacted*, That said grants of money to Tennessee shall, as a part of the Agricultural Fund, be committed to the Trustees of the University of Tennessee, now in charge of the State Experiment Station, there to be applied as the said Act of Congress directs, and all results and expenditures shall be reported in accordance with the provisions of the Act making the grants which is hereby accepted.

SEC. 3. *Be it further enacted*, That all laws in conflict with this Act be, and the same are hereby repealed.

Passed March 28th, 1887.

APPENDIX C:
SELECTED PHOTOGRAPHS FROM ANNUAL REPORTS
OF THE UNIVERSITY OF TENNESSEE
AGRICULTURAL EXPERIMENT STATION

**“Agricultural and Experiment
Station Building,” 1892 Annual
Report, front cover.**

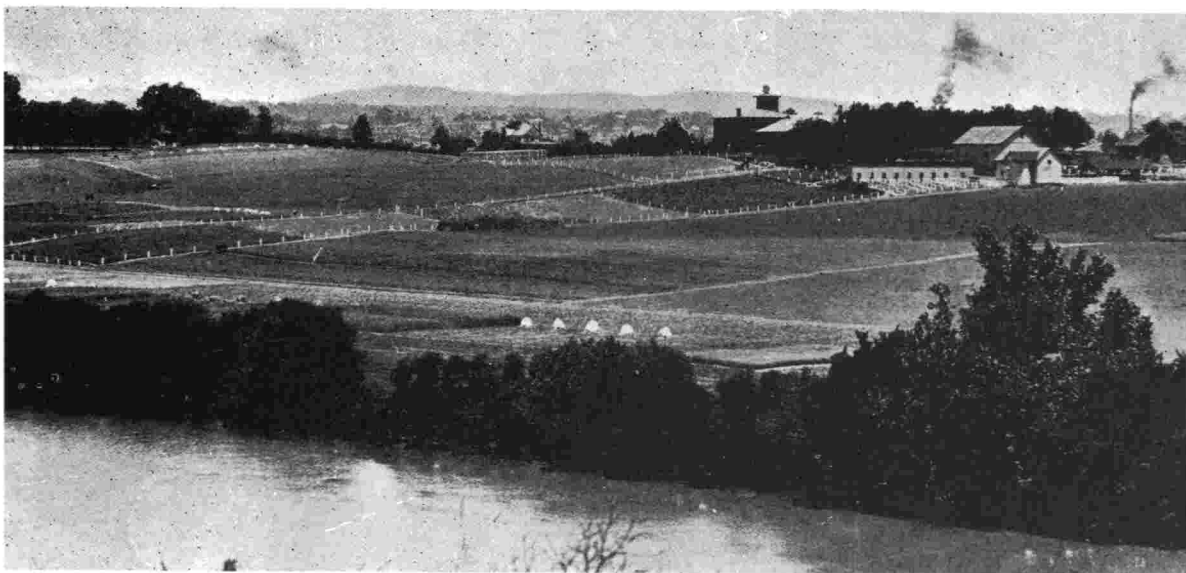


**“Taking soil sample, Madisonville,
Monroe Co.,” 1892 Annual Report,
page 14.**



“Agricultural Department, Plant House and Insectary, University of Tennessee,” 1897 Annual Report.

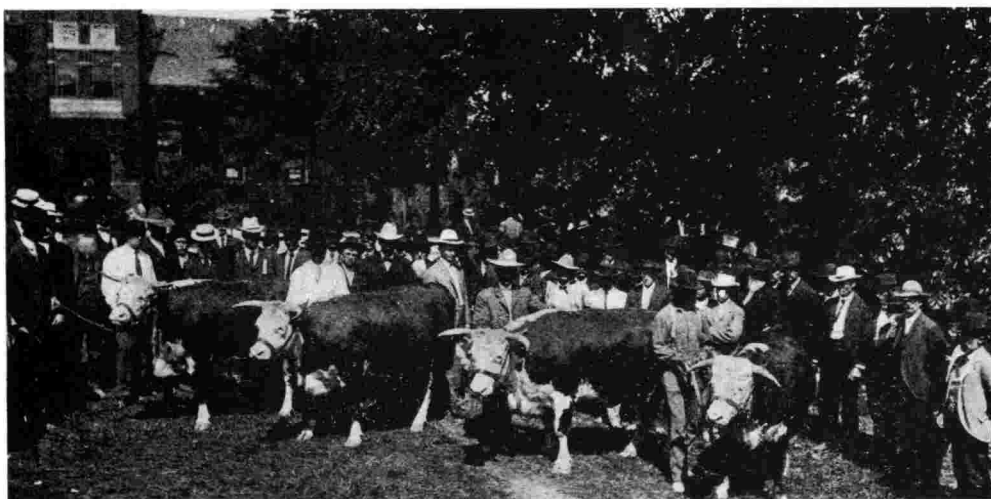
“View of the Experiment Station Farm from Across the Tennessee River,” 1907 Annual Report.



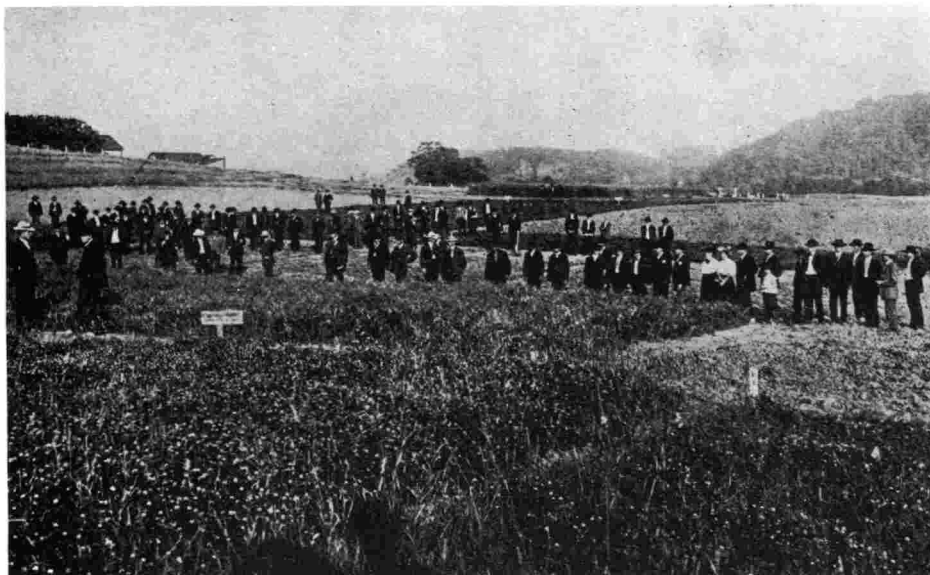


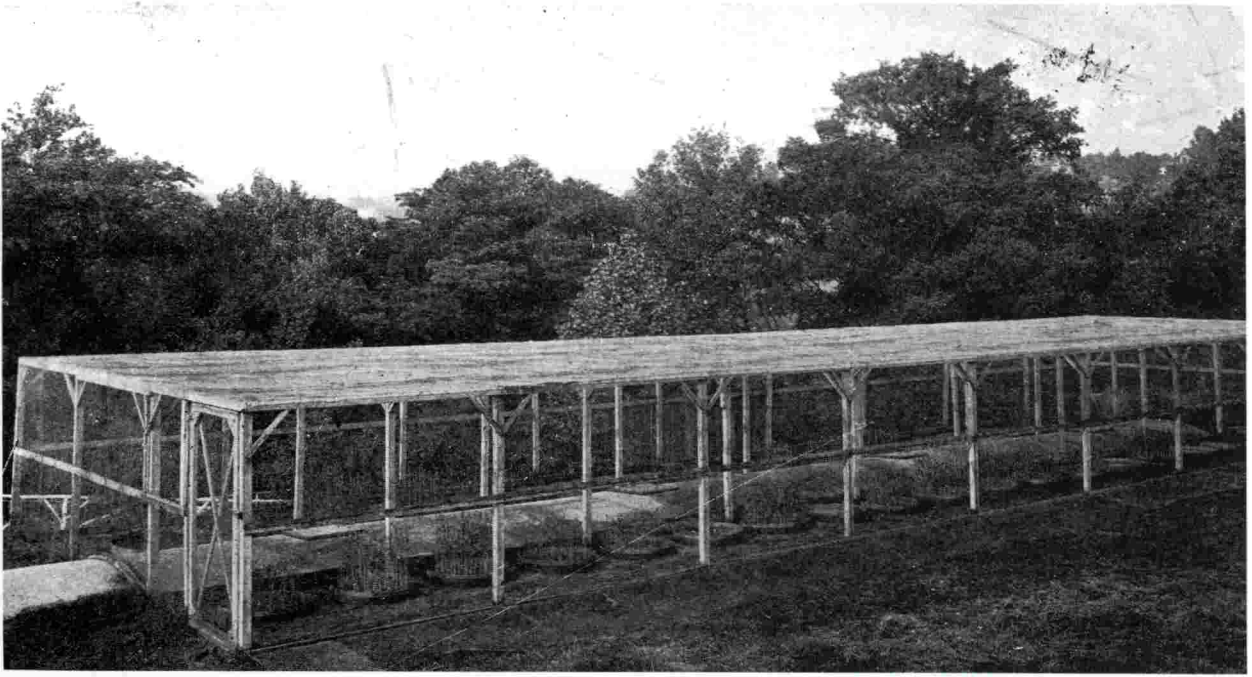
"East Tennessee Farmers' Convention Delegates in an Alfalfa Field, Experiment Station Farm," 1907 Annual Report.

