Work and Progress of the Agricultural Experiment Station

for the Year Ended June 30, 1915

COLUMBIA, MISSOURI
April, 1916
UNIVERSITY OF MISSOURI
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Agricultural Experiment Station
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C. E. Deardorff, B.S.A., Assistant, Soil Survey.
F. L. Duley, A.M., Assistant, Soils.
A. J. Durant, A.M., Research Assistant, Veterinary Science.
J. E. Hamilton, Assistant, Veterinary Science.
H. C. Heaton, B.S.A., Assistant, Veterinary Science.
A. H. Hollinger, B.S.A., Assistant, Entomology.
F. Z. Hutton, B.S.A., Assistant, Soil Survey.
C. E. Mangels, B.S.A., Assistant, Agricultural Chemistry.
B. E. Slive, Ch.E., Assistant, Agricultural Chemistry.
W. E. Thrun, A.M., Assistant, Agricultural Chemistry.
E. E. Yankees, M.S.A., Assistant, Agricultural Chemistry.
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In the service of the U. S. Department of Agriculture.
To His Excellency,

HONORABLE ELLIOTT W. MAJOR,
Governor of Missouri.

Sir:

The Federal Hatch Act establishing Agricultural Experiment Sta­tions and approved March 2, 1887, provides that "It shall be the duty of each of said stations annually, on or before the first day of Febru­ary, to make to the Governor of the State or Territory in which it is located a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said stations, to the said Commissioner (now Secre­tary of Agriculture) and to the Secretary of the Treasury of the United States."

In accordance with the provisions of this Act I am submitting herewith a report of the work and progress of the Agricultural Ex­periment Station of the College of Agriculture of the University of Missouri for the year ended June 30, 1915. The aim of this re­port is to give in condensed form a brief statement regarding each important project coming under the administrative direction of this Division. The Agricultural Experiment Station has made real pro­gress during the year. Many important projects have been completed while new projects involving investigations of new problems have been begun.

Respectfully submitted,

F. B. MUMFORD,
Director.
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Work and Progress of the Agricultural Experiment Station

F. B. Mumford, Director

The Missouri Experiment Station was established as a result of the Federal law known as the Hatch Act approved March 2, 1887. It is one of 59 Agricultural Experiment Stations in connection with the land-grant colleges of the United States. The Act of Congress establishing Agricultural Experiment Stations was introduced by the Honorable William H. Hatch of Missouri and the law bears his name. The Missouri Agricultural Experiment Station during its earlier years was poorly equipped and inadequately supported. Much of the earlier work of this Station was in the nature of demonstration of known agricultural practices rather than fundamental research. With the increasing resources available for scientific investigation and the general progress of agricultural research the Missouri Agricultural Experiment Station was able to devote more and more of its energies to the investigation of the more fundamental problems of agricultural production. The work of the Agricultural Experiment Station and its progress from year to year are recorded in the annual reports. The present status of the Station is in large measure due to the wise leadership of the earlier directors and investigators connected with the Station. At the present time the Station is reaping the results of the unselfish services of the men who were formerly connected with the Experiment Station.

During the year covered by this report the work of the Station has shown great progress. In every department carefully planned investigations have been conducted and a real advance made in the solution of many important problems.

The resources of the Experiment Station are derived from the Hatch and Adams appropriations made by the Federal Congress, from State appropriations, sale of farm products and income from the Fertilizer Inspection work of the Station. The resources of the Station as compared with some other states are not large but the investigational work has been organized in such a manner as to insure
the use of Experiment Station funds exclusively for investigational purposes.

In the earlier years of the Experiment Station a considerable amount of time and energy was devoted to various extension activities which interfered with the more serious work of investigation. With the funds recently made available by the Smith-Lever Act which provides adequate funds for agricultural extension it will be possible to still more completely apply the Experiment Station funds to the sole purposes of fundamental research in agriculture.

The report is prepared with a view to placing on record all the important events in the affairs of the Experiment Station for the year covered by this report. In accomplishing this result a record has been made of changes in the Experiment Station staff, additions to equipment, information regarding the distribution of bulletins, publications issued with a synopsis of the bulletins, and a report on the actual investigational work by projects. In general the work of the Station has shown great activity. Many of the investigations have yielded important practical results, and in general the work of the Station has resulted in real contributions to the science of agriculture.

**ADDITIONS TO EQUIPMENT**

Material additions have been made to the research laboratories and the libraries during the year. There have been added 1,438 volumes to the Agricultural Library. Of this number 1,099 were purchased, 271 are bound periodicals and 68 were gifts. The Agricultural Library now numbers 15,540 volumes. Reports and bulletins covering the investigational work of agricultural workers in America and all foreign countries are now available to Experiment Station workers. A carefully prepared card index makes this information readily available.

A number of important buildings have been added to the general equipment of the University which have incidentally added to the facilities for investigation in the Station. A modern library building has been completed. A part of the Agricultural Library has been transferred to the new Library building, thus relieving the overcrowded condition of the Agricultural Library.

The Biology building, a modern laboratory building, fire proof throughout, has been occupied by the departments of Botany and Zoology. This building is well equipped for investigational work.

A considerable area of forest land on the College Farm has been assigned to the department of Forestry for forestry investigations. Additional land has been rented by the department of Farm Crops in
the vicinity of Columbia for investigations with field crops. Increases have been made to the live stock equipment used for investigational purposes.

The present Agricultural building building, which was occupied of the first time in 1909, has already proved inadequate to the needs of the College and Station. The institution has great need of a new and much larger building for the division of Agriculture.

CHANGES IN THE STATION STAFF

A number of changes have occurred in the personnel of the investigating staff during the year.

Mr. W. L. Howard, professor of Horticulture, resigned to accept a similar position at the University of California. Professor W. H. Lawrence, professor of Horticulture at the University of Arizona, was appointed to fill this vacancy.

Mr. P. M. Brandt was appointed Superintendent of Short courses and Assistant to the Dean and Director.

Mr. E. M. McDonald of the Massachusetts Agricultural College was appointed Assistant Professor of Farm Crops.

Below is a list of all appointment and resignations for the year.

NEW APPOINTMENTS

P. M. Brandt, B.S. in Agr., A.M., Superintendent of Short Courses and Assistant to the Dean and Director
M. E. Hays, B.S. in Agr., Assistant in Horticulture
H. C. Heaton, B.S. in Agr., Assistant in Veterinary Science
A. H. Hollinger, B.S. in Agr., Assistant in Entomology
W. H. Lawrence, B.S., A.B., M.S., Professor of Horticulture
C. E. Mangles, B.S. in Agr., Assistant in Agricultural Chemistry
E. M. McDonald, B.S., Assistant Professor of Farm Crops
C. E. Neff, B.S. in Agr., Assistant in Farm Crops
B. E. Sive, B.Ch. E., Assistant in Agricultural Chemistry
O. C. Smith, A.B., Assistant in Agricultural Chemistry
M. W. Talbot, B.S. in Forestry, Secretary to the Dean
H. K. Thatcher, Assistant in Soil Survey
W. E. Thrun, A.B., M.S., Assistant in Agricultural Chemistry

RESIGNATIONS

R. H. Besse, B.S. in Agr., Assistant in Farm Management
C. E. Brashear, B.S. in Agr., Assistant in Animal Husbandry
T. R. Douglass, B.S. in Agr., Assistant Professor of Agronomy
W. L. Howard, B. Agr., B. S. Agr., M.S., Ph.D., Professor of Horticulture
O. C. Smith, A.B., Assistant in Agricultural Chemistry
Boleslaus Szymoniak, B.S. in Agr., Assistant in Horticulture
Thomas J. Talbert, B.S. in Agr., Assistant in Entomology, Deputy Inspector of Nurseries
M. W. Talbot, B.S. in Forestry, Secretary to the Dean
H. K. Thatcher, Assistant in Soil Survey
Talmage T. Tucker, B.S. in Agr., A.M., Assistant in Veterinary Science
W. I. Watkins, B.S. in Agr., Assistant in Soil Survey
C. A. Webster, B.S.A., Assistant in Poultry Husbandry

FREE MAILING LISTS

The mailing list includes the Agricultural Experiment Station officers and members of the United States Department of Agriculture. The list was classified in the following manner at the end of the fiscal year of 1914-15.

TABLE 1.—CLASSIFICATION OF FREE MAILING LISTS

<table>
<thead>
<tr>
<th></th>
<th>General List</th>
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<tbody>
<tr>
<td></td>
<td>Missouri</td>
<td>United States</td>
</tr>
<tr>
<td>Fertilizers</td>
<td>2038</td>
<td>398</td>
</tr>
<tr>
<td>Dairy Husbandry</td>
<td>2028</td>
<td>739</td>
</tr>
<tr>
<td>Animal Husbandry</td>
<td>4094</td>
<td>979</td>
</tr>
<tr>
<td>Farm Crops and Soils</td>
<td>4952</td>
<td>1160</td>
</tr>
<tr>
<td>Horticulture</td>
<td>2143</td>
<td>700</td>
</tr>
<tr>
<td>All Publications</td>
<td>2838</td>
<td>773</td>
</tr>
</tbody>
</table>

In addition to the above, all bulletins are sent to these unclassified lists:

Libraries .................................. 457
Presidents, deans and directors ................. 120
Foreign (outside United States) .................. 244
Missouri newspapers .......................... 779
Missouri farm journals ........................ 34
United States agricultural journals ............ 508

There are 15,500 names on the station mailing list, all of which are reached at different times by publications.

Of all bulletins and circulars published, about two-thirds were sent to the people whose names are kept on these regular mailing lists.
The others are sent out in response to individual requests from farmers of Missouri and other states.

**PUBLICATIONS**

During the year, five new circulars, eight reprints of circulars, fourteen bulletins, one bulletin reprint, and five research bulletins have been issued. The size of the editions have been somewhat increased in order to meet the demands of a larger mailing list. The above represents a total of 8,643,500 pages of printed matter issued during the year. In addition to the above, forty-nine press bulletins were sent to newspapers, farm journals, libraries, and to officials of the Agricultural Experiment Stations and the United States Department of Agriculture.

Following is a list of the publications issued during the fiscal year:

**NEW CIRCULARS**

70. The Hessian Fly in Missouri  
71. Shock Corn for Silage  
72. Silage for Horses and Mules  
73. Rye and Blue Grass Pasture for Ewes  
74. The Yellow Color in Cream and Butter

**REPRINTS OF CIRCULARS**

37. Variations in Cream Tests  
41. Directions for Testing Milk on the Farm  
57. Keeping Records of Dairy Cows  
47. Raising Calves on Skimmilk  
68. The Seeding of Meadows and Pastures  
40. The Seeding of Alfalfa (Reprinted twice during year)  
53. The Seeding of Cowpeas

**NEW BULLETINS**

119. Soil Investigations in Jasper County  
120. Rations for Breeding Ewes  
121. Land Tenure  
122. Inspection of Commercial Fertilizers, 1914  
123. Experiments with Farm Crops in Southwest Missouri  
124. Profits from Spraying Missouri Orchards  
125. Cost of Production on Missouri Farms  
126. Soil Experiments in Northeast Missouri  
127. Soil Experiments in Central and Northeast Missouri  
128. Soil Experiments in North Missouri  
129. Soil Experiments on Red Limestone Upland of Southwest Missouri  
130. Soil Experiments on Gray Prairie of Southwest Missouri  
131. Work and Progress of Experiment Station, 1913–14  
132. The Control of the San Jose Scale in Missouri  
133. The Silo and Its Use  
134. Insect Pests of Field Crops

**BULLETIN REPRINTS**

110. Forage Crop Rotations for Pork Production
NEW RESEARCH BULLETINS

15. An Experimental Study of the Rest Period in Plants, The Summer Rest of Bulbs and Herbaceous Perennials
16. An Experimental Study of the Rest Period in Plants, Pot Grown Woody Plants
17. An Experimental Study of the Rest Period in Plants, Seeds
18. The Maintenance Requirement of Cattle As Influenced by Condition, Plane of Nutrition, Age, Season, Time on Maintenance, Type, and Size of Animal
20. Studies of the Timothy Plant
21. An Experimental Study of the Rest Period in Plants, Physiological Changes Accompanying the Rest Period

PRESS BULLETINS

50. Care of Eggs on the Farm, H. L. Kempster
51. Second Brood of the Army Worm Coming, Leonard Haseman
52. Preserving Eggs for Winter Use, C. A. Webster
53. Provide Shade for Poultry, H. L. Kempster
54. Garden Web-Worm Destroys Alfalfa, Leonard Haseman
55. Sow Wheat Late and Escape the Fly, Leonard Haseman
56. More Pork with Less Corn, L. A. Weaver
57. A Southern Moth Injures Missouri Fruit, Leonard Haseman
58. Corn Harvesting Machinery, M. A. R. Kelley
59. Fall Planting of Bulbs, H. F. Major
60. Grading and Packing Apples, J. C. Whitten
61. Home Storage of Apples, J. C. Whitten
62. Feeding for Egg Production, H. L. Kempster
63. Preparation of Corn for Fattening Steers, H. O. Allison
64. Making the Winter Flock Pay, H. L. Kempster
65. Winter Care of Ewes, Howard Hackedorn
66. Winter Care of Brood Sows, L. A. Weaver
67. Mistakes in Planting Trees on the Farm, Frederick Dunlap
68. Why the Serum Alone Treatment, J. B. Gingery
69. Soil Experiments on the Jasper County Experiment Field, M. F. Miller
70. The Boys' and Girls' Clubs of Missouri, R. H. Emberson
71. Care of the Breeding Flock, Howard Hackedorn
72. Boys' Live Stock Judging Contest at Farmers' Week, R. S. Besse
73. Girls Receive Special Training During Farmers' Week, R. S. Besse
74. Spring Wheat not Recommended for Missouri, C. B. Hutchison
75. Care of Mare and Foal at Foaling Time, E. H. Hughes
76. Discing Land before Plowing, M. F. Miller
77. How to Spray for San Jose Scale, Leonard Haseman
78. Large Profits for Missouri Orchards, W. L. Howard
79. Early Hatching Pays, H. L. Kempster
80. What Corn to Plant for Silage, W. M. Regan
81. A Chick Saving Hatching Coop, H. L. Kempster
82. Southwest Missouri Crop Experiment, C. B. Hutchison
83. The Care of New Hatched Chicks, H. L. Kempster
84. Feed Cows some Grain while Grass is young, W. M. Regan
85. Boys' and Girls' Clubs Popular, R. H. Emberson
86. Harrow Corn to Get Rid of Weeds, C. B. Hutchison
87. Care of Chicks Ten Days Old, H. L. Kempster
88. Easy to Build Concrete Silos, M. A. R. Kelley
89. Profits for Missouri Farmers from Soil Experiments, M. F. Miller
90. Chinch Bug Disease Found Everywhere, Leonard Haseman
91. Chinch Bugs Becoming Dangerous, Leonard Haseman
92. What to Do for Scours in Calves, J. G. Watson
93. Dust Strip Stops Chinch Bugs, Leonard Haseman
94. Apple Blotch Causes Fruit Losses, F. W. Faurot
95. Binder Trouble Avoided by Starting Right, M. A. R. Kelley
96. Chicks Die from Lack of Shade in Summer, H. L. Kempster
97. Home Cured Meats Mould in Damp Weather, P. F. Trowbridge
98. Renewal and Cultivation of Old Strawberry Fields, F. W. Faurot
SYNOPSIS OF THE YEAR'S EXPERIMENT STATION PUBLICATIONS

In the paragraphs following there is given a brief summary of the Agricultural Experiment Station publications which have been issued during the year. This synopsis attempts to record in briefest form the important contents of each publication. Copies of these publications which are still available may be secured by writing to the

Director of the Agricultural Experiment Station, Columbia, Missouri.

