

TWENTY-SECOND ANNUAL REPORT

OF THE

Agricultural Experiment Station

OF THE

UNIVERSITY OF TENNESSEE

FOR 1909

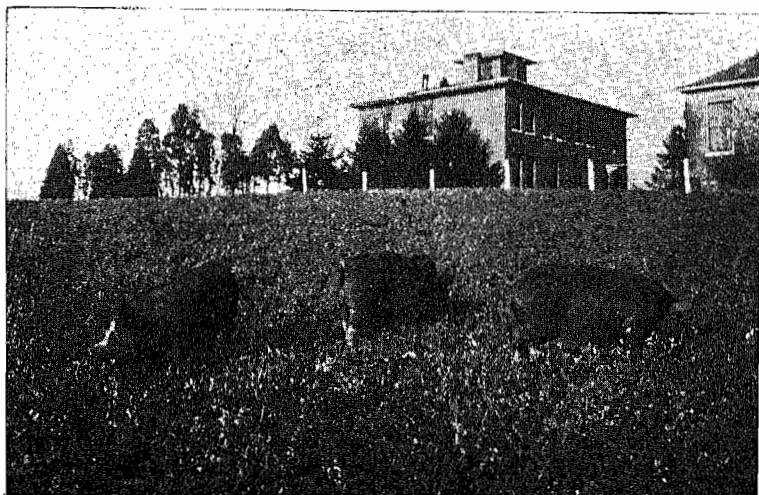


KNOXVILLE

UNIVERSITY OF TENNESSEE PRESS

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HOGS GRAZING ON ALFALFA

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The Agricultural Experiment Station

OF THE UNIVERSITY OF TENNESSEE

BROWN AYRES, President

EXPERIMENT STATION COMMITTEE

BROWN AYRES

HUGH L. ANDERSON

T. F. P. ALLISON

HARRIS BROWN

TREASURER

JAMES MAYNARD

SECRETARY

WM. RULE

STATION OFFICERS

BROWN AYRES, President of the University

H. A. MORGAN, Director, Zoologist and Entomologist

S. M. BAIN, Botanist

C. A. MOOERS, Chemist and Agronomist

C. A. KEFFER, Horticulturist

S. E. BARNES, Field Expert in Dairying, in cooperation with the U. S.
Dept. of Agr.

M. JACOB, Veterinarian

_____, Animal Husbandman

S. H. ESSARY, Assistant Botanist and Mycologist

G. M. BENTLEY, Assistant Zoologist and Entomologist

MAURICE MULVANIA, Assistant Bacteriologist

E. C. COTTON, Assistant Entomologist

F. H. DENNISS, Dairyman

SHERMAN LEAVITT, Soil Chemist

J. F. VOORHEES, Consulting Meteorologist

W. K. HUNTER, Assistant Chemist (Soil Investigations)

W. H. MAYNARD, Assistant Chemist (Fertilizers and Feeds)

W. A. CAMPBELL, Farm Foreman

S. M. SPANGLER, Assistant in Plot Work

J. E. CONVERSE, Assistant in Cooperative Experiments, Crossville

W. N. RUDD, Assistant in Cooperative Experiments, McMinnville

L. R. NEEL, Assistant in Cooperative Experiments, Columbia

S. A. ROBERT, Supt. West Tenn. Exp. Station, Jackson

F. H. BROOME, Librarian and Secretary

MISS RUBY FRANKLIN, Office Assistant

MISS MARGARET COOMES, Stenographer

The Experiment Station building, containing the offices and laboratories, and the plant house and part of the Horticultural Department, are located on the University campus, 15 minutes walk from the Custom House in Knoxville. The experiment farm, the barns, stables, dairy building, etc., are located one mile west of the University, on the Kingston Pike. The fruit farm is adjacent to the Industrial School and is easily reached by the Lonsdale car line. Farmers are cordially invited to visit the buildings and experimental grounds.

Bulletins of this Station will be sent, upon application, free of charge, to any farmer in the State.

LETTER OF TRANSMITTAL

KNOXVILLE, TENN., January 1, 1910.