"Hereford Cattle Exhibited During the Farmers' Convention Held at the University," 1910 Annual Report.

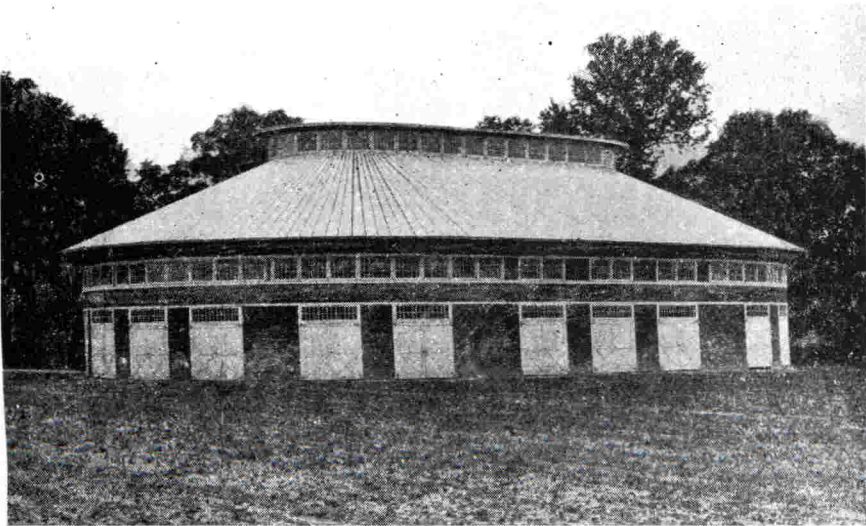


"Delegates of East Tennessee Farmers' Convention Examining Clover Plots, Experiment Station Farm," 1912 Annual Report.





"Pit System for Investigation of Soil Leachings," 1913 Annual Report.



"Auditorium and Implement Building at West Tennessee Experiment Station," 1915 Annual Report, inside front cover.



"Superintendent's Residence, West Tennessee Experiment Station, Jackson," 1919 Annual Report.

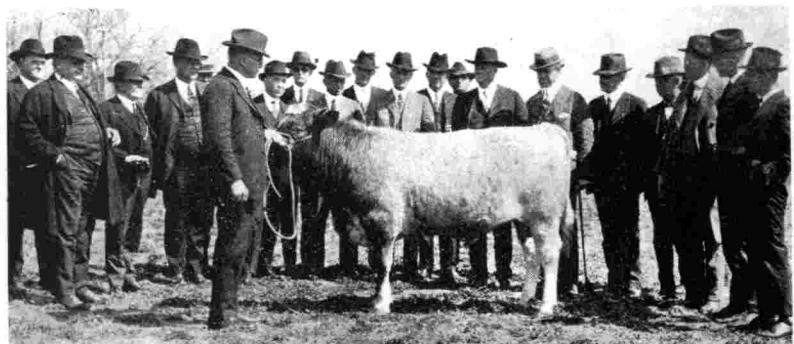
**“New Agricultural Building,”
1921 Annual Report.**

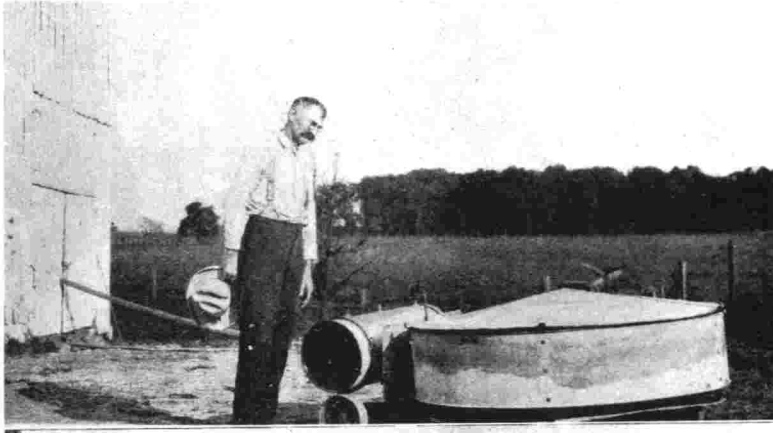


(Right) “Views at the West Tennessee Experiment Station, Jackson. Above, a few of the automobiles parked near the farm buildings during the 1924 Farmers’ Institute. Below, a typical Farmers’ Institute crowd looking over the field experiments.” 1924 Annual Report front cover.

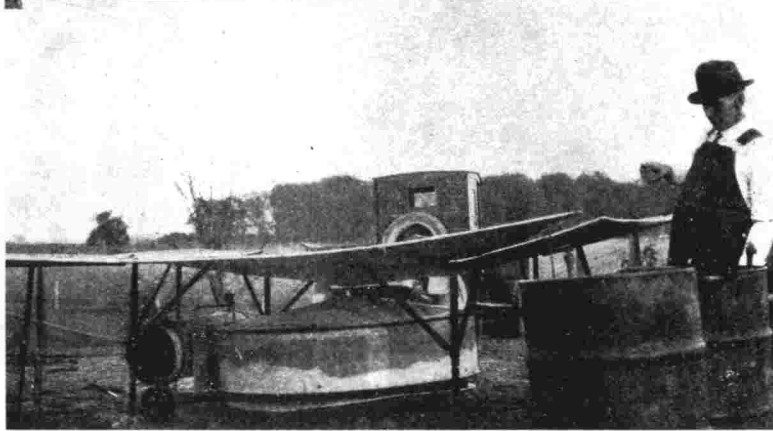


“Members of the Alabama Legislature Looking over the Jackson Station Livestock—President Morgan of The University of Tennessee in Charge,” 1924 Annual Report, page 32.





“Reynolds Tobacco-Curing Heater. Above, used on the farm of Henry Bryan; below, a later modification to spread the warm air. The results obtained in trials in Montgomery County were favorable.” 1924 Annual Report, page 18.



“Dusting Beans with Sodium Fluosilicate Mixed with Lime,” 1924 Annual Report, page 30.

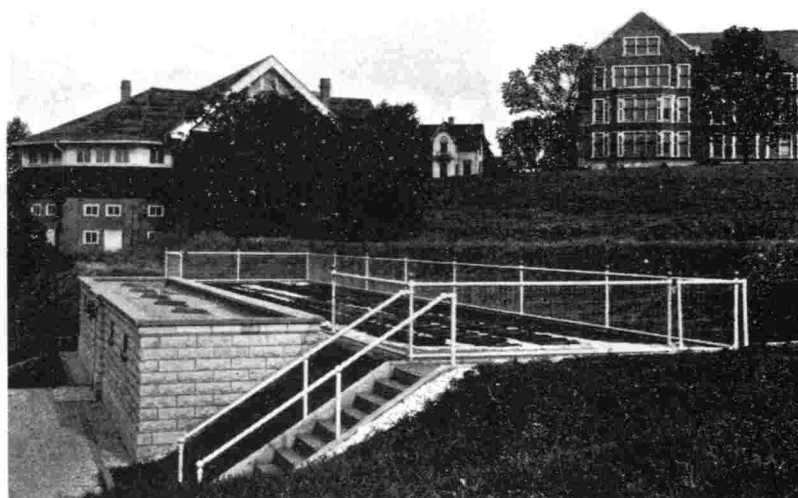


“Union University students, Jackson, inspecting horticultural work at the station,” 1926 Annual Report, page 15.



(Left) “Smith-Hughes students from Medina visit the Jackson Station,” 1926 Annual Report, page 20.

(Right) “Farmers inspecting the field plot experiments at the West Tennessee Experiment Station,” 1927 Annual Report, front cover.



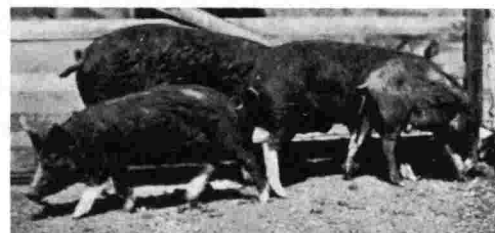
(Left) “The Fulton plant lysimeter plant. The new lysimeter plant is named in honor of the donor, Mr. Weston M. Fulton, a well-known inventor and manufacturer in Knoxville. The structure was begun in 1926, and completed in 1927, in time to be inspected by the members of the First International Society of Soil Science on their transcontinental tour,” 1927 Annual Report, page 42.



(Left) "A corner of the soils laboratory," 1928 Annual Report, page 19.

(Below, center) "Soil scientists from the First International Congress of Soil Science visit the lysimeters at the University Farm, June, 1927. Lysimeters are an important part of the Station's equipment for soil investigation," 1928 Annual Report, front cover.

