

RESEARCH *for* AGRICULTURE



TABLE OF CONTENTS

Department of Agricultural Chemistry	5
Department of Agricultural Economics	6
Department of Agricultural Engineering	9
Department of Animal Husbandry	11
Department of Dairy Husbandry	14
Department of Entomology	16
Department of Field Crops	18
Department of Forestry	22
Department of Home Economics	24
Department of Horticulture	25
Department of Poultry Husbandry	28
Department of Rural Sociology	30
Department of Soils	31
School of Veterinary Medicine	34

**UNIVERSITY OF MISSOURI
COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
J. H. Longwell, Director
BULLETIN 677 NOVEMBER 1956**

FOREWORD

November 1, 1956

The Importance of Agricultural Research

The Agricultural Experiment Station is the public agricultural research agency of the State of Missouri. The Director of the Station is also the Dean of the College of Agriculture and is directly responsible to the President of the University.

The diversity of Missouri soils, climate, weather, vegetation, types of farming and market facilities requires research closely adapted to these major variations. Nearly every kind of crop and livestock produced in the United States with their accompanying weeds, insects, diseases and parasites is produced and marketed in Missouri.

In its laboratories, libraries and offices, in its fields and gardens, through its livestock and poultry and on the farms of Missouri, the scientists of the Agricultural Experiment Station seek the whats, the whys, the whens, the wheres and the hows of hundreds of problems that confront the operators of farms, rural homes and families and the many industries depending on or serving agriculture. The Station workers develop new facts, new principles, create or find better plants and animals which repay many times the costs provided from public and private sources.

Kinds of Research

1. *Basic or Fundamental Research*—The search for new knowledge and understanding particularly in regard to what is occurring and *why* it occurs. While the knowledge may not have immediate practical significance in itself, from it comes the ideas for the most practical and significant applied research.

2. *Applied Research*—This is the deliberate hunt for specific information and materials for practical use on the farm; the *when*, *where* and *how* of solving problems in production, utilization and marketing of the resources and products of farms.

3. *Developmental Research*—The procedures for converting new ideas and materials into effective use on the farm and in industries serving or depending upon agriculture.

Station Research Accomplished Through Projects

The research program of the Missouri Agricultural Experiment Station is conducted through carefully prepared and approved project outlines showing 1. the problem, its importance and background and previous attempts, if any, to solve it, 2. the specific objectives of the research, 3. the procedures

of attack and study, 4. the estimated requirements for personnel, funds and equipment and 5. provision for periodic review and revision according to progress and results. The Station has in operation 330 research projects.

Each project is reviewed at least once annually. Some projects are terminated each year; a few that are not dependent on growing seasons or successive generations of plants or animals may be completed in a few months. Many are revised each year to take into account progress, new leads, new methods, or greater emphasis on certain objectives. To be more effective and productive, research must be flexible and the workers must be encouraged in developing new approaches that may not have been foreseen when the work was originally planned.

Population Changes Increase Need for Research in Agriculture

Farm population in Missouri, like that of the entire nation, is decreasing. In 1950 the census showed 232,000 farms in the state and the farm population represented 22% of the total. The 1955 census showed 200,000 farms and the farm population represented only 19% of the state total. The average size of farms had increased from 157 acres to 175 acres during these 5 years.

These big changes in agriculture in Missouri and in the entire nation have significant meaning:

1. This shift in population has been one of the major factors in our industrial development, releasing energy from food and fiber production to various other industries.

2. The entire population becomes dependent upon fewer and fewer farmers for the raw materials of agriculture.

3. The individual farmer becomes relatively more important in the total economy.

4. His requirements are intensified for new ideas, better equipment, better plants, better animals, new ways of doing, such as better use of water, better fertilizers, better insecticides, better weed killers, better methods of control of diseases in plants and animals, better controls of quality, better marketing systems, etc.

5. Farming becomes a more complex business and consequently a higher class of farmers is required; ones with greater ability, greater knowledge and greater know-how.

6. The capital requirements for farming are far greater than formerly. Capital outlays for equipment, gasoline, oil, electricity, chemicals and other materials tend to replace the energy formerly obtained through man, mule and horse.

7. It is more difficult for young people to get started in farming.

8. Programs for conservation of soil, water and human resources require far more attention from the population as a whole.

9. There has been a great change in the type of foods consumed, and a major need is to find ways and means of adjusting farm production to present and future market potentials.

Research Has a Vital Role Today and Tomorrow

In the face of surpluses of a few major crops, why expand expenditures on agriculture research? There are many reasons—to prepare for the future increases in population is only one. Others are in brief:

1. Research continually protects the gains made so far against the constant threats to plants and animals of old and new forms of insects, diseases and parasites, including the newly important nematodes and certain livestock diseases communicable to man.

2. Research will show further methods of cutting costs of production, distribution, and marketing. For instance, the beef and swine industry must keep pace with the research-made advances in poultry, chemical controls of pests, weeds, insects and diseases.

3. Research leads to improvement and protection of the qualities of products offered consumers and to reduced losses during processing, transportation and distribution.

4. Research is required to determine market needs and potentials, and to aid in developing and broadening local and national markets for Missouri products.

5. Research shows how to store and use home-grown grain and grass crops more efficiently in livestock production.

6. Research can aid in showing how to reflect premiums for quality to producers.

7. Research can point out ways to adjust production to the future demands of potential domestic and foreign markets.

8. Research is needed to develop more methods of meeting the severely recurring drouths in Missouri and reducing the accompanying risks in farming.

9. Research shows the way to conserve and use the basic physical resources of Missouri—soil and water.

10. Research can lead the way in attracting and helping to train effective leaders for service in the agriculture of tomorrow.

Permanent advances in the agriculture of Missouri have been won by the scientific research of the past; advances being made by intelligent application of the recent findings of devoted scientists and research now underway, or in prospect, give high hopes of other advances in the future. The experience of the past half century has proved that scientific research in agriculture repays the original cost many times; it has led again and again to great reductions in the labor and time costs and efficiency of farm production and marketing to the benefit of all citizens of the State and Nation.

Missouri ranks sixth among the 48 states in total farm income. If the Agricultural Experiment Station is to conduct a research program that the magnitude of the State's agriculture justifies, a substantial increase in appropriations will be required. The following table shows the rank in farm income, rank in state appropriation to the Agricultural Experiment Stations, and the amount of appropriations of the 10 high states:

State	Rank in Agriculture Income	State Appropriation for Agricultural Research	
		Rank	Amount (annual)
California	1	1	\$6,592,154
New York	13	2	3,763,206
Florida	27	3	2,839,612
Louisiana	31	4	2,202,933
Minnesota	5	5	1,680,822
Illinois	4	6	1,633,300
Washington	21	7	1,629,183
Michigan	15	8	1,594,370
Iowa	3	9	1,538,135
Oregon	29	10	1,416,215
Missouri	6	37	595,000

On the following pages are listed the various research projects now being conducted at the Missouri Agricultural Experiment Station by members of the staff of the College of Agriculture.

The projects are grouped according to Department. Within the department they are grouped according to area of work. A short statement concerning each research project is given explaining the objective of the particular project.

The intent of this publication is to give an idea of the amount of research and the number of projects now being conducted at the Missouri Agricultural Experiment Station.

Respectfully submitted


J. H. Longwell
Dean and Director

RESEARCH FOR AGRICULTURE

Department of Agricultural Chemistry

Study Areas and Personnel

<i>Analytical Services</i>	E. E. Pickett R. E. Hankins H. E. Fiebler S. R. Koirtyohann L. D. Haigh C. W. Gebrke E. W. Cowan B. R. Smith J. A. Bevirt W. M. Lankin E. L. Wood F. J. Johnson W. G. Godbey
<i>Animal Breeding</i>	D. T. Mayer F. M. Orsini R. E. Berry Mike Milicevic F. R. Alleva
<i>Nutrition</i>	B. L. O'Dell A. G. Hogan L. M. Flynn W. O. Regan E. R. Morris O. A. Lacerdal B. A. Erickson
<i>Physiological Chemistry of Domestic Animals</i>	M. E. Mubrer G. B. Garner E. J. Carroll W. R. Thomas J. S. Baumstark

ANALYTICAL SERVICES

Project 132, Analytical Services.

This project includes the work of the Experiment Station Analytical Chemistry Laboratories. Routine analytical services for this and other departments in the College of Agriculture is maintained. In addition, research is conducted to develop new methods for the analysis of agricultural products. By far, the greatest service is for fertilizer control samples. Here the composition of fertilizers sold in Missouri is determined. This assures the farmers in the state of Missouri that they are getting the amount of fertility indicated on the label of the product purchased.

Project 76, Spectrographic Services.

This is a highly specialized analytical service to analyze samples submitted by other Experiment Station Projects with the approval of the Director. The methods employed are usually optical or instru-

mental, using existing methods when possible, and developing suitable methods when necessary.

Project 148, Milk Stability.

This project involves a study of the protein and mineral composition of milk and the relation of composition to the stability of heated milk.

Project 147, Forage Minerals.

The purpose of this project is to determine whether or not Missouri grown forages are deficient in any of the major or minor elements for animal feeding; to determine if Missouri soils are deficient in trace elements that would prevent maximum plant growth. Samples of soils and forage plants are collected over the state and analyzed in the Spectrographic Laboratory.

ANIMAL BREEDING

Project 81, Animal Reproduction.

This project is concerned with the biochemical and physiological aspects of natural and artificial breeding. This includes the chemical composition of both the male and female germ cells. Techniques are being developed to evaluate male sperm and female ova. This information is important when applied to problems of preserving sperm for artificial insemination and maintained fertility in female farm animals.

Project 223, Reproductive Physiology.

In this project a study is made of the role of various hormone secretions in each phase of the reproductive cycle. Tests are being developed whereby the reproductive efficiency of a female farm animal can be determined. With this information therapeutic methods and production practices can be recommended to achieve maximum productivity of our breeding animals.

NUTRITION

Project 212, Food Conservation.

Vitamin and amino acid composition of feeds and food is studied in this project. Nutrients found in grains and forages are studied in relation to soil

fertility and environmental factors. The composition and feeding value of farm crops during drouth and other adverse growing conditions is being studied.

Project 137, Poultry Nutrition.

This project is concerned with unrecognized growth factors and the balance of recognized growth factors required by chickens. The results should prove valuable to the poultry industry in formulating efficient and effective poultry rations that are adequate but not wasteful of critical and expensive feed constituents such as vitamin and amino acid supplements.

Project 149, Mineral Nutrition.

This study points to the value of a balanced mineral content in a diet, and the importance of certain minerals in obviating the injurious effects of high or low intake of other minerals in the diet of a Guinea pig. It also indicates the importance of food factors in muscle metabolism that may be related to arthritis.

Project 151, Maternal Nutrition.

Adequate maternal nutrition has been found to be necessary for normal offspring. A correlation is being studied between vitamin content of the mother rat's diet and the ability of the young rats to learn. The effect of inadequate maternal diet on developing tissue, especially brain tissue, is being studied. Malformations, which in the past have been attributed solely to heredity, produced by nutritional deficiencies in the mother are harelip, cleft palate, eye defects and skeletal abnormalities.

PHYSIOLOGICAL CHEMISTRY OF DOMESTIC ANIMALS

Project 56, Hemorrhage in Farm Animals.

The mechanisms of hemostasis as applied to bleeding in farm animals are being studied. The Missouri Experiment Station has the first animal other than man shown to have an inherited bleeding condition. This research tool is of value in studying one of the most prevalent sources of livestock losses.

Project 152, Rumen Culture.

The symbiosis between microorganisms in the rumen and the ruminant host is the basis for this study. The role of the rumen microorganism in cellulose digestion, vitamin synthesis, improving protein quality and production of unknown growth factors is being thoroughly investigated. In addition, the organisms are being separated, preserved and used to improve the growth of their host, as well as other animals. This includes predigesting feed for non-ruminant use.

Project 247, Forage Poisoning.

This project was initiated following the 1954 drouth. During the drouth many cattle were poisoned on forages, especially corn fodder. Since a close relationship existed between toxicity and nitrate content of the feed the effects of nitrate on the physiological mechanisms in ruminants is being studied. Tests for toxic forages as well as preventative and therapeutic recommendations are being developed.

Prepared by M. E. Muhrer, Chairman
Department of Agricultural Chemistry

Department of Agricultural Economics

Study Areas and Personnel

<i>Farm Management</i>	Clay R. Moore B. H. Frame Stanley Spangler Howard Friese Otis Miller O. R. Johnson	<i>Horticulture</i>	J. C. Grady
	Frank Miller Melvin Blase Ronald Bird	<i>Livestock</i>	Elmer R. Kiehl V. James Rhodes C. L. Cramer Kieffer Lehman Norman Wilson Edwin Jaenke Richard Maxon Durward Brewer Russ E. Price Robert J. Reid Curtis Braschler
<i>Land Economics</i>	J. W. McKinsey David Harrington Kenneth Blase S. F. Whitted		John D. Miller Lloyd Bender Quentin Banks
<i>Cash Crops</i>	J. N. Smith Linwood Tipton Gary Hanman H. E. Armstrong	<i>Poultry</i>	Gordon B. Nance O. R. Johnson
<i>Dairy</i>		<i>Price and Price Policy</i>	

FARM MANAGEMENT

Project 112: Farm Business Analysis.