The Hessian Fly in Missouri. Leonard Haseman (Missouri Station Circular 70 (1914) pp. 21-24, figs. 10). The Hessian Fly is the most destructive wheat pest in Missouri. Its development is similar to that of other flies. Normally, in Missouri there is a fall brood, one full spring brood, and a later partial spring brood. It is most effectively controlled by proper methods of farm practice. All infected stubble should be plowed under in July, volunteer wheat kept down and the wheat sowed late enough in the fall to escape the fall generation of flies.

Shock Corn for Silage. C. H. Eckles (Missouri Station Circular 71 (1914), pp. 25-28, fig. 1.)—Shock corn put into the silo makes satisfactory feed but not as good as silage from corn put in at the proper time. It is not practicable on a farm except where a water system makes it possible to add plenty of water as the corn goes in. The tests show that about a pound of water should be added for every pound of fodder.

Silage for Horses and Mules. E. A. Trowbridge (Missouri Station Circular 72, (1914), p. 29-32, fig. 1).—Corn silage is now being fed successfully by a large number of horsemen and farmers to all classes of horses and mules. It should be fed in combination with other feeds and under no circumstances should it be spoiled or moldy.

Rye and Blue Grass Pastures with and without Grain for Ewes Suckling Lambs. Howard Hackedorn (Missouri Station Circular 73, (1915) pp. 33-40, figs. 2).—The results of this particular experiment show that, unless the ewes are to be sold with the lambs at weaning time, as a rule it is not profitable to feed grain to ewes suckling lambs on good rye or blue grass pasture. There proved to be little difference in the efficiency of rye and blue grass pasture for ewes suckling lambs. When grain was fed to the ewes the blue grass was somewhat superior, while on the other hand, when neither lot received grain the rye proved slightly more efficient. Rye has the advantage of coming earlier than blue grass, while blue grass has the advantage of affording a good pasture longer.

The Yellow Color in Cream and Butter. L. S. Palmer (Missouri Station Circular 74, (1915) pp. 41-48).—Experiments conducted at the Missouri Station showed that the natural yellow color of cream and butter is due to carotin, a yellow coloring matter present in all feeds, but especially abundant in green roughages and carrots, that is transferred from the feeds to the milk fat. It was also found that the color of the body fat of cows is due to carotin and, that Guernsey and Jersey cows store up more of this coloring matter in their body fat than those of other breeds. The experiments also showed that the white butter of the winter season is due to the small amount of carotin in the feed at this time; and that the higher color of the milk and cream of Guernsey and Jersey cows under these conditions is due to the greater storage of carotin in their bodies. It is pointed out that a higher yellow color in milk and cream does not necessarily indicate increased richness. The increased color of these products when cows are on fresh pasture is due simply to an increase in the carotin of the fat, not to an increase in the percentage of fat in the milk.

Investigations at the Jasper County Experiment Field. M. F. Miller and H. R. Hudelson (Missouri Station Bulletin 119, (1914) pp. 1-32, figs. 7).—A crop rotation should be adopted for this soil and such a system of farming practiced as will give a large amount of manure or other organic matter to plow under. Where it is possible a green-manuring crop should be grown between the regular crops of the rotation also corn should be taken that such crops do not exhaust the soil moisture and plant food at the time when the main crops of the rotation need it most. Manure has a high value on this soil. Every effort should be made to save and return to the land all manure produced on the farm.

Rations for Breeding Ewes. Howard Hackedorn (Missouri Station Bulletin 120 (1914), pp. 29-57).—This investigation was conducted for the purpose (1) of comparing
clover hay, and timothy hay, corn stover, and corn silage as roughages for pregnant ewes; (2) of determining the advisability of feeding a grain ration with the roughages mentioned for maintaining pregnant ewes during the winter and (3) of studying the effect of a treatment of pregnant ewes upon the growth and vigor of lambs. The sheep used were from two to four years old, and averaged 86 pounds weights in a medium condition of flesh. Clover hay and grain proved more efficient as a ration than timothy hay and grain. Clover hay alone was sufficient for maintenance up to lambing time, after which the addition of grain was found advisable. Corn silage, when fed with clover hay with grain, and with both clover hay and grain, proved a slightly better roughage than corn stover fed with the same combinations of grain and clover hay. Moldy or extremely sour corn silage is dangerous feed for sheep. A ration of corn silage, clover hay, and grain proved to be the most efficient way of utilizing silage. Grain and corn stover have very satisfactory results when sufficient and proper concentrates were used. Corn stover, clover hay, and grain proved the most satisfactory method of utilizing stover. Both corn silage and stover were found to be better roughages than timothy hay when fed with grain.

**Land Tenure.** O. R. Johnson and W. E. Foard (Missouri Station Bulletin 121 (1914), pp. 57-112, figs. 10).—In this locality in Johnson County, the tenant grew more grain crops and sold a larger proportion of those grown than did the man who farmed his own land. He farmed more land with a given equipment than the owner but got lower yields of grain and about the same of hay. His income was $501 as compared with $314 for the owner. With the same capital he made the larger income. Farm owners with more than a rural education made nearly $600 more than those who stopped with the rural school. The man with the higher education remained a tenant only from half to a quarter as long as the man with only a rural school education.

**Inspection and Analysis of Commercial Fertilizers.** (1914), P. F. Trowbridge (Missouri Station Bulletin 122 (1915) pp. 109-160, fig. 1).—There was a marked increase in the use of fertilizers in the state in 1914 over 1913. The deficiencies as compared with the guaranties, were greater in 1914 than 1913, and in all ingredients except potash greater than for the five years before. However, the average value of all fertilizers examined in 1914 was 57 cents a ton above the average guaranty.

**Experiments With Farm Crops in Southwest Missouri.** C. B. Hutchison and T. R. Douglass (Missouri Station Bulletin 123 (1915), pp. 161-168, figs. 3).—Commercial White and Boone County White have been found to be the best varieties of white corn for southwest Missouri. Reid's Yellow Dent and Leaming have given best results among the yellow varieties. In three years out of four, the early maturing varieties of oats have produced higher yields than the large late maturing varieties. Kherson and Texas Red Rust-proof have given best results. Soft Winter wheats gave better yields than hard winter varieties. Of the beardless varieties, the Red Prolific and Early Ripe gave best yields, while the best yielding bearded varieties were Fulcaster, Rudy, and Lebanon. Among the best varieties of cowpeas are Whippoorwill and Black; Soybeans, Medium Early Yellow, Peking, Austin, and Morse.

In a three year average drilling oats gave an increase of 2.8 bushels an acre as compared with broadcasting. Drilling cowpeas at the rate of four pecks an acre gave 4475 pounds of cured hay, a larger amount than broadcasting or planting with a corn planter. In some alfalfa experiments the use of lime, manure and bone meal proved very beneficial. The use of 4500 pounds of lime, 27,000 pounds of manure and 300 pounds of bonemeal an acre gave an average yearly production of 11,688 pounds as compared with 7455 pounds for lime and manure, 4083 pounds for lime alone, and 778 pounds an acre where no soil treatment was given.

**Profits from Spraying Twenty-five Missouri Orchards in 1914.** W. L. Howard (Missouri Station Bulletin 124 (1915) pp. 185-288 figs. 5).—The results of tests show that as a whole lime-sulphur and Bordeaux seem to be equally efficient in controlling apple scab, blossom-end rot, and cedar rust. The cost of spraying with lime sulphur and lead arsenate was 9.29 cents per tree for each application. The cost of Bordeaux and lead arsenate was 6.67 cents a tree for each application. Missouri orchardists are advised to spray their orchards at least three times: before blooming, immediately after blooming, and again ten days or two weeks later.

**The Cost of Production on Missouri Farms.** O. R. Johnson and W. E. Foard (Missouri Station Bulletin 125 (1915) pp. 285-316, figs. 6).—The average cost of using equipment on twelve farms was 2.28 cents per horse hour. The average cost a year of keeping a work horse on fourteen farms was $88.33. The average length of work day per horse on twenty-eight farms was 3.57 hours, and the average cost per hour of horse labor on all farms 7.9 cents. The average annual cost of keeping a cow for supplying home needs was $47.95 on six farms, while on a single dairy farm with twelve cows it was $85.10.
The cost of keeping a brood sow was $25.91; the cost of keeping a hen under farm conditions was 65.7 cents.

**Soil Experiments on the Level Prairies of Northeast Missouri.** M. F. Miller, C. B. Hutchison, and R. R. Hudelson (Missouri Station Bulletin 126 (1915) pp. 315-354, figs. 7). The chief needs of this soil are found to be drainage, organic matter, lime and soluble phosphates. Phosphatic fertilizers in small quantities pay well as does lime. Large application of fertilizers are justified only in connection with drainage.

**Soil Experiments on the Dark Prairies of Central and Northeast Missouri.** M. F. Miller, C. B. Hutchison, R. R. Hudelson (Missouri Station Bulletin 127 (1915) pp. 353-384, figs. 8). The dark prairie land of northeast and north central Missouri is adapted to live stock farming, although general farming, and on the better part of this prairie, grain farming with green manuring, may be practiced. Much of the land needs lime and phosphates.

**Soil Experiments on the Rolling Glacial Lands of North Missouri.** M. F. Miller, C. B. Hutchison, and R. R. Hudelson (Missouri Station Bulletin 128 (1915) pp. 383-402, figs. 5). Systematic crop rotations under systems of livestock farming or general farming, together with the careful saving of manure, and the use of green manure crops where practical are recommended for maintaining the supply of organic matter. Where the soil is sour the application of one to two tons of ground limestone an acre is recommended, applied once in from four to six years. In handling this land, every reasonable precaution to prevent erosion should be taken including proper systems of rotation combined with the use of rye, or other winter cover crop.

**Soil Experiments on the Red Limestone Uplands of Southwest Missouri.** M. F. Miller, C. B. Hutchison, and R. R. Hudelson (Missouri Station Bulletin 129 (1915) pp. 40-424, figs. 6). Stock farming, particularly dairy farming near the railroad is especially adapted to southwest Missouri. In every live stock system, the manure should be returned to the land. Pure grain farming is not recommended although mixed farming may be very satisfactory where green manures are used in addition to barnyard manures and cover crops to prevent washing. Phosphates and potash pay well on this land.

**Soil Experiments on the Gray Prairie of Southwest Missouri.** M. E. Miller, C. B. Hutchison, and R. R. Hudelson (Missouri Station Bulletin 130 (1915) pp. 421-444, figs. 5). The increased yields resulting from laying tile every six rods paid the cost and a fair rate of interest on the investment, during seven years experiment, the use of dynamite for loosening the subsoil brought an increased yield worth $1.60 an acre a crop altho the cost has not been met. Very economical means may be used to build up this soil by rotation, manuring; legume-growing, and green manuring. The use of phosphates and potash in small to medium quantities pays well.

**Work and Progress of the Agricultural Experiment Station.** F. B. Mumford (Missouri Station Bulletin 131 (1915) pp. 441-512, figs. 10). The report of the director covers work and publications of the station, the work of the college extension service, and a financial statement of the station for the fiscal year ended June 30, 1914.

Twenty new appointments to the staff were made and five resignations were accepted during the year. In March 1914, the Department of Agronomy was divided to form the Department of Farm Crops and the Department of Soils. In June 1914, the Agricultural Extension Service was organized. Previously no separate organization for the administration of the extension work of the College of Agriculture existed. A staff of trained extension workers is being organized.

During the year, two new greenhouses for the Departments of Horticulture, Farm Crops, and Soils to be used for experimental and instructional work were contracted. Work was begun on the new $50,000 hog cholera serum plant which is located on a tract of land recently purchased two and one-half miles North of Columbia. The capacity of this plant will be sufficient to take care of any emergency.

During the year six new circulars and nine reprints of circulars, four bulletins, and eight research bulletins were issued. The size of the editions were somewhat increased. Thirty press bulletins were also sent out to the newspapers of the state. Reviews of the bulletins are included in the report; 223 agricultural journals have been bound; 106 bound volumes of publications have been received as gifts to the Agricultural Library; it now contains 12,300 volumes.

A list of the experimental projects is included in the report. The progress made during the year of each project is given. In cooperation with the United States Department of Agriculture the detailed soil survey was completed in five counties during the year, making a total of 33 counties that have been surveyed in detail in Missouri. Surveying was begun on four counties during the year. In cooperation with the United States Department of Agriculture a seed testing laboratory has been maintained in which farm seeds are examined.
free. In the year being reported on 1,520 samples of various farm seeds were tested. Also in cooperation with the United States Department of Agriculture, eleven counties of Missouri are employing County Agents. Three new counties were added during the year.

Nineteen soil and crop experiment fields were conducted out in the state during the year. On six of these the primary investigation was with crops. Twelve included mainly a study of the soil and one was a drainage field. These were located in 18 counties. Two crop fields were established in the year and two soil fields were discontinued. The Agricultural Experiment Station cooperate with 652 farms of the state in thirty different projects in almost every county.

The Control of the San Jose Scale in Missouri. L. Haseman (Missouri Station Bulletin 132 (1915 pp. 4).—San Jose Scale can be easily controlled at slight expense and every farmer or fruit grower should secure a spraying outfit to suit his needs and buy or prepare spray material as directed. It has been found from experiments that a badly infested orchard requires two applications, one in the late fall and one in the spring before the buds open. Thoroness is all important and a large bearing tree will require from five to ten gallons of solution for a thorough application.

The Silo and its Use. C. H. Eckles (Missouri Station Bulletin 133 (1915) pp. 19, figs 5) is mainly a reprint of Bulletin 103. The Silo for Missouri Farmers. It includes a description and illustration of the wood stave, solid concrete, concrete block Gurier and tile silos. Facts concerning the cost of each of these types of silos are given. The bulletin also includes a discussion of crops for silage in Missouri. The use of field corn, kaffir corn, sorghum, and cowpeas is discussed. Instructions for filling the silo and a discussion of the causes of silage spoiling are included.

Insect Pests of Field Crops. L. Haseman (Missouri Station Bulletin 134 (1915) pp. 1–40, figs 39).—In the control of insect pests of field crops, it is seldom advisable to use spray mixtures. Most of the pests can be more effectively and economically controlled by following proper farm practices. Where it is necessary, spray solutions and other artificial remedies should be used as cure, but prevention is always better than cure. Crop rotation, clean culture, fall and winter plowing, timing of sowing and cutting of crops are all of value in the campaign against insect pests and cost nothing to apply.

An Experimental Study of the Rest Period of Plants. The Summer Rest of Bulbs and Herbaceous Perennials W. L. Howard (Missouri Station Research Bulletin 15 (1915) pp. 1–25 figs 8).—Bulbous plants have a pronounced rest period which begins a short time after flowering. This rest period was not successfully broken by agents capable of arousing woody plants into growth but observations indicated that low temperature might be more efficient than any other agent.

Herbaceous perennials probably also have a rest period which can be broken by the application of proper agents.

An Experimental Study of the Rest Period in Plants—Pot Grown Woody Plants. W. L. Howard (Missouri Station Research Bulletin 16 (1915) pp. 1–28, figs. 12).—Experiments reported in Research Bulletin No. 1 showed that the rest period of attached twigs can be broken by etherization, desiccation, freezing, etc.

Plants of the same species but growing in soil, were subjected to similar treatments and similar results and conclusions were reached. Bud growth always occurred first regardless of whether the twigs were attached to a root system or not. The roots were uninfluenced by any of the treatments.