(Below, right) "Hog-feeding experiment at Knoxville Station." Top photo, fed corn alone in dry lot, average gain per head, 28.6 pounds. Center photo, fed corn and tankage in dry lot. Average gain per head, 225.5 pounds. Lower photo, fed corn, tankage, and mineral mixture, on pasture. Average gain per head, 233.1 pounds. 1928 Annual Report, page 21.



(Left) "The biochemical laboratory," 1928 Annual Report, page 16.

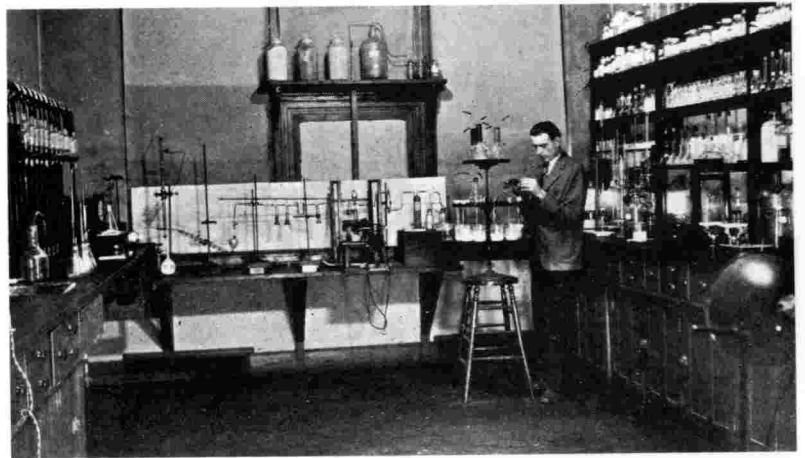
“West Tennessee farmers studying the plot experiments at the Jackson Station. Thousands of people visit this station every year,” 1928 Annual Report, page 48.



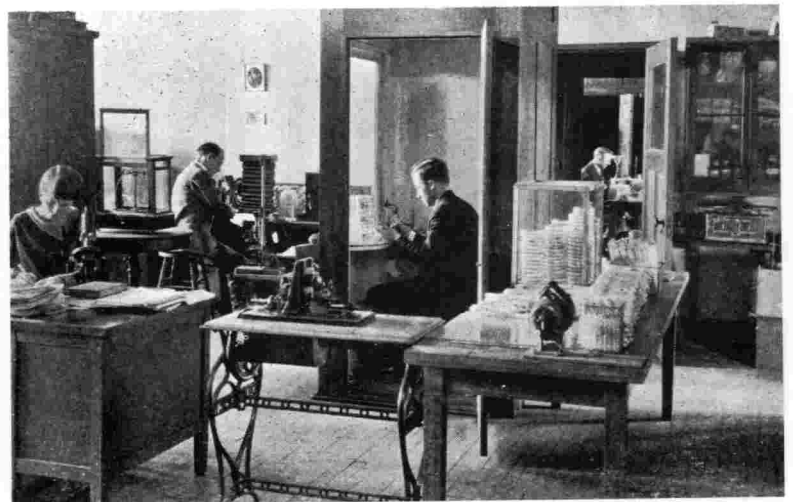
“Automobiles parked at the Jackson Station during a farmers’ convention,” 1928 Annual Report, page 48.

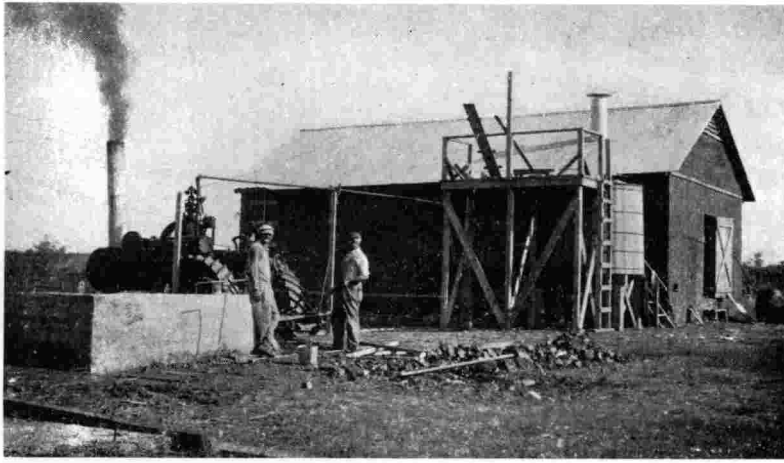


“Laboratory for the study of insecticides,” 1928 Annual Report, page 19.



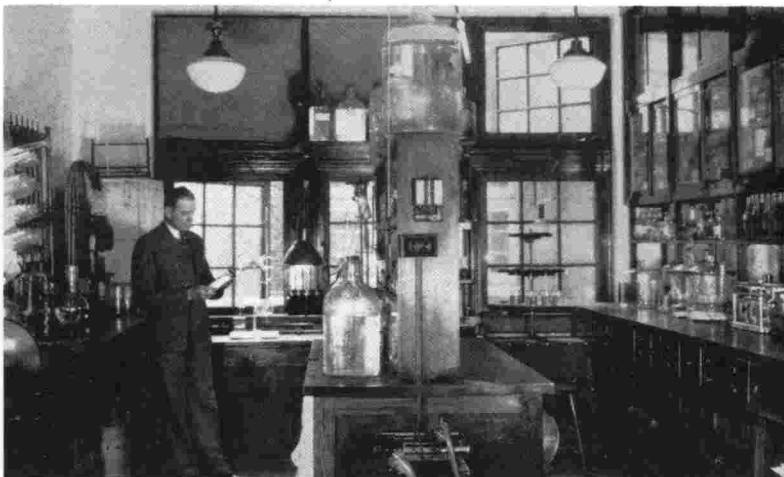
“Plant pathology laboratory. Plant diseases are studied here,” 1928 Annual Report, page 31.





“Experimental sorghum processing plant,” 1935 Annual Report, page 29.

(Below) “Farmers attending crops experiments at the West Tennessee Experiment Station, Jackson. A loud speaker mounted on a car makes possible effective explanation of the work to large groups of people,” 1936 Annual Report, front cover.

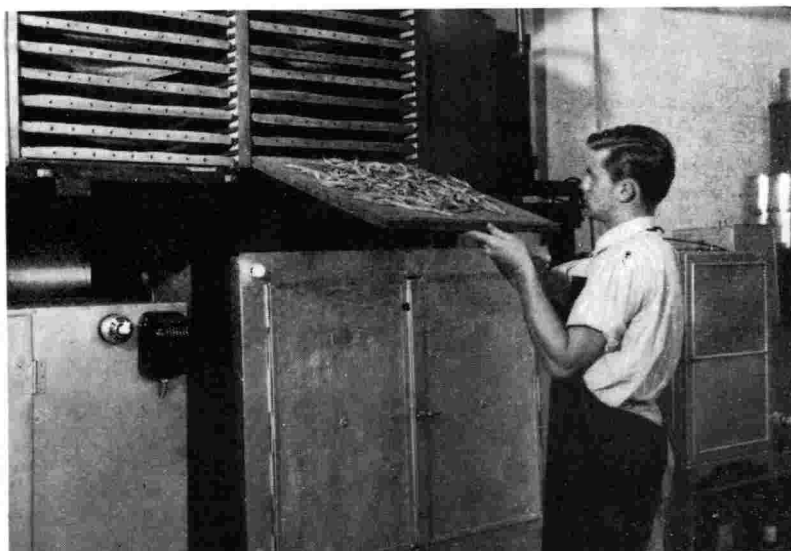


“Chemical laboratory for the study of sorghum sirup, cottonseed, and other farm products,” 1938 Annual Report, page 44.

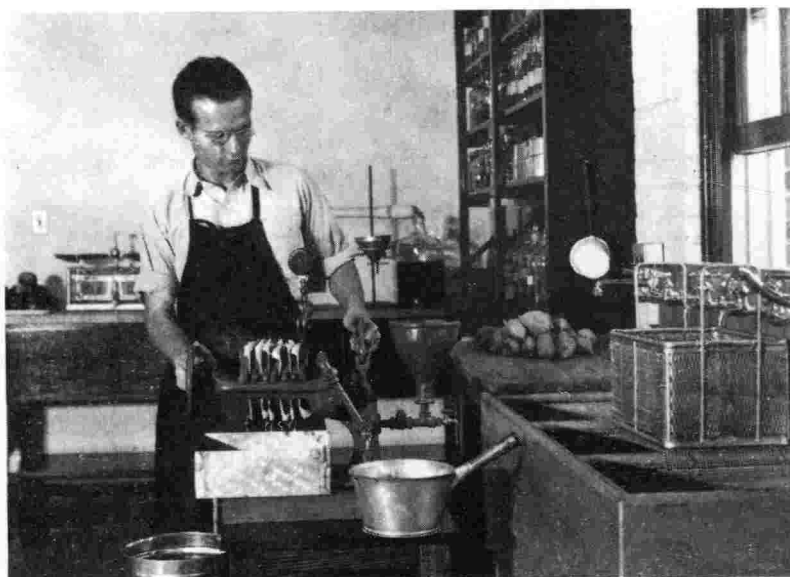
“Some of the experimental plots at Knoxville,” 1939 Annual Report, front cover.