Under this project an effort is made to keep currently informed concerning developments and changes in the farm business including earnings, types of farming, degree of intensity, and combination of factors. It includes analysis of the farm records being obtained from the farms of Balanced Farming clients of the Extension Service. We are now in process of reporting on farm business results obtained on beef cattle fattening farms in Clay, Ray, Clinton, and Andrew Counties.

Project 110: Enterprise Costs and Returns.

Analyses are made of major farm enterprises, particularly emphasizing costs and returns. As resources permit, one after another of our major farm enterprises in the various types of farming areas in the state will be examined.

Project 256: Dairy Farming Adjustments.

This project involves studies of needed adjustments on dairy farms in Missouri that formerly emphasized the sale of butterfat but, due to changing economic circumstances, no longer provide promising income prospects.

LAND ECONOMICS

Project 44: Trends in Land Use.

Under this project we keep up to date on changes in number of farms, acres and importance of various crops and pastures, and undertake to explain the major changes which are occurring.

Project 61: Farm Real Estate.

This is the present version of a project which has been a continuing one for more than 30 years. Its objective is to trace the changes in farm land prices, and number of transfers, comparing sale value with assessed value, examining the relation of changes to density of population, development or decline of farm activities, etc.

Project 111: Economic Resources.

Major points of interest in this study include: Variation in productivity of lands, size of farm units; availability of capital and other resources; the relation of capital available to land quality; adequacy of farm units; and availability of non-farm income

resources or employment.

Project 279: Getting Established in Farming.

We have assembled the records from 175 farms that were organized since 1945, with special attention to the manner in which these farm operators succeeded in establishing a promising farm business. We want to know how they did it, where they got their assistance, what the requirements were, what resources they had to begin with and the growth which they have achieved from year to year.

Project 44, Land Use: Credit for Missouri Farmers.

Here an examination is being made of the nature and adequacy of credit needed by farmers. Technological developments of the last few years have indicated the need for more acres, more livestock, and more cash for farm expenses. These needs have greatly increased the pressure on credit institutions, not only as to volume required but the terms under which credit should be made available. The cost of such credit and its contribution to the efficiency of the farm will be examined.

MARKETING

Project 65: Cotton Marketing.

The cotton marketing project for 1956-57 involves a study of risks in gin operation and the influence of accidents and fire hazards on costs. Costs are increasing and they are higher in Missouri than in most other cotton growing areas. A careful examination will be made of programs designed to reduce risk and decrease costs. Other problems in gin operation are created by the adoption of the mechanical cotton picker for harvesting.

Project 179: Economics of Grain Storage.

The general use of the combine has greatly increased the burden on storage and transportation facilities for small grain. Combining and moving the product directly from the field to commercial storage prevents the conditioning and curing which used to occur after the grain was cut and before it reached the commercial elevator. What these developments do to quality and precautions to preserve quality needs careful examination. Practically the entire winter wheat crop in any community reaches commercial storage facilities within a very few days. Formerly, this was distributed over many days or weeks. This is part of the problem.

DAIRY**Project 167: Dairy Industry Developments.**

This is a description, developed by areas within the state, of the marketing processes. It is presented in four parts, geographically. The report for southwest Missouri is in published form. For southeast, northwest and northeast, it is in process of preparation for publication. In all areas, the sale of Grade A milk is on the increase as this gives the highest return of any form of dairy products. These studies are chiefly descriptive.

Project 199: Marketing Dairy Products.

This study involves the impact of new techniques on the dairy industry. Such developments as the use of paper containers, milk vending machines, and bulk tank collection from farms are involved. A regional paper container report has been issued. (Report Number 39). Reduced weight, danger of breakage, and necessity of returning empty glass bottles are all important factors in cost of distribution. Paper containers have reduced costs significantly. They have also expanded the trade area and have resulted in providing quality products in some areas that formerly were not reached. The effects of vending machines and bulk tank collection in this state have not been sufficiently appraised. This is a current objective.

HORTICULTURE**Project 262: Horticultural Products.**

As this is the first study in this field to be undertaken in Missouri the first assignment is determining the structure and significance of the vegetable industry in Missouri. We need to know what is produced, where it is produced, and how products are marketed now. Then more significant analyses will be undertaken.

LIVESTOCK**Project 7: Livestock Marketing.**

This project is concerned with the efficiency of our livestock markets. We will examine first the importance of daily fluctuations. Likewise, seasonal and longer time trends and the effect of these on cost of marketing will be examined. Market news service will come in for scrutinizing. An examination of shrinkage and other losses in the market process will be ascertained. We will also study the effect of market processes on quality of meats.

Project 86: Meat Preference.

This study is in its third year. We want to learn the preference of consumers for beef as related to grades used in the trade and how nearly these grades represent eating qualities. The objective is to eventually develop grades which are more meaningful to consumers rather than merely a convenience to processors. The problem goes deeper than this. The study is expected to furnish some guidance to producers so that what producers furnish the trade will more nearly correspond with consumer preference.

Project 150: Meat Marketing.

This is largely a cost study to learn about the cost of retailing and costs of packing plant operations, in the interest of increasing economic efficiency of the whole processing and distribution process. This is of interest to both producers and consumers.

Project 215: Frozen Meats.

An appraisal of the economic feasibility of frozen meat distribution is still to be made. There are both technical and economic road blocks which should be removed so far as feasible. New kinds of cuts, prejudices, and many other questions are involved. This study should contribute to more economic meat distribution.

Project 216: Consumer Pork.

This study parallels Project 86 but applies to pork rather than to beef. In some respects it has developed more rapidly. There is still much to be done in learning how to translate consumer preference for lean pork into prices paid producers who are producing lean pork. The results should be significant not only for producers of meat animals but also to producers of feed concentrates for those meat animals. Having the price of a pig discounted because consumers don't like fat and because the pig had too much corn, is a significant question for the whole production and marketing process.

POULTRY**Project 67: Poultry Prices.**

This is a study in cooperation with three other corn belt states. It involves an examination and appraisal of sources of information used in reporting poultry and poultry product prices. It is hoped that an adequate analysis will permit a more objective

and dependable reporting of poultry prices which are quoted in the daily press.

Project 228: Consumer Preference for Eggs.

We are initiating a poultry preference study with emphasis on eggs, comparable to the one now being pursued with beef and pork. The questions are: Can consumers differentiate between grades as they now exist or should some other kind of grade be developed which more nearly represents consumer preference? Are there too many grades so that comparison is meaningless if the consumer cannot distinguish between grades? Also involved in this inquiry are problems associated with grade deterioration in the distribution process. Causes and the responsibility for them will be significant in improving the grading system for eggs.

PRICE & PRICE POLICY

Project 254: Co-op Marketing.

This project involves the determination of the

physical significance of cooperative marketing agencies in assembly and distribution of agricultural products. We should learn the extent to which these facilities are being used, the excellence of their performance and their significance in improving the marketing process for agricultural products.

Project 115: Agricultural Prices and Price Policy.

This project is a consolidation of a study of agricultural prices which has been under way for several years and price policy which is of more recent origin. The studies being conducted under this consolidation include (a) a study of seasonal variation and changes which may be occurring due to changing techniques; (b) the development of weighted indexes of prices received by Missouri farmers for major farm products; (c) the relating of pricing programs to prices received for products of major importance on Missouri farms but not of high priority in the region.

Prepared by O. R. Johnson, Chairman,
Department of Agricultural Economics.

Department of Agricultural Engineering

Study Areas and Personnel

<i>Farm Power and Machinery</i>	M. M. Jones D. B. Brooker C. L. Day J. S. McKibben R. E. Larson
<i>Farm Buildings, including</i>	R. E. Stewart
<i>Animal Shelter Engineering</i>	R. G. Yeck T. O. Hodges J. C. Wooley M. D. Shanklin C. N. Hinkle
<i>Utilization of Electricity</i>	K. L. McFate C. L. Day M. M. Jones
<i>Farm Home Water Supply</i>	T. O. Hodges M. D. Shanklin
<i>Water Management, including</i>	R. P. Beasley
<i>Soil Erosion Control,</i>	R. B. Curry
<i>Irrigation and Drainage</i>	
<i>Crop Drying, Processing, and</i>	D. B. Brooker
<i>Handling</i>	T. O. Hodges J. S. McKibben C. L. Day

FARM POWER AND MACHINERY

Project 138: Forage Harvesting, Handling, Storage and Feeding.

This project may be considered as a project in "systems engineering," in which various methods and machines are studied for the production of high quality forages with a minimum of labor and costs. Complete processes from harvesting to consumption by livestock are studied. One phase of this project is on grass and small grain silage, stored in a horizontal "bunker" type silo, and then self-fed to steers from the silo.

The other phase of this project involves hay. The hay is cut and allowed to cure partially in the field. Then it is picked up and chopped by a field harvester and blown into a forage wagon and hauled to a self-feeding barn where it is elevated into place. Curing of the hay is then finished by blowing air through it, and it is finally self-fed without further handling.

Project 153: Weed Machinery.

This project is concerned with equipment and procedures in spraying for control of weeds and brush. It is a cooperative one with the Department of Field Crops and with the U. S. Department of

Agriculture. Studies are being made on development and improvement of equipment for applying herbicides to control weeds in soybeans and corn; on costs and effectiveness of different methods for controlling brush in pastures and on right-of-way; and on the effect of various factors on toxicity of herbicides, such as droplet size, nozzle size, concentration, and equipment adjustment. These studies also include the use of the rotary hoe and cultivators in conjunction with chemical weed control.

Project 224: Storage of Tractor Fuels.

Studies have been made to determine the effect of tank color, shade, chemical surfactant, and pressure-vacuum release vents on the evaporation losses and quality of gasoline in farm storage tanks.

Project 272: Corn Production.

This project is also essentially one of "systems engineering" wherein various methods and machines are studied with a view to developing the most practical systems for reducing labor and other costs of production of corn and of certain substitute crops in intensive two-crop, one-year rotations. The work is being done at the Midway Agricultural Engineering Farm on small replicated plots, and on field-size areas of approximately 17 acres. Harvesting of crops is done at as early a stage as possible, with consequent real savings in harvesting losses. Short-cut tillage and seeding methods are being used to quickly plant the succeeding crop at considerable savings in cost over conventional methods. The soil is kept covered with growing crops a greater percentage of the time, which results in decreased erosion hazards.

FARM BUILDINGS

Project 66: Climatic Laboratories.

This project is concerned with the effect of various climatic factors, principally temperature, humidity, wind, and radiation, upon the growth and production of farm animals. It is in cooperation with the Department of Dairy Husbandry and the U. S. Department of Agriculture. It is a basic, scientific study aimed at determining the most desirable conditions for animal health and production.

Project 71: Farm Buildings Plans.

This is the oldest project in the Department of Agricultural Engineering. It has to do with the design of farm buildings and equipment to meet the needs and conditions of the state.

Project 136: Animal Shelters.

This is part of a North Central Regional Project and is related to the work done in the Climatic Laboratory. It has two main parts. One is a basic, fundamental study of the ways that animals get relief from heat. A calorimeter is under construction to determine just how much of the heat an animal gives off is radiated, and how much is given off by convection and conduction. The other part of this project has to do with practical trials of radiation cooling of animals in shelters. This part is just getting started on the Midway farm.

UTILIZATION OF ELECTRICITY ON FARMS

Project 282: Utilization of Electricity on Farms.

The objectives of this project are to study costs and benefits of the uses of electricity on Missouri farms, to develop new uses, and to adapt existing equipment to new uses in productive farm enterprises, with the ultimate objective of increased beneficial use of electricity and improved economic conditions and living standards on farms. This project is cooperative with the Missouri Farm Electric Utilization Council and is supported by grants from private power companies and rural electric cooperatives in the state. It is in its first year, and is concerned at present with crop drying, grain and feed handling, and garden irrigation. Studies and observations are made on farms in various parts of the state.

FARM HOME WATER SUPPLY

Project 155: Farm Water Supplies.

This project has to do with the development and improvement of methods of obtaining good water for farm household use, particularly the collection, filtration and treatment of pond water. This is part of a North Central Regional Project. It is also carried on in consultation and with the cooperation of the Missouri State Division of Health. Some experimental filters have been developed and are being tried out. Since the performance of filters is dependent largely upon the quality of water which is to be filtered, emphasis is being given to studies of the effects of treatment of ponds and pond watersheds upon the quality of pond water.

WATER MANAGEMENT

Project 2: Use of Water in Corn Production in One-year Rotations with Small Grains.

This project is closely related to project 272 on corn production. It is to determine the effect of irrigation on crop yield, quality, germination, early growth rate, maturity date, and decomposition of crop residue in intensive one-year rotations; and to determine the irrigation practices best suited to production of crops in such rotations. Replicated plot studies are in progress comparing three different moisture levels and three different levels of nitrogen.

Project 43: Soil and Water Conservation Management.

The objectives of this project are (1) to determine the best terrace spacing, grade, and channel capacity, and the extent to which point-rows may be eliminated for the major soil areas in Missouri; (2) to determine the effect of terraces on power, labor and machine costs in crop production and on crop yields; and (3) to develop and investigate new designs of water management structures with a view to improving them and reducing their costs.

Considerable progress has been made recently in developing improved, straightened or less crooked terraces and methods of building them.

Project 226: Pasture Irrigation

This project is cooperative with the Department of Animal Husbandry and is to determine the effect of irrigation and irrigation plus heavy fertilization on improved pastures for sheep.

Project 227: Farm Reservoirs.