To His Excellency, Malcolm R. Patterson, Governor of Tennessee:

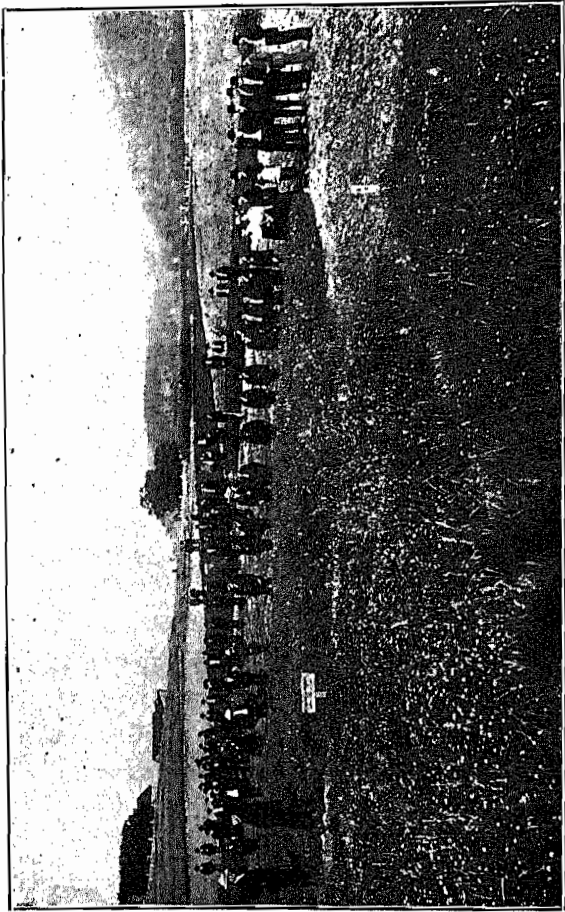
Sir:—I have the honor to transmit herewith, on behalf of the Board of Trustees of the University of Tennessee, a report of the work and expenditures of the Agricultural Experiment Station for the year 1909. This report is submitted in pursuance of the law requiring that the Board having direction of the Experiment Station shall annually submit to the Governor of the State a report of its operations and expenses.

Especial attention is called to that part of the report of the Director relating to the West Tennessee Station. During the year, under the authorization of the Commission, the work was outlined, experimental areas were located and buildings erected; and departments representing agronomy, animal husbandry, dairying, horticulture, and farm management were equipped.

Cooperation with the State Department of Agriculture has continued, and most gratifying progress is being made in all the departments of Station.

Very respectfully,

BROWN AYRES, President.



EAST TENNESSEE FARMERS' CONVENTION DELEGATES AT THE STATION FARM

TWENTY-SECOND ANNUAL REPORT OF THE AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF TENNESSEE FOR 1909

REPORT OF THE DIRECTOR

To President Brown Ayres:

The West Tennessee Station

In the last report announcement was made of the gift by Madison County of a farm for the West Tennessee Agricultural Experiment Station, and the selection, by the Commission appointed under the act establishing such a station, of 180 acres of land adjacent to the city of Jackson. During the year, acting under the authorization of the Commission, the heads of departments of the Experiment Station outlined the work of the West Tennessee Station, selected experimental areas, and erected buildings. Under the efficient superintendency of Prof. F. C. Quereau up to July 1 and Mr. A. T. Anders and Mr. S. A. Robert subsequently, departments representing agronomy, animal husbandry, dairying, horticulture, and farm management were equipped.

The buildings erected were, a large main building; a barn, embracing apartments for dairy and beef cattle experiments; a plot seed barn; a greenhouse; a potting and potato house; six labor cottages; and a 5000-gallon water tank. The location and setting of the buildings conform to an early plan made by Prof. C. A. Keffer. The plan sought facility, the best for the money available, and protection to the experimental interests of the Station.

The site selected for future agronomic investigations is admirably adapted for such work, and with much care the ranges and plots have been surveyed and a season's test of the various crops and systems of fertilization and rotation has been made. A 15-acre orchard of varieties of fruits of all species has been set out and varieties of all the small fruits have been planted. Experiments in systems of orchard management have been outlined and during the next year trucking experiments looking to the betterment and further encouragement of vegetable and truck crops for West Tennessee will be inaugurated.

In connection with the large farm barn two silos were erected, and, from crops grown, these were filled in October. Late in Novem-

ber a comparative feeding test of cotton-seed hulls and silage was begun with 50 head of grade Shorthorn cattle. This experiment is enlisting much interest, as the feeder of dairy and beef cattle in the past depended almost entirely upon hulls as roughage. With the increased price of this product and the absence of experience and knowledge of silage, the problem of economical feeds becomes perplexing. It is believed that these experiments will awaken an interest in crops for the silo and encourage rotations of great value to live stock farming and to the general agricultural interests of this section.