“Food-processing laboratory: Dehydration experiments on fruits and vegetables,” 1940 Annual Report, page 56.

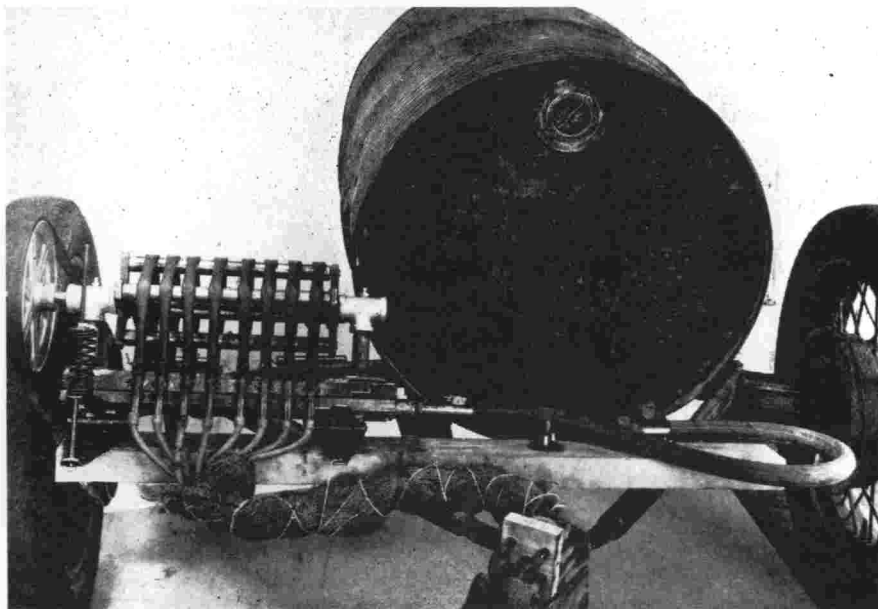


“Food-processing laboratory: Preparation of juices and other products from fruits and vegetables,” 1940 Annual Report, page 57.



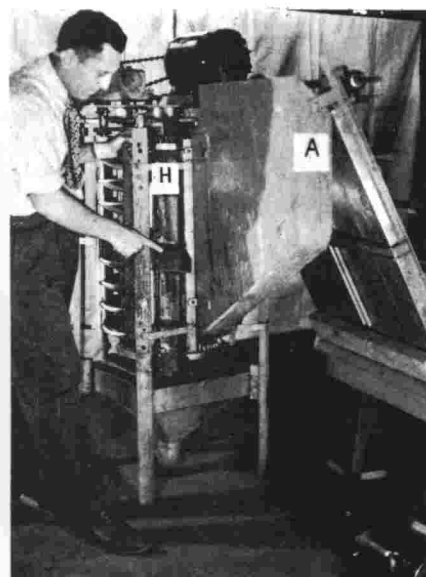
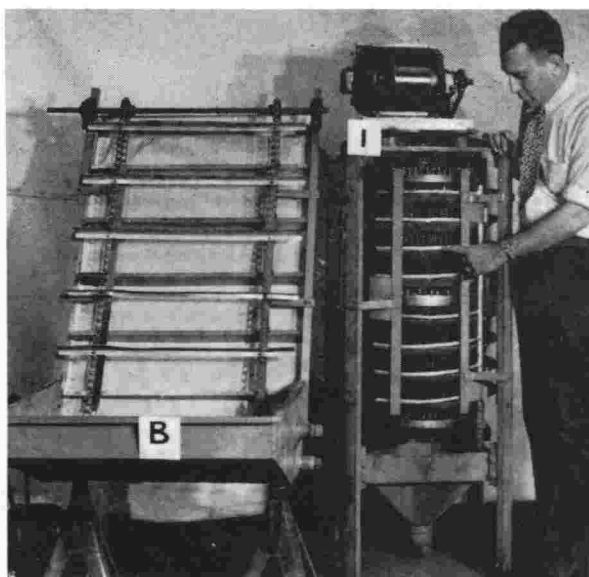


"Fiber research laboratory, showing operators measuring fiber length with the fibergraph (left), fiber fitness with the arealometer (center), and fiber strength with the Pressley instrument (right). Such tests also are made available to the industry through the Fiber Testing Service, thus combining research with its application," 1941 Annual Report, front cover.



"Liquid fertilizer distributor: pump and tank mounted on trailer," 1943 Annual Report, page 27.

(Below, left): "Front view of strawberry capper." (Below, right): "Left side of strawberry capper. Uncapped strawberries enter the capper . . . and are propelled around the rotating, vertical, capping drum, where capping takes place." 1947 Annual Report, pages 33 and 34.



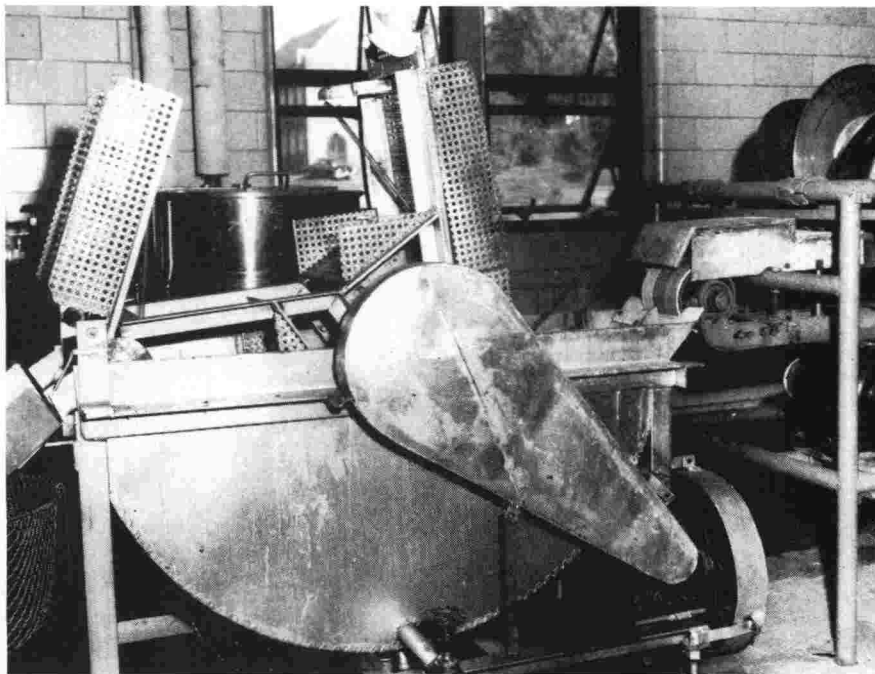
**“McCord Hall and Dairy
Industry Buildings,”
1949 Annual Report, front cover.**



**“Cow Brand No. 88 was exposed [accidentally in the
Alamogordo, N.M. test] to radiation from the ‘first’ atomic
bomb. Performance of exposed cattle . . . [in 1949 was] being
carefully checked against control cattle,” 1949 Annual Report,
page 162.**

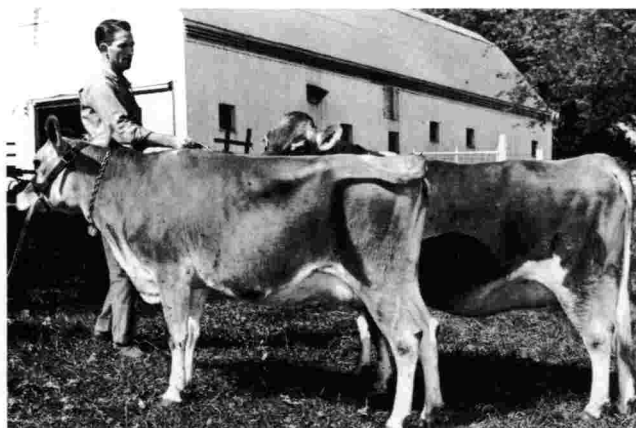


“Among speakers on the program dedicating the Frank S. Chance Administration Building were the leaders shown . . . [to the left]. They are, left to right, University of Tennessee President C. H. Brehm; James T. Granbery, Chairman of the Agriculture Committee, UT Board of Trustees; Experiment Station Vice Director Frank S. Chance (standing); Clyde B. Austin, Chairman of the Finance Committee; UT Board of Trustees; and Dean and Director J. L. McLeod, of the College of Agriculture, Experiment Station, and Extension Service.” 1951 Annual Report, page 112.



“Automatic dipping of fruits and vegetables into an anti-browning solution was achieved with development of this machine at the UT Agricultural Experiment Station,” 1951 Annual Report, page 14.

“Use Identical Twins in Dairy Experiments: This pair of identical twin Jerseys at first calving is typical of seven pairs used to compare fast fattening growth with leaner ‘normal growth.’ They differed 237 pounds in weight, but the leaner heifers outmilked the fat ones.” 1961-62 Annual Report, page 22.



(Right) “During the year, over 6,500 chicks were used in Agricultural Experiment Station broiler nutrition studies. The research included studies of fish meal levels, selenium toxicity, dried whey levels, and deficiencies in diets that contained large amounts of hydrolyzed feather meal.” 1964 Annual Report, page 38.