An Experimental Study of the Rest Period in Plant Seeds. W. L. Howard (Missouri Station Research Bulletin 17 (1915) pp. 1–62).—Planting of seeds from barely 200 species showed that:

1. Seeds dried for one month germinated more quickly and with a higher percentage than seeds planted immediately upon maturity.
2. Seeds from closely related species behave very much alike in germination.
3. Germination of immature seeds is uncertain and usually will not occur if the seeds are allowed to become air-dry.
4. Stratification of seeds of woody species increased and hastened their germination. These effects became more marked if the seeds were etherized after germination.
5. Etherization of dry seeds has but little effect on their germination but soaked seeds responded somewhat more favorably to this treatment. Seeds from different species showed considerable variation in this regard.

The Maintenance Requirement of Cattle. P. F. Trowbridge, C. R. Moulton, and L. D. Haigh (Missouri Station Research Bulletin 18 (1915), pp. 62, figs. 16).—A study of the cost of maintaining beef cattle at constant body weight over a period of time and of the influence of the condition of the animal, the previous plane of nutrition, the age, the season of the year, the length of time on maintenance, the type and the size of the animal
upon this cost. Besides the taking of data on the amounts of feed consumed and the analysis of the feed the study included digestion trials, slaughtering of the animals and analysis of the carcasses. Measurements were made on the surface area, blood weight, body weight, empty body weight, and the active body tissue as measured by the nitrogen content.

The relations of the empty weight to live weight, the active nitrogen to empty weight, the surface area to empty weight, and the blood to empty weight are shown. From the digestible nutrients consumed the energy consumption was calculated by the aid of certain factors. The maintenance cost is given in terms of digestible nitrogen consumed per 100 grams of active body nitrogen and of metabolizable and net energy consumed per 100 grams of active nitrogen and square meter of body surface. The digestible nitrogen and energy consumption per unit of blood is also given. For comparison with the usual standards the cost is given per 100 pounds of animal.

Condition alone seems to have no effect upon the cost of maintenance. The cost is high after a previous full fed period and the higher the plane of nutrition the greater this increase in cost. Age decreases the cost. It is least in the spring and greatest in the winter. A long maintenance trial seems to cause a lowering cost, but age and previous treatment are strong contributory causes. Greater activity and poor thrift carry with them a higher maintenance cost. The heavier the animal the greater its need for energy per unit of surface area.

Studies of Timothy Plant. I. H. J. Waters (Missouri Station Research Bulletin 19 (1915) pp. 68, figs. 20).—A discussion of the influence of maturity upon the yield, composition, digestibility, palatability, and feeding value of timothy hay.

The hay was gathered in five stages of growth, the first stage about the time the plants were in full head and the last stage at the time the seed was fully ripe. This was continued for five successive seasons, beginning in 1896. Analyses were made of all the cuttings of hay and digestion and palatability trials were made of all the cuttings of the first three seasons.

The largest yields of hay and dry matter in the hay were obtained on the average from the third cutting at about the time the bloom was shed and the seed just formed.

In composition, protein, ash and ether extract show higher percentage values on the dry basis in the young than in the ripe plant; while for crude fiber and nitrogen free extract the reverse condition is true. Tests of digestibility show that all the nutrients except ether extract are more digestible in the young than in the mature plant.

Palatability trials made with young steers receiving no other feed but timothy hay showed in a striking manner the preference of these animals for the hay from the young plants. Cows in milk being fed liberally with mixed grain and corn silage showed less preference for any particular cutting but did prefer the young cuttings to the very ripe hay. Full fed sheep on the other hand, ate one cutting with apparently as much relish as the other.

The convenience of harvesting timothy hay is shown to depend upon the locality to a great extent. In New England it is convenient from the farmer's standpoint to harvest the young hay, while in the corn belt it is more convenient to harvest the ripe hay. Weather conditions at the time of harvesting ripe hay are better for field curing than when the hay is young. Moreover, mature hay is easier to cure than young hay.

The bulletin discusses and illustrates in detail the life history of the timothy plant and shows that growth of new plants from the seed. Factors which prevent full development of the bulb, such as early or too frequent cutting, or that kill the bulbs, such as trampling by stock, alternate freezing and thawing of winter will thin the stand, reduce the yield and destroy the quality of hay by permitting the growth of other grasses and weeds in the meadow.

The selling quality of timothy hay is shown to be better for young hay than for mature hay. If hay were purchased from the farm according to quality the farmer would receive a bonus for making good hay and less poor hay would be marketed.

Clover and timothy are also compared in their effect upon soil fertility, showing that timothy does not "rest" land but only withdraws the fertility more slowly than grain crops.

Studies of the Timothy Plant. II. P. F. Trowbridge, L. D. Haigh, and C. R. Moulton (Missouri Station Research Bulletin 20 (1915) pp. 67). A study of the changes in the chemical composition of the timothy plant during growth and ripening with a comparative study of the wheat plant. This is a chemical study of the entire timothy plant by parts in an attempt to inquire further into changes in composition pointed out by the chemical data in Part I (Bulletin No. 19). Three plots across a timothy field were selected and the hay, stubble, and bulbs collected simultaneously from a small area in each plot, in
The results show that the young timothy plant has the highest percentage of moisture and as growth proceeds this percentage decreases. All parts of the plant increase their amount of dry matter during growth and ripening except the bulbs where the amount becomes constant before ripening. Nitrogen and ash are taken up most rapidly in the young stages of growth while carbohydrates increase most rapidly at the later stages, especially in the heads. Ash constituents tend to decrease somewhat in the stalks and leaves at maturity, due to washing by rain, dropping off of dried leaves and transfer of material toward the head of the plant. Carbohydrates alone show a substantial increase in the bulbs at maturity; these nutrients apparently consist of gums and pentosans, starch being entirely absent.

Of the ash constituents, potassium oxide reaches its maximum before full ripening, but phosphorus pentoxide is continuously assimilated up to the time of ripening, especially in the head of the plant.

The wheat plant shows about the same kind of changes in the composition of the parts as does the timothy plant. The most striking difference between the timothy and wheat plants is, the greater rate of increase of dry matter in the heads, and the greater decrease of dry matter in the roots and stubble, of wheat plants.

An Experimental Study of the Rest Period in Plants—Physiological Changes Accompanying Breaking the Rest Period. W. L. Howard (Missouri Station Research Bulletin 21, pp. 1-72 figs. 10).—Physiological studies made with the view of determining, if possible, the fundamental cause of the beginning, as well as the breaking, of the rest period, led to the conclusions. That (1) the beginning of the rest period is due to the inhibition of enzyme activity because of the over-accumulation of their products and (2) this period of rest either naturally or by outside agents is broken because of the stimulation of the enzymes into activity again.

Data are presented showing that the carbon dioxide production of twigs is greatly stimulated by etherization, desiccation and freezing but this stimulation is considerably lessened toward the end of the rest. Treated twigs also showed an increase over untreated material in the activity of diastatic, proteolytic, and fat-splitting enzymes. The oxidases were also affected in the same way. Etherization tended to increase the amount of sugar present but this effect was not so noticeable towards the close of the rest. The respiratory activity and the amount of sugar present seem to be good indices as to the relative amounts of growth which will take place under growing conditions.

New rest-period-breaking agents were found in weak solutions of copper sulphate, hydrochloric acid, oxalic acid, acetic acid, sodium nitrate, potassium chloride, ammonium oxalate, and manganese dioxide.

PROGRESS OF INVESTIGATIONAL WORK AT COLUMBIA

EXPERIMENT STATION PROJECTS

All of the investigational work in the Agricultural Experiment Station is organized by departments. The investigational work within the department is organized by projects. Before an experiment can be undertaken by any department a complete plan of the investigation including a statement of the reasons for such investigation is filed with the Director. This plan includes a statement of the probable cost, time required for its completion, and person or persons who are to conduct the investigation. If the investigation is approved it becomes an authorized project of the Agricultural Experiment Station.

The investigational projects now in progress in the Agricultural Experiment Station are listed below. It is of course true that the name of a project gives little information as to the real character and extent of the investigation. Among the projects listed, many are
of the greatest fundamental significance. A few should probably be classed as minor projects.

Five projects have been completed, fifteen new ones have been added, and seventy begun prior to July 1, 1914, were continued thru the year. Owing to a reorganization of the projects of the Department of Farm Crops, in which many of those carried on by that department have been divided into smaller ones, the total number of projects carried on during the year has been increased from fifty-nine to ninety.

Projects Completed

1. Feeding Wheat to Fattening Swine
2. Preparation of Corn for Fattening Cattle
3. Chemical and Physiological Relations of the Pigments of Egg Yolk to Carotin and Xanthophylls of Green Plants
4. Farm Management Survey (Johnson County Survey Completed)
5. Spraying Fruits for Insects and Fungus Diseases

New Projects

1. A Study of the Effect of the Periods of Gestation and Lactation upon the Growth and Composition of Swine
2. Chemical and Physiological Relations of the Pigments of Egg Yolk to Carotin and Xanthophylls of Green Plants (Begun and Completed)
3. An Investigation to Determine the Life History Development and Habits of the Corn Ear-Warm and Practical Methods of Controlling it
4. An Investigation of the Hessian Fly Resistant Qualities of Wheat
5. An Investigation to Determine the Cause of the Periodical Recurrence of Insect Pests as Scurges
6. An Investigation of Methods for Controlling the Chinch Bug
7. Injurious Insect Pests of Melon and Related Crops
8. A Working Plan for a Portion of the Experiment Station Woodlot
9. Determination of the Relative values of Different Forms of Phosphorus on the Soil at Columbia
10. A Study of the Cultural Requirements and Adaptation of Sudan Grass
11. A Comparison of the Most Important Grain Sorghums With Corn for Grain and Forage Production
12. Investigation with Spanish Peanuts to Determine the Value of Peanuts as a Crop in the Southeast Missouri Lowlands
14. The Influence of Spacing Rows of Wheat and Oats Upon the Yield and Quality of Grain Produced
15. Experiments with Sorghums, Sudan Grass and Spanish Peanuts for Forage

Projects Begun Prior to July 1, 1914, and Still in Progress

1. Factors Influencing the Normal Rate of Growth in Domestic Animals and the Permanency of the Effects of Arrested Development
2. Use of Food
3. Corn Silage as a Part Ration for Horses of Various Ages
4. Forage Crops for Pork Production
5. Age as a Factor in Animal Breeding
6. A Study of the Residual Effects of Forage Crops for Swine
7. Micro-Organisms in Silage
8. Grain-Smut Investigation and Control
9. A Systematic and Physiological Study of Rusts
10. The Physiological Relations of the Powdery Mildews to Their Hosts
11. An Investigation of Forest Tree Diseases
13. Silage Investigations
14. Factors Influencing the Composition of Milk
   (a) Influence of Plane of Nutrition. (Present features completed but other phases to be taken up)
   (b) The Effect of Cottonseed-Meal and Cottonseed By-Products
15. Factors Influencing the Development of Dairy Haulers
   (a) Wintering of Haulers
16. An Investigation to Determine What Insects are Injurious to Nursery Stock in the State, Their Life Histories, Distribution, Injury and Methods of Control
17. An Investigation of the Life History, Development, Injury and Remedies for the Apple Leaf Hopper on Nursery Stock
18. The Study of Stop-Back on Nursery Stock and Methods of Prevention
19. An Investigation of the Method of Culture and Varieties of Basket Willows for Missouri
20. A Study of the Methods of Prolonging the Service of Wood Fence Posts
21. Effect of Storage Conditions on the Vitality of Forest Tree Seeds
22. Farm Cost Accounting
23. The Distribution of Farm Labor
24. The Cost of Family Living on the Farm
25. Effect of Various Crop Rotations on the Physical Characters of the Soil
26. Crop Rotation and Fertilizer Experiments (Twenty-sixth year)
27. Relation of Cowpea Growing to Wheat Production on Continuously Cropped Land
28. Experiments in the Associated Growth of Corn and Cowpeas
29. Factors Influencing the Development of the Maize Plant - Nutrition and Moisture Studies
30. Soil Experiments on the More Important Soil Types of Missouri
31. Fall vs. Spring Planting of Fruit Trees
32. Fruit Bud Development of Fruit Trees as Influenced by Treatment and Previous Crops
33. Apple Breeding for Late Blooming Habit
34. Orchard Tillage - Sod Clean Cultivation, Mulch, Combined Cultivation, and Cover Crops
35. Rest Period of Plants
36. Bud Selection for Increasing Yields - Apples
37. Peach Breeding for Hardy Sorts
38. Orchard Nutrition
39. Asparagus Selection
40. Self Fertility and Self Sterility of Fruits
41. Examination of Buds in Winter for Forecasting Probable Bloom
42. Treatment of Apple Canker Diseases
43. Cultural Experiments With Corn Including the Rate of Planting, Methods of Preparing Sod Land and Stubble Land, Depth of Plowing and Subsoiling, Methods of Cultivation and Planting
44. A Study of the Adaptations of the Important Varieties of Corn to Missouri Conditions
45. A Study of the Adaptations of the Important Varieties of Spring Barley to Missouri Conditions
46. Corn Breeding Investigations to Determine to what Extent the Yield of a Commercial Variety of Corn may be Increased by the Selection of High Yielding Strains by the Ear to Row Method
47. Investigations With Winter Barley Including Variety Tests and Methods of Improvement
48. A Study of the Adaptations of the Important Varieties of Cotton to the Southeast Missouri Lowlands
49. Cultural Experiments With Cotton Including Fertilizer Tests
50. Investigations With Winter Oats Including Variety Tests and Improvement
51. Cultural Experiments With Oats Including Methods of Preparing the Seedbed and the Rate of Seeding
52. A Study of the Adaptations of the Important Types, Varieties, and Regional Strains of Alfalfa to Missouri Conditions
53. A Study of the Important Varieties of Oats for Missouri Conditions
54. A Study of the Adaptations of the Important Varieties of Wheat to Missouri Conditions
55. Cultural Experiments With Wheat Including Methods of Preparing the Seedbed and the Rate of Seeding
56. A Study of the Inheritance of Quantitative Characters in the Wheat Plant
57. Comparison of Soybeans and Cowpeas for Hay and Seed Production
58. Cultural Experiments with Cowpeas Including the Method of Seeding, Time of Seeding and Rate of Seeding
59. A Study of the Adaptation of the Important Varieties and Selections of Soybeans to the Various Soil Types of the State
60. Cultural Experiments with Soybeans Including Time of Seeding, Method of Seeding and Rate of Seeding
61. A Study of the Adaptations of the Important Varieties and Selections of Cowpeas to the Various Soil Types of the State
62. Influence of Environment Upon the Development of the Wheat Plant
63. Factors Influencing the Development of the Maize Plant—Field Studies of the Plant
64. Wheat Breeding Investigations Including the Improvement of Commercial Varieties by the Pure Line Method of Breeding and Hybridization and Subsequent Selection.
65. Sweet Clover Investigations Including Varietal Studies, the Variation of Cumarin Content and Cultural Experiments
66. A Study of Certain Spring, Summer and Fall Sown Crops for Forage
67. Cultural Experiments with Alfalfa to Determine the Adaptation and the best Methods of Obtaining a Stand of Alfalfa on the Various Soil Types of the State
68. Hog Cholera Immunity Investigations
69. Contagious Abortion Investigations
70. Investigation in Mendelian Inheritance

DEPARTMENT REPORTS ON THE PROGRESS OF INVESTIGATION

It is desirable to record annually the progress of investigation in connection with the various authorized projects of the Agricultural Experiment Station. Such a record not only has great historic value, but presents a birdseye view of the activities of the entire Agricultural Experiment Station organization. It is a definite attempt to place on record the research activities of the Experiment Station in a brief but somewhat comprehensive way. It is believed that one may secure by reading the following account of the progress of investigation during the year, an intelligent notion of the important problems which are receiving the attention of the station staff.