This is a study of the use of farm reservoirs for the storage and use of surface runoff for irrigation. It is cooperative with the U. S. Department of Agriculture. Objectives are (1) to determine the amount of runoff that may be expected from watersheds on different soil types; (2) to determine the losses by evaporation and seepage from farm reservoirs and to develop methods for reducing these losses; and (3) to determine the effect of irrigation on the amount of runoff and on soil loss. The work is presently carried on at McCredie and at Midway.

Project 265: Water Distribution and Application.

This project also is in cooperation with the U. S. Department of Agriculture. Its purpose is to determine the adaptability and efficiency of surface and overhead methods of applying water on Mississippi River bottom soil, and to develop design criteria for furrow irrigation, such as row lengths, slope in the row, rate of applying water, and total amounts to apply. The work is carried on at Elsberry. The crops used are alfalfa, corn, and soybeans.

Project 271: Cotton Water Management

This project has to do with drainage and irrigation in cotton production in southeast Missouri. It has been active just one year and due to limitations in funds and personnel the work has been largely exploratory in nature. An irrigation engineer with headquarters in southeast Missouri is now to be employed to work intensively on this project. Experiments in drainage and irrigation are to be set up on field size areas to develop specific recommendations for drainage and irrigation practices on the soil types common to that area.

CROP DRYING, PROCESSING, AND HANDLING

Project 225: Grain Drying.

The objectives of this project are to study the characteristics of grain and ear-corn drying systems, with emphasis on the distribution of air in the grain mass, and to determine the limits of practicability of drying grain with unheated air under Missouri conditions. Ear corn and small grains are harvested as soon after maturity as possible and dried with unheated air. Moisture data are kept as drying proceeds and the costs of drying determined.

Some experimental work on barn drying of chopped hay is conducted under project 138 on forage harvesting.

Prepared by M. M. Jones, Chairman,
Department of Agricultural Engineering.

Department of Animal Husbandry

Study Areas and Personnel

Animal Breeding John F. Lasley
C. M. Bradle,
J. R. Cook.
C. W. Foley
John Massey
L. F. Tribble
L. A. Weaver

Animal Nutrition J. E. Comfort.
A. J. Dyer
G. V. Wright
Mike Milicevic
William H. Pfander
C. M. Bradley
L. F. Tribble

	<i>L. A. Weaver</i>
	<i>A. J. Dyer</i>
	<i>D. T. Lyons</i>
	<i>G. B. Thompson</i>
	<i>W. C. Ellis</i>
	<i>J. L. Ketcham</i>
<i>Meats</i>	<i>D. E. Brady</i>
	<i>H. B. Hedrick</i>
	<i>A. M. Mullins</i>
	<i>H. D. Naumann</i>
	<i>Steve Zobrisky</i>
	<i>L. A. Weaver</i>
	<i>O. S. Koblenberg</i>
	<i>G. G. Kelley</i>
	<i>R. B. Sleeth</i>
	<i>Eugene Birmingham</i>
	<i>J. E. Comfort</i>
	<i>O. W. Zinn</i>
<i>Beef Production</i>	<i>J. E. Comfort</i>
	<i>C. M. Bradley</i>
	<i>L. A. Weaver</i>
	<i>A. J. Dyer</i>
	<i>W. H. Pfander</i>
<i>Sheep Production</i>	<i>A. J. Dyer</i>
	<i>C. M. Bradley</i>
	<i>A. M. Moles</i>
	<i>L. A. Weaver</i>
<i>Swine Production</i>	<i>L. F. Tribble</i>
	<i>C. M. Bradley</i>
	<i>J. R. Cook</i>
	<i>C. W. Foley</i>
	<i>J. F. Lasley</i>
	<i>John Massey</i>
	<i>L. A. Weaver</i>

ANIMAL BREEDING

Project 3: Swine Improvement.

The objectives of this project are: To study the effectiveness of recurrent selection for maximum performance of strain crosses; to study the influence of environment on the effectiveness of progeny tests; to determine the effects of inbreeding and cross breeding on milk production and growth; and to develop more accurate and useful measures of performance.

Project 198 & 198-1: Cattle Improvement.

The objective of this research is to determine the effectiveness of breeding methods for improvement of performance in beef cattle by these processes: Developing improved methods of performance in reproduction, growth, feed utilization, conformation, and carcass desirability and lactation; determining the heritability of and nature and degree of genetic-physiological association between characters; testing the effectiveness of intra-herd selection in comparison with a control herd mated to sires from representative herds of the breed.

Project 222: Physiology of Reproduction.

Here is an attempt to study carbonate metabolism in swine as related to growth and reproduction; and study endocrine factors in embryonic mortality in swine.

Project 276: Endocrine Secretions.

The purpose here is to study the influence of sex and various hormones on the body development and carcass quality of market hogs, as well as determine the influence of certain hormones on milk production of sows.

ANIMAL NUTRITION

Project 250: Roughages.

This is a project designed to observe changes in the physical structure as indicated by x-ray diffraction and electron microscopy of wheat and lespedeza during their growth and digestion by rumen microorganisms.

Project 251: Nitrate Poisoning.

It is the intent to observe the effects of feeding forages grown under conditions which favor nitrate accumulation on the rumen function and general performance of sheep and cattle and to determine if the effects observed above can be duplicated by adding nitrate to the normal ration of cattle and sheep.

Project 248: Mineral Nutrients of Ruminants.

This project is to re-evaluate the qualitative and quantitative mineral requirements of ruminants and to obtain additional information on the roll of mineral in balances in the etiology of: stiff lamb diseases; urinary calculi; and tetany.

Project 169: Ruminant Digestion.

Here is a project designed to develop techniques to be used to study Ruminant Digestion, to determine the effect of Chemical Compounds on Digestion, and to attempt to establish rumen flora by inoculation at times of ration change.

MEATS

Project 5: Meat Acceptability.

This is a project to determine the extent of shrinkage losses as they relate to grade and speed of processing; to determine the minimum amount of

finish (quality) generally desired by the consumer both in the fresh and processed product; to evaluate the effect that maturity and breeding practices may have on the processing quality; and to determine the optimum leanness of comminuted meat products as related to consumer acceptance.

Project 257: Meat Microbe Development.

A project to determine the optimum environmental conditions for holding or aging beef of various qualities.

Project 88: Swine Carcass Evaluation.

It is the purpose to develop improved methods of evaluating live hogs and pork carcasses, and to adapt these methods to practical swine production and marketing to the end that the product will be more acceptable to the consumer to the benefit of all phases of the industry.

Project 100: Stability in Cured Meats.

A project designed to further study the techniques of using sodium ascorbate and other food additives in the curing solution to enhance the quality factors of cured meats.

Project 238: Handling of Beef.

The object is to study the influence of stress and remedial measures on the physical and chemical characteristics of the live animal and subsequent carcass.

Project 217: Frozen Meats.

Here is an effort to determine the technical feasibility of frozen meat distribution, as well as to determine consumer acceptance and preference for the frozen product.

Project 218: Pork Grades.

A research project designed to determine by sampling what proportion of that consumer population detects a noticeable difference in eating satisfaction between two or more grades of pork for several important cuts; to determine the grade preferred by those consumers expressing a preference; to determine insofar as possible the economic significance of those preferences; to determine whether or not those consumers with definite preferences are able to identify by visual inspection the grade they preferred; to determine by sales tests the merchandising potentialities of the various grades in terms of the grade or grades to be sold and the prices charged

in one or more retail stores; and to determine the effect of various processing techniques of pork cuts in relation to consumer acceptability and preferences.

BEEF PRODUCTION

Project 78: Production of Slaughter Calves.

A cow-calf proposition to determine the advantages and disadvantages of calves dropped in September and October with those calved the following January and February when both groups are fed grain while suckling their dams and full fed after weaning to the same degree of finish. Also to determine the value of the use of improved pastures for calves fed as indicated above, and to determine the advantages or disadvantages of beginning the fattening period of February-April calves, 6 to 8 weeks before weaning at the end of the grazing season compared with starting them on feed after weaning.

Project 237: Fattening Cattle.

A project designed to determine the effects of adding rumen organisms, hexestrol or both to a standard steer fattening ration, using the following criteria to measure results: rate of gain; feed consumption; efficiency of converting feed into gain; quality of product produced, determined by live and carcass grades of cattle; shrinkage in transit to market; comprehensive studies of the wholesale rib cuts by the meat section; and in the case of cattle fed hexestrol, measure the residual activity of hexestrol in certain tissues.

Project 154: Pasture Improvement.

A project to determine the type of cattle which make the best gains from pasture; the periods of maximum response to different pastures; under what conditions pastures produce a high incidence of bloat and to devise simple methods of management to control; and the effects of hexestrol on yearling cattle that are grazed and subsequently finished for market.

SHEEP PRODUCTION

Project 142: Sheep Production.

A continuing study to determine the nutritional adequacy of fescue and rye pastures for bred ewes producing late lambs. Also to further study the reliability of birth weight as a criterion for growth rate of lambs. In addition, to determine the most satisfactory year-round pasture system for sheep.

Project 235: Sheep and Irrigation.

A project to study the effects of the following upon sheep production by using the response of ewes and lambs as criteria: different pastures i.e. a comparison of orchard grass-ladino clover; orchard grass-Korean lespedeza and orchard grass alone; irrigation of said pastures; and addition of nitrogen to irrigated pastures.

SWINE PRODUCTION**Project 141: Nutrients Required by Swine.**

This is a study of vitamins and unrecognized nutrients in swine rations, amino acids and proteins requirements, and nutritive requirements and manner of feeding suckling pigs.

Department of Dairy Husbandry**Study Areas and Personnel**

<i>Dairy Cattle Feeding, Rumen</i>	C. P. Merilan
<i>Bacteriology, and Milk Production</i>	K. W. Bower P. R. Cornelison H. S. Peet R. D. Prewitt A. C. Ragsdale G. A. Stewart R. J. Wilson
<i>Dairy Cattle Breeding—Artificial</i>	C. P. Merilan
<i>Insemination</i>	K. W. Bower P. R. Cornelison F. M. Orsini H. S. Peet B. W. Pickett A. C. Ragsdale
<i>Endocrinology and Milk Secretion</i>	C. W. Turner C. E. Grosvenor G. W. Pipes A. C. Ragsdale J. Saroff W. F. Williams
<i>Influence of Climatic Factors on</i>	H. D. Johnson
<i>Growth and Productive Processes</i>	H. E. Dale C. S. Cheng H. H. Kibler A. C. Ragsdale P. Stahl
<i>Dairy Bacteriology and Sanitation</i>	Joe E. Edmondson Kenneth W. Smith
<i>Milk Processing and Dairy</i>	W. H. E. Reid
<i>Products Manufacturing</i>	J. E. Edmondson G. E. Huskey K. W. Smith D. S. Shelley.

DAIRY CATTLE FEEDING, RUMEN BACTERIOLOGY, AND MILK PRODUCTION**Project 55: Diet and Growth.**

The objectives of this project are: (1) To determine the effects of concentrate feedstuffs, various drugs, and feed additives, including antibiotics, on the growth and development of calves and young

animals as well as on the production of lactating dairy cattle in order to provide better and more economical dairy rations. (2) To determine the most efficient and practical methods for maximal utilization of roughages, pasture, and silage in Missouri dairy feeding programs. This includes studies on the individual constituents of the roughages such as nitrates and nitrites and their relationship to the well-being and production of dairy cattle.

Project 134: Official Testing.

An official testing service is provided to purebred cattle and milk goat breeders in Missouri so that Advanced Registry and Herd Improvement Registry records may be made available for use in planning breeding programs and as a basis for herd improvement. The proving of sires and dams, and the locating of brood cow families and superior transmitting sires are important factors in this program.

Project 246: Rumen Bacteriology.

The major objective of this project is to determine the specific requirements and function of each microorganism as well as the net effects of the entire group of organisms in the rumen flora of dairy cattle under various feeding, climatic, and management conditions. This is being accomplished by: (1) Isolating, identifying, and determining the cultural characteristics of specific organisms followed by mixed culture studies to get the net effect of the rumen population. (2) Developing new techniques for isolating and identifying rumen organisms and observing changes in the rumen microflora of fistulated dairy animals on various types and amounts of feeds. (3) Determining the effects of changes in the rumen population as a result of changing nutritional or environmental conditions on the animals' general condition and production. A study is now

being made of changes in milk and blood vitamin levels of animals exposed to various environmental temperatures, ranging from 10°F up to 105°F.

DAIRY CATTLE BREEDING—ARTIFICIAL INSEMINATION

Project 35: Dairy Cattle Breeding.

The major objectives of this project are: (1) To determine the relative merits and practicality of various breeding plans and practices for developing strains of dairy cattle with improved productive performance. (2) to determine the interrelationship between the inheritance of production, physical characteristics, reproduction, and related physiological functions including hormone levels in order to develop improved selection techniques for early culling of animals with low potentials for milk production and regular reproduction.

Project 54: Artificial Insemination.

The objective of this project is to develop improved artificial insemination techniques for dairy cattle by: (1) Determining the physical and chemical characteristics of bovine semen and their relation to viability and fertility under various storage and handling conditions. This includes the development of improved semen evaluation tests and determining optimal conditions for the prolonged storage of highly fertile semen in the liquid, frozen, and dried states (no one storage technique has proven completely satisfactory under all herd management conditions). (2) Determining the effect of various management, environmental and nutritional conditions on spermatogenesis, ovulation and fertilization so that artificial insemination may be more effectively used in our dairy herds.