“This is a mechanical snap bean harvester owned by the Agricultural Experiment Station collecting samples for use in studying the effect of mechanical adjustments on the quality and efficiency of harvested snap beans. This harvester is also being used to evaluate the adaptability of several bean varieties for mechanical harvesting. The departments of Agricultural Engineering, Horticulture, Food Technology, and Agricultural Economics are involved in the snap bean research program, which was begun in 1964.” 1964 Annual Report, page 11.



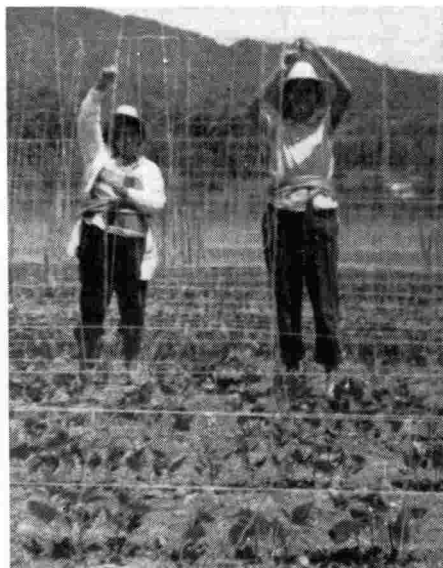


“During the winter of 1964-65, several investigators both here in Tennessee and in other states, found the alfalfa weevil could be controlled almost to harvest time by winter burning of stubble. Burning the stubble destroys eggs of the weevil. One factor that made this method impractical was the slow speed necessary with the hooded propane flame cultivator. Agricultural Engineering, Entomology, and Agricultural Economics researchers built a flamer on a bush hog frame, thus utilizing the body of the bush hog to contain the heat longer and allow a faster speed. Good results are obtained at speeds of 3 miles per hour and 40 pounds per square inch of propane gas. . . .” 1964 Annual Report, page 28.

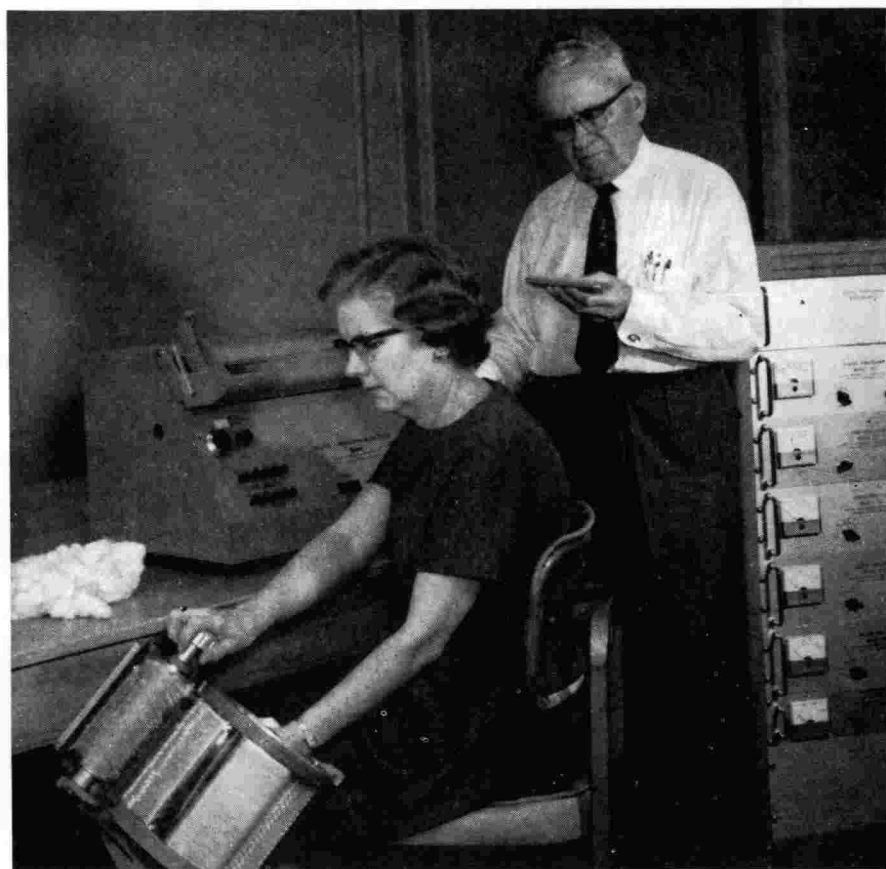


“Much of the research work in Agricultural Economics and Rural Sociology involves using research from other departments and obtaining basic information direct from farmers, food processors, farm supply firms, and farm units at the Ames Plantation. In the photo, data are being punched onto cards by a machine operator on the University of Tennessee agricultural campus. . . .Finally, guidelines and plans that can help farmers and agricultural business firms make management decisions will result from the computing process.” 1965 Annual Report, page 11.

“The sharp decrease in the supply of farm labor makes it desirable wherever feasible to substitute machines or other forms of capital for labor. For example, the Agricultural Economics and Rural Sociology Department has studied operations of food processing firms to determine the comparative costs for stretching wire and topping string for pole beans: A) manually and B) mechanically.” 1966 Annual Report, page 12.



“A digital fibrograph for measuring cotton fiber length is shown along with the transistorized control cabinet to the right. Samples are prepared for scanning with the fibrosampler in the left foreground. The digital model fibrograph is readily adaptable to automatic data acquisition.” 1967 Annual Report, page 41.





“Harvesting cotton plots with one-row spindle picker equipped with a special sacking attachment for collecting samples,” 1968 Annual Report, page 16.



“Potassium levels determine corn stalk strength and standability of corn for mechanized harvest. High levels of potassium produce strong stalks, very little lodging, and low mechanized harvest loss. Low levels of potassium result in weak stalks, increased lodging, and high mechanized harvest loss.” 1968 Annual Report, page 27.

“At Ames Plantation Field Station in West Tennessee, different patterns of resource organization have been established on eight farm units. Over a period of years, the net income resulting from each organization pattern will provide information that will be helpful to other farmers who have similar resources.” 1969 Annual Report, page 26.



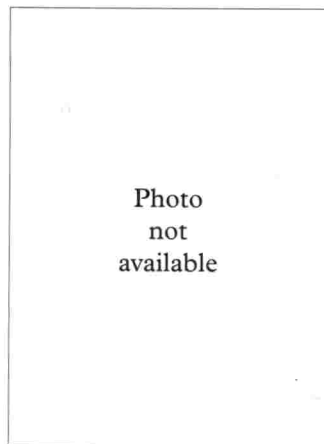


“The Agricultural Experiment Station has continually reported results of its research work through a variety of methods such as printed bulletins and field days at its Branch Stations. In 1965, the Middle Tennessee Experiment Station at Spring Hill hosted the Second National Grassland Conference and Field Day.” 1969 Annual Report, back cover.



Research by the Tennessee Agricultural Experiment Station in no-till production is known throughout the world and is featured at the annual Milan No-Till Field Day. Held the fourth Thursday of July each year, the Milan No-Till Field Day and Planting Equipment Demonstrations draw thousands of visitors from throughout the region and beyond. Aerial photo shows West Tennessee Agricultural Museum, satellite broadcast uplink, and exhibit tents. 1993 Annual Report.

APPENDIX D: ADMINISTRATORS OF THE TENNESSEE AGRICULTURAL EXPERIMENT STATION



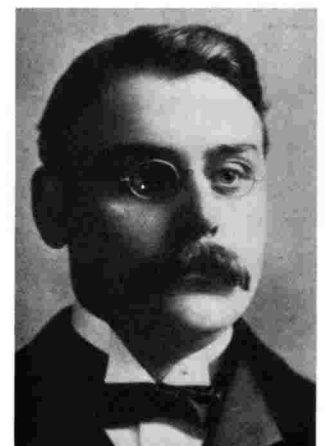
John W. Glenn
Director, 1882-1887



Charles W. Dabney
Director, 1887-1890;
1892-1903



F. Lamson Scribner
Director, 1890-1892



Andrew Soule
Director, 1903-1904



H. A. Morgan
Director, 1904-1923



C. A. Mooers
Vice Dir., 1919-1923
Director, 1923-1946



C. E. Brehm
Director, 1946-1948



J. H. McLeod
Director, 1948-1956



F. S. Chance
Asst. Dir., 1943-1946
Vice Dir., 1946-1956



John A. Ewing
Asst. Dir., 1950-1956
Director, 1957-1969
Dean, 1969-1976



Eric Winters
Assoc. Dir., 1955-1969
Assoc. Dean, 1969-72



D. M. Gossett
Asst. Dean, 1972-76
Dean, 1976-1987



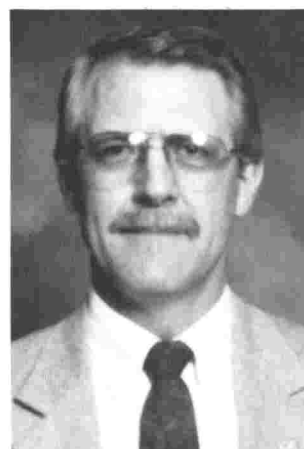
T. J. Whatley
Asst. Dean, 1972-76
Assoc. Dean, 1976-86