The selections of cotton made by Professor Bain, in cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture, have been placed upon the Station farm. The Trice variety was largely planted last year and was most favorably considered by a number of cotton growers who visited the Station. Considerable seed of this variety was produced and will be distributed among cotton growers another year.

During the coming year the West Tennessee Station will be further equipped and the experimental lines of work very much extended.

The Short Course in Agriculture held in Jackson early in December by the University of Tennessee was most helpful to the Station's interests, since it offered a larger opportunity to present the purposes of the Station to the farmers attending this course from Madison and neighboring counties.

The outlines of the various departments of the Experiment Station are included in this report and indicate the general lines of agricultural investigation and activity embraced by the Station.

Attention is called to the report of the Consulting Meteorologist, Mr. J. F. Voorhees, and to Bulletin No. 87, written by him, on "The Relation of the Weather Service to the Farmers of Tennessee," the character of work presented being practically new to our Station. The data

Climatology collected and the use made of the material have an important bearing upon the interpretation of the results of every department of the

Station. Above all are shown the dangers of general recommendations as to crops, varieties, and rotations without a knowledge of the duration of the growing season and the amount, distribution and type of rainfall. His results in a very great measure account for the differences of opinion arising among experimentalists and farmers as to results of experiments conducted along practically the same lines in different localities, even upon similar soils. These results may account for the variance in behavior of varieties under crop or experimental test of many farm plants.

Cooperative work The cooperative work with the U. S. Department of Agriculture has continued, except in cereal work with the Bureau of Plant Industry. The cooperation of the State Department of Agriculture has been most

generous and helpful. The Station staff has been permitted, through State institutes, to carry the results of their work to the people, and at the division institutes held in Knoxville, Nashville, and Jackson have met representative farmers of practically every county in the State.

Changes in the staff

The following changes have occurred in the Station staff: Mr. F. C. Quereau, Animal Husbandman and Dairyman, and for three months (March to May, inclusive) Acting Superintendent of the West Tennessee Station, resigned July 1 to accept the position of Assistant Director of the Rice Experiment Station at Crowley, Louisiana. Mr. A. T. Anders, of the College of Agriculture, was Acting Superintendent of the West Tennessee Station from June 1 to August 1, on which date Mr. S. A. Robert, formerly agriculturist of the Murray State School of Agriculture, Tishomingo, Oklahoma, became Superintendent.

The Department of Chemistry and Agronomy suffered the loss of a most efficient chemist, Mr. H. H. Hampton, who resigned July 1 to study medicine at the Johns Hopkins University. Mr. Sherman Leavitt, of the Bureau of Chemistry, U. S. Department of Agriculture, was secured, September 1, as the successor to Mr. Hampton, and he came well recommended for the position. Another change in this Department was occasioned by the resignation on April 1 of Mr. W. E. Grainger, Fertilizer and Food Chemist, who had done highly satisfactory work in connection with the analysis of fertilizers for the State Inspection. Mr. Grainger resigned to take a promising commercial position. The Station was fortunate in securing for this work, on June 10, Mr. W. H. Maynard, a graduate of the South Carolina State Agricultural College, at Clemson College, who had in addition enjoyed a year's experience as an assistant to Dr. Wait, Professor of Chemistry of the University of Tennessee. An additional analytical chemist was fortunately secured on April 1, in the person of Mr. W. K. Hunter, a graduate of the University of Tennessee, of the class of 1898, and a well-trained and experienced man in this line of work.

On May 1 Mr. L. R. Neel was appointed to the position in Middle Tennessee formerly occupied by Mr. Hite, that of assistant in cooperative experiments, with headquarters at Columbia, Maury County. Mr. Neel was graduated from the University, in the Agricultural Department, in the class of 1908, and the following session was appointed a fellow in agriculture.

Need of larger State appropriations

Larger State appropriations for agricultural investigation and equipment are essential. The present funds—Hatch and Adams, and State funds for cooperative experiments in Middle Tennessee and for the West Tennessee Agricultural Experiment Station—are restricted by the acts making the appropriations and must be

used as outlined. This condition limits the usefulness of the Station, even prohibiting the testing within Tennessee of valuable results secured elsewhere, and the dissemination of agricultural facts well known to the Experiment Station and little known to the farmers of the State. Of the 225,000 farmers in Tennessee, not more than 10,000 receive the bulletins because of insufficient funds to publish larger editions. Many practical lines of investigation suggested by the correspondence of the Station await appropriations. Large interests, such as the dairy, beef, sheep, hogs, poultry, truck, and fruit, are demanding information that the Station is in no position to acquire. The need of relief in this direction is urgent.