Project 64: Hatch Dairy Experiment Station Farm (Hannibal, Missouri).

To develop and demonstrate dairy herd and farm improvement and operational practices contributing to an efficient farm enterprise. Attention will be centered on the breeding program directed toward developing Jersey cattle with a capacity for large milk production, of good size, superior type and long life. The use and development of superior sires and brood cow families will be an important factor in attaining the objectives.

Attention will be directed toward improved farm practices and costs with emphasis on pasture, silage, soiling and hay crops as an aid to improved

and special feeding practices to supplement the herd improvement program.

Project 200: Foremost Guernseys.

The Foremost Guernsey herd and farm (gift of J. C. Penney) has as its primary objective, breeding for herd and breed improvement. This involves a determination and application of breeding plans and practices and developing improved strains of Guernsey cattle and the interrelationships between the inheritance of production, physical characteristics, reproduction and related physiological functions.

A balanced farm plan has been prepared involving field layouts, terracing, pasture and crop plans and related management problems, which will be put into effect gradually over the next 5 to 10 year period or as soon as circumstances permit.

ENDOCRINOLOGY AND MILK SECRETION

Project 28: Hormone-Enzyme (Enzymes of the Mammary Gland).

The enzymes of the mammary glands in the udder of dairy cattle control the growth and functional activity (milk secretion) of the individual cells. Under this project it is proposed to determine the nature of the enzymes present in the cells and how they respond to various hormonal stimuli during growth and in the synthesis of the various constituents of milk.

The yield of milk of which cows are capable is dependent upon the intensity of milk production in each cell in the mammary gland. In each cell all of the constituents of milk such as the protein (casein etc.) sugar (lactose) and fats are actually synthesized from other constituents in the blood plasma. The transformation of blood plasma to milk constituents is accomplished through the action of the enzymes present in the cells. Our objective is to determine which enzymes act to manufacture each of these milk constituents. Also under study are the hormones which influence the enzymes. Knowledge of the relation between the hormones and the enzymes is of great importance in providing the knowledge to help obtain the greatest yield of milk.

Project 80: Endocrine-Genetics of Milk Secretion.

The objectives are: (1) To determine the hormones which influence the intensity of milk secretion in dairy cattle. (2) To seek methods by which the limitations in the production of milk may be

determined in individual cows. (3) To develop methods based upon knowledge of the hormones which limit productivity by which the potentially poor producing cows may be detected as calves, thus making it possible to save the cost of growing the poorer one-third of the calf crop. (4) To develop methods by which sterile cows can be brought into commercial milk production without pregnancy. This study also includes developing methods by which the milk production of such cows *or* of normal cows may be maintained at high levels for long periods.

INFLUENCE OF CLIMATIC FACTORS ON GROWTH AND PRODUCTIVE PROCESSES

Project 125: Climatic Factors (Effects on Productive Processes and Physiological Reactions of Cattle).

The objective is to study the effects of climatic factors such as temperature, humidity, light, wind, etc. on the physiological reactions and productive processes, such as growth, milk and meat production in cattle. These studies also involve consideration of many physiological, neuro-endocrine, enzyme, and vascular systems which influence heat conservation and dissipation and thus enable animals to tolerate extreme climatic conditions such as heat and cold. This study has already shown that high producing dairy cattle are very cold-tolerant, but *not* heat-tolerant. High temperatures depress such productive processes as growth, milk, and meat production.

This research also furnishes agricultural engineers a basis for designing animal shelters against heat and cold, and provides dairymen with criteria for selection and breeding of heat- and cold-tolerant strains of cattle.

DAIRY BACTERIOLOGY AND SANITATION

Project 133: Characterization of Microorganisms (Common to Dairy Industry).

Many types of microorganisms cause deteriora-

tion of milk and milk products, affect herd health, limit herd replacement and influence the efficiency of rumen digestion. Many of these microorganisms are familiar to the bacteriologist but little is known about other species specific to the dairy industry. New cultural techniques and chemical tests are needed to simplify the identification of the many dairy microorganisms. This investigation provides for a study of the several species responsible for spoilage of dairy products, and of rumen microorganisms responsible for cellulose digestion.

MILK PROCESSING AND DAIRY PRODUCTS MANUFACTURING

Project 37: Milk Products (Ice Cream Quality).

The ice cream industry is continually searching for products which will enhance the flavor, body, texture and melt-down properties of ice cream. Two of these products of importance are sweeteners and emulsifiers. There are many of these on the market and it is important to know their specific effects. Some are known to produce an excellent body and texture but to cause an undesirable flavor and melt-down. Our purpose is to conduct exhaustive testing of sweeteners and emulsifiers as they influence flavor, body texture and melt-down properties of ice cream. We will also include studies of the effect of dehydration of the ice cream mix on the quality of the finished ice cream.

Project 284: Milk Quality Marketing.

This investigation is designed to determine the nature, cause and extent of deterioration which occurs in milk and milk products when moved in market channels. The introduction of various types of self service marketing methods has resulted in a need for dairy products with longer storage shelf life. Our first objective is to determine the effects of temperature and time on the storage life of Grade A milk which has been processed in different marketing areas. Similar research on cottage cheese and other milk products is planned.

Prepared by A. C. Ragsdale, chairman
Department of Dairy Husbandry

Department of Entomology

Study Areas and Personnel

Apiculture Leonard Haseman
Field and Forage Crop Insects Robert L. Shotwell
Paul Spangler

Harry E. Brown
Philip C. Stone
Arthur K. Burditt, Jr.

	<i>Perry L. Adkisson</i>
	<i>Lee Jenkins</i>
	<i>Harry E. Brown</i>
<i>Horticulture and Forestry Insects</i>	<i>Wilbur R. Enns</i>
	<i>Jerome Brezner</i>
<i>Insect Information</i>	<i>All staff members</i>
	<i>Wilbur R. Enns</i>
	<i>Harry E. Brown</i>
	<i>Philip C. Stone</i>
	<i>Curtis W. Wingo</i>
<i>Livestock Insects</i>	<i>Curtis W. Wingo</i>
<i>Soil Insects</i>	<i>Harry E. Brown</i>
	<i>Paul Spangler</i>
	<i>Curtis W. Wingo</i>
	<i>Philip C. Stone</i>

APICULTURE

Project 45: Bee Foulbrood.

This project is a study of the distribution and residual action of sulfa drugs and antibiotics on disease organisms in the bee hive. In this project sulfathiazole was proved several years ago to be an effective and inexpensive drug for controlling American foulbrood of bees.

FIELD AND FORAGE CROP INSECTS

Project 286: Corn Grasshoppers.

This new cooperative project between the USDA and the Missouri Agricultural Experiment Station deals with investigations of the biology, ecology, and control of grasshoppers injurious to corn and related crops. During the first year, emphasis is being placed on chemical control of grasshoppers in crop-pasture farming to develop proper timing and application of insecticides and to determine the feasibility of using these insecticides to halt movements of grasshoppers into crops.

Project 269: Corn Insects.

This project is a study of the major corn insects other than the European corn borer. Special emphasis is placed on the study of the soil insects such as rootworms, wireworms, and white grubs that attack the roots and seeds below ground; the corn earworm; the southwestern corn borer; and stored grain insects. Under this project a nematode parasite of insects is being studied which can be sprayed on the soil and foliage to control insect pests.

Project 270: European Corn Borer.

This project involves some 15 different special

studies on the biology and control of the European corn borer in all parts of the state, with emphasis on corn borer parasites, chemical control, and the effect of date of planting and corn maturity on borer populations. The project includes cooperation with the North Central States Regional Project NC-20 to follow the annual changes in abundance of the corn borer in Missouri, to compare these changes with those found in other states and to study the influence of weather conditions, the basic controlling factors, and soil management on borer populations.

Project 214: Cotton Insects.

Until this past year cotton insects had never been studied extensively in this state. Emphasis is being placed by one co-project leader this year on thrips, flea hoppers, red spiders and the bollworm in order to be able to advise farmers about the control of these pests. The other co-project leader is studying the soil nematode problem in cotton and the effect of the European corn borer as a new pest in Missouri on cotton.

Project 102: Field Crop Insects.

In this project investigations are made of the primary soybean insects in southeastern Missouri, the migration of the potato leafhopper through the state, the spotted alfalfa aphid, the Hessian fly, and also the effect of insecticides commonly used to control soil insects on the seeds of corn, wheat, cotton, and soybeans.

HORTICULTURE AND FORESTRY INSECTS

Project 294: Acorn Insects.

Each year the insects that attack acorns eliminate a large part of this food source for wildlife in Missouri. This project is sponsored by the Missouri Conservation Commission and is a systematic study of the insects which attack acorns, with special emphasis on the nut curculios.

Project 31: Codling Moth.

This type of project was initiated many years ago to help the fruit growers with their insect problems. At the present time this project is developing more effective and efficient spray programs for fruit and garden pests and studying the residues of chemicals applied to these crops under field and laboratory conditions.

INSECT INFORMATION**Project 30: Insect Information.**

This project makes it possible for all staff members to investigate specific insect problems of farmers or groups of farmers, survey for possible insect outbreaks, and furnish Missouri farmers with timely information on insects and their control.

Project 36: Entomology Museum.

The museum supplies adequate safe storage for the entomology collection and furnishes facilities for those qualified to pursue research in the collections. It also provides a ready reference collection for the identification of Missouri insects, mites, and ticks.

LIVESTOCK INSECTS**Project 46: Livestock Insects.**

Biological investigations are made and control studied for the stable fly, horse fly, and house fly as

animal pests. Improved methods of control of ticks, mangel mites, cattle grubs, and screwworms also are investigated.

SOILS**Project 283: Soil Insecticides.**

This study is in cooperation with a North Central States Regional project and is a study of insecticidal accumulation in soils under normal usage, the plant and animal tolerance for varying degrees of soil contamination and the rate of insecticidal decomposition in a four-year rotation in soils following initial applications at normal and excessive rates.

Project 74: Soil Minerals on Insects.

This project is a study of the influence of different elements and plant nutrients on the well-being and fecundity of the house cricket and other insects. The study is revealing the effect of minute amounts of certain foods on insect growth.

Prepared by Dr. Philip C. Stone, Chairman,
Department of Entomology.

Department of Field Crops**Study Areas and Personnel**

<i>Pasture Improvement</i>	<i>E. Marion Brown</i> <i>Joe D. Baldrige</i> <i>Norman Brown</i> <i>Carl Hayward</i>
<i>Seed Improvement</i>	<i>Lloyd E. Cavanah</i> <i>Wynard E. Aslin</i> <i>Viola M. Stanway</i> <i>Norman Brown</i> <i>Carl Hayward</i>
<i>Soybean Improvement</i>	<i>Leonard F. Williams</i> <i>Norman Brown</i> <i>Carl Hayward</i> <i>Arnold L. Matson</i>
<i>Cotton Production</i>	<i>William P. Sappenfield</i> <i>O. Hale Fletchall</i> <i>Norman Brown</i> <i>Arnold L. Matson</i> <i>Marvin D. Whitehead</i>
<i>Corn Breeding</i>	<i>Marcus S. Zuber</i> <i>Clarence O. Grogan</i> <i>Marvin D. Whitehead</i> <i>Phil Smith</i> <i>Arnold L. Matson</i> <i>Norman Brown</i>
<i>Small Grain Breeding</i>	<i>J. M. Poehlman</i> <i>Charles Hayward</i> <i>Dale T. Sechler</i> <i>Carl Hayward</i> <i>Norman Brown</i>

<i>Genetics Studies</i>	<i>Myron G. Nuffer</i> <i>Ernest R. Sears</i>
<i>Irrigation</i>	<i>Phil Smith</i> <i>Norman Brown</i>
<i>Pathology</i>	<i>Marvin D. Whitehead</i>
<i>Weed Control</i>	<i>O. Hale Fletchall</i> <i>Harold D. Kerr</i> <i>Norman Brown</i> <i>Carl Hayward</i>

PASTURE IMPROVEMENT**Project 213: Pasture Improvement.**

The improvement of pastures with legumes involves studies to determine which legume to use with adapted grasses for profitable pasture production under different conditions of weather, soil, and use. Studies on grass-legume stand maintenance are being carried out using different mixtures and different cultural practices at four locations throughout Missouri. At Columbia the persistence of birdsfoot trefoil and of ladino clover is being determined in bluegrass mowed to simulate grazing. Methods for the establishment of legumes in old pastures without destructive sod tillage are also being worked out.

Project 220: Grass Testing.

This project compared new species and varieties of grasses and legumes made available by plant introduction and by plant breeding, with species and varieties now in use. Their value for pasture, hay, and grass silage in different climatic regions and on different soils in Missouri is determined. Varieties of bromegrass, orchard grass, sudan grass, and red clover are being compared with respect to herbage yields, disease resistance, and stand survival. Varieties and interspecific hybrids of bluegrass, are being observed under frequent mowing to determine their comparative value both for forage and for turf production.

Project 221: Grass Breeding.