The reports of progress are compiled from the reports made by the chairmen of departments to the Director. The relation of the individual members of the station staff to the various projects is indicated in the text.

Agricultural Chemistry

Use of feed experiment (P. F. Trowbridge, C. R. Moulton, L. D. Haigh).—It was found that heifers grown on a low plane of nutrition seem to produce as well-fleshed calves as those grown on a higher plane of nutrition.

A thrifty yearling steer has a strong tendency to grow. One that gained only half a pound a day became thinner in flesh. At the end of a year on such a plane of nutrition he had a less tendency to grow and an increased tendency to put on fat. A thrifty yearling steer kept at body-maintenance weight for a year made a marked skeletal growth, used most of his reserve tissue fat but none of the fat stored in the
skeleton. Another such steer continued to grow when made to lose half a pound a day, but the fat from the skeleton as well as the tissue fat was consumed during a year of such treatment.

Table 2 shows the composition of a thin three-year-old steer and the composition of the first and second five hundred pounds of weight that he can be made to gain.

![Figure 1](rapid_growth.jpg)

**FIG. 1.—RAPID GROWTH**

The steer fed to secure the greatest growth without storing fat increased his weight about a pound a day until two and one-half years old. When photographed at the age of one year, one-month, nineteen days this steer weighed 510 pounds.

**TABLE 2.—COMPOSITION OF GAIN**

<table>
<thead>
<tr>
<th>Composition</th>
<th>Steer</th>
<th>First 500 lbs.</th>
<th>Second 500 lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water per cent</td>
<td>56.40</td>
<td>37.58</td>
<td>17.77</td>
</tr>
<tr>
<td>Fat per cent</td>
<td>18.59</td>
<td>48.56</td>
<td>75.88</td>
</tr>
<tr>
<td>Protein per cent</td>
<td>18.85</td>
<td>11.92</td>
<td>5.15</td>
</tr>
<tr>
<td>Ash per cent</td>
<td>5.72</td>
<td>1.96</td>
<td>1.50</td>
</tr>
</tbody>
</table>

Measurements indicate that such an animal makes a marked skeletal growth during the period of fattening.
FIG. 2.—GROWTH SOMEWHAT RETARDED
A typical steer of the group so fed as to gain about one-half a pound a day, weighed 341 pounds when one year, one month, and 28 days old.

FIG. 3.—GROWTH GREATLY RETARDED
A typical steer of the group so fed as to gain about one-third of a pound a day, weighed 231 pounds when this picture was taken at the age of one year, two months, and 16 days.
Factors influencing the normal rate of growth in domestic animals and the permanency of the effects of arrested development (F. B. Mumford, P. F. Trowbridge).—Beef calves at present are the subject of this experiment. Seven animals were placed in the group to receive a low plane of nutrition, three were in the medium plane group and two in the high plane group. Two of those in the group receiving the low plane of nutrition died during the year. This group of animals was especially susceptible to ailments. It has not been difficult to hold the animals in the low plane of nutrition group to the required rate of growth on a roughage ration of three parts alfalfa hay and two parts oat straw. This experiment has been in progress a short time only.

Administration (P. F. Trowbridge, C. R. Moulton, L. D. Haigh, E. E. Vanatta, C. E. Mangels, B. E. Sive, W. E. Thrun, D. J. Griswold).—The Department of Agricultural Chemistry is the clearing house for all the chemical work of the departments of the Agricultural Experiment Station. Analyses of many samples of butter-fat, feed-stuffs, eggs, insecticides, soils, crops harvested from experimental plots, and determinations required in order properly to interpret the results of digestion trials on farm animals were made. This work is all essential to the proper execution of the research work of the various departments. In addition to the above, the regular analytical work connected with the inspection of commercial fertilizers was done.

Animal Husbandry

Age as a factor in animal breeding (F. B. Mumford, L. A. Weaver).—Records have been made on a total of 141 pigs born during the year. Of this number, 58 were from the immature-sow group, 73 pigs from the half-mature group and 10 from the mature group. The sixth generation of breeding in the immature group has now been reached. Observations have been made to date on 615 pigs of sows of the various groups.

The records include careful skeletal measurements on the mothers and their offspring; feed and weight records; number and character of pigs in each litter and a careful study of such physiological changes as are difficult of exact measurement but are registered in the general vigor and health of the animals. The pigs from very young mothers are apparently somewhat less vigorous and smaller at birth than the pigs from older sows. The first period of lactation in the very young sows exerts a markedly retarding effect on the growth of the mothers. The year's work has confirmed the results described in the previous report. A new feed barn has been added to the equipment.
A study of the residual effects of forage crops for swine (L. A. Weaver).—The object of this experiment is to compare the rate and economy of gain put on in dry lot by shotes which have been previously on pasture to that made by shotes which have been for a similar time in a dry lot.

FIG. 4.—MEASURING THE EFFECT OF EARLY BREEDING ON GROWTH

Six year's tests show that an extra well fed, well developed sow may safely be bred younger than one kept under ordinary conditions. Sows bred young and properly handled should prove more profitable than those allowed to remain open too long.

The results for this year's trial were the reverse of those obtained the previous year. Instead of showing a slight advantage in favor of the shotes in Lot II which were on forage during the summer, this trial gave a slight advantage to those of Lot I, which were in dry lot at the same time. From the results of two year's investigation there is little evidence that hogs fed on forage crops during the summer are more quickly or economically fattened after such treatment than similar hogs fed in a dry lot during the same period.

Forage crops for pork production (L. A. Weaver).—Rape, or a mixture of rape and oats, has been the best spring sown forage for swine in Missouri during six previous years of experimental work. During the last year the plan of the work was changed to take up the
different methods of sowing rape and the best grain ration with which to supplement rape pasture. The grain rations tried were: (1) corn alone; (2) corn twelve parts, tankage one part; and (3) corn sixteen parts, tankage one part. The results of the first year's test indicate that it is not necessary to supplement a corn ration with tankage or other high protein food when hogs are on rape pasture. Results of other tests indicate that it is a profitable practice to feed a small amount of tankage to hogs pastured on corn and cowpeas.

**Feeding wheat to fattening swine** (L. A. Weaver).—Bulletin 136 is a report on this project, which was completed during the year. The first trial of this experiment was reported a year ago. The hogs fed wheat made more rapid gains than the hogs fed corn and required less pounds of grain to produce a hundred pounds of gain. A mixture of wheat and corn, equal parts by weight, is less economical for pork production than wheat alone but more so than corn alone. To be most economical for pork-production, wheat, like corn, should be supplemented with tankage in the proportion of wheat ten parts, tankage one part.

**Corn silage as a part ration for horses of various ages** (E. A. Trowbridge, E. H. Hughes).—Twenty horses were used in the first trial

![FIG. 5.—GOOD RESULTS FROM SILAGE](image)

The silage fed mule was kept in better condition as shown by her hair, skin, and general appearance, and yet she cost less to feed than the mule on the left which received no silage. Similar results were obtained with horses.
of this experiment which began December 24, 1914, and ended March 18, 1915. The animals studied included draft horses and mules, saddle mares, draft and saddle foals, two-year-old fillies and three-year-old geldings divided into pairs. Each animal received the same grain ration consisting of corn two parts, oats two parts, bran one part. One of the animals in each pair of the growing and idle horses received alfalfa hay as its roughage, part of which was fed at night and part in the morning. The other animal in each pair received alfalfa hay in the morning and corn silage at night. The draft animals at work were fed the same except that timothy hay was used instead of alfalfa. Some difficulty was experienced in getting the animals that had been on dry feed previous to the test to eat the silage. With two exceptions, the animals receiving silage were in a more thrifty condition at the end of the trial.

The results of the first test indicate that silage can be successfully substituted for a part of the hay in the ration of horses at the rate of two pounds of silage for one pound of hay. This experiment will be continued.

**Botany**

The physiological relation of the powdery mildews to their hosts (George M. Reed).—The principal work with the powdery mildews during the past year has been in connection with the determination of the relation of the various varieties of wheats to the wheat mildew and the various varieties of oats to the oat mildew. During the past year 22 new varieties of wheats have been tested with relation to the mildew from the common wheat. All except three of these gave 100 per cent infection. Two varieties remained entirely immune, while another gave an infection of 75 per cent. Most of the varieties tested belong to the types *Triticum durum* and *Triticum vulgare*.

Additional tests with the wheat mildew were made on 44 varieties of wheats that had been worked with in previous years. The results obtained substantiated in practically every way the earlier results.

The oat mildew was tested for the first time on six species and varieties of *Avena*. With one exception these tests resulted in 100 per cent of infection. *Avena barbata*, a fairly well defined species of oats, has proved partially resistant. This is the first case of a variety or species belonging to *Avena* being found even partially resistant.

Additional tests were made on eleven species and varieties of oats. These confirmed the results of previous years.
Grain smut investigation and control (George M. Reed, Emma B. Mundy, N. M. Gibbs).—During the year experiments were conducted to determine the rate of infection of bunt in wheat, the susceptibility of the various species of oats to the loose smut, the relation of early and late planting of oats to the amount of smut and effect of various temperatures, moisture content of soil, planting at various depths, and germinating the seed before inoculation on the amount of smut. *Avena strigose* is the only variety of oats that remained immune in all the experiments, while *Avena sterilis* gave the highest percentage of infection. Most of the species of common oats, *Avena satira*, have been susceptible to loose smut except Burt oats and Early Ripe. They have remained practically free. Contrary to the common belief among plant pathologists, late planting has resulted in a higher percentage of infection than early planting.

In all the other tests one variety of common oats, Early Champion, which is supposed to be highly resistant, gave a good percentage of infection while the Early Ripe and Burt varieties remained practically free.

An investigation of forest tree diseases (George M. Reed, Lucille Keene).—Fungi responsible for forest tree diseases have been collected for a number of years. Most of the fungi collected have been provisionally named. During the year fifty species have been collected. Some of these are new. They are mainly polypores which attack living trees or timber. A few have been obtained near Columbia but many have been collected from the University forests in Phelps and Pulaski counties. Some of those collected are the cause of serious forest tree diseases. They most frequently attack the pine, ash, and the oaks.

**Dairy Husbandry**

Factors influencing the development of dairy heifers (C. H. Eckles, T. C. Reed).—Work on this subject is being pursued along two lines at the present time. Efforts are being made to find the protein requirements of growing animals and the normal rate of growth.

**Protein Requirements**

One heifer has now been carried from the age of 6 months to the time of calving at the age of 28 months on a ration containing less than half a pound of digestible protein daily, or about half of that prescribed by the Armsby feeding standard. This amount is apparently below the minimum required, since, although plenty of energy for growth was supplied, the growth of the animal was retarded in both skeleton and tissue development and her calf was born with rudimentary eyes. The problem of securing for experimental purposes a ration with which it is possible to control the
amount of protein, and energy of the ration as desired and at the same time supply a complete protein has been solved by using skim-milk powder as a source of protein, a small amount of timothy hay for roughage, and a mixture of starch and sugar to supply the energy. Mineral matter is added in the form of bone meal and citrates of potassium and magnesium. A heifer on a ration made up in this manner has shown practically normal growth for seven months with a protein consumption of approximately three quarters of a pound a day. The present methods of conducting the investigation will enable some definite results to be secured within the next two years, it is believed.

NORMAL GROWTH

The work for this year is a continuation of that reported previously. While progress has been made in so far as the records are nearer completion, no new facts have been developed besides those reported last year. The great value of such records for experimental purposes are more fully appreciated. Constant use is found for the data already available as a basis for comparison in other work, such as the study of protein requirements.

Our results show that under normal conditions the curve of growth is very similar for each individual animal. If one animal is below the average in the beginning, it is generally about the same distance below the normal during the growing period.

Pregnancy exerts but little effect upon the curve of growth. Lactation results in a decided check to growth. A low mineral content of the ration does not show any appreciable effect upon the rate of growth.

A ration containing less than half the protein called for by Armsby’s Standard for growing animals resulted in the animal making 73 per cent of normal growth in height and 54 per cent of normal growth in weight.

Silage investigations (C. H. Eckles, T. C. Reed).—Investigations covering the season of 1914-15 corroborate those of the previous year regarding normal temperature in silage and the little influence upon temperature that can be attributed to the material used in constructing the silo. It was found under carefully controlled conditions of temperature that within the limits of from 60° to 100° F. there is little difference in the quality of silage produced. Since normal silage remains above 60° except in the latter part of winter, it is believed that the importance of the question of temperature in silage has been over estimated. A further test was made regarding the accuracy of small silos for experimental purpose. The results of two trials show
that silage produced in the experimental silos 3 x 6 feet in size with weight applied, compares in every respect with that from a large silo where the same corn was used.

Investigations have been continued on the weight of silage per cubic foot. The weights per cubic foot varied from 35 to 60 pounds in different silos, but is exceedingly variable. The chief factors influencing the weight per cubic foot seem to be the amount of moisture and the packing at time of filling.

Samples of silage were also taken to determine if there is any variation in composition due to the material of which the silo is constructed. The results show that no such differences can be detected. The whole question of silage preservation seems to be one of keeping out the air.

Trials with legumes under different conditions for silage have been continued but results are not ready to be reported.

Further data have also been accumulated with reference to the loss of nutrients in putting crops in the silo. The results are not as yet complete enough to be reported.

**Entomology**

The corn ear-worm (L. Haseman).—Powdered arsenate of lead applied with a powder-gun was most effective in reaching the worms. Tests were made on both field and sweet corn. Observations showed that from 75 to 80 per cent of field corn grown on bottom land that had been previously in corn and winter plowed was attacked. In fall grown sweet corn, 100 per cent of the ears were attacked.

The Hessian fly-resistant qualities of the different varieties of wheat (L. Haseman, A. H. Hollinger).—There appears to be a distinct difference in the number of Hessian-fly larvae which may be found in the different varieties of wheat grown in the same plot. The physical and chemical make-up of the young plants is being studied to see if the difference in the number of larvae harbored by the various varieties may be explained in that way. This project is only well started.

Injurious insects pests of melons and related crops (L. Haseman).—In this investigation, special attention has been devoted to the squash stink-bug, the stripped cucumber beetle and the melon louse. These insects have been studied in the field and insectary. Probably by the summer of 1916 the application of the control methods which have been worked out will be inaugurated in the melon-growing section of Southeast Missouri.

The cause of stop-back on nursery stock and methods of prevention (L. Haseman).—The use of insecticides in attempting to control the tarnished plant bug, which causes this injury, has been abandoned. Wheat planted as a trap crop between the nursery rows has proved
ineffective. Clean culture in and near the nursery blocks has greatly reduced the number of bugs and consequently lessened the amount of "stop-back" present. Driving the bugs with the wind has been of some help. The injury is less abundant where the nursery blocks are kept small.

**Farm Crops**

**Wheat breeding investigations** (C. B. Hutchison, E. M. McDonald).—One hundred and twelve pure lines of wheat selected from twelve commercial varieties were under test at Columbia during 1914. These pure lines are from the most promising selections made in previous years. Forty-nine of them gave larger yields in 1914 than the commercial variety from which they were selected. The results obtained from thirty-four pure lines of Mediterranean are typical. The commercial variety yielded 28.68 bushels to the acre. Sixteen pure lines yielded 33.70, and eighteen yielded 23.50 bushels to the acre.