Respectfully submitted,
H. A. MORGAN, Director.

REPORT OF THE BOTANIST

During the past year the work of the Botanical Department has been directed along the same general lines as in the previous year. Considerable time has been spent in perfecting the general laboratory equipment, and a number of minor improvements have been made in this direction, and new apparatus has been added to the equipment.

Weed seeds Especial mention should be made of a collection of seeds of weeds and native plants which was made during the year. Some attention has also been given to seed testing in cooperation with the State Commissioner of Agriculture in order to assist in excluding serious weeds from certain cultivated crops in Tennessee covered by the newly enacted Seed Law. Especial mention should be made of the prevalence of dodder in the clover fields of the State.

Plant diseases In connection with general correspondence, travel over the State, and in other ways, the Botanical Department endeavors to keep track of the serious plant diseases each year. The Assistant Botanist, Mr. Essary, has compiled a list of such diseases known to occur during 1909, and it is given below:

PLANT DISEASES REPORTED IN THE STATE DURING 1909

- Alfalfa Leaf Spot, *Pseudopeziza medicaginis*.
- Alfalfa Root Rot, *Rhizoctonia* sp.?
- Apple Bitter Rot, *Glomerella rufomaculans*.
- Apple Black Rot, *Sphaeropsis malorum*.
- Apple Leaf Rust, *Gymnosporangium macropus*.
- Apple Scab, *Venturia pomi*.
- Apple Twig Blight, *Bacillus amylovorus*.
- Bean Anthracnose, *Colletotrichum lindemuthianum*.
- Bluegrass Rust, *Puccinia graminis*.
- Cherry Leaf Spot, *Cylindrosporium padi*.

Clover Anthracnose, *Colletotrichum trifolii*.
 Corn Smut, *Ustilago zeae*.
 Corn Wilt, Unknown bacterial disease (Middle Tennessee).
 Ginseng Wilt, *Alternaria panax*.
 Grape Black Rot, *Guignardia bidwellii*.
 Oat Rust, *Puccinia* sp.
 Oat Smut, *Ustilago avenae*.
 Peach Brown Rot, *Sclerotinia fructigena*.
 Peach Leaf Curl, *Exoascus deformans*.
 Pear Blight, *Bacillus amylovorus*.
 Plum Black Knot, *Plowrightia morbosa*.
 Plum Pockets, *Exoascus pruni*.
 Potato Blight, *Phytophthora infestans*.
 Potato Scab, *Oospora scabies*.
 Rose Leaf Mildew, *Sphaerotheca pannosa*.
 Soy Bean, Unknown disease, *Fusarium* sp.?
 Wheat Root Rot, Unknown disease.
 Wheat Rust, *Puccinia graminis*.
 Wheat Scab, *Fusarium roseum*?
 Wheat Smut, loose, *Ustilago tritici*.

Resistant clover

Much time has been devoted to the propagation of the Tennessee Resistant clover. The field tests in several sections well distributed over the State were eminently satisfactory during the past year, though the seed crop did not turn out very well on account of the unfavorable season. It is hoped, however, to have about 75 acres growing during the season of 1910, most of which should produce a crop of seed.

Cotton breeding

The cotton breeding experiments, in cooperation with the Bureau of Plant Industry, were moved to the West Tennessee Experiment Station, at Jackson, in the spring of 1909, and will in the future be conducted there. Several important lines of breeding and selection for the improvement of cottons are being followed. Publications on the results so far obtained are to be issued in the near future.

Clover disease

Studies on the life-history of the fungus causing the anthracnose of clover have been continued during the past year.

Soil biology

The work in soil biology, by Mr. Maurice Mulvanian, has been conducted along the lines of the general projects as originally outlined.

Two divisions of the subject are now under way; one being the determination of the effect of different species of bacteria upon the accumulation of humus in the soil, and the other the growth of higher plants under absolute bacterial control. The experimental methods are now practically worked out, and some preliminary tests have

been made. Considerable time has been consumed in getting together the necessary equipment for this work, and many serious difficulties were encountered, but in the main they have been solved and some definite results should be secured within the next few months.

Attention may again be called to the urgent need of a greenhouse for experimental work in this Department.