Activities of this project are directed toward the development of varieties of birdsfoot trefoil superior to present varieties in seed producing habits, persistence of stands, seedling vigor, and other agronomic qualities; also toward the development of more aggressive and productive varieties of annual lespedeza resistant to bacterial wilt, and to screen strains of perennial lespedeza. New varieties of trefoil are selected from large populations and then screened by elimination procedures. The better plants are progeny tested, then the elite plants are combined to form experimental varieties and start a new cycle of selection. Also a study is being made of the problems and possibilities of breeding trefoil. Some of the lespedeza work was suspended for the 1956 season due to lack of personnel. Some work is being done in the testing of previously developed hybrid strains, the production of breeders' seed of Climax and F.C.31057-5, and the screening of strains of perennial lespedeza, particularly sericea.

Project 241: Alfalfa Testing.

Experiments under this project are based on the improvement of alfalfa in yield, quality, and resistance to disease, through the selective testing of varietal strains. Forage yields of the varieties and strains under test are being obtained from each of the alfalfa variety tests located at Lathrop, Columbia, Weldon Springs, Pierce City, and Sikeston. Stand counts are made on each variety at each location. Low crown and creeping alfalfas are being observed at Columbia to determine their relative merits for use in pasture mixtures. Vernal alfalfa has proved to be the up and coming alfalfa variety and is now being recommended for Missouri.

SEED IMPROVEMENT**Project 19: Seed Improvement.**

Improvement of Missouri farm seeds is the broad objective which includes the creation or development of better farm plants through research in plant breeding and introduction of new varieties and new strains, increasing and maintaining seed of such plants through a Foundation Seed Stock program, and establishing such plants as crops and pastures on Missouri farms. We maintain a seed testing laboratory for testing seeds of the many agencies who teach and demonstrate the value of superior seeds. Also to be included is the distribution of these seeds to members of the Association who are willing and capable of increasing the seed most rapidly under a strict set of regulations.

The work of the project includes field inspection of seed in standing crops for such qualities as general purity, healthiness, and freedom from objectionable weeds; increasing and maintaining breeders seed of superior strains; multiplying and processing inbred and single-cross corn lines to be used in producing the recommended double-cross hybrid corn varieties.

SOYBEAN IMPROVEMENT**Project 49: Soybean Improvement.**

This project includes: Development of new varieties of soybeans for the various production areas in Missouri with improved yielding ability and chemical composition and improved resistance to shattering, lodging, and diseases; securing information needed to make recommendations to farmers on the adaptation and performance of new and standard varieties of soybeans; securing information on the effects of various cultural practices such as varying the rates and dates of planting; and securing basic information which will improve the efficiency of the breeding program.

Major emphasis at present is on the production of yellow soybean varieties suitable for industrial use and resistant to the diseases common to Missouri—root rot, stem canker, bacterial pustule, wildfire, downy mildew, brown spot and frog-eye leaf spot.

Genetic studies are under way on a moderate scale as well as studies on the efficiency of various breeding techniques.

An extensive experiment has been started to study the usefulness of X-rays and atomic radiation in producing new types, particularly in regard to

disease resistance.

More than 3000 soybean strains from the Orient have been tested in a search for resistance to leaf, stem, and root diseases. Resistance to several diseases thus discovered is being incorporated into our best varieties.

Results from this program are quickly accepted by Missouri farmers. The new variety Clark, first tested in 1949 and found to be higher yielding than comparable varieties in widespread tests at 15 locations from 1951 on, is now the dominant variety in the northern half of Missouri and is widely planted in the southern half.

COTTON PRODUCTION

Project 160: Cotton Production.

This project includes variety tests on six different soil types in the cotton growing region of southeast Missouri. All available varieties that may be adapted to that area are tested. Efforts are being made to produce a new improved variety that is earlier in maturity and has a high yield of quality fiber. Ways are being sought to reduce production costs, especially through the use of chemicals for weed control. Herbicides are now recommended for weed control in cotton and even more promising methods and chemicals are being studied. Experiments are under way to find ways to mechanize or else to eliminate the need for thinning cotton. This, in combination with chemical weed control would greatly increase the efficiency of cotton production. New chemicals are being tested for defoliating cotton and attempts are being made to understand the reasons for failures with current defoliant. A solution of this problem would eliminate the greatest disadvantage of the mechanical cotton picker—low quality cotton.

CORN BREEDING

Project 85: Hybrid Corn.

The scope of this project revolves around the breeding of better hybrid corn varieties for Missouri. This includes the development of agronomically superior hybrids; the development of hybrids for special purposes; investigations in pathological, entomological, and cultural problems; and investigation of new breeding techniques. In 1955 a new yellow double-cross, Missouri 843, was released to commercial channels for northern Missouri. The results from a five-year average show this hybrid to yield approximately 7 bushels per acre better than U.S. 13. Three

new double-cross pipecorn hybrids were released for the 1956 growing season. These are Mo. Pipe 4, 6, and 8. They have been tested extensively and will replace the hybrid pipe composite currently in use. The cytoplasmic male sterility factor and pollen restorers are being transferred to a number of inbred lines, and when this work is completed, the seed producer will not have to detassel his double-cross production field.

SMALL GRAIN BREEDING

Project 203: Oat Breeding.

Under this project an effort is being made to breed improved varieties of early oats for Missouri. Mo. O-205, developed by the Missouri Agricultural Experiment Station and distributed in 1951, has set a new standard for yield and disease resistance and is now the leading variety in Missouri. Specific attention is being given to the improvement of Mo. O-205 in the following areas (a) stiffer straw, (b) resistance to additional races of stem rust, and (c) improvement of quality. Increased attention is being given to winter oats. Some research is being done on neutron irradiated oats for light seed color and stiffer straw.

Project 90: Barley Breeding.

The objective of this project is to breed winter barley for yield, winter-hardiness, and disease resistance with special emphasis on resistance to smut diseases. Due to drouth, restrictions in wheat acreages, recognition of winter barley as a valuable feed crop, and increased safety in growing the crop which comes from greater use of fertilizers and new, more productive varieties, barley acreage increased from 299,000 acres in 1954 to 499,000 acres in 1955. The Missouri B-400 variety distributed in 1950 is now being planted on an estimated 90 percent of the Missouri acreage. A new variety, Mo. B-475 was distributed to growers in the fall of 1955. Mo. B-475 is superior to Mo. B-400 in yield and winter-hardiness, threshes cleaner, is resistant to common races of smut, moderately resistant to mildew, and similar to Mo. B-400 in straw strength and height. Three new strains that have proved to be of particular interest are B-637 with a high yield and covered smut resistance, B-899 with a good yield and stiff straw and B-893 with outstanding winter-hardiness.

Project 202: Wheat Improvement.

This project's objective is to breed and evalu-

ate new strains of soft wheat for resistance to leaf rust, loose smut, and Hessian fly. Efforts are being made to improve upon the present varieties of soft wheat which meet with disfavor by farmers because they are so tall, and are mostly susceptible to leaf rust and Hessian fly. Shorter and stiffer strains would enable the farmer to increase yield by heavier fertilizer application. Earliness would permit escape from weather hazards.

GENETIC STUDIES

Project 48: Genetic Studies.

The studies on mechanism of heredity in corn are carried on in this project. Its objectives are to determine the effects of X-rays and ultraviolet radiation on gene mutation, to study genetic control of gene mutation to determine the structure at selected genes, and study the mechanism of genetic control of biochemical processes. The facts gained in this type of research are fundamental principles that can be applied to plant breeding methods.

Project 261: Wheat Cytogenetics.

The objectives of this project are to get additional information concerning the fundamental genetics of wheat, to locate genes on the chromosomes of wheat, and to transfer desirable genes to wheat from other genera. Included in the fundamental genetics of wheat are studies in chromosome relationships and gene evaluation. Testing is being done for the location of genes for stem-rust resistance and for leaf-rust resistance. The transfer of disease resistance and other characters from rye to wheat is being attempted.

IRRIGATION

Project 204: Field Crop Irrigation.

We expect to learn the effects of irrigation on yield and quality of corn and cotton grown under different levels of fertilization; and on yield and quality of soybeans, pastures for beef cattle, and forage crops. At McCredie in 1955, corn yields were increased from 79 to 154 bu/acre by the addition of 10.5 inches of water. Soybean yields were increased 13 bu/acre by adding 8 inches of water, although this was unprofitable. Beef gains were increased 92 lb/acre by supplying 13 inches of water to orchard grass, timothy, ladino clover pasture. The importance of supplemental irrigation in reducing drouth hazards in becoming more widely recognized in Missouri.

PATHOLOGY

Project 127: Cereal Diseases.

This project deals with studying diseases of economical importance to field crops and describing those found to be new; making estimates of crop yield loss due to diseases; determining the resistance of present varieties, breeding lines, and hybrids to diseases and working with plant breeders in developing new, more resistant varieties; searching for cultural methods such as environmental factors to control diseases; testing chemicals and antibiotics for possible economical control of diseases; and studying methods of inoculation and developing new techniques for studies of field crops diseases. The recognition of new disease occurrences will aid the plant breeders to improve the crop concerned. Improved varieties are being developed with higher disease resistance.

WEED CONTROL

Project 156: Weed Control.

Weed Control Research includes experiments in control of weeds in corn, soybeans, cotton, pastures and meadows and the control of brush, Johnsongrass, giant foxtail, garlic, and other weed pests.

The control of weeds in pastures and meadows involves the selective effect of chemicals in reducing competition of weeds in forage crops; the effectiveness of chemicals for weed control as an aid in establishing legumes; and the relative cost of controlling unwanted brush by different methods as well as the chemical effects on desirable forage. Extensive tests are now being run on the establishment of legumes, especially birdsfoot trefoil from spring seedings. The use of dalapon and TCA coupled with cultural methods is proving very effective in establishing trefoil. The use of chemicals as a substitute for some tillage operations in renovating grass pastures has been proven possible. Aerial spraying of chemicals shows promise of increasing the efficiency of brush control.

The control of weeds in corn, cotton, and soybeans includes the testing of new and standard herbicides as pre-emergence treatments, post-emergence treatments, and directed sprays under varying conditions of crops, weather, and soil; and comparing various combinations of chemical and cultural weed control practices from the standpoint of efficient crop production. Promising chemicals now being tested on the weed research field at the University of Missouri South Farms are Simazin as a pre-emer-

gence treatment in corn, Dalapon as directed spray to control Johnson grass and giant foxtail in corn, and PCP as a pre-emergence band treatment to con-

trol weeds in soybeans.

Prepared by O. Hale Fletchall, Assistant Professor,
Department of Field Crops.

Department of Forestry

Study Areas and Personnel

<i>Forest Ecology</i>	R. E. McDermott P. W. Fletcher R. A. Musbach J. M. Nichols J. Harty
<i>Forest Economics</i>	R. C. Smith A. J. Nash
<i>Forest Fire Control</i>	J. M. Nichols R. A. Musbach
<i>Forest Watershed Management</i>	P. W. Fletcher R. A. Musbach R. Z. Whipkey J. Harty
<i>Forest Pathology</i>	T. W. Bretz W. D. Buchanan T. W. Jones
<i>Marketing of Forest Products</i>	R. B. Polk R. A. Musbach L. K. Paulsell R. C. Smith R. H. Westveld L. Leney W. J. O'Neil J. Harty
<i>Range Management</i>	C. L. Kucera
<i>Silviculture</i>	R. H. Westveld R. B. Polk L. K. Paulsell P. W. Fletcher R. A. Musbach J. M. Nichols J. Harty
<i>Wood Products</i>	R. C. Smith W. J. O'Neil L. Leney R. A. Musbach J. Harty

FOREST ECOLOGY

Project 123: Ecological Studies in Forestry.

This project includes three studies designed to secure fundamental knowledge of the behavior of forest vegetation: acorn production, site requirements of eastern redcedar, and the effects of grazing on forest vegetation.

Project 260: Relation of Tree Species to Soil Characteristics.

Although this project is designed to determine the distribution of various tree species in relation to

soil and parent matter, the current work is limited to these relationships for shortleaf pine. This project will provide fundamental information which will suggest the soil and parent matter limitations under which shortleaf pine can be grown successfully.

FOREST ECONOMICS

Project 124: Economics of Timber Production.

The purpose of this project is to determine some of the factors in costs and returns from timber growing. The project includes studies of forest taxation, studies of growth and yield, and case studies of income from timber management.

FOREST FIRE CONTROL

Project 290: Fire Control.

This project was initiated at the beginning of the current fiscal year. Its objective is the development of a new type of fire fighting equipment which utilizes forced air to move leaves and litter in building fire lines.

FOREST WATERSHED MANAGEMENT

Project 158: Effect of Forest Cover on Soil and Water Conservation.

The purpose of this project is to determine the effect of different types of forest cover on soil and water conservation and the effect that different methods of forest land management and abuses have on soil and water conditions. The studies now in operation include hydrologic orientation and soil moisture studies.

FOREST PATHOLOGY

Project 52: Oak Wilt Studies.

Objectives are to determine the conditions under which oak wilt attacks various species of oak and to determine practical measures for control of the disease.

MARKETING OF FOREST PRODUCTS

Project 120: Marketing the Timber Crop.

Studies in progress include fence post preservation and lumber grading.

The purpose of this project is to determine the methods of timber utilization which will yield the best income to the producer.

Project 245: Marketing Christmas Trees.

Studies are being made to determine (1) the size and character of the demand for Christmas trees; (2) consumer preference for different species and grades of trees and for tinted trees; (3) relative merits of different marketing methods; and (4) the factors that should be used in pricing trees.

Project 259: Marketing of Hardwood Panelling.