At the same time 62 selections from hybrids were compared with their parents and with pure lines selected from these parents. In most cases the pure lines made better yields than the hybrids.

**Investigations with winter oats** (C. B. Hutchison, E. M. McDonald, A. R. Evans).—In the fall of 1913, four varieties of winter oats were sown on a field in Columbia. The Winter Turf and Culbertson came thru the winter in fair condition. Argentine Winter and Texas Red Rust Proof were badly winter-killed. About 500 head selections were made of each of the varieties. These were planted in rows in the fall of 1914. The cold-resistant qualities of the different lines will be studied. At present winter oats are not being recommended any farther north than the latitude of Springfield and Cape Girardeau, which in general, includes the south fifty miles of Missouri.

**Investigations with winter barley** (C. B. Hutchison, E. M. McDonald, A. R. Evans).—From the plants that survived the winter of 1913-14, 500 single head selections were made of Tennessee Winter, Wisconsin Winter, Tenkan, and two-row Hybrid. These were planted in head rows in the fall of 1914. Cold-resistant plants will be selected from these plantings.

**A study of the adaptation of the important types, varieties and regional strains of alfalfa to Missouri conditions** (J. C. Hackleman).—The severe drought of 1914 reduced alfalfa production to two crops of hay. Yields were calculated on an air-dry basis; and the greatest total yield, 2¼ tons, was made by Plot 15, the seed for which came from Mongolia. The next best yield was on a row of Minnesota
Grimm. Others yielding well were France, Montana (selected), Bohemia, and Montana (stock).

A new test including seed from the best rows of the old plot, which had been running since 1910, with a large number of new strains and varieties was started in the fall of 1914. Seed for this plot was secured from a wide range of territory representing not only the alfalfa sections of the United States but also several foreign countries.

**Cultural experiments with soy beans (J. C. Hackleman).**—The method and rate of seeding studies were continued on the same plan as heretofore. The results agree in general with previous results. The yields obtained this year place the rates of seeding from best to poorest at 42 pounds, 104 pounds, 64 pounds, and 82 pounds to the acre.

In the width-of-seeding tests, weeds and grasses were prevalent in the plots seeded eight and sixteen inches apart. In the plots seeded twenty-four, thirty-two and forty inches apart, cultivation kept the weeds down. The plot with rows forty inches apart gave the greatest yield of hay. This was followed by those seeded eight, twenty-four, sixteen and thirty-two inches apart in the order named.

**Sweet clover investigations—seeding and breeding (C. B. Hutchison, J. C. Hackleman, A. R. Evans).**—Owing to the drought of 1914, no data of value were collected as to the forage produced by the forty different samples of seed that were planted. There was a wide variation in the percentage of hard seed present in the samples sowed. Many samples germinated as low as ten per cent. Sulphuric-acid treatment increased the germination as much as sixty per cent in some cases.

Dry weather interfered with the seeding tests. Best stands were obtained by seeding alone, between April 1 and June 1 and between August 15 and September 1.

**A study of certain spring, summer, and fall grown crops for forage (J. C. Hackleman, A. R. Evans).**—The fall sown series of forage plots, which were harvested June 13, were very satisfactory except for the crimson clover, which showed about 75 to 80 per cent winter-kill ing. The best combinations for winter pasture and spring forage seemed to be rye and vetch followed by rye and crimson clover.

The spring sown series was injured by the drought, the oats in particular being affected. Rape seemed to be the best forage both in point of total growth and in resistance to drought.

The summer-sown series harvested in October shows very little difference in weight of dry forage between sorghum and cowpeas and corn and cowpeas. The greatest difference in the two is in the proportion of peas in the mixture, there being a larger percentage of peas in
the corn than in the sorghum, altho the seeding of peas was at the same rate. Soybeans and corn were not quite equal to the cowpea mixture, altho the difference in yield was less than 5 per cent of the total.

**FARM MANAGEMENT**

Farm management survey (in Johnson County) (O. R. Johnson, W. E. Foard, R. M. Green).—Bulletin 121 was completed and published during the year. A summary appears in the section on publications. In addition other data are being developed and will later be presented in bulletin form. Comparisons of the average of all farms below 120 acres in size are made with the average of all farms more than 120 acres in size. The large farmer receives about twice as much a day for work on crops and about three times as much a day for work on live stock as the farmer on a small farm. Corn is the most important money crop of the small farm, while wheat and hay bring most income from crops to the large farmer. Cattle, hogs, and poultry are of about equal importance on the small farm. On the large farm about one-half the total live stock receipts come from hogs. About ten per cent of the return comes from poultry, a small amount from sheep and the rest from cattle.

An investment of $70 to $95 an acre was found on the most successful farms of each group. Less investment of capital per acre means that the farmer raises less live stock. The value per acre of land does not run uniformly with the productivity of the soil. The yields increase as the value per acre increases up to the 60 to 80-dollar land. Above this point the increase in yield is not as rapid as is the increase in market value.

Similar surveys will be made in other agricultural regions of Missouri.

Farm cost accounting (O. R. Johnson, W. E. Foard, R. M. Green).—Bulletin 125 was issued during the year. A summary of this bulletin is included in the section on publication. On March 1, 1915, diaries were placed with seventy-two farmers. This is about twice the number of farm diaries kept during the previous year.

**FORESTRY**

A study of the methods of prolonging the service of wood fence posts (E. C. Pegg).—At the end of the second year about twenty different varieties of fungi were found to be growing on the posts. Some of the fungi showed a very vigorous growth. The general infection of the posts at this time is due to their very favorable location for the growth of fungi. Rank growths of weeds have been permitted to
grow up around them. The weeds are cut at the end of the growing season to permit a close examination of each post.

**Horticulture**

**Orchard nutrition** (J. C. Whitten, C. C. Wiggans).—No data are available from peaches this year, spring frosts having killed all the buds.

In the South Missouri soil where a part of this project was conducted nitrogen applied as fertilizer seemed to increase the number of apples on young trees just beginning to bear. Potassium and phosphorus or a mixture of nitrogen, phosphorus and potassium failed to give appreciable results. It was also noticed that apple blight attacked more severely the trees fertilized with nitrogen.

Trees were planted in wooden pots each capable of holding from 150 to 200 pounds of soil. Part of these pots were filled with loess soil and part of them with sand. Nitrogen, phosphorus, and potassium, was applied singly and in combination to two series of four trees each, one series growing in loess soil and the other in sand. In every case the pots fertilized with nitrogen gave greatly increased growth. Where potassium alone was applied growth was less that on the check pots. The pots treated with a mixture of all three elements gave slightly better results than any others except fertilized with nitrogen alone.

**Spraying fruits for insect and fungous diseases** (J. C. Whitten, W. L. Howard, C. C. Wiggans).—Under this project 25 orchards in various sections of the state were sprayed during the spring and summer of 1914. Figures were obtained covering the cost of the various applications. The average of all orchards is given below.

<table>
<thead>
<tr>
<th>Sprays</th>
<th>Cost per tree</th>
<th>Cost per acre</th>
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<tr>
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<tr>
<td>First</td>
<td>6.6</td>
<td>$3.96</td>
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<td>Second</td>
<td>13.0</td>
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Figures gathered at picking time showed that the value of the fruit from an unsprayed acre averaged $18.05, while a sprayed acre produced fruit valued at $187.19. The average net profit due to spraying was 143.03 per acre, while in certain particular instances it was as much as $300 to $400 per acre.
Various spraying materials were also used, and the following general results noted:

Bordeaux and lime-sulphur were equally efficient in controlling apple scab, blossom-end rot (black rot), and cedar rust. The average cost of spraying with Bordeaux was $4 per acre, while the lime sulphur solution cost $5.56 per acre. Bordeaux mixture, however, is very much more likely to russet the fruit when applied as a calyx spray. However, this solution must be used for the applications controlling bitter rot and apple blotch.

Dry or powdered lead arsenate gave just as good results as when twice the amount of the paste form was used. The difference in cost is negligible.

Soluble sulphur as now found on the market is likely to destroy the leaves and injure the calyx of the apple. This is especially true when this material is used in a combination spray with lead arsenate as an insecticide. However, there seems to be some promise in the material since it was an efficient fungicide.

Pyrox and Bordeaux arsenate (prepared Bordeaux mixture) proved satisfactory in every respect except that they were likely to burn the fruit.

As a result of the experience in these orchards, spraying at least three times is recommended—(1) just before blooming, (2) just after blooming, and (3) about ten days or two weeks later. For the first spray use three gallons of lime-sulphur for every one hundred gallons of water, or 6-6-100 Bordeaux mixture, that is, a mixture of 6 pounds of copper sulphate, 6 pounds of fresh stone lime, and 100 gallons of water. For the second spray use a 3 to 100 lime-sulphur mixture, or the 6-6-100 Bordeaux mixture may be used for the third spray, and later applications of Bordeaux should be made if bitter rot or blotch should seem likely to cause trouble.

The value and cost of dust sprays is being given a further trial on the Station orchard. Crops gathered in the fall of 1914 indicate that coddling moth can be successfully controlled, but no determination of the fungicidal value was possible because diseases were not prevalent.

**Treatment of apple canker diseases (J. C. Whitten).—** In treating trees for apple canker disease the method used was to scrape out all diseased tissue until a rim of healthy tissue was reached, then disinfect and paint the area scraped. Mercuric chloride, copper sulfate, iron sulfate, and paint alone were tried as disinfectants. The mercuric chloride applied in a solution with a strength of 1 part to 500 parts water was the most efficient disinfectant. One application stopped
the disease in 82 per cent of the cases treated. In most cases a second treatment was able to stop the disease completely in these cases in which the first treatment failed. When the first treatment failed to check the canker over a large proportion of the wound the second treatment also failed.

It appears that canker can be largely eradicated from resistant varieties like Jonathan and Winesap if treatment is given before a large area is involved. When once it gets deeply seated in susceptible varieties like Ben Davis and Gano this treatment will not stop it.

**Peach breeding for hardy sorts (J. C. Whitten).**—The crosses made in the spring of 1914 were allowed to mature, the seed gathered, stratified and planted in the spring of 1915. Only a few of the crosses made earlier are in fruiting yet, but during the past winter a self-fertilized Lewis tree was able to bring 16 per cent of its buds through a temperature of -12.8. On all of the leading commercial varieties at least 98 per cent were killed and in most cases 100 per cent.

On account of the damage done by this temperature of 13 degrees below zero it was impossible to make any crosses in the spring of 1915.

**Self fertility and self sterility of fruits (J. C. Whitten, C. C. Wiggans).**—In the spring of 1915 representative fruit spurs of the leading commercial varieties producing fruit buds were enclosed in sacks previous to blooming. None of the blossoms in sacks set fruit. This indicates a tendency to self-sterility on the part of cultivated varieties of apples, especially in certain years. In previous years a few varieties have set fruit from sacked flowers, but none have set fruit freely in sacks.

It is the purpose in future seasons to open the sacks during the blossoming season, and pollenate the pistils with pollen from anthers of their own flowers, in order to determine whether failure of sacked flowers to set fruit has been due to failure of the pollen to reach the pistils where pollen carrying insects are excluded by the sack, or whether the flowers are self-sterile.

**Fruit bud development of fruit trees as influenced by treatments and previous crops (C. C. Wiggans).**—This experiment was continued from the previous year, the same three trees being used. In July, 1913, the spurs which set fruit were labeled. At picking time the spurs maturing a fruit were also labeled. Later a record of the performance of the individual spurs were secured. Some of the more striking results are stated in Table 4.

It would seem from the above that a great majority of the spurs on trees of these varieties are not able to bear fruit two years in succession.
The spurs blossoming in 1915 on these trees were labeled as in the previous season. Other varieties also included were Ingram, Bladwin, Grimes, Winesap, and York.

During the winter and early spring several freezing point determinations of sap from spurs bearing fruit in 1914 and also from spurs not bearing in 1914 were made. In every case the sap from bearing twigs froze at a lower point than that from non-bearing twigs but the variety and the kind of soil seem to have considerable influence. These determinations were continued thru the early summer and the freezing point of leaf sap was taken.

Some young Jonathan apple trees just coming into bearing were etherized at various times during the winter and summer with the object of determining the effect of this treatment upon the formation of the fruit spurs for the following year.

Nursery trees of different varieties were girdled at regular intervals during the spring of 1915, and the freezing point of sap secured from various parts of the tree was determined every two weeks during the season.

This work is to be continued during the summer of 1915. Up to June 30, 1915, these determinations did not indicate that etherization had resulted in any increase in sap concentration. If such influence does occur it may be expected later in the summer and autumn after length growth ceases.

**Fall vs. spring planting of fruit trees (J. C. Whitten).**—The advantage of fall transplanting over spring transplanting has been more marked in the case of cherries than any other fruit, altho previous results indicating the advantage of fall planting over spring planting for other hardy fruit varieties have been confirmed. This is important, since cherries are transplanted with more difficulty than any other commonly grown fruit and since early spring planting has been generally recommended by nurserymen for that fruit.

**Rest period of plants (W. L. Howard, W. H. Lawrence).**—Owing to the resignation of W. L. Howard, active work on this project was discontinued during the year, and all his time was devoted to the publication of Research Bulletins 15, 16, 17, and 21, which are re-
viewed on earlier page of this report. W. H. Lawrence will have charge of this project in the future.

**Soils**

*Crops rotation and fertilizer experiments* (twenty-sixth year) (M. F. Miller, C. A. LeClair).—A brief summary of the important results of the first quarter-century of work on these plots appeared in the last annual report. The plan of handling some of the plots in this rotation field was changed at the end of the twenty-five year period. All the original treatments and rotations are included in the new plan, but some plots in which useless duplication occurred have been changed to include the use of lime and various combinations of fertilizers. A new plan of handling the border strips which will add to the accuracy of the work has been inaugurated.

**Relation of cowpea growing to wheat production on continuously cropped land** (C. A. LeClair).—Observations during the year indicate that the character of the season greatly influences the relative effect of the methods of handling the soil where wheat is grown continuously. If wheat is continuously grown and cowpeas are planted after each crop, it appears that a better yield of wheat is obtained than if the soil is fallowed.

Whether or not it is more profitable to cut the cowpea crop for hay and then disk and roll the land heavily before sowing wheat; to
cut the crop for hay and then disk the land without rolling before wheat; to plow under cowpeas, disk and roll; or simply to disk under the cowpea crop; is determined entirely by the rainfall and prevalence of insect pests. Similar factors seems to overshadow the effect of the nitrogen supply of the legume on medium poor land so far as observed in the three years of study. In addition to a continued

study of the net return under the systems outlined above, samples of soil accurately taken at the beginning of the experiment have been submitted to the chemist so the effect of the treatment upon the composition of the soil can be reported in the future.

**Determination of the effect of the addition of organic matter to the soil upon the development of soil acidity (C. A. LeClair).**—Preliminary work on the effect of turning under organic matter upon the development of the soil acidity has been in progress for two years. The first work was done last year on the twenty-sixth year rotation plots in determining the amount of acid in the soil under this treatment. Experiments have been conducted in the greenhouse and in the field. The indications to date are that the turning under of organic matter has very little effect upon increasing soil acidity as determined by the methods used. As a matter of fact, there are some indications that the reverse is true.

**Experiments in the associated growth of corn and cowpeas (M. F. Miller, C. A. LeClair).**—Results of two years' work show that if corn and cowpeas are seeded together at the same time the growth of both plants is limited. A decrease in the percentage of nitrogen in the ear of the corn has resulted when cowpeas are planted in the row with corn. Where cowpeas are drilled between the rows of corn at the last cultivation a slight increase in the nitrogen content of the ear
of corn results. Where this method is followed, in two years' time an increase in yield of three bushels to the acre has resulted. The amount of stover has been increased in proportion to the grain.