Respectfully submitted,

SAMUEL M. BAIN, Botanist.

REPORT OF THE CHEMIST AND AGRONOMIST

AGRONOMY

The field work of the Department of Agronomy may be divided with reference to location of experiments into three sections, as follows:

(1) That at the Experiment Station at Knoxville; (2) the Middle Tennessee cooperative experiments conducted in several counties of the middle division of the State; (3) the West Tennessee Experiment Station work at Jackson. At all these places variety trials of corn, wheat, oats, soy beans, etc., were made during the past season; also fertilizer, liming, and manure experiments.

With the exception of work necessarily just begun at Jackson, the majority of these experiments are continuations of those commenced in 1905, 1906, and 1907, and are increasing in value with each additional year's results. Lime proves to be of fundamental importance on the majority of soils, and by its use not only increased yields of legumes are obtained, but also of corn and wheat. The general recommendation as first made, that one ton of burnt lime or two tons of ground limestone to the acre be applied once in six or eight years, is apparently ample under average conditions. At the Jackson Station the effect of lime on soy beans and cowpeas was unusual, the crops being practically doubled. Soil and fertilizer problems continue to be of first importance, both on account of the demand of the agricultural interests of the State and the large number and wide divergence in plant food requirements of the soil types.

The improvement of some of the common cereal crops by selection and breeding has progressed far enough to warrant further mention.

The main objects in view have been: (1) the increase of grain production with regard to different kinds of soil, chiefly those differing in fertility; (2) increased hardiness in case of winter oats and of winter beardless barley; (3) earliness with respect to winter oats. To accomplish these purposes, individual plant selections have been made from the best three varieties of wheat and from one variety each of winter oats and beardless barley; the method of cross breeding has been utilized in order to get a hardy

winter beardless barley, and both crossing and individual plant selection have been used in the case of one variety of corn. The result of this work has been to obtain two desirable strains of Poole wheat, a desirable strain of Culberson oats, and an improved strain of Hickory King corn.

Improvement of other crops

In addition to the breeding work with cereals, attention is being given to the improvement of at least two other crops, tall oat grass and soy beans. The great interest in the soy bean

throughout the State amply justifies an extra effort in this direction. Tall oat grass, which seems to be well suited to our climate and soil, both as a hay and a pasture grass, and may also be grown for seed, which is at present practically all imported, can without doubt be separated into a number of strains, some of which can hardly fail to result in an improvement over that which is being grown at present. This grass can be recommended as hardier than orchard grass, and as a heavy producer of a nutritious hay, combined with great possibilities for pasture purposes. It may be sown either in the fall (September) or in the spring. The number of varieties of soy beans tested has been greatly increased. This was made possible through the cooperation of the Bureau of Plant Industry, U. S. Department of Agriculture. Date-of-planting trials with some sixteen varieties were made during the past season. The latter test is necessary in order to learn the adaptability of any variety not only to our climatic conditions but also to the systems of agriculture commonly practiced. Effort is now being made to improve some of the most promising sorts by individual plant selection. Date-of-planting trials with several other crops have been made with profitable results.

Crops worthy of trial

For hay purposes a mixture of red clover and Culberson oats sown last August has proved very promising and can be recommended for trial throughout the State. In the cooler parts

of the State a mixture of buckwheat and crimson clover sown in July has also proved successful, the crimson clover making excellent hay in the spring after the buckwheat, which is harvested for grain in the fall.

Publications

Bulletin No. 86, under the title of "Experiments with Soils, Fertilizers, and Farm Crops," was published in April, and gives the results

of the first two years of the cooperative work of this Department in Middle Tennessee. Ample data are on hand for several bulletins and their publication at an early date is considered desirable.

At the West Tennessee Station

The opportunities afforded at the West Tennessee Station, at Jackson, for field experiments are superior to those under our control elsewhere. The soils are typical for that part

of the State, are practically unmodified by previous manuring, and lie well for experimental purposes. The results obtained the first season were all that could be expected. Variety trials were made of various farm crops, such as corn, cotton, soy beans, and oats. Fertilizer and liming experiments were also made with satisfactory results. Lime and nitrate of soda gave marked increases in yields of all the crops tested. A special series of experimental crop rotations has been inaugurated, and includes not only a comparison of different rotations but also the effect of manuring and a comparison of various phosphates. Such a series as this requires several years for the accumulation of data before conclusions can be drawn, but the fundamental importance of the problems is considered to justify the outlay and time required.