This project includes not only the marketing of hardwood panelling, but also methods of processing hardwood panelling. Because this project covers more than marketing, it is included also under Wood Products. The purpose of the marketing phase of this project is to determine consumer preference for different types of panelling as well as different finishes of panelling and to determine the most feasible method of marketing to meet the requirements of the "do-it-yourself" customer and other types of customers.

RANGE MANAGEMENT

Project 79: Range Plants.

Better knowledge of the identity of the forage plants and their life cycles and behavior on various sites on the so-called Glade Region of Missouri are the objectives of this investigation.

SILVICULTURE

Project 9: Christmas Tree Culture.

The purpose of this project is to develop satisfactory methods of Christmas tree culture to produce the types of trees which are in greatest demand on the market. Studies under it include adaptability of different tree species to different soils, mulching, spacing, pruning, fertilization, site preparation and subsequent cultivation.

Project 75: Improvement of Understocked Forests.

Development of techniques for improving the

volume and quality of production of understocked timber stands is the aim in this project. It involves studies of the effects of fire on timber, pruning, and the conversion of low-value hardwood stands to conifers.

Project 122: Cutting Methods.

This project is designed to determine the effects of different cutting methods on various types of forest stands. The effects under study are in regeneration, rate of growth, timber quality, and income.

Project 157: Reforestation.

The purpose of this project is to determine the best methods of doing reforestation work and to determine which species are best adapted to the wide variety of sites found in Missouri.

Project 166: Control of Inferior Species.

The best methods of eliminating low-value or worthless species from timber stands are sought in this project. Included are studies of various chemicals and of girdling.

Project 287: The Effect of Stand Treatment on Bottomland Hardwoods

Bottomland hardwood forests are being studied, such as those found along the Mississippi and Missouri Rivers, where periodic flooding is common. The purpose of this project is to determine the best methods of handling these stands both for timber and wildlife production.

WOOD PRODUCTS

Project 159: Utilization of Native Timber and Residues.

The purpose of this project is to determine the best uses for various Missouri species and to develop new uses for them. Studies under way include seasoning of wood and cutting methods for improving wood quality.

Project 259: Marketing of Hardwood Panelling

This project was referred to under Marketing of Forests Products. The phases of the project that are being studied under the wood products project are: methods of panelling manufacture, cost studies for different manufacturing methods, and panelling design.

Prepared by R. H. Westveld, Chairman,
Department of Forestry

Department of Home Economics

Study Areas and Personnel

<i>Foods</i>	Leta Maharg Helen Gordon Virginia Holt Mina Glidden Isabelle Delaney Georgia Amick George Kelley Margaret Mangel Muriel Caldwell
<i>Marketing (Cooperative Research with Animal Husbandry and Agricultural Economics)</i>	Ruth Cook Virginia Holt Margaret Mangel
<i>Nutrition</i>	George Kelley Helen Gordon (other positions yet to be filled)
<i>Textiles</i>	Adella Ginter Cecilia Alearbck Ruth Poss

It is hoped that research can be undertaken in the additional areas of Child Development, Interior Design, Home Management, Equipment and Family Economics as well as in additional aspects of Marketing Research in the very near future.

FOOD RESEARCH

Project 87: Meat Pigments.

An extensive study of the behavior of meat pigments in solution has been undertaken. Measurement of these pigments is done spectrophotometrically and it is possible by this means to detect the change from red to brown as the pigments deteriorate. It is hoped that information regarding the study of these pigments will lead to improved methods for the treatment and care of meat as well as for evaluation of freshness and detection of additives to meats.

Project 130: Food Improvers.

This is a series of studies designed to increase utilization of Missouri products and new forms of food products as they occur on the market. Quite frequently, the homemaker needs help in using these materials. New products which are thought to contribute to the nutritive value of the diet are tested and recommendations for their use are made as they appear on the market.

A. Work is continuing on development of recipes and recommendations for the use of non-fat dry milk solids as well as for adapting recommendations to the new instant forms of this material.

B. In the past several years a number of new meat tenderizers have come on the market. It was thought that the use of these tenderizers by the homemaker and by institutions would encourage the use of less tender cuts of meat which could be prepared by broiling or frying. These cuts of meats ordinarily do not bring as high prices in the summer, due to the fact that few homemakers are willing to use long slow cookery processes. A study of the enzymatic activity of 14 of these meat tenderizers has been completed. Future work will center on recommendations for suitable methods of application of tenderizers to meats since many of the methods now recommended cause decomposition of the surface before tenderizing the interior.

C. Missouri is one of the leading producers of dried milk and eggs. The development of a high nutritive value mix for quick breads containing both dried milk and dried eggs has been undertaken. To date this mix has been developed and standardized with dried milk and hydrogenated fat. Future work will deal with standardization with lard and with dried eggs.

D. This part of the project deals with recommendations for freezer storage of Missouri products. A number of products which present problems in storage will be studied but emphasis will be placed on baked goods.

E. This part of the project is concerned with the best method of incorporating dried eggs in food products. Dried eggs present a problem in this respect and it is hoped that more satisfactory methods will be found for use of this substance.

Project 163: Food Preparation.

A. This project is concerned with studies to determine food preparation practices in Missouri. A survey on preparation of vegetables is planned as the first phase of this project.

B. The development of new uses of soft wheat from whole through cracked to wheat flour has been undertaken with the aim of increasing the uses of this Missouri product.

Project 205: Wheat Flour Study.

This project is undertaken in cooperation with the Field Crops Department. Physical and baking tests are done in the evaluation of flours from pro-

mising new wheat varieties which have been developed by the Field Crops Department. In addition, studies to improve the methods used for evaluation in these flours are underway.

MARKETING RESEARCH

Project 109: Meat Preference Studies.

This is a consumer acceptance and preference study undertaken in conjunction with Agricultural Economics and Animal Husbandry Departments. These studies are designed to test the ability of consumers to discriminate within and between grades of meat and to determine their preferences for meats of various grades. In addition, development of methods for measuring acceptability of grades and cuts is being studied. If evidence is found concerning the inadequacy of the present grading system, recommendations for a revised retail grading system may be presented.

Project 219: Pork Studies.

This study has been undertaken in cooperation with the Agricultural Economics and Animal Husbandry Departments. It is concerned with determining consumer preferences for grade, with particular reference to amount of fat in pork.

NUTRITION RESEARCH

Project 95: Nutritional Status of Older Women.

The study of nutritional status and dietary habits of older women of Missouri is part of a North

Central Regional project to study these factors in the region as a whole. The Missouri Experiment Station has studied: first, the dietary habits of 25 older women by analyzing their diets to determine the actual intakes in relation to nutritional status. In addition, one long-term study has been undertaken to determine whether or not cyclic variations in intakes and excretions do occur. More recently, the Missouri Experiment Station began an attempt to determine minimum levels of the essential amino acid lysine which will maintain nitrogen balance in women. This work has been done for men but not for women. Other stations are conducting similar experiments and data will be combined for purposes of developing recommendations for intakes of the essential amino acids and hence of food proteins. Diets of the women studied have been analyzed by means of chemical and calorimetric methods in the hope of development of more accurate methods of determining calorie intakes.

Project 162: Children's Clothing.

This study is also a North Central Regional project and is designed to determine the serviceability of various textiles in children's clothing. Present work deals with characteristics and serviceability of boys ready-to-wear gingham and cotton flannel shirts. Serviceability is determined with regard to laundry and wearing qualities by means of objective methods.

Prepared by Margaret Mangel, Chairman,
Department of Home Economics.

Department of Horticulture

Study Areas and Personnel

Breeding and Variety Evaluation ... D. D. Hemphill
A. D. Hibbard
V. N. Lambeth
General Cultural Problems M. N. Rogers
James E. Smith
A. D. Hibbard
Weed Control D. D. Hemphill
Marketing and Economics A. E. Gaus
R. A. Schroeder
J. W. McKinsey
Physiology of Growth and D. D. Hemphill
Reproduction A. D. Hibbard
Plant Diseases R. N. Goodman
D. F. Millikan
H. G. Swartwout
D. D. Hemphill

Plant-Soil Relations, Moisture, J. E. Smith
Nutrition, Management M. N. Rogers
A. D. Hibbard
V. N. Lambeth
D. D. Hemphill
H. G. Swartwout
Processing M. R. Johnston

BREEDING AND VARIETY EVALUATION

Project 291: Small Fruit Culture.

To be able to recommend to Missouri growers the most desirable varieties of blackberries, raspberries and strawberries, a program of comparing newly

introduced varieties with presently recommended varieties is carried on continuously.

High yielding, disease-resistant, high quality market varieties are the primary objectives of a breeding program to develop varieties of strawberries better suited to the needs of Missouri growers.

Project 126: Stone Fruits.

The performances of new peach varieties are compared with standard varieties. About 50 varieties will be tested continuously.

Project 121: Truck Crops.

Under this project new varieties of tomatoes, sweet potatoes and Irish potatoes will be tested for their adaptation to Missouri conditions.

Project 128: Vegetable Breeding.

A program of developing watermelon varieties that are adapted to Missouri conditions, disease resistant, and meet present day market demands is being carried on.

Also under this project is a program of breeding tomatoes for disease resistance, particularly wilt.

GENERAL CULTURAL PROBLEMS

Project 293: Flower Production

The effects of different methods of cooling greenhouses on the production and quality of the leading flower crops will be studied under this project.

The life of cut flowers as influenced by temperatures, packaging, and treatment to reduce water loss will also be studied.

Project 126: Stone Fruits.

The pruning of peaches will be studied in an effort to develop a method that will reduce hand labor to a minimum yet produce a tree of desirable form and high productivity.

WEED CONTROL

Project 146: Horticulture Crop Weeds.

The objectives of this project are to develop methods of controlling weeds which will reduce the high requirement of hand labor. This study will deal with the use of chemical weed killers (herbicides), mulches, geese, flame weeders, and new mechanical developments in flower crops, lawns, orchards, small fruit plantings, vegetable planting and

vineyards.

MARKETING AND ECONOMICS

Project 63: Marketing Fruits and Vegetables.

Under this project a cost-of-production study of vegetable crops is being made in the St. Louis area.

PHYSIOLOGY OF GROWTH AND REPRODUCTION

Project 195: Fruit Setting.

A study of the effects of certain chemicals on the fruit setting of apples is being conducted in an effort to develop chemical methods of thinning apple fruits at blossom time.

The effects of these growth regulator types of chemicals on the pre-harvest drop and storage quality of fruit is also being studied.

Project 129: Plant Reproduction

The possibility of increasing the yields of certain fruits and vegetables by the use of "hormone-like" chemicals to increase production of flowers is being investigated. The possibility of increasing yields of lima beans, strawberries, and tomatoes by chemical sprays to reduce flower bud drop is also being studied.

The amount of winter injury experienced by peach buds is related to their dormancy. A physiological study is being conducted on the possible control of dormancy by naturally-occurring growth regulators.

Project 126: Stone Fruits.

To reduce hand labor and improve quality, various chemical agents are being tested in an effort to develop reliable chemical methods of thinning peaches.

PLANT DISEASES

Project 27: Antibiotic Sprays.

Under this project different antibiotic materials are being used in an attempt to control some of our most perplexing and serious plant diseases, including fire blight on apples and pears, bacterial spot of peaches, carnation wilt and mushroom diseases.

A study will also be conducted on the uptake and translocation of antibiotics by the plant and of the occurrence of natural antibacterial substances.

Project 285: Chemical Inhibition of Viruses.

The possibility of the inactivation of viruses in the plant by the use of certain chemicals will be determined under this project.

Project 232: Fruit Diseases.

This project will entail the use of different chemicals for the control of diseases such as apple scab and cedar rust. Effects of these fungicides on fruit finish as well as disease control will be determined.

Project 258: Horticulture Pathogens.

This project is a service to both commercial and non-commercial growers in the state. Diseases occurring in the state on horticultural crops are identified and control measures for them are suggested. This not only helps the individuals concerned but also may aid in the early detection of potentially dangerous epidemics.

Project 243: Peach Diseases.

Controls of brown rot, bacterial spot, scab and other peach diseases are studied under this project. Various chemicals are evaluated for their disease control properties and their effects on the finish of the fruit.

Project 291: Small Fruit Culture.

A sterility condition in which plants bloom profusely but do not develop fruit has become quite prevalent in named varieties and wild strains of blackberries. The causes and possible methods of control are being studied.

Project 194: Spraying.

Fungicidal chemicals are being evaluated continually for the control of black rot and downy mildew, the most serious diseases of grapes. This work is conducted primarily in commercial vineyards in south central Missouri.

Project 68: Stone Fruits Viruses.

A program of surveying peach and cherry plantings for virus infection is being carried out. In addition, major apple and pear varieties are being tested for virus infection. Virus-free stock, when found, will be propagated for use as certified stock.

Laboratory studies are being conducted to learn more about the nature of viruses and their physiological effects on the host plant. Possibilities of the chemical treatment of viruses will also be investigated.

PLANT-SOIL RELATIONS—MOISTURE, NUTRITION, MANAGEMENT

Project 293: Flower Production.

This project includes a study of the relationships between fertilizer application and flower production and quality and will be carried out in cooperation with commercial florists in the state.

Project 1: Irrigation.

The relation between available soil moisture and the growth and yield of vegetable crops will be carried out under this project. In a number of commercial orchards, soil moisture relationships will also be followed at various soil depths. The water-holding capacity of the soil and the infiltration rates will be studied. As a result of this, a better system of determining the timing and extent of orchard irrigation can be worked out.