Don O. Richardson
Dean, 1988-



J. I. Sewell
Asst. Dean, 1977-1986
Interim Dean, 1987-88
Assoc. Dean 1986-



T. H. Klindt
Asst. Dean, 1986-90
Assoc. Dean, 1990-

Department of Agricultural Economics



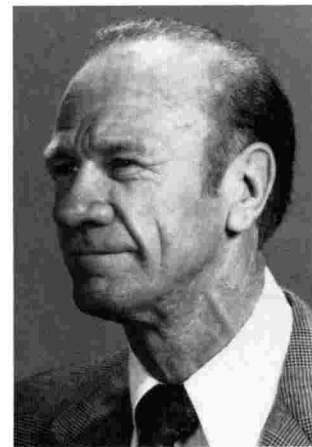
C. E. Allred
1919-1949



E. J. Long
1950-1955



T. J. Whatley
1958-1972

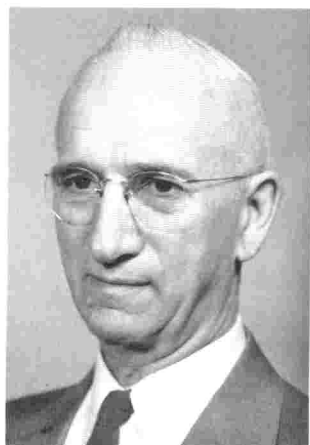


J. A. Martin
1972-1988



Handy Williamson, Jr.
1988-

Department of Agricultural Engineering



M. A. Sharp
1938-1955



C. W. Bockhop
1957-1959



J. H. Anderson
1960-1961



John J. McDow
1962-1973



D. H. Luttrell
1973-1991



Fred D. Tompkins
1991-

Department of Animal Science



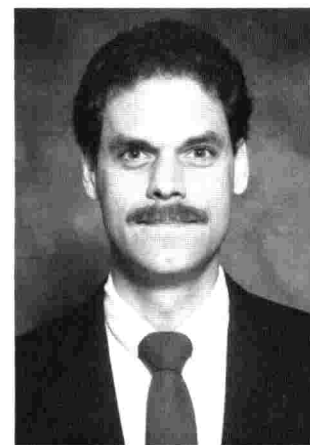
S. L. Hansard
1972-73



R. R. Johnson
1974-1981



D. O. Richardson
1982-1988



K. R. Robbins
1989-



M. Jacob
Dept. Ani. Husbandry
1941-1942



C. S. Hobbs
Dept. Ani. Husbandry
1947-1971



C. E. Wylie
Department of Dairy
1943-1959



J. T. Miles
Department of Dairy
1960-1971



O. E. Goff
Department of Poultry
1947-1971

Department of Communications



A. J. Sims
1943-1959



R. L. Hamilton
1960-1972



Fletcher Sweet
1973-1974



G. W. F. Cavender
1975-1981

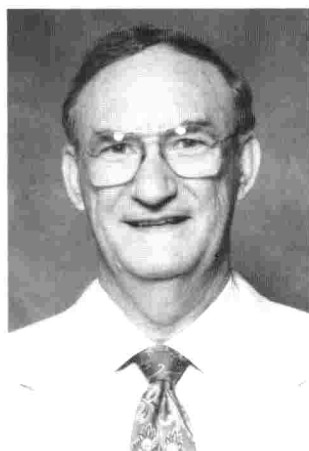


B. J. Reed
1982-1983



Bonnie P. Riechert
1985-

Department of Entomology and Plant Pathology



C. J. Southards
1974-



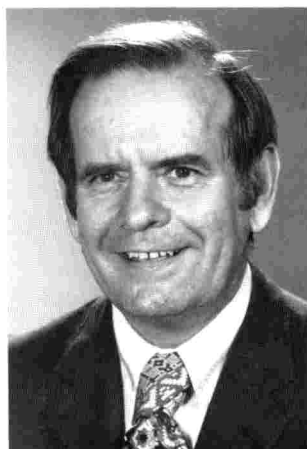
C. D. Sherbakoff
Department of
Plant Pathology
1933-1949



Simon Markovitch
Department of
Entomology
1933-1958



J. O. Andes
Department of
Plant Pathology
1950-1964



S. E. Bennett
Department of
Agricultural Biology
1965-1974

Department of Food Science and Technology



M. J. Johnston
1957-1971



J. T. Miles
1972-1985



H. O. Jaynes
1985-1993

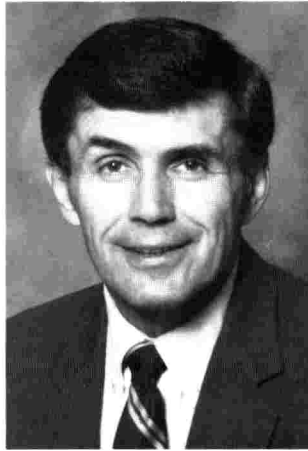


M. P. Penfield, Acting
1993-

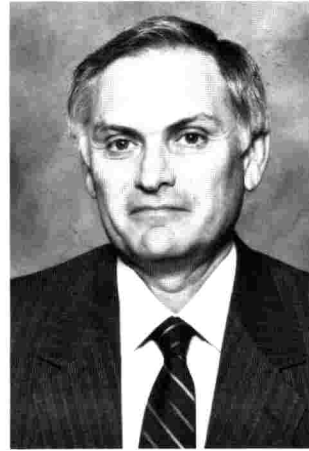
Department of Forestry, Wildlife, and Fisheries



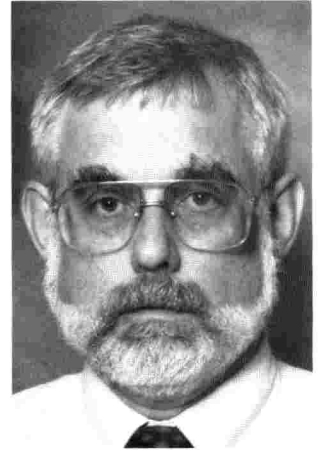
J. W. Barrett
1964-1977



Gary Schneider
1977-1985



George T. Weaver
1986-1993



John C. Rennie, Acting
1993-

College of Human Ecology



Florence L. MacLeod
Asst. Dir. for Home Ec.
Research, 1947-1961



Ruth A. Highberger
Child Dev. & Family
Relations, 1962-1969



Grayce E. Goertz
Food Sci. & Inst. Mgmt.
1965-1973



Anna Jean Treece
Textiles & Clothing,
1962



Mary Rose Gram
Nutrition, 1964-1973
Food Sci., Nutr., & Food
Sys. Admin., 1974-1976