Factors influencing the development of the maize plant (M. F. Miller, J. C. Hackleman).—From results to date it appears that from the standpoint of the supply of both moisture and nutrition the most im-

![Image: Nutrition studies with corn](image)

**FIG. 8.—NUTRITION STUDIES WITH CORN**

The variations in size of plants show the effects of full feeding and scant feeding at different periods of the plants growth.

portant period in the growth of the plant is the second period—that period between the time the corn is normally laid-by and the time when the silks appear. In the case of nutrition supply, the first period in growth is second in importance and the third period is third in importance to the production of total dry matter, ear weight and root weight, altho an increased weight of the part above the ground has not been followed by a proportionate increase in root weight. Leaf growth is influenced more by the variation in the nutrient elements than is stalk growth. Less concordant results are found when the moisture supply is varied. The second period is generally the most important of the three as influencing ear development and total dry matter. The least water requirement was found in the potometers having an optimum water supply maintained during the first period, followed by a minimum supply during the last two periods. The high-
est water requirement was found in those having the water supply at optimum thru all three periods.

**Veterinary Science**

**Hog cholera immunity investigations** (J. W. Connoway, A. J. Durant). **Object.**—The purposes of the hog cholera immunity investigations have included the solution of such problems as establishing and making practical complement-fixation test for use in the investigations of various problems in hog cholera and immunization against that disease, the diagnosis of doubtful cases of hog cholera, the detection of immune infection-carriers, and test the potency of anti-hog-cholera serum.

**Methods.**—In the preparation and use of the various components of the complement fixation test for hog cholera, the usual technique found successful in applying this method to syphilis and dourine has been followed as closely as possible.

**Antigens.**—The preparation of a “specific antigen” that will react with the serum of all cholera immune swine has been the difficult feature of this research, as was to be expected. But progress worthy of mention has been made.

**Source of experimental material.**—For the preparation of the experimental antigens, it was planned to use the most virulent materials obtainable; such as blood, pathological exudates, urine, extracts from the spleen, liver, kidneys, congested lymph nodes and hemorrhagic lungs from young swine suffering from the acute hemorrhagic type of cholera.

It was also planned to test the antigenic properties of the blood and organ extracts of swine suffering from the chronic type of cholera and particularly extracts of the “button ulcers” and diffuse diphtheritic thickening of the intestines.

Negatives results were obtained with the experimental antigen prepared from the blood, kidneys and lymph nodes of a few pigs suffering from the acute hemorrhagic type of cholera. More extensive work was done with spleen antigens from acute cholera cases, and ulcer antigens from chronic cases, and better results were obtained.

**Spleen extract antigens.**—In the previous report mention was made of the preparation of an experimental spleen extract antigen which, with serum from one hog (No. 7) hyperimmunized to hog cholera, gave a deviation of the “complement,” but which, with serum samples from other hyperimmune swine, gave a negative reaction. This work has been continued with the following results: A total of 76 spleen extracts have been prepared and tested for antigenic properties. Of these, eight extracts yielded positive results, or more than ten per cent of the spleens used in these experiments showed antigenic properties.
In one experiment, serum samples from sixty-seven immunes ("hypers" from the serum plant) were tested with an experimental spleen extract (No. 3). Of these, thirty-five samples gave a positive reaction, thirty-two samples were negative. The important fact is thus established that a distinctly complement fixation reaction did occur with the serum of a considerable number of cholera immune swine, when an antigen extract from the spleen pulp of a certain pig that had died from an attack of cholera of the acute hemorrhagic type was used.

The question remains open, however, as to whether the results obtained were due to a specific hog cholera antigen in the spleen extracts, or to associated antigens. But in this connection it is pertinent to state that the cholera spleen from which the experimental antigens were prepared failed to yield cultures of the Salmon bacillus (*B. Suipestifer*), the micro-organism most commonly associated with the filterable virus of hog cholera. Moreover, tests made with an antigen prepared from a pure culture of *B. Suipestifer* gave no deviation of the complement with serum samples obtained from hogs which gave a positive reaction to the spleen antigen extracts.

Ulcer extract antigens.—Experimental antigens were also prepared from the intestinal button ulcers obtained from swine affected with the chronic type of hog cholera; and a positive deviation of the complement was obtained when tested with serum from several cholera immune hogs, whose serum had previously given a positive reaction with spleen antigens. Tests were made with nine experimental ulcer antigens. One sample was a composite of ulcers from three cholera infected hogs; the other eight samples were from individual hogs.

At this stage of the investigation, the conclusion cannot be drawn that the positive reactions observed are due to a specific hog cholera antigen occurring in the ulcers, since the necrotic ulcer material used in preparing the experimental antigens, without doubt, contains a number of contaminating micro-organisms and toxic products which have no causative relation to hog cholera but which under certain conditions possibly may stimulate the production of their special antibodies in the blood of a cholera infected hog. The *B. Coli communis*, *B. Suipestifer*, *B. Necrophorus*, and the *Spirochaeta hyos* have all been found in these ulcers. Nevertheless, the probability that the complement deviation observed in these experiments was due to the specific hog cholera antigen is strengthened by the fact that small quantities of the positive reacting ulcer material produced typical cases of hog cholera, when injected into susceptible pigs, and the disease was transmitted to check pigs from pen exposure. In the preparation of
the ulcer extracts the ulcer material used was thoroughly washed with sterile water to remove all fecal matters and loosely adherent saprophytic micro-organisms. Moreover, the peritoneal and muscular tissues overlying the ulcers were cut away as closely as possible so as to leave only the necrotic ulcer material. The antigen material thus obtained was practically free from blood and blood-carrying tissue containing any large amount of the circulating "filterable virus."

The possibility of ultimately utilizing the complement fixation test in determining the variations in potency of the serum is indicated by a test of the serum of Cholera Hog 7 with one of the antigens, at widely separated periods. This antigen and others were found to give strong positive reaction when titrated against the serum of this hog. This animal, on account of an accident which caused lameness, was left out of the experimental work for a period of six months. At the end of this time the above mentioned antigen failed to deviate the complement with serum from this hog; but ten days after the hog had received a hyperimmunizing dose of hog-cholera virus, when this antigen and the blood serum of this hog were used in the test, a positive deviation of the complement was obtained. The spleen antigen was not as strong at this time as in the previous test, but tests with fresh antigens indicated that the serum of Hog 7, after the hyperimmunization, was again rich in antibodies.

Further work will be done to isolate the antigen in as pure form as possible from the positive reacting spleens and ulcers, so as to eliminate complicating factors in the practical application of the test.

**Contagious abortion investigations** (J. W. Connaway, A. J. Durant).—The work of the preceding year (see report 1913-14) demonstrated so clearly the practical value of the Complement Fixation Test in the diagnosis of contagious abortion in cattle herds as to justify its larger use in investigational work and field diagnosis during the year just closed.

**Cooperation with cattle breeders.**—Twenty-nine suspected herds, comprising a total of 610 cattle, have been tested. Including animals retested, 1218 blood serum samples have been examined. Twenty-four or a little over 80 per cent of the suspected herds contained positive reacting animals with a history of abortion. In one herd, in a group of 70 cows, 41 gave a positive reaction, and 29 a negative reaction. That is, about 57 per cent of the mature cows in the herd gave a positive reaction. In other herds the percentage of positive reactors was less. Taking the entire number of animals tested in the infected herds, 43 per cent gave a positive reaction.

The use of the test in detecting infected herds and the infected individuals in a herd enable the owner to institute measures to prevent
the infection from passing to clean animals and measures of eradication of the disease from the herd. By applying the test to recently purchased breeding cattle, the dangers of introducing the disease into clean herds are lessened. The laboratory has given valuable aid in this direction during the past year. Cooperation with the cattle breeders in this work will be continued.

The data and material from this field work are being utilized, as fully as circumstances will permit, in the investigation of special problems relating to contagious abortion.

Research work in cooperation with the Department of Dairy Husbandry.—Research in cooperation with the Department of Dairy Husbandry has been instituted to develop more definite knowledge regarding the nature of contagious abortion in cattle, and particularly in regard to how the infection is conserved and transmitted; and how the disease may be prevented and eradicated by handling the herd more intelligently.

In the experiments the complement fixation test, checked by the breeding and clinical history of the reacting animals, has proved very serviceable and will be used wherever applicable in the further investigation.

Zoology

Investigation in Mendelian inheritance (George LeFevre, E. H. Rucker).—1. Silver-Spangled Hamburg X Brown Leghorn crosses. The chief matings made during the past spring in this experiment have been directed toward obtaining the $F_3$ generation, with a view to testing the apparent sex-linked nature of the inheritance of the spangled pattern. The birds of this year will be thoroughly studied during the coming fall. A large number of excellent photographs of the birds previously obtained in the same crosses have been made.

2. The Sebright X Rose-comb Black Bantam crosses.

The $F_2$ cocks from these crosses showed three conditions (1) male-feathered (SS); (2) hen-feathered (ss); and (3) intermediate condition (Ss).

Matings, during the past spring, have been made between the three types of cocks and the pure-bred Sebright hens and black hens, the object being to test their genetic constitution in respect to feather characters concerned. Many photographs have been taken.

COOPERATION WITH THE UNITED STATES DEPARTMENT OF AGRICULTURE

The Missouri Agricultural Experiment Station is cooperating with the United States Department of Agriculture in two projects.
Soil survey (M. F. Miller, H. H. Krusekopf, E. W. Knoble, C. E. Deardorf).—In cooperation with Bureau of Soils of the United States Department of Agriculture, a detailed soil survey of Missouri is being conducted. At the close of the year ended June 30, 1915, 37 counties had been surveyed in detail. Four counties were completed during the year, Harrison, Grundy, Johnson and Pettis. Work was begun on Buchanan, Newton and Ripley counties.

FIG 9.—THE DETAILED SOIL SURVEY

The counties in black had been completely surveyed by June 30, 1915, and work on others is being completed as rapidly as possible.

The reconnaissance soil survey which was nearly complete at the end of the last fiscal year is still incomplete, but it is hoped that sufficient data will be collected during the next year for a complete map of the state to be published, with a discussion in bulletin form. In 1908 such a map was published of the Ozark Region of Missouri.

Seed testing laboratory (C. B. Hutchison, Etta O. Gilbert).—In cooperation with the Bureau of Plant Industry, the Station has been conducting a seed testing laboratory in which farm seeds are examined free. During the last year, 1934 samples of farm seeds were tested. This is an increase of 414 samples over the number received.
during the year previous. Of the samples tested, 1828 were from farmers and 1106 were from seedsmen. Altogether, 1587 tests for germination, 1012 for purity, 75 for rough examination and 54 for identification were made. As indicated by the increased number of samples received during the year this service is increasingly valuable.

**COOPERATIVE WORK OUT OF COLUMBIA**

**Soil survey of Missouri counties.**—The soil survey is fundamental to all soil investigations. It is the basis of intelligent recommendation of proper soil treatments. The first appropriation for the soil survey was made in 1905. Appropriations have been made by succeeding legislatures, and as a result surveys have been made of more than one third of the agricultural area of the state.

**Soil and crop experiment fields.**—The purpose of the Agricultural Experiment Station in establishing soil and crop experiment fields is to supplement the work done locally by similar work on the various soil types and under the different climatic conditions that obtain in Missouri. In this way the results of work done at Columbia are adapted to the local conditions.

One new soil field has been established during the year. This is at Windsor in Henry County, on the Southwest Missouri level prairie. Work at one soil-experiment field was completed during the year—the one at Laclede in Linn County. The crop experiment field at Lewiston in Lewis County was completed, and the crop field at New Madrid in New Madrid County was discontinued. Altogether, 12 soil and 7 crop experiment fields were in operation during the year or 19 fields in 18 counties of the state.

These fields have developed some valuable information, which, in the case of the work with farm crops, is correlated with the results of cooperative tests carried out by individual farmers.

During the year ended June 30, 1915, results of the work on soil experiment fields have been published in six bulletins, summarized on earlier pages of this report. These bulletins give the exact yields of each crop and the profit or loss on the various soil treatments used on each soil type.

Some of the more important results may be summarized as follows:

Tile drains can be profitably installed on the level prairies of Southwest and Northeast Missouri. On the Northeast prairie, the tile should be laid not more than five rods apart. It has required practically seven years of cropping to pay for the cost of laying the tile on the Northeast Missouri prairie. On the southwest Missouri prairie, the tile can be laid six rods apart at a cost of $18.31 an acre. The
total increased return due to tiling was $21.94 an acre. The southwest Missouri prairies are not so tight as the northeast prairie.

Phosphorus brings the largest net return in most Missouri soils. Phosphorus brings satisfactory returns on most of the soils of Missouri that have begun to need fertilizer. In the experiments conducted, bone meal gave the better net returns. The recommendation is that the man who must have immediate returns should use bone meal at the rate of three hundred pounds to the acre every four years, while the man who can afford to wait for returns should use raw rock phosphate at the rate of 800 pounds per acre once every four years.

Ground limestone has brought consistent returns on practically all the fields under experiment. Considering an average of all experiments, an application of one ton of ground limestone before corn in a rotation of corn, oats, wheat and clover has given an increase worth $5.30. The cost of application has varied from $1 to $3 a ton. This does not necessarily mean that ground limestone will pay a profit on all the soils of the state, for the soil experiment fields have been located on some of the soil types in greatest need of lime.
Barnyard manure is worth $1.65 a ton when applied before corn in a four-year rotation of corn, oats, wheat and clover. This is a conservative estimate of the value of manure, as the experiments have not run long enough for the full value of manure to be obtained. In two of the fields under experiment the return from barnyard manure has been over $3 an acre.

On the Shelbina crop field, early deep plowing for wheat increased the yield over early shallow plowing about 4 per cent, over late shallow plowing about 5 per cent and over late deep plowing about 13 per cent. Seeding wheat at the rate of seven pecks to the acre gave a higher yield than seeding either at a lighter or heavier rate.

On the Shelbina crop field, owing to the drought in 1914, the oat crop failed. In 1912 and 1913 double discing and harrowing increased the yield over plowing for oats 8.3 per cent. Drilling oats increased the yield over broadcasting 13.5 per cent. Seeding at the rate of eight and ten pecks per acre gave about equal yield—both better than seeding at the rate of either six or twelve pecks to the acre. At Warrensburg, during the same years, seeding at the rate of eight pecks to the acre gave best results.

The best varieties of white corn for Missouri conditions are Boone County White, St. Charles County White and Johnson County White. The best varieties of yellow corn are Reid's Yellow Dent and Leaming.

Alfalfa can be grown on all the soils of Missouri except the level prairies of the Northeast and Southwest sections. Manure and inoculation are the two necessary soil treatments for the successful production of alfalfa. Frequently phosphates can be profitably applied.

**Hog-cholera serum distribution.**—During the year ending June 30, 1915, the Agricultural Experiment Station produced 191,889 doses of hog cholera serum. The serum was distributed direct to farmers who applied it themselves, thru representatives of the Department of Veterinary Science, thru County Agents and thru veterinarians. Altogether, 161,797 doses were applied to about 153,538 hogs on approximately 2013 farms located in 95 counties of the state. It is estimated that 90 per cent of the hogs treated were saved. At $8 a head, this represents a saving to Missouri farmers of about $1,105,473.