Project 4: Plant Nutrition.

Leaf analyses will be performed on samples obtained from various apple orchards in the state and the data compared with previous management practices. The relationships between N, P and K and moisture will be studied in reference to the yields and leaf analyses of strawberry plantings. Studies will also be made under this project to develop a fertilizer program for grape growers, using the effect of different levels of N, P and K on the yield and quality of Concord grapes.

Project 126: Stone Fruits.

The effect of different soil management techniques on a young peach orchard will be noted. The practicability of sod culture in peach orchards will be investigated.

Project 196: Vegetable Nutrition.

The response of several vegetables to different fertility levels will be investigated under both field and greenhouse conditions.

PROCESSING

Project 233: Apple Technology.

Under this project, the cider-making qualities of various apple varieties will be investigated, particularly with reference to frozen, concentrated cider. Different types of yeast will also be tried for fermentation qualities and the blending procedure studied. In addition, the mechanics of apple juice extraction will be examined.

Project 295: Marketing Processed Crops.

A study will be made of the market potential of various Missouri grown vegetables, their production of harvest also will be investigated, as will be the relation of time of harvest to quality.

Project 234: Potato Technology.

The comparative storage quality of irish potato varieties will be determined and the effects of various treatments on sprouting and rot prevention noted. The effects of storage factors on frozen mashed potato products will be examined.

Prepared by R. A. Schroeder, Chairman,
Department of Horticulture.

Department of Poultry Husbandry

Study Areas and Personnel

<i>Breeding</i>	<i>A. B. Stephenson</i> <i>Q. B. Kinder</i> <i>E. M. Funk</i>
<i>Hatchability</i>	<i>E. M. Funk</i> <i>James Forward</i>
<i>Management</i>	<i>Q. B. Kinder</i>
<i>Marketing</i>	<i>E. M. Funk</i> <i>James Forward</i>
<i>Marketing and Processing</i>	<i>E. M. Funk</i> <i>Owen Cotterill</i> <i>O. J. Kablenberg</i> <i>James Forward</i>
<i>Nutrition</i>	<i>J. E. Savage</i> <i>Q. B. Kinder</i>
<i>Physiology</i>	<i>H. V. Biellier</i>
<i>Turkeys</i>	<i>H. V. Biellier</i> <i>E. M. Funk</i>

Assistance is also given by students and graduate students in carrying on these projects.

BREEDING**Project 164: Systems of Breeding for Performance in Poultry.**

The Missouri Agricultural Experiment Station is cooperating with the North Central States Regional Poultry Breeding Project in attempting to determine the better methods of breeding chickens. The methods being tested at Missouri are the conventional closed flock method, with occasional introduction of new stocks, and the recurrent selection method. The Missouri breeding project is planned to determine the relative rate of progress by these two systems of breeding.

The recurrent selection method is similar to a top cross in that it is a cross between inbred and non-inbred parents. It differs from the top cross in that selection is made each generation in the non-inbred populations for better "nicking" or combining ability with the inbred lines. Selection is based on how well the progeny of the cross performed..

Project 26: Testing the Performance of Different Strains and Crosses of Poultry.

This project is testing the performance of pure-breds, crosses, and hybrids for egg production with a view to finding the better breeding stock for Missouri hatcherymen to produce and for Missouri producers to use in their flocks.

HATCHABILITY**Project 40: Care of Hatching Eggs.**

Missouri produces approximately 100,000,000 chicks each year. An increase of 1 percent in hatching would result in extra chicks worth \$150,000 per year.

This investigation seeks to find the factors in the care of eggs that affect hatchability. The effects of temperature, humidity, turning, and position of egg are being investigated. Publications reporting some of the effects of temperature, humidity, and turning have been issued by the Missouri Agricultural Experiment Station.

MANAGEMENT**Project 26: Systems of Flock Replacement.**

The objectives of this project are:

- A. To compare costs and returns of confinement reared pullets with those of range reared pullets for egg production.
- B. To develop a compact and more profitable farm unit of poultry for egg production.

There is a trend to confinement rearing of pullets. This project compares confinement with range rearing and seeks to evaluate the two systems for Missouri farmers.

A system of brooding, rearing, and managing

layers hatched at three seasons of the year is being tested with the hope of saving labor and improving the management of the farm flock in Missouri.

MARKETING

Project 161: Relation of Refrigeration, Thermostabilization, and Frequency of Gathering to the Quality of Shell Eggs Reaching the Market.

This is an investigation of methods for maintaining the quality of eggs. A serious problem confronting the poultry industry of Missouri and the midwest is that of maintaining the quality of eggs on the farm and through the channels of trade so consumers will get a better product and will be willing to pay producers more for a quality product.

MARKETING AND PROCESSING

Project 17: Minimizing Quality Losses in Shell Eggs and Dressed Poultry in Market Channels.

A. Relation of age of bird to initial quality and loss of quality in shell eggs in market channels.

B. Relation of time (season) of production to initial quality in shell eggs in market channels.

This project is part of a regional project (NCM-7) designed to reduce losses in quality of poultry and eggs in market channels and thereby improve the quality of these products for the consumer. The producer should also benefit from the increased demand for the higher quality poultry products.

The process of thermostabilization of shell eggs developed under this project has been introduced into India with very favorable results. It was reported by Indian students attending the American Poultry Science Association in 1956 that this process is being used extensively in India. Since there is no refrigeration there for eggs, this process which devitalizes the embryos of fertile eggs (most eggs in India are fertile) makes possible the movement of shell eggs into the city markets. Eggs that would be spoiled in two or three days retain their edible properties for eight to ten days when thermostabilized and, therefore, can be marketed.

New Projects Planned in Processing

New projects in processing are planned to improve the processing of poultry meat and eggs and the use of by-products.

NUTRITION

Project 24: The Effect of Amino Acids, Unidentified Factors and Agricultural By-products on Growth and Feed Efficiency in Broilers.

Feed costs make up over 60 percent of the cost of producing broilers. Increased growth and feed efficiency directly lower the cost of production. Utilization of agricultural by-products, especially those available in surplus supply, will tend to provide a market for these products. Use of animal fats and greases in broiler and hen feeds is an example of the use of a surplus agricultural by-product.

In all broiler ration experiments, the chicks are kept for 9 or 10 weeks in floor pens. Some groups receive a test diet that is similar to a good practical broiler ration that is used by many broiler growers. Other groups receive the same ration with the amino acids or other substance added. The supplement is judged by its effect on growth rate and feed efficiency. The cost of any supplement that improves growth or feed efficiency will determine whether it is profitable to add it to a particular broiler ration.

Project 255: Rations for Laying Hens.

Current nutritional research with laying hens is in three fields. The effect of changing the energy level by feeding a high protein concentrate with corn as the only source of grain is compared to a concentrate with corn and oats. These two concentrates and grains are fed free choice and are further compared with a lower protein, free-choice mash and a hand-fed grain program. Egg strain birds are used in all of these comparisons.

Other experiments with broiler strain hens measure the effect on hatchability when milk products, fish products or fermentation products are added to the ration.

The third area of study is concerned with the effect that the diet of the hen has on the growth of the chick. In this work, chicks are hatched from the broiler strain hens that receive the different supplements and are grown out to broiler size. Differences in growth rate of the chicks are a measure of the effect of the hen diet on chick growth.

Project 277: The Nutritional Requirement of the Chick for Amino Acids and Unrecognized Growth Factors.

Maximum growth in chicks is usually obtained by adding various sources of "unidentified growth factors" to the ration. These supplements are ex-

pensive and their value difficult to determine. In some cases, the growth effect of these supplements has been found to be due to extra amounts of amino acids supplied by the supplement rather than a growth response produced by an unrecognized factor. With more exact knowledge of the amino acid requirements of the chick, it will be possible in many instances to use more economical sources of these nutrients.

In the chick amino acid work underway, crystalline amino acids and purified proteins high in selected amino acids are added to purified chick diets. Various protein levels are fed, and the requirement of the chick for a specific amino acid is determined. Crude materials that have been reported to contain unrecognized growth factors are added to diets found to be adequate in amino acids and the effect of the crude material evaluated by its effect on growth and feed efficiency.

PHYSIOLOGY

Project 296: Role of Thyroxine, Androgens, and Estrogens in Chickens and Poults.

This is a fundamental study of the effect of thyroxine and male and female hormones on the growth of chicks and poults. Radioiodine will be used as a tracer to determine the rate of secretion of thy-

roid hormone.

The effects of male and female hormones in reversing sex are also being investigated.

Project 292: Photoperiodicity and Age on Chicken Reproduction.

This is a fundamental study of the effect of light on egg production in chickens, looking toward increased egg production and improved efficiency in producing eggs. The birds in part of this experiment receive only artificial light under controlled conditions.

New ideas for maintaining egg production in hens by the use of artificial light are being investigated.

TURKEYS

Project 72: Improvement of Market Turkeys by Hormone Administration.

This research is directed toward improving the growth rate and finish on turkeys with a view to marketing large-type turkeys at an earlier age (19 to 20 weeks of age as contrasted to 24 to 26 weeks of age).

A new turkey farm is being developed to expand turkey investigations at the University of Missouri. New projects designed to answer the problems of Missouri turkey producers will be initiated.

Department of Rural Sociology

Study Areas and Personnel

<i>Communications</i>	<i>Herbert F. Lionberger</i> <i>C. E. Lively</i> <i>John S. Holik</i> <i>Edward W. Hassinger</i> <i>Florence Long</i>
<i>Health</i>	<i>Robert W. McNamara</i> <i>C. E. Lively</i> <i>Mary Bonwell</i>
<i>Marketing</i>	<i>C. L. Gregory</i> <i>C. E. Lively</i> <i>Mary Bowman</i> <i>L. S. Malone</i>
<i>Institutions</i>	<i>Lawrence M. Hepple</i>

COMMUNICATIONS

Project 29: Social and Cultural Factors Affecting the Dissemination and Use of Scientific Farm Information.

This project is concerned with the dissemination, acceptance and use of scientific farm informa-

tion by Missouri farmers. It is now apparent that under present conditions such information tends to accumulate at the research centers more rapidly than it is understood and accepted for use by the farmers of the state. This project studies the entire process of diffusion of such information, from laboratory to use on the farm, with a view to shortening and speeding up the process.

HEALTH

Project 201: Illness in Rural Missouri.

This project is concern with the study of health conditions in rural Missouri, the factors affecting its variation from area to area, and the prevailing practices in meeting the impact of illness, including family and home practices as well as the use made of professional medical and hospital services. It is now known that illness and disability in rural Mis-

souri is of serious proportions, and it varies considerably from area to area; also that the reasons for these conditions are not entirely economic. The aim of this project is to understand these causes so that more effective improvement programs can be introduced.

MARKETING

Project 266: Social and Psychological Factors Affecting Consumer Demand for Food.

This project attempts to distinguish some of the more important social and social-psychological factors that influence consumer demand for food products. It is well-known that many factors besides price and product quality are involved in consumer demand for food. In a multiple choice situation such as that provided by the modern food market, such factors as traditional diet, social status, knowledge of food values and their relation to health, as well as others, are involved in making choices. A thorough

study of the influence of certain of these factors is now under way. The results should contribute to a better understanding of consumer demand.

INSTITUTIONS

Project 143: The Rural Church in Missouri.

This four-year project, now nearing completion, has been supported financially by the Rockefeller Foundation. A thorough-going study of the rural church as a social institution has been made and several reports will be forthcoming during 1957. In these reports, the number, size and activities of Missouri rural churches will be reported by denomination and by broad geographic areas. Also, the life-history and work program of the ministers. A measuring stick for comparing the functioning of rural churches has also been devised.

Prepared by C. E. Lively, Chairman,
Department of Rural Sociology.

Department of Soils

Areas of Research and Personnel

<i>Soil Genesis or Soil Origin</i>	C. E. Marshall W. L. Decker E. R. Graham Wm. A. Albrecht M. H. Brown
<i>Soil Physical Properties</i>	G. E. Smith Phil Smith C. M. Woodruff W. L. Decker M. E. Springer C. L. Scrivner H. H. Krusekopf Vernon Jamison G. S. Carter
<i>Soil Chemical Properties and Chemodynamics</i>	E. R. Graham C. M. Woodruff
<i>Soil Fertility (Inorganic) and Nutrition of Microbes and Plants</i>	E. R. Graham M. H. Brown Wm. A. Albrecht G. E. Smith J. A. Roth Theo Dean L. E. Barnes Carl Hayward Phil Smith
<i>Soil Organic Matter, Plant Nutrition and Plant Composition</i>	Wm. A. Albrecht G. E. Smith Theo Dean

The research work in the Department of Soils is concentrated on the questions of why and how

rocks and their minerals, when decomposed by the weathering forces of climate, can equip soils to nourish microbes and plants, and in turn to nourish animals and man.

This extensive area inviting investigation in the science of soil seems to divide itself logically into the following five major divisions and subdivisions.

I. SOIL GENESIS OR SOIL ORIGIN

Project 6: The Characteristics and Development of Heavy Clays in the Soil of Missouri.

Clay is the secondary mineral residue of rock decomposition. On it, the soluble elements from the decomposition may be held in available form and protected against leaching loss by high rainfall. Thus, the characteristics and degrees of development of clays that give different kinds of them have laid the foundation for application of fertilizers for service in plant nutrition. The comprehension of the chemical behavior of clays in relation to salt treatments as fertilizers, to plant root reactions and to continued mineral breakdown have been the basis for better soil management through which increased crop yields have been possible.