In addition to variety trials, rates, dates, and methods of seeding were tested for several crops. Trice cotton, Hickory King corn, Mammoth Yellow soy beans, and the Kherson spring oat, which is very popular in the West, proved very promising.

CHEMISTRY

Investigation work, etc.

The chemical work of the Station is being pursued in cooperation with the work in agronomy. The humus investigations, a project under the Adams fund, are progressing satisfactorily. Four typical soils are being studied, both by means of cylinders sunk four feet into the ground, and by cans which permit the drainage water under several different conditions of both depth of soil and manurial treatment to be collected. Pot experiments are also included, and the whole is supplemented by chemical investigations in the laboratory.

The main purpose of this undertaking is to determine the influence of certain chemical and physical factors in humus formation. In addition to the humus study, minor investigations have been made with reference to: (1) the effect of manure on the solubility of finely ground rock phosphate; (2) the composition of the soy bean plant at different stages of growth; and (3) the acidity of typical Tennessee soils.

Miscellaneous

In addition to the foregoing there has been miscellaneous work, such as the analysis of soils, feeding stuffs, and especially limestones, due to recent interest in the use of ground limestone rock. The chemical analysis of these samples has done much to weed out those of low or inferior grade.

Respectfully submitted,

CHARLES A. MOOERS, Chemist and Agronomist.

REPORT OF THE DAIRYMAN

Feeding experiment Feeding experiments with the dairy herd were conducted throughout the months of January, February, and March. Home-grown feed stuffs were compared with commercial feed stuffs with reference to efficiency and economy of production; also different home-grown rations were compared one with another; while special attention was given to increased palatability of the rations during these three months of experimental feeding. The work as a whole should be repeated before the results appear in bulletin form. A few conclusions, however, stand out preeminently. They are as follows:

1. Home-grown rations are just as efficient as commercial rations, and more economical. The secret of successful dairying in Tennessee is to reduce the cost of production by feeding these home-grown rations.

2. Soy-bean meal is equal to cotton-seed meal for milk production and is cheaper, while the bean stover is more relished by stock than corn stover.

3. Palatability will improve the efficiency of any roughage ration by increasing the digestibility of the components of the ration and stimulating the appetite for greater consumption. This desired feature in feeding was secured by mixing the cut stover, hay, and straw with corn and sorghum silage in alternate layers and sprinkling each layer of the dry roughage with salt and water and allowing the whole to stand twelve hours before feeding.

Comparison of 1908 and 1909

The herd of 30 cows for 1909 shows considerable improvement over 1908 in milk and butter-fat production and profits. The average cost of keeping each cow was \$5.66 greater than for 1908. This was due to the fact that they were rather more liberally fed on grain, and consumed more roughage as a result of palatable rations. The average increased production for each cow over 1908 was 375.2 pounds of milk and 23.14 pounds of butter fat, equivalent to 26.99 pounds of butter. The average increased profit for milk for each cow was \$4.72 and for butter \$11.01. The greater average increase for butter is due to the fact that the milk for 1909 was slightly richer in fat than that for 1908 and the butter was valued at 30 cents per pound instead of 25 cents.

Records

greatly reduced.

The dairy records have been somewhat simplified and measurably condensed, and the work necessary to keep them up consequently

Milking machine

The use of the milking machine was discontinued temporarily awaiting the installation of recent improvements.

Respectfully submitted,

F. H. DENNISS, Dairyman.

REPORT OF THE FIELD EXPERT IN DAIRYING

The field work in dairying during the year 1909 has been directed chiefly toward the improvement of dairy herds by means of records and more economical feeding.

Herd records Thirty-two dairymen have been induced to keep records of their herds, and record blanks have been furnished them for this purpose. Some of these men have kept the record work up for an entire year, and report that they have derived great benefit from it. In every case they have been willing to cull at least one-third of their cows, and have found some individuals that are much more valuable than they thought. Many of the dairymen are purchasing pure-bred bulls and are beginning to raise the heifer calves from their best cows, which is a move in the right direction.

Meetings and short courses Many meetings for dairymen have been held, at which instruction has been given in barn and silo building, rotation of crops, and proper feeding. Short courses for farmers in different sections of the State, held by the State Department of Agriculture and the University of Tennessee, have been attended, and considerable interest in dairying has thus been aroused.