R. E. Beauchene
Food Sci., Nutr., & Food
Sys. Admin., 1977-1981



Betty Jean Carruth
Food Sci., Nutr., & Food
Sys. Admin., 1981-1988



Jim Moran
Prof. and Assoc. Dean
1989-



Michael Zemel
Nutrition
1990-



Nancy Fair
Textiles, Retailing,
and Int. Design, 1991-

Department of Ornamental Horticulture and Landscape Design



Don Williams
1972-82



G. D. Crater
1982-



B. D. Drain
Department of
Horticulture
1941-1946

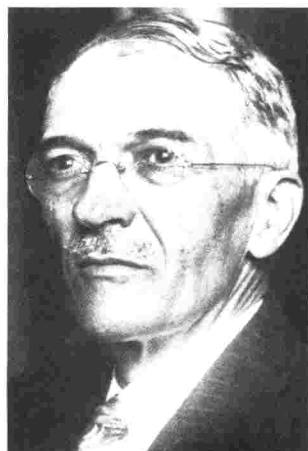


N. D. Peacock
Department of
Horticulture
1947-1949



B. S. Pickett
Department of
Horticulture
1950-1972

Department of Plant and Soil Science



C. A. Mooers
1933-1945



Eric Winters
1946-1954



L. N. Skold
1955-1960



Lloyd F. Seatz
1960-1984



J. E. Foss
1985-



N. J. Hancock
Department of
Botany
1947-1962



W. H. MacIntire
Department of
Chemistry
1933-1954



G. A. Schuey
Department of
Chemistry
1955-1958

Ames Plantation



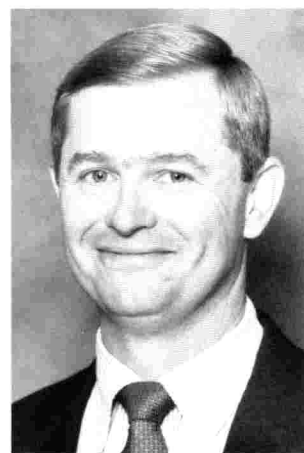
Ruben H. Scott
Supt., 1932-1965



James M. Bryan,
Asst. Mgr., 1951-1965
Mgr., 1965-1972
Supt., 1972-1979

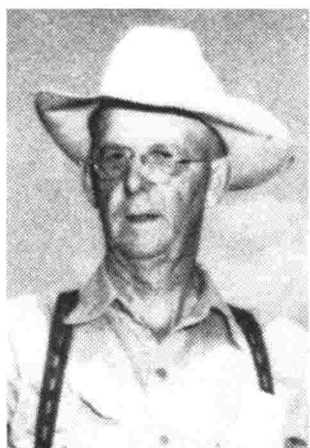


James M. Anderson
Assoc. Supt., 1976-79
Supt., 1979-



R. J. Carlisle
Asst. Supt., 1981-91
Assoc. Supt., 1991-

Dairy Experiment Station



A. G. Van Horn
Supt., 1939-1958



John Owen
Supt., 1958-1987



Henry Dowlen
Supt., 1988-

Forestry Experiment Station

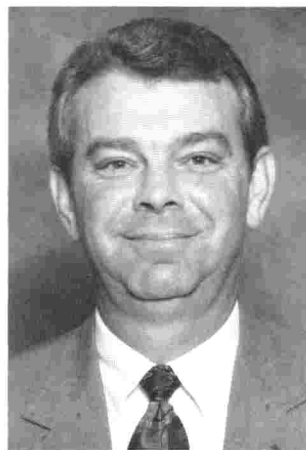


Richard Evans
Supt., 1972-

Knox Experiment Station



J. N. Odum
Supt., 1944-1975

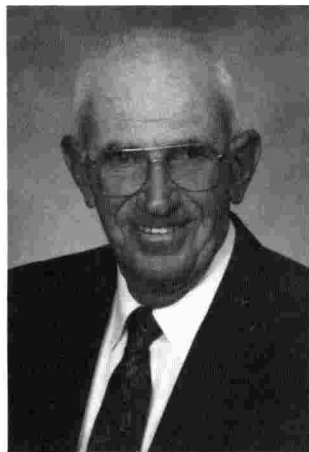


John Hodges III
Supt., 1975-



Robert A. Reynolds,
Asst. Supt., 1987-

Highland Rim Experiment Station



Lawson M. Safley
Supt., 1952-1986



Dennis O. Onks
Supt., 1986-

Martin Experiment Station



O. Glenn Hall
Supt., 1965-1967



Harold J. Smith
Supt., 1967-1981



Harry A. Henderson
Supt., 1981-

Middle Tennessee Experiment Station



L. R. Neel
Supt., 1922-1946



John A. Ewing
Supt., 1946-1950



E. J. Chapman