Project 281: Effects of Climatological Variations on Agricultural Production in Missouri.

Since agricultural production represents plant growth as the soil and climatic forces produce it, it is necessary to summarize the climatic data from the meteorological stations by minima and maxima of temperature, rainfall, snow fall and various meteorological manifestations for the areas of Missouri in order to interpret the climate of the state in relation to agricultural production.

The climatic setting also determines the degree of soil development. Missouri is in the mid-continent where variations in climate may cause drouth and call for irrigation in some seasons.

Project 207: The Fertility Level of Missouri Soils.

While the fertility of the soil coupled with the rainfall and other meteorological conditions determines agricultural production, the soil itself in its degree of development from rock decomposition, is the result of the climate. The origin of the soil, as the original rocks and the climatic forces made it, does much to report the fertility potential, especially the calcium-potassium ratio, as to whether mainly carbonaceous crops or those also producing proteins may be more readily grown.

II. SOIL PHYSICAL PROPERTIES

The projects grouped under this research area, subdivide themselves into (a) *texture and potential fertility*; (b) *structure and potential fertility*; (c) *water relations, and plant production, and (d) soil mapping and classification.*

Project 70: Effects of Deep Fertilization on Runoff, Erosion, etc., and Crop Yields, (a, b).

The physical properties of soil (texture) do not lend themselves to be changed economically, hence their relations to fertility must be considered for modification for higher production through soil treatments. Deeper soil treatments aiming to increase the depth of the soil on a field scale are being studied.

Project 77: Effects of High Fertility on Runoff and Erosion on Claypan Soils. (Texture; Structure).

Claypan soils are highly developed in their origin and represent unfavorable structure for root entrance and nourishment. Fertility management is varied and its means for offsetting erosion to the toler-

able limit readily shown.

Project 209: Reclamation of Eroded Soils. (a, b). (Texture; Structure).

Erosion of the surface soil to expose the subsoil gives the farm a clay texture and poor soil structure. In order to study the production potential under this change in the soil's physical properties, this project was designed to learn what management of the subsoil is required to restore it to production. Results have outlined much that is possible and give encouraging data for reclamation.

Project 210: Effects of Meterological and Climatival Variations on Agricultural Production (c).

The temperature of the soil is modified by the texture and structure of the soil, more particularly as these properties determine the soil-water relations. Investigations of the soil temperature in relation to meteorological variations made the former predictable in no small measure from the latter as related to the soil properties.

Project 211: Infiltration Rates and Available Water Capacity. (c).

This study aims to obtain data on the infiltration rates and available water capacity of the root zone for (a) interpreting runoff and water supply from rainfall, and (b) for design of irrigation systems.

Project 206: Missouri Soil Survey and Classification.

This survey aims to classify the soils of Missouri as the evaluation of their characters and qualities makes such possible. This procedure depends mainly on the visible properties, texture, and structure, connected with the genesis of the soil, the experiences in its management in general agricultural use, and potential production as chemical tests have inventoried it. Maps are made of the soil types as classified and published along with descriptions of the soil's potential in agricultural use.

III. SOIL CHEMICAL PROPERTIES AND CHEMODYNAMICS

The projects listed under this area of research divide themselves into three smaller groups, (a) *colloidal adsorption and exchange*; (b) *chemodynamics and energetics, solutions and colloids*; and (c) *chemical*

analyses of total supplies of elements, exchange capacities, and exchangeable supplies.

Project 170: Soil Testing Methods (a, b).

This project aims to develop methods of making an inventory of the nutrient supplies in the soil as these serve in crop production. As the genesis of the soil and the nature of the clay are more completely understood, then, the accuracy of taking this inventory increases.

Project 263: Energetics of Ionic Relationships in Soils and Plants (b).

This project aims to deduce the fundamental principles that govern the relationships between the many ions in the soil, and to evaluate ionic behaviors of one as influenced by those of the others. The hope, then is to express the nutritional environment, or the chemodynamic situation which the soil presents to the root of plant nutrition.

IV. SOIL FERTILITY (INORGANIC) AND NUTRITION OF MICROBES AND PLANTS

Projects grouped under this research area arrange themselves under the subheads (a) *suites of ions (exchangeable) and ratios for plant nutrition*; (b) *interionic effects, ionic activities*; (c) *suites of ions and plant composition, carbohydrates versus proteins*; (d) *supplies of ions and crop yields*; and (e) *roots, their ionic saturation and exchange*.

Project 207: Fertility Levels of Missouri Soils (a).

If we are to view the state potential production of crops in agriculture some inventory must be available of the fertility levels of soils. As a consequence the many soil tests must be assembled; the genesis of the soils must be recorded; and the outlying experimental field results must be interpreted so that any major soil type can be inventoried as the starting basis for viewing the state's potential in wise soil management. Any soils work must use the natural fertility as inventoried to date before modifications in experiment are undertaken. (This project also falls under research areas IV and V.)

Project 229: Soil Tests and Fertilizer Correlations (a).

In studying field responses to modification of the soil's fertility level by fertilizer treatment, soils are first tested to learn with what the work is started and from that the modifications are projected. Then the yield and plant chemical compositions are re-

lated to the treatment as a means of learning accurately how to treat any soil, if the inventory has been taken. This study aims to improve (a) the diagnosis of the fertility situation, and (b) the prescription of soil treatments accordingly for judicious soil management.

Project 92: Minor Soil Elements (a).

While the functions of elements of larger amounts in the plants and bodies of animals have been noted, there are elements of minor amounts which have not yet been classified. The major elements are related more closely with increased yield of plant bulk, while the minor elements are apparently related to plant processes. These may not register via variable plant mass but via quantity of that bulk as protein or other plant properties. Viewed as aids in functions as catalysts, enzymes, vitamins, etc., much remains to be learned about what services in plants and animals are rendered by the list of so-called "minor" elements.

Project 178: Fertilizer Applications on Farm Crops (a).

This project aims to test the diagnosis of the soil's fertility need as suggested by the information coming from any other research areas of the soil. It divides soil treatment into (a) starter fertilizers and (b) sustaining fertility, namely those of soluble nature, and those adsorbed or of mineral nature, with residual effects. It considers these all in relation to the requirements of the crop and uses the many outlying and station fields in its approach to the more complete results.

Project 268: Soil Fertility for Corn Production (a).

As a subdivision under the broader portion of the study of fertilizer application on crops, this project aims to meet the nutritional requirements of corn for higher yields. Extensive field work, greenhouse test pots, and chemical studies of soil and plant, coupled with other attempts at testing, are given to this major crop and its nutrition via the soil.

Project 267: Soil Fertility and Cotton Production (a).

This duplicates in principle for cotton what has been outlined for the corn crop.

Project 242: Soil Treatments for Alfalfa Production.

This duplicates in principle for alfalfa, a legume, what has been outlined for corn. Here the minor elements have suggested their significance much

more than has been true for corn and cotton, though the latter has not failed to demonstrate effects from some of them.

Project 230: Soil Treatments for Maximum Yields (a).

Following the plans for separate crops, heavy treatments are used to learn what maximum yields are possible. This is the reverse approach of what is commonly considered that of the "limiting element." In this approach the complete nutrition as we can envision it is attempted. Later the withholdings of single elements are tested.

Project 231: The Improvement of Soil Fertility Through Heavy Applications of Nitrogen and Carbonaceous Organic Matter (b).

This project deals with applications of carbonaceous organic matter. It commonly brings detrimental effects to the next crop. The objective is to offset those effects by providing nitrogen fertilizers to balance the organic matter as a microbial ration. Since the natural ecological climax builds up organic matter under no crop removal, this project aims to study means of building organic matter into the soil, even under some removal in the crop.

Project 117: Crop Sequences and Continuous Cropping as Affected by Legumes and Fertility of Soil.

This project covers many plots under various crop sequences (rotations). Its objective is to learn how to nourish one crop place (continuous cropping) before we can solve the nutrition of a group of different crops in sequence. Legumes are used as possible contributors or competitors in the matter of both the inorganic and organic fertility.

V. SOIL ORGANIC MATTER, PLANT NUTRITION AND PLANT COMPOSITION

Projects under this research area divide them-

selves into three divisions, (a) *soil organic matter and plant nutrition*, (b) *production of organic matter in crops, its composition related to the soil fertility*, and (c) *anions and crop yields*.

Project 99: The Permanence of Grass-Legume Sod (a).

This study has suggested that the changing degrees of saturation of the colloid-organo-complex by calcium, etc., and the accumulation of organic nitrogen are significant factors in determining the flora in a permanent sod. Thus by soil treatments supplementing the situation as it is so far comprehended by research to date, and as the reserve minerals in the soil contribute, one may manage pastures more successfully over long periods. It is the object of this project to learn how to feed protein-rich and mineral-rich forages for nutrition of healthy animals with the minimum of soil tillage where erosion is a large hazard.

Project 208: The Protein Role of Nitrogen in Organic Matter (a).

In chemical analysis of crops, we usually study the ash elements or emphasize cremation, by taking the "ash" nitrogen and by multiplying that by 6.25 call it protein. In this study the role of nitrogen of the organic matter in the soil and the crops is studied in terms of its combinations of amino acids as these may be "complete" proteins for growth of different microbes, or animals subsisting on the soil organic matter or on the organic products created by crop growth. It aims to study the inorganic contents of the soil along with nitrogen in relation to their services in synthesizing the various amino acids according to the array of them required to feed various forms of life. It aims to arrive at soil management to grow proteins in their completest service in nutrition of farm folks and their livestock.

Prepared by Dr. William A. Albrecht,
Chairman, Department of Soils.

School of Veterinary Medicine

Study Areas and Personnel

Contagious Diseases Cecil Elder
D. E. Rodabaugh
H. B. Wright
A. H. Groth
H. C. McDougle

A. J. Durant
L. D. Kintner
A. A. Case
C. J. Bierschwal
Drug Studies A. D. Allen

	<i>John Lasley</i>
	<i>A. W. Uren</i>
	<i>C. J. Bierschwal</i>
	<i>H. E. Dale</i>
	<i>P. M. Newberne</i>
	<i>H. C. McDougle</i>
	<i>E. L. McCune</i>
<i>Experimental Surgery</i>	<i>J. T. McGinity</i>
	<i>H. E. Dale</i>
	<i>E. F. Ebert</i>
	<i>A. W. Uren</i>
<i>Nutritional Diseases</i>	<i>Cecil Elder</i>
	<i>H. H. Berrier</i>
<i>Parasites</i>	<i>G. C. Shelton</i>
	<i>D. E. Rodabaugh</i>

CONTAGIOUS DISEASES

Project 8: Blood Titre Studies in Brucellosis.

Attempts are being made to devise methods to differentiate between blood titres resulting from natural infection with *Brucella* organisms and that from administration of Strain 19 vaccine.

Project 140: Hog Cholera Immunization.

Various stress factors that may effect development of immunity against hog cholera with special reference to the ration are being studied.

Project 145: Pullorum Testing and Production of Pullorum Antigen.

The tube test for pullorum disease is conducted on turkey blood samples. Isolations are attempted from reactor birds and organisms classified. Efforts are being made to produce a more specific and accurate antigen to be used in the testing program.

Project 176: Salmonella Infections in Fowls.

Isolation and transmission studies with positive identifications of organisms involved, particularly in turkeys as well as other fowls are a part of these studies.

Project 175: Swine Diseases.

This project originally was related to studies on transmission of respiratory and enteric infection from carrier sows and gilts to new-born pigs. Later studies include the control of swine erysipelas and hog cholera in the experimental swine herds of the Department of Animal Husbandry. Effective progress was being made until leptospirosis was introduced into one herd. Studies are now being expanded to include eradication and control methods for leptospirosis.

An additional objective will be added this fall involving causes and transmission of enteric diseases with special reference to the effectiveness of several therapeutic agents.

DRUG STUDIES

Project 177: Drug Studies.

This project was originally established to study the effectiveness of new therapeutic agents as they become available for use on livestock and poultry. Several objectives are presently in effect, and others will be added from time to time. They are: Studies on the effects of sex hormone therapy on the lactation sterility of gilts and sows. In cooperation with Animal Husbandry; Studies made on the effects of the intrauterine administration of antibiotics on reproduction in the cow. In cooperation with Dairy Husbandry; Study of the effectiveness and toxicity of coccidiostats and other drugs on young chickens and poults; Study of effectiveness of chemicals that are added to the litter on different stages of intestinal worms of poultry.

EXPERIMENTAL SURGERY

Project 252: Experimental Surgery of the Ruminant Stomach.

Various surgical procedures are attempted that may be effective in aiding studies relating to ruminant digestion and abnormalities that occur naturally in the ruminant. In cooperation with Animal Husbandry, Dairy Husbandry and Agricultural Chemistry.

NUTRITIONAL DISEASES

Project 144: Pregnancy Disease of Sheep.

Field cases are being studied as to management methods in the flocks, and various new therapeutic agents are being used as they become available.

PARASITES

Project 108: Internal Parasites of Ruminants.

Life cycles, methods of transmission, control by management, and the testing of various therapeutic agents are included. Particular emphasis is and will be placed on the possible influence of pasture irrigation on parasitic infestation. In cooperation with Animal Husbandry.

Prepared by Dr. A. H. Groth, Dean,
School of Veterinary Medicine.