Rented farms A large number of the dairymen in the State are operating on rented farms, and it is difficult to persuade them to grow their own feed, or build silos and make other up-to-date improvements. Gradually, however, as a result of instruction, they are becoming convinced that it would be more economical to move farther out and buy even small places on which they could use the manure and grow at least a part of their feed.

Tennessee Dairy Association The Tennessee Dairy Association has been making good progress during the year, and now has over 100 members. It is hoped that this Association will eventually become an important educational agency. It has been instrumental in organizing county associations, has promoted the exchange of pure-bred bulls among its members, and has induced about 150 dairymen in the State to subscribe for dairy papers.

The field work in dairying is creating much interest, but much more good could be done with increased funds and facilities.

Respectfully submitted,

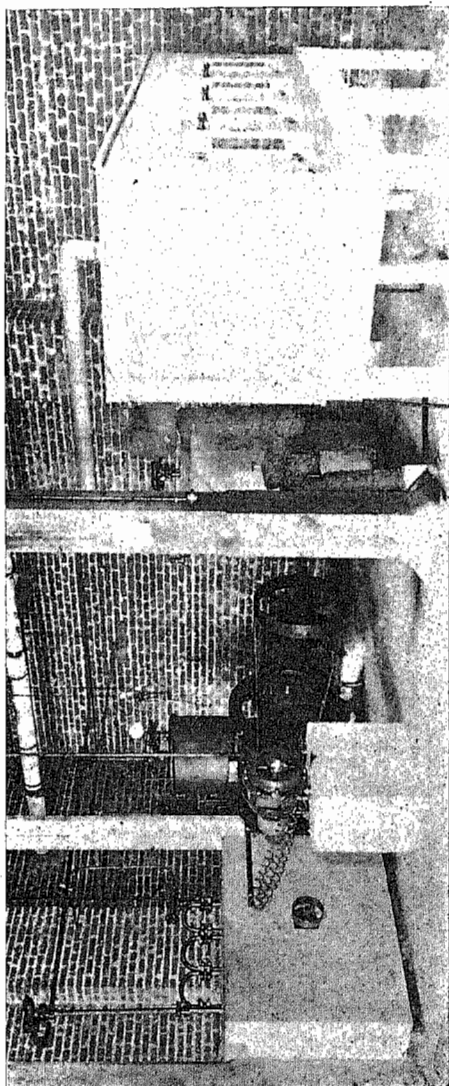
S. E. BARNES, Field Expert in Dairying.

REPORT OF THE ENTOMOLOGIST

The field work in entomology and the nursery inspection are in charge of Mr. G. M. Bentley, and the experimental work is in charge of Mr. E. C. Cotton. Their reports follow:

FIELD WORK AND NURSERY INSPECTION

- Classification** The field work in entomology may be classified under five heads: Correspondence; investigation of injurious insects; spraying demonstrations; the fever tick; and the collection of insects.
- Correspondence** The correspondence has consisted in the answering of letters relative to insect attacks upon fruits, vegetables, and other crops, and the prescribing of remedies. The people of the State are gradually learning that the Station is the proper source of information on these subjects. The correspondence is steadily increasing, and is the means not only of disseminating information but of collecting data as to the distribution of crop and fruit pests throughout the State. Through county correspondents this Department is kept in touch with insect conditions in each county in the State.
- Injurious insects** Numerous injurious insects have been studied. During the latter part of August and the month of September many orchards in Middle Tennessee were examined with reference to the peach tree borer. This work has added to the information already gathered upon the life-history of this insect, and the study of this form will be continued during the spring and summer months of the coming year.
- Spraying demonstrations** The spraying demonstrations consisted in the making and applying of the lime-sulphur solution. These were practical orchard demonstrations. The places where demonstrations were given, the dates, and the number of persons in attendance were as follows: Feb. 2 and 3, Santa Fe, 15; Feb. 4, Columbia, 17; Feb. 5, Franklin, 4; Feb. 7, Clarksville, 23; Mar. 23, Pleasant Hill, 48. Discussions were given at these meetings on the subject of spraying apparatus. A barrel sprayer and various kinds of nozzles were exhibited.
- The fever tick** Some time has been devoted to the interpreting of data already collected from experiments, and the arranging of same for reference and for tabulation, for the purpose of indicating practical applications.
- Collection of insects** A collection of insects is being made, with the object in view of getting a good representation of the insect fauna of the State to use for reference in identifying new material.
- Nursery inspection** The number of nurseries inspected is 251, an increase of 6 over the number inspected last year, and representing a large increase in acreage. The inspections are bringing about improved conditions, which are shown by the attention given to cultivation and the arranging of stock. During February and March six different centers in the State



LOW-TEMPERATURE APPARATUS

were visited for the purpose of inspecting foreign nursery stock for winter nests and egg masses of the brown-tail and gypsy moths. These inspections resulted in the finding of several winter nests of brown-tail moth—fewer, however, than were found the previous year.