**Fertilizer control.**—(P. F. Trowbridge) The Missouri Fertilizer Law was enacted by the Forty-second General Assembly for the protection of Missouri farmers. The administration of this law was placed in the hands of the Director of the Missouri Agricultural Experiment Station. The essential requirements of that law are:

1. Each brand of fertilizer offered for sale in Missouri must first be registered with the Director of the Experiment Station. (2)
The registration must include a guaranteed chemical composition. (3) Each package, parcel, or bag offered for sale must have plainly indicated upon it the guaranteed chemical composition and must bear the registration tag which the manufacturer or dealer must secure from the Agricultural Experiment Station at Columbia, Missouri. (4) It is made the duty of the Agricultural Experiment Station to collect samples of fertilizers from the cars, farmers' wagons, or any other place, for the purpose of analysis to determine if the manufacturers are complying with the law.

Bulletin 122, summarized on an earlier page of this report, states the result of the inspection work of 1914. More than 700 samples of fertilizer were collected during the year. The total number of analyses reported by the laboratory were 1380. Thirty-nine per cent of these gave results below the manufacturer's guarantee. It is estimated that about 60,000 tons of fertilizer were sold in Missouri in 1914.

**Nursery inspection** (L. Haseman, T. J. Talbert, A. H. Hollinger, K. C. Sullivan).—The Forty-Seventh General Assembly of Missouri passed the Nursery Inspection Law and placed its administration in the hands of the Director of the Missouri Agricultural Experiment Station. Following is a detailed report of the inspector's work for the year ending June 30, 1915.

<table>
<thead>
<tr>
<th>Nurseries Inspected</th>
<th>Nurseries treated for San Jose Scale</th>
<th>Nurseries given inspection certificates</th>
<th>Nursery stock inspected, acres</th>
<th>Counties in which inspections were made</th>
<th>Men assisting with inspection work</th>
<th>Cases of imported stock inspected</th>
<th>Inspection certificates issued</th>
<th>Dealers' certificates issued</th>
<th>Growers' permits issued</th>
<th>Agents' permits issued</th>
</tr>
</thead>
<tbody>
<tr>
<td>135</td>
<td>14</td>
<td>125</td>
<td>2551</td>
<td>44</td>
<td>4</td>
<td>540</td>
<td>125</td>
<td>69</td>
<td>94</td>
<td>249</td>
</tr>
</tbody>
</table>

Of the nurseries inspected, fourteen were found to have some infested or infected stock. This was destroyed or treated before an inspection certificate was issued to the grower.

**Official testing of dairy cows** (T. C. Reed).—The various dairy cattle associations have asked the agricultural experiment stations in the various states to assume the responsibility of conducting all official tests of the cows of the breeds and vouching for the accuracy of these tests. At the Missouri Agricultural Experiment Station this work is administered by the Department of Dairy Husbandry.

During the year ending June 30, 1915, 309 cows of the four chief dairy breeds were tested. In the preceding year only ninety-four cows were tested. Altogether, 1175 different tests were conducted during the year. Of the tests made, 26 were of seven days' duration and 1149
were of two days’ duration and conducted for year records. There were 261 Jerseys, 41 Holsteins, 4 Guernseys and 3 Ayshires tested. It is significant that the testing in Missouri has increased 223 per cent during the year.

**COOPERATIVE EXPERIMENTS WITH FARMERS**

The Agricultural Experiment Station has cooperated with from six hundred to seven hundred farmers annually on as many as thirty different projects. This cooperative work was carried on thru seven different departments. Since the organization of the Agricultural Extension Service the projects of the departments of Dairy Husbandry, Entomology, and Horticulture which were clearly demonstrational in nature, have been taken over by that division. The following projects which depend upon the cooperation of farmers in the state were conducted during the year ended June 30, 1915, as experimental projects.

1. Corn Variety Tests
2. Corn Breeding Investigations
3. Wheat Variety Tests
4. Oat Variety Tests
5. Cultural Experiments With Alfalfa
6. Experiments With Winter Vetch
7. Fertilizer Experiments With Potatoes
8. Crimson Clover Experiments
9. Barley Variety Tests
10. Cotton Variety Tests
11. Fertilizer Experiments With Cotton
12. Sweet Clover Seeding Experiments
13. Cowpea Variety Tests
14. Soybean Variety Tests
15. Investigations With Grain Sorghums
16. Winter Barley Variety Tests
17. Spring Barley Variety Tests
18. Cultural Experiments With Sudan Grass
19. Experiments With Spanish Peanuts
20. Farm Management Survey (Johnson County)
21. Distribution of Labor
22. Cost of Family Living on the Farm
23. Farm Cost Accounting

Several projects have been added to the soils and crop work since the last report. They include experiments with spring barley, Sudan grass and Spanish peanuts.
The Department of Farm Management has discontinued two projects, one on the Management of Labor and the other on Management of Work Stock. It has added a project to study Systems of Renting Land and Rent Rates. All of the investigational work of this department is necessarily conducted in cooperation with farmers.

THE WORK OF THE AGRICULTURAL EXPERIMENT STATION AND THE EXTENSION SERVICE

It is the function of the Agricultural Experiment Station to render service to the farmers of Missouri by helping them to solve their problems thru investigation. It is clear that if the great body of farmers in Missouri are to base their agricultural practice upon the findings of the Experiment Station there must be an efficient and far reaching plan conceived for the purpose of carrying an accurate knowledge of how these results may be applied to the actual business of farming.

The only means provided in the original Hatch Act for bringing this information to farmers was thru the publication of bulletins. Experience has proved that while this method is valuable and effective it is not as effective as actual demonstration and instruction thru personal visitation. Every college of agriculture therefore has found that it can serve the interests of its farming population best by extending a knowledge of its operations thru various educational activities such as the Movable Schools of Agriculture; Boys' and Girls' Clubs; Movable Schools of Home Economics; and Demonstration Work on Farms, in Orchards, and in Creameries.

The success of this type of work resulted in the passage of the Smith-Lever Act, providing funds for agricultural extension. Under the provisions of this law a great impetus has been given to agricultural extension work. The College of Agriculture of the University of Missouri has been able to extend greatly all non-resident activities which have for their purpose the systematic instruction of farmers and in demonstrating the improved systems of agricultural that have been worked out by the Agricultural Experiment Station.

For administrative purposes the Agricultural Extension Service may be regarded as a distinct administrative unit set apart and unrelated to college teaching and investigation. It never has been possible, and it never will be possible to separate the work of the Agricultural Experiment Station from the work of the Agricultural Extension Service.

The measure of the influence of the investigational work of the Agricultural Experiment Station on farm practice cannot be based alone upon the results obtained, however valuable and important these
may be. The results of the work of the Experiment Station will be measured largely by the efficiency of the organization for carrying these results to the farmers themselves. In attempting therefore to make a report on the activities of the Experiment Station and to measure its influence upon agricultural practice it is believed that a brief statistical summary of the work of the Agricultural Extension Service should be included.

The Agricultural Extension Service has published a separate report dealing with the non-resident instructional activities of the College of Agriculture for the year ended June 30, 1915. This report is prepared by A. J. Meyer, Secretary, in charge of the Agricultural Extension Service and the summary following is compiled from this report.

THE SMITH-LEVER PROJECTS

Boys' and Girls' Club Work

<table>
<thead>
<tr>
<th>Kind of Club</th>
<th>Clubs organized</th>
<th>Membership</th>
<th>Clubs completing work</th>
<th>Members completing</th>
<th>Clubs continuing</th>
<th>Members continuing</th>
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<td>Corn</td>
<td>40</td>
<td>423</td>
<td></td>
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<td>Tomato</td>
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<td>29</td>
<td>317</td>
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<td>22</td>
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<td>Stock judging</td>
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DAIRY EXTENSION WORK

<table>
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<th>Activity</th>
<th>Number</th>
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<tbody>
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<tr>
<td>Number of cooperators secured</td>
<td>75</td>
</tr>
<tr>
<td>Public meetings held</td>
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<tr>
<td>Total attendance</td>
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<tr>
<td>Number of counties</td>
<td>25</td>
</tr>
<tr>
<td>Number of silos started</td>
<td>3</td>
</tr>
<tr>
<td>Number of blue prints and specifications furnished</td>
<td>75</td>
</tr>
<tr>
<td>Number of counties receiving silo help</td>
<td>40</td>
</tr>
<tr>
<td>Number of milk stations, ice cream factories, creameries, and laboratories given direct help</td>
<td>94</td>
</tr>
</tbody>
</table>

### Home Economics Schools

#### In County Agent Counties

<table>
<thead>
<tr>
<th>County</th>
<th>Schools</th>
<th>Approximate average attendance</th>
<th>Total attendance</th>
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</thead>
<tbody>
<tr>
<td>Buchanan</td>
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<td>66</td>
<td>331</td>
</tr>
<tr>
<td>Audrain</td>
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<td>128</td>
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<tr>
<td>Cooper</td>
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<td>Dade</td>
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<td>Johnson</td>
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<td>Scott</td>
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<tr>
<td>St. Francois</td>
<td>6</td>
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<td><strong>66</strong></td>
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#### In Other Counties

<table>
<thead>
<tr>
<th>Post office</th>
<th>County</th>
<th>Days</th>
<th>Attendance</th>
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<td>40</td>
</tr>
<tr>
<td>Cowgill</td>
<td>Caldwell</td>
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<td>30</td>
</tr>
<tr>
<td>Porter School</td>
<td>Adair</td>
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<td>55</td>
</tr>
<tr>
<td>East Center</td>
<td>Adair</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Elsberry</td>
<td>Lincoln</td>
<td>3</td>
<td>40</td>
</tr>
<tr>
<td>Nevada</td>
<td>Vernon</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>Marshall</td>
<td>Saline</td>
<td>4</td>
<td>45</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7 Counties</strong></td>
<td><strong>25</strong></td>
<td><strong>330</strong></td>
</tr>
</tbody>
</table>

### Hog Cholera Eradication

1. Number of new counties in which work was started: 3
2. Number of counties in which established work was continued: 2
3. Report of organizing campaigns:

<table>
<thead>
<tr>
<th>Counties</th>
<th>Cass</th>
<th>Bates</th>
<th>Knox</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of meetings:</td>
<td>24</td>
<td>21</td>
<td>17</td>
<td>62</td>
</tr>
<tr>
<td>Total attendance at meetings:</td>
<td>802</td>
<td>844</td>
<td>575</td>
<td>2221</td>
</tr>
<tr>
<td>Number anti-hog cholera clubs formed:</td>
<td>21</td>
<td>23</td>
<td>15</td>
<td>59</td>
</tr>
<tr>
<td>Total membership:</td>
<td>586</td>
<td>755</td>
<td>316</td>
<td>1887</td>
</tr>
</tbody>
</table>
4. Number of farms visited for demonstration purposes: 673
5. Number of hogs vaccinated: 14,203
6. Number of follow-up meetings of organized clubs: 68
7. Attendance at meetings: 1,093
**Work Done by County Agents or at Their Suggestion**

**Work With People**

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Different farmers visited on their farms</td>
<td>3,584</td>
</tr>
<tr>
<td>Total number of farms visited made</td>
<td>4,755</td>
</tr>
<tr>
<td>Calls on agents at office relating to country agent work</td>
<td>15,826</td>
</tr>
<tr>
<td>Meetings held under auspices of farm bureaus or agents</td>
<td>1366</td>
</tr>
<tr>
<td>Total of all meetings addressed by agents (including No. 4)</td>
<td>10,027</td>
</tr>
<tr>
<td>Total attendance at such meetings</td>
<td>109,183</td>
</tr>
<tr>
<td>Membership in farm bureaus or country organizations</td>
<td>10,955</td>
</tr>
<tr>
<td>Associations organized for adults during 1915</td>
<td>2184</td>
</tr>
<tr>
<td>Boys' and girls' clubs organized during 1915</td>
<td>71</td>
</tr>
<tr>
<td>Total membership in such clubs organized in 1915</td>
<td>10,890</td>
</tr>
<tr>
<td>Agricultural articles written by agents published in local papers</td>
<td>2641</td>
</tr>
<tr>
<td>Local circulars and circular letters distributed</td>
<td>61,185</td>
</tr>
<tr>
<td>Copies of United States and State bulletins distributed</td>
<td>8278</td>
</tr>
<tr>
<td>Letters written</td>
<td>25,046</td>
</tr>
<tr>
<td>Number of local movable schools at which agents assisted</td>
<td>35</td>
</tr>
<tr>
<td>Days devoted by agents to movable school work</td>
<td>83</td>
</tr>
<tr>
<td>Total enrollment at such movable schools</td>
<td>1977</td>
</tr>
<tr>
<td>Total from counties attending farmers' week at University</td>
<td>564</td>
</tr>
<tr>
<td>Schools assisted in developing agricultural instruction</td>
<td>178</td>
</tr>
<tr>
<td>School grounds improved</td>
<td>15</td>
</tr>
<tr>
<td>Agricultural observation parties conducted (automobile, etc.)</td>
<td>40</td>
</tr>
<tr>
<td>Total number of persons in such parties</td>
<td>789</td>
</tr>
<tr>
<td>Library books distributed</td>
<td>454</td>
</tr>
<tr>
<td>Meetings or demonstrations held at which assistance was rendered by spe-</td>
<td>376</td>
</tr>
<tr>
<td>cialists from the college or U. S. Dept.</td>
<td></td>
</tr>
<tr>
<td>Township fair held</td>
<td>17</td>
</tr>
<tr>
<td>Attendance at township fairs</td>
<td>1750</td>
</tr>
</tbody>
</table>

**Work With the Farm and Farmstead**

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm buildings planned or improved</td>
<td>111</td>
</tr>
<tr>
<td>Silos constructed</td>
<td>137</td>
</tr>
<tr>
<td>Water supply systems introduced or improved</td>
<td>10</td>
</tr>
<tr>
<td>Lighting systems installed</td>
<td>7</td>
</tr>
<tr>
<td>Heating systems installed</td>
<td>2</td>
</tr>
<tr>
<td>Home grounds planned or improved</td>
<td>20</td>
</tr>
<tr>
<td>Sanitary conditions improved</td>
<td>117</td>
</tr>
<tr>
<td>Crop-rotation systems planned</td>
<td>163</td>
</tr>
<tr>
<td>Drainage systems planned</td>
<td>26</td>
</tr>
<tr>
<td>Acres in drainage areas so planned</td>
<td>2153</td>
</tr>
<tr>
<td>Miles of public road improved</td>
<td>12</td>
</tr>
<tr>
<td>Farm power machines installed on advice or suggestion of agents</td>
<td>25</td>
</tr>
<tr>
<td>Farmers influenced to insure property</td>
<td>124</td>
</tr>
<tr>
<td>Farmers using cement on advice or suggestion of agents</td>
<td>113</td>
</tr>
<tr>
<td>Farmers given advice or assistance by agent in clearing land</td>
<td>114</td>
</tr>
</tbody>
</table>