Supt., 1950-1964

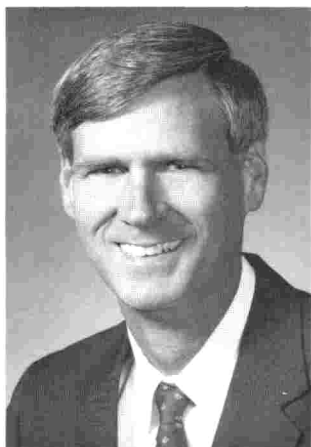


Joe W. High Jr.
Supt., 1964-

Milan Experiment Station



John C. McCutchen
Supt., 1962-1983



John F. Bradley
Supt., 1983-



John Odum
Supt., 1947-1972



Robert D. Freeland
Supt., 1972-

Plateau Experiment Station

Tobacco Experiment Station



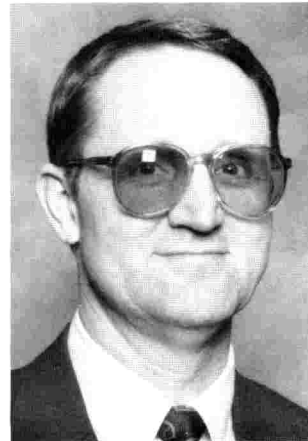
F. S. Chance
Supt., 1942-1943



J. Hugh Felts
Supt., 1946-1974



Donald D. Howard
Supt., 1974-1981



Phillip P. Hunter
Supt., 1981-

West Tennessee Experiment Station



Ben P. Hazelwood
Supt., 1929-1970



D. M. Gossett
Supt., 1970-1972



Haywood W. Luck
Supt., 1971-1977

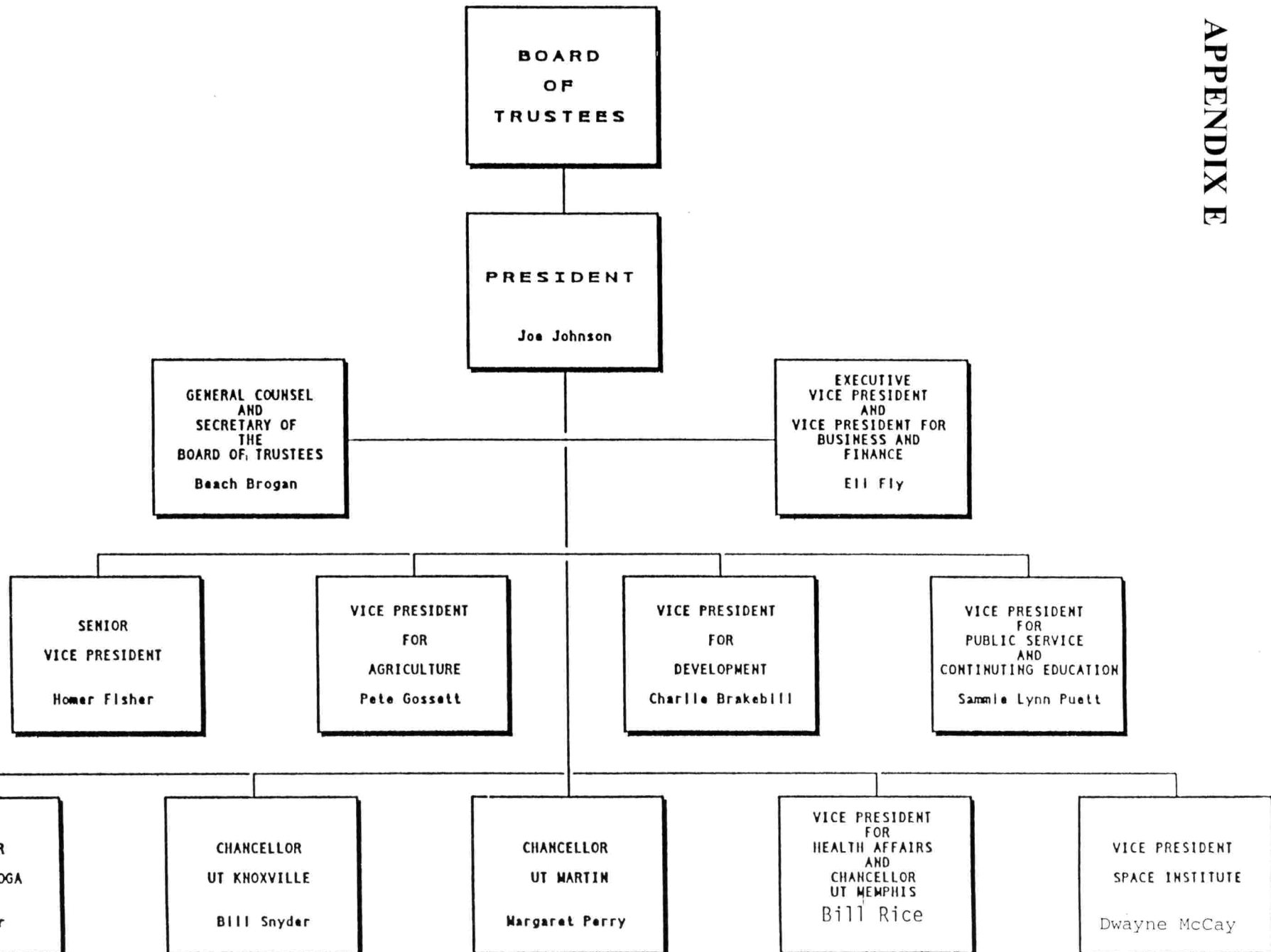


James F. Brown
Supt., 1977-

Not pictured:
S. A. Roberts
Supt., 1909-1929

SYSTEM ADMINISTRATION

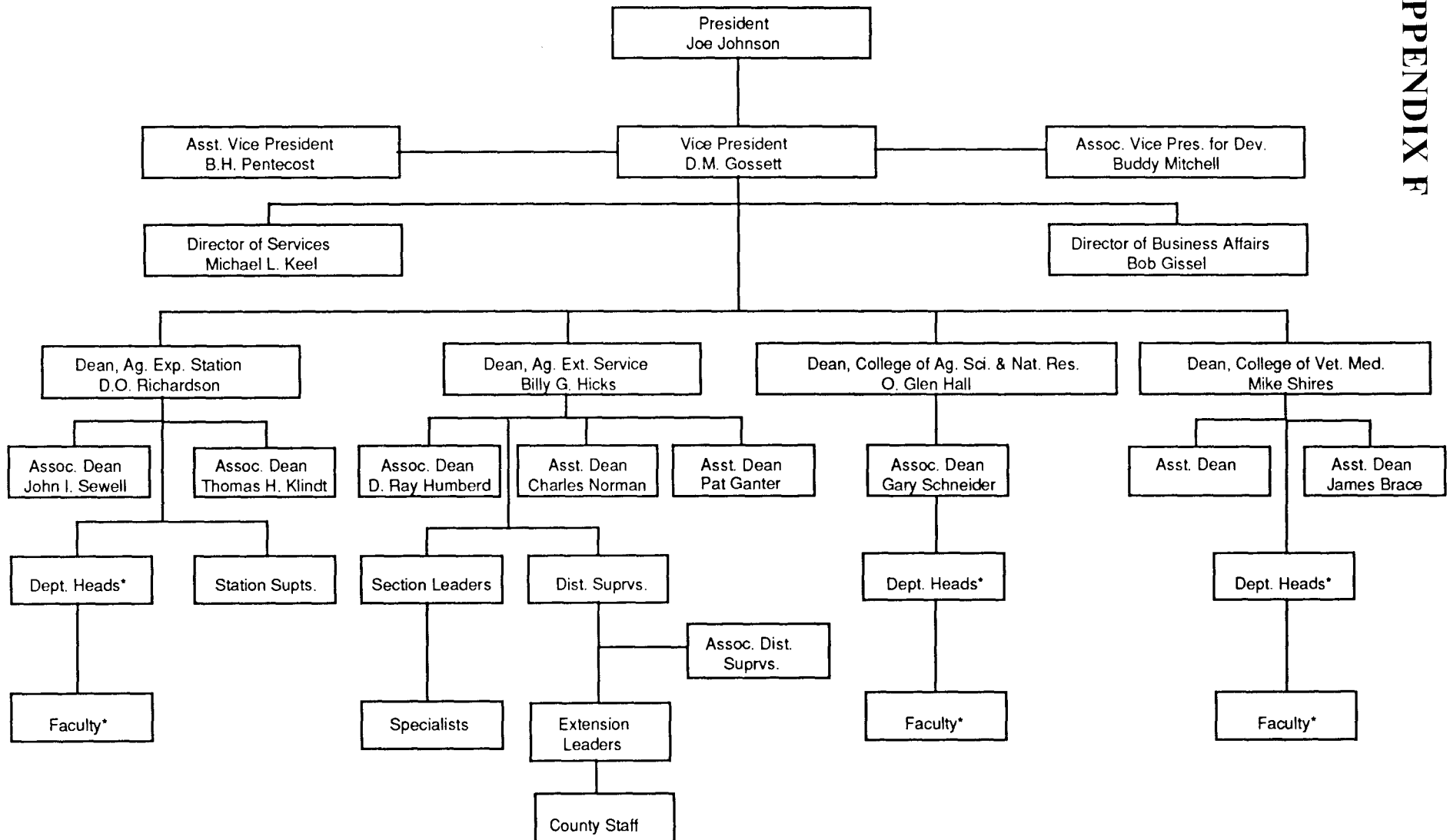
APPENDIX E



THE UNIVERSITY OF TENNESSEE

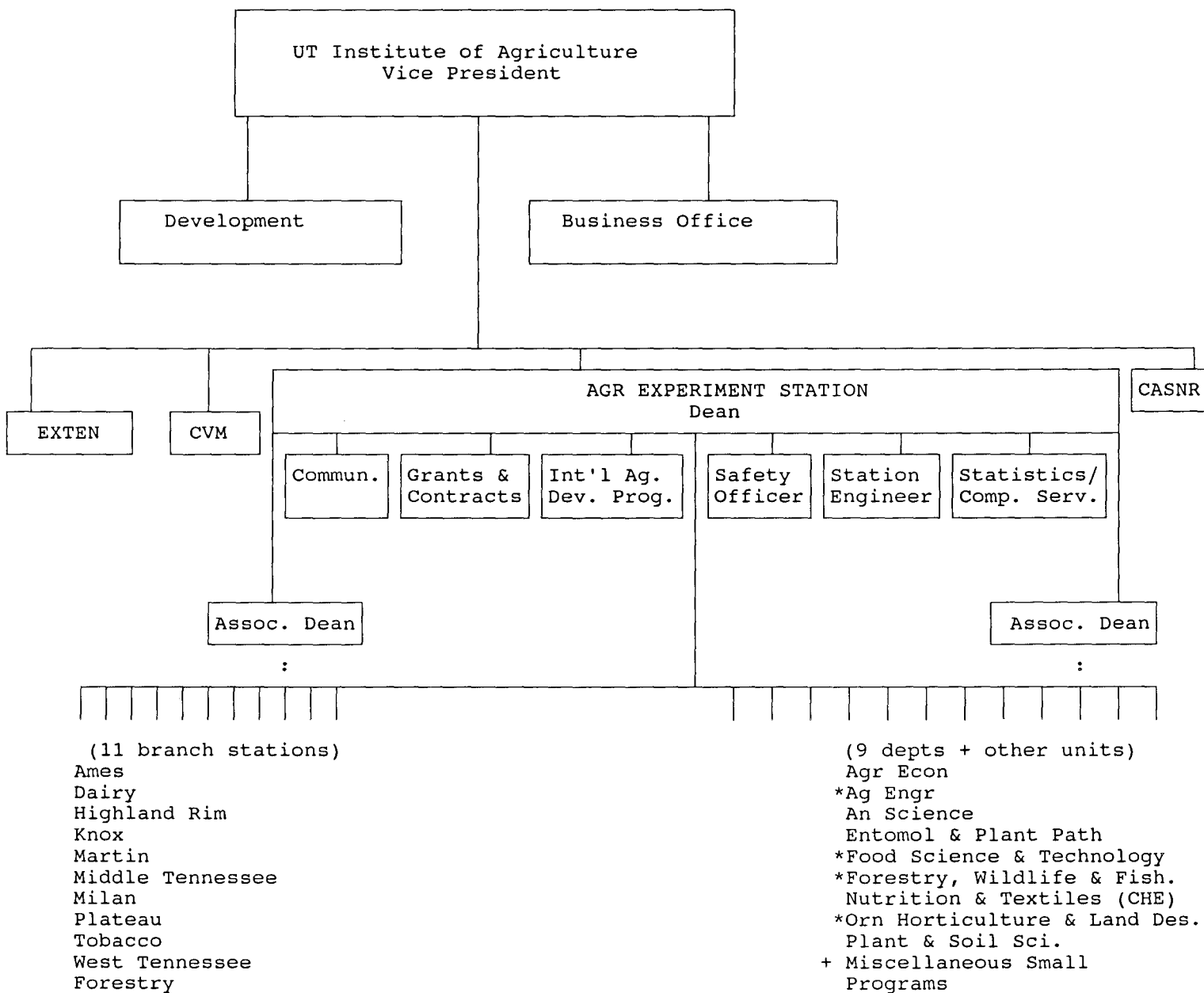
Institute of Agriculture

APPENDIX F



*Joint Appointments

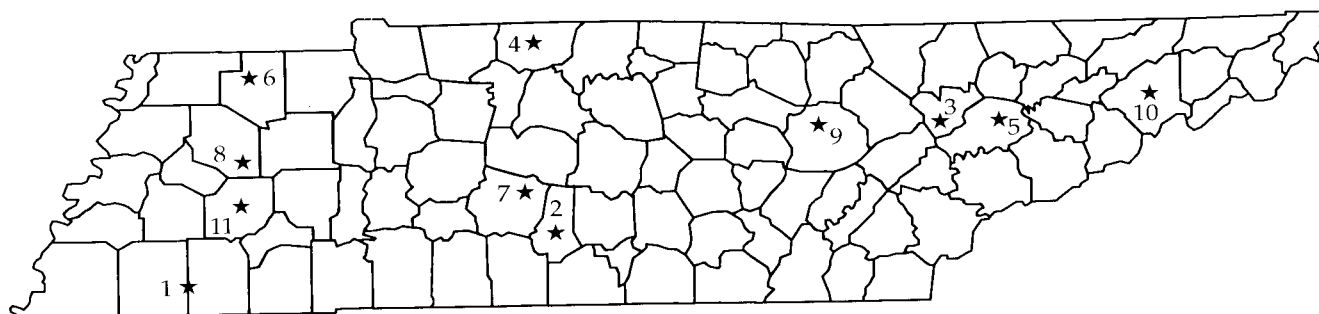
APPENDIX G: ORGANIZATIONAL CHART OF THE AGRICULTURAL EXPERIMENT STATION, 1994



*These depts. have an Extension mission in addition to Teaching and Research

APPENDIX H: STATION LOCATIONS IN THE TENNESSEE AGRICULTURAL EXPERIMENT STATION

Agricultural Experiment Station Research Centers



1. Ames Plantation

Fayette and Hardeman Counties, Grand Junction

2. Dairy Experiment Station

Marshall County, Lewisburg

3. Forestry Experiment Station

Anderson County, Oak Ridge

4. Highland Rim Experiment Station

Robertson County, Springfield

5. Knoxville Experiment Station

Knox County, Knoxville

6. Martin Experiment Station

Weakley County, Martin

7. Middle Tennessee Experiment Station

Maury County, Spring Hill

8. Milan Experiment Station

Gibson County, Milan

9. Plateau Experiment Station

Cumberland County, Crossville

10. Tobacco Experiment Station

Greene County, Greeneville

11. West Tennessee Experiment Station

Madison County, Jackson