**Work With Field Crops**

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farms selecting seed corn in fall</td>
<td>866</td>
</tr>
<tr>
<td>Acres planted with selected seed corn</td>
<td>21,650</td>
</tr>
<tr>
<td>Farms testing seed corn for germination</td>
<td>598</td>
</tr>
<tr>
<td>Acres of corn planted with tested seed</td>
<td>16,062</td>
</tr>
<tr>
<td>Farms on which the agents know that corn was grown following their suggestions</td>
<td>520</td>
</tr>
<tr>
<td>Total acres of corn so grown</td>
<td>18,621</td>
</tr>
<tr>
<td>Resultant increase corn yield in bushels per acre on 39 farms where yield was determined</td>
<td>12.2</td>
</tr>
<tr>
<td>Farms on which the agents know that wheat was grown following their suggestions</td>
<td>179</td>
</tr>
<tr>
<td>Total acres of wheat so grown</td>
<td>5440</td>
</tr>
<tr>
<td>Resultant increased wheat yield in bushels per acre on 20 farms where yield was determined</td>
<td>6.2</td>
</tr>
</tbody>
</table>
Farms on which the agents know that oats were grown following their suggestions
Total acres of oats so grown
Resultant increased oat yield per acre on 4 farms where yield was determined
Farms on which the agents know that alfalfa was sown following their suggestions
Total acres of alfalfa so planted on above farms
Farms on which the agents know that the seed or soil for alfalfa was inoculated
Acres inoculated for alfalfa on above farms
Farms on which the agents know that sweet clover was grown following their suggestions
Acres of sweet clover grown
Farms on which the agents know that soybeans were grown following their suggestions
Acres of soybeans so grown
Orchards cared for in whole or in part on suggestions of agents
Wood lots planted or improved on suggestions of agents
Acres of orchards sprayed
Acres of orchard pruned
Bushels of apples packed

<table>
<thead>
<tr>
<th>Work With Live Stock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registered stallions which the agents know were secured on their suggestions:</td>
</tr>
<tr>
<td>Registered bulls which the agents know were secured on their suggestions:</td>
</tr>
<tr>
<td>Registered cows which the agents know were secured on their suggestions:</td>
</tr>
<tr>
<td>Registered rams which the agents know were secured on their suggestions:</td>
</tr>
<tr>
<td>Registered ewes which the agents know were secured on their suggestions:</td>
</tr>
<tr>
<td>Registered boars which the agents know were secured on their suggestions:</td>
</tr>
<tr>
<td>Registered sows which the agent know were secured on their suggestions:</td>
</tr>
<tr>
<td>Registered sires transferred from one community to another:</td>
</tr>
<tr>
<td>Dairy cows purchased (other than pure bred) on agents' suggestion:</td>
</tr>
<tr>
<td>Cow-testing associations organized by agents:</td>
</tr>
<tr>
<td>Cows tested for milk production through such association:</td>
</tr>
<tr>
<td>Cows tested for milk production by individuals on suggestion of agents:</td>
</tr>
<tr>
<td>Live-stock breeding associations organized by agents:</td>
</tr>
<tr>
<td>Total membership in such live stock breeding associations organized in 1915:</td>
</tr>
<tr>
<td>Farms influenced to feed more live stock:</td>
</tr>
<tr>
<td>Farms on which balanced rations figured by county agents are known to have been adopted:</td>
</tr>
<tr>
<td>Farms on which the agents know that the poultry management has been improved following their suggestions:</td>
</tr>
<tr>
<td>Farmers given advice in regard to control of poultry diseases:</td>
</tr>
<tr>
<td>Number of chickens in flocks where changes were made:</td>
</tr>
<tr>
<td>Animals tested for tuberculosis by agents or on their suggestion:</td>
</tr>
<tr>
<td>Animals treated for blackleg by agents or on their suggestion:</td>
</tr>
<tr>
<td>Animals tested for contagious abortion:</td>
</tr>
<tr>
<td>Hogs vaccinated for cholera by agents:</td>
</tr>
<tr>
<td>Hogs vaccinated for cholera by veterinarians or farmers on agents' suggestion:</td>
</tr>
<tr>
<td>Anti-hog cholera clubs organized (1915):</td>
</tr>
<tr>
<td>Number of members in anti-hog cholera clubs:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Work on Fertilizers and Fertility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers reinforcing manure with acid phosphate or floats:</td>
</tr>
<tr>
<td>Farms using chemical fertilizer on suggestion of agents:</td>
</tr>
<tr>
<td>Tons of chemical fertilizer so used:</td>
</tr>
<tr>
<td>Local sources of lime or limestone developed:</td>
</tr>
</tbody>
</table>
Limestone crushers or grinders introduced on the suggestion of agents .................. 8
Tons of lime or limestone used ........................................... 2119
Acres of clover plowed under for green manure ......................................... 1900
Acres of soybeans plowed under for green manure ....................................... 15
Acres of cowpeas plowed under for green manure ........................................ 785
Acres of vetch plowed under for green manure ........................................... 20
Acres of rye plowed under for green manure ............................................. 2055
Number of farms on which agents tested soil acidity .................................. 268
Number of acres concerned ........................................................................... 12,375
Samples of limestone tested ........................................................................... 1143

Work Done With Farm Business

Farm analysis records taken by county agent ................................................... 256
Farmers induced by agents to keep farm accounts, partial or complete .............. 19
Farmers' exchanges organized in 1915 ........................................................... 2
Value of business done through such exchanges organized in 1915 .................. $2703
Farms rented through exchanges ...................................................................... 1503
Farm supplies with laborers through exchanges or otherwise ........................ 8
Total number of laborers furnished to farmers ................................................ 88
Other purchasing and marketing associations organized .................................. 5
Total value of all business done in 1915 by all associations organized by agents or on their suggestions ................................................................. $31,069
Approximate saving affected by such associations ........................................... $1,429

Movable Schools

Enrollment and Attendance Record

<table>
<thead>
<tr>
<th>Population of town</th>
<th>Schools</th>
<th>Average enrollment</th>
<th>Average attendance</th>
<th>Farmers attending</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 2000 ..........</td>
<td>3</td>
<td>325</td>
<td>117</td>
<td>89</td>
</tr>
<tr>
<td>Between 1000 and 2000</td>
<td>4</td>
<td>209</td>
<td>125</td>
<td>106</td>
</tr>
<tr>
<td>Less than 1000 .....</td>
<td>5</td>
<td>104</td>
<td>86</td>
<td>70</td>
</tr>
<tr>
<td>In the open country</td>
<td>3</td>
<td>190</td>
<td>95</td>
<td>71</td>
</tr>
</tbody>
</table>

Short Course Summary

Movable schools ......................................................................................... 15
Counties in which short courses were held ............................................... 12
Smallest average daily attendance .......................................................... 60
Largest average daily attendance ................................................................ 150
Average daily attendance for all courses ................................................. 104
Smallest enrollment .................................................................................. 70
Largest enrollment .................................................................................... 400
Total enrollment ....................................................................................... 2700
Number of instructors .............................................................................. 14

Farmers' Week at the University

(Farmers Short Course)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of people attending</td>
<td>2,843</td>
</tr>
<tr>
<td>Number of counties represented</td>
<td>14</td>
</tr>
<tr>
<td>Number of states represented</td>
<td>14</td>
</tr>
<tr>
<td>Numbers of distinct short courses given</td>
<td>10</td>
</tr>
<tr>
<td>Number of lectures and demonstrations</td>
<td>154</td>
</tr>
</tbody>
</table>
PROGRESS OF THE AGRICULTURAL EXPERIMENT STATION

FARM BUILDINGS AND CONSTRUCTION
(For one month only—June, 1915)

<table>
<thead>
<tr>
<th>Silo plans furnished</th>
<th>41</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silos built from these plans</td>
<td>34</td>
</tr>
<tr>
<td>Farm house plans furnished</td>
<td>11</td>
</tr>
<tr>
<td>Barn plans furnished</td>
<td>41</td>
</tr>
<tr>
<td>Hog house plans furnished</td>
<td>16</td>
</tr>
<tr>
<td>Corn crib plans furnished</td>
<td>2</td>
</tr>
<tr>
<td>Dipping vat plans furnished</td>
<td>77</td>
</tr>
<tr>
<td>Counties reached</td>
<td>53</td>
</tr>
</tbody>
</table>

Agricultural Exhibits at Fairs

<table>
<thead>
<tr>
<th>Fair</th>
<th>County</th>
<th>Attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Bloomfield</td>
<td>Callaway</td>
<td>6,000</td>
</tr>
<tr>
<td>New Bloomfield</td>
<td>Callaway</td>
<td>6,000</td>
</tr>
<tr>
<td>Knox City</td>
<td>Knox</td>
<td>10,000</td>
</tr>
<tr>
<td>St. Joseph Inter-State</td>
<td>Buchanan</td>
<td>2,000</td>
</tr>
<tr>
<td>Bolivar</td>
<td>Polk</td>
<td>14,000</td>
</tr>
<tr>
<td>Butler</td>
<td>Bates</td>
<td>5,000</td>
</tr>
<tr>
<td>Troy</td>
<td>Lincoln</td>
<td>5,500</td>
</tr>
<tr>
<td>Trenton</td>
<td>Grundy</td>
<td>1,800</td>
</tr>
<tr>
<td>New Cambria</td>
<td>Macon</td>
<td>5,000</td>
</tr>
<tr>
<td>Montgomery City</td>
<td>Montgomery</td>
<td>8,000</td>
</tr>
<tr>
<td>Sedalia (State Fair)</td>
<td>Pettis</td>
<td>84,762</td>
</tr>
</tbody>
</table>

- Number of county fairs | 9 |
- Attendance of county fairs | 63,300 |
- Attendance at state fairs | 84,762 |
- Total attendance, all fairs | 143,062 |

Orchard Demonstrations

| Spraying demonstrations | 28 |
| Persons participating | 152 |
| Counties reached | 7 |
| Demonstrations receiving second visit | 13 |
| Orchards inspected for disease | 3 |
| Countries in which orchards were inspected | 3 |
| Formal addresses | 2 |
| Attendance at addresses | 216 |
| Pecan orchard topworked | 1 |
| Pruning demonstrations | 3 |
| Counties at pruning demonstrations | 85 |
| Counties in which pruning demonstrations were held | 2 |

Extension Work by Resident Members of the College Staff

Department of Home Economics

| Women doing extension work | 4 |
| Shows judged | 5 |
| Addresses and demonstrations | 24 |
| Home economics credit courses by correspondence | 5 |
| Students in correspondence study | 24 |

Department of Soils

| Men in field | 3 |
| Movable schools attended | 2 |
| Meetings attended | 4 |
| Addresses made | 1100 |
| Attendance at meetings | 1100 |
| Farms visited for purpose of giving advice | 53 |
| Letters written | 2550 |
Addresses delivered at poultry meetings ........................................ 3
Poultry shows judged ................................................................... 12
Counties reached ........................................................................... 12
Letters answered ........................................................................... 1500

Department of Dairy Husbandry (Report of Jackson County Cow Testing Association)

Number of cows completing the first year's test .......................... 185
Average milk production, pounds .............................................. 5407.5
Average butter production, per cent ........................................ 4.71
Average production above feed ................................................. $104.47
Highest individual record
  Pounds of milk ................................................................. 11001
  Pounds of butterfat ........................................................... 430.32
Lowest individual record
  Pounds of milk ................................................................. 1445
  Pounds of butterfat ........................................................... 69.58
Highest production of milk ....................................................... 11780

Miscellaneous Extension Work in Dairying

Meetings attended ....................................................................... 12
Attendance at meetings ............................................................... 1,654
Fairs judged ................................................................................. 3
Classes of dairy cattle judged ..................................................... 25
Silo plans furnished .................................................................... 30
Educational butter scoring for creameries, number of contests ....... 6
Creameries sending samples ......................................................... 22
Counties represented ................................................................. 15
Samples of butter scored and analyzed for salt and moisture ......... 51
Letters written ............................................................................ 4118

Department of Entomology

Lectures to farm clubs on insect control .................................... 13
People attending ......................................................................... 540
Counties reached by lectures ..................................................... 7
Special campaigns on chinch bug, Hessian fly, and army worm control 9
Counties reached by campaigns ................................................ 9

Department of Animal Husbandry

Lectures and Demonstrations

Special meetings ......................................................................... 31
Addresses .................................................................................... 29
Demonstrations .......................................................................... 2
Attendance ................................................................................ 2412
Movable Schools ......................................................................... 1
Addresses .................................................................................... 10
Attendance ................................................................................ 450
Total days required for all meetings .......................................... 25
Men doing work .......................................................................... 5
Counties reached ........................................................................ 12

Fairs Judged

Fairs judged ................................................................................. 56
Days of judging .......................................................................... 145
Counties reached ........................................................................ 41
Attendance ................................................................................ 380,736

1 Includes 17 days judging at five fairs in five counties by the extension representatives of this department.
Cattle exhibited ........................................ 1,076
Swine exhibited ........................................ 1,175
Sheep exhibited ........................................ 416
Horses exhibited ........................................ 3,858
Goats exhibited ........................................ 19
Mules and jacks exhibited ............................ 1,511
All livestock ........................................... 8,046
Classes judged .......................................... 2,432
Average number of animals per class ............. 3
Men judging ............................................. 24

Letters received ........................................ 8,570
Letters written ........................................ 8,166

Men lecturing .......................................... 4
Meetings attended .................................... 18
Counties reached ....................................... 12
Lectures given ......................................... 31
Total days devoted to work ......................... 22
Total attendance of lectures ....................... 2140

Mens acting as judges ................................ 5
Shows judged ........................................... 19
Counties reached ..................................... 15
Samples judged ........................................ 5302
Total days devoted to work ......................... 35
Total value of prizes awarded ...................... $10,194
Total attendance at shows judged ................. 135,700

Men who have visited farms ......................... 1
Farms on which help was given .................... 11
Counties reached ..................................... 6
Total days given to work ............................ 9

Letters written ........................................ 5944
Estimated number of inquiries answered .......... 4000
## FINANCIAL STATEMENT

The Missouri Agricultural Experiment Station, in Account with the United States Appropriation—1914-15.

<table>
<thead>
<tr>
<th>Dr.</th>
<th>Cr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>By salaries</td>
<td>$16,015.80</td>
</tr>
<tr>
<td>By labor</td>
<td>$5,886.10</td>
</tr>
<tr>
<td>Publications</td>
<td>$1,252.63</td>
</tr>
<tr>
<td>Postage and stationery</td>
<td>$349.59</td>
</tr>
<tr>
<td>Freight and express</td>
<td>$215.39</td>
</tr>
<tr>
<td>Heat, Light, Water and Power</td>
<td>$4.85</td>
</tr>
<tr>
<td>Chemical supplies</td>
<td>$742.55</td>
</tr>
<tr>
<td>Seed, plants, and sundry supplies</td>
<td>$418.44</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>$63.16</td>
</tr>
<tr>
<td>Feeding stuffs</td>
<td>$3,173.53</td>
</tr>
<tr>
<td>Tools, machinery, and appliances</td>
<td>$308.38</td>
</tr>
<tr>
<td>Furniture and fixtures</td>
<td>$3.90</td>
</tr>
<tr>
<td>Scientific apparatus and specimens</td>
<td>$881.26</td>
</tr>
<tr>
<td>Live stock</td>
<td>$463.85</td>
</tr>
<tr>
<td>Traveling expenses</td>
<td>$270.48</td>
</tr>
<tr>
<td>Buildings and land</td>
<td>$450.09</td>
</tr>
</tbody>
</table>

$30,000.00 $30,000.00

We, the undersigned, duly appointed auditors of the corporation, do hereby certify that we have examined the books and accounts of the Missouri Agricultural Experiment Station for the fiscal year ended June 30, 1915, that we have found the same well kept and classified as above; and that the receipts for the year from the treasurer of the United States are shown to have been $30,000, and the corresponding disbursements $30,000, for all of which proper vouchers are on file and have been by us examined and found correct.

And we further certify that the expenditures have been solely for the purpose set forth in the acts of Congress approved March 2, 1887, and March 16, 1906.

Attest:

J. G. BABB,
Secretary.

EDWARD E. BROWN,
Business Manager,
Acting as Auditor for the Board of Curators.