Respectfully submitted,

G. M. BENTLEY, Assistant Entomologist.

EXPERIMENTAL ENTOMOLOGY

Fever tick investigations

The work in experimental entomology has been in the main a continuation of the experiments under way during 1908; the life-history studies of the fever tick claiming the larger share of attention. The outdoor incubation and seed-tick longevity tests were continued and some valuable results were obtained, confirming in a large measure previous conclusions.

The pathogenicity tests were also continued; the lone star tick (*Amblyomma americanum*) and the cayenne tick (*Amblyomma cajennense*) being the species studied.

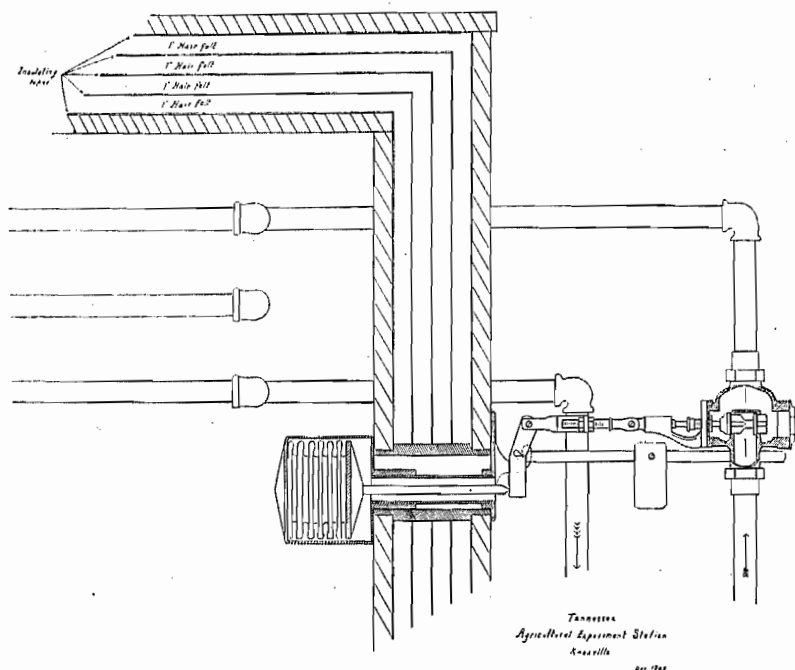
Constant low- temperature apparatus

During the latter part of the year the refrigerating plant, constructed for studying ticks and insects under constant low temperatures, was completed. From the use of this apparatus we expect to secure some valuable results in the study of the fundamental problems of tick life. The plant is located in the sub-basement of Morrill Hall, and consists of a compressor of 2 tons refrigerating capacity, an electric motor, a brine tank of 200 gallons capacity containing the expansion coils, a brine pump, and an insulated box containing four chambers, each supplied with cooling coils.

The compressor is a two-cylinder machine using CO₂ gas and operated at 70 and 30 atmospheres, respectively, on the high and low-pressure sides of the cylinders. The motor is 7 1-2 horse power, its capacity being 1 rated horse power above that required to operate the compressor.

The brine system consists of a brine tank of about 200 gallons capacity constructed of 3-16-inch boiler plate and contains 200 lineal feet of 1-inch expansion coils; an automatic pump connected to the city water service, which furnishes pressure to the brine coils; and coils of 1-inch pipe in the various chambers with the necessary connecting pipes. The entire brine system, with the exception of the coils in the chambers, is thoroughly insulated by wrapping with two thicknesses of 1-inch hair felt with one layer of waterproof insulating paper between.

The chambers in which it is desired to maintain constant temperatures are four in number, each 2 feet square inside. Each chamber is supplied with a set of cooling coils of 1-inch pipe, the absorbing sur-



SECTION THROUGH WALL OF COOL CHAMBER OF LOW-TEMPERATURE APPARATUS, SHOWING THERMO-REGULATOR AND BALANCED VALVE AND CONNECTIONS

face of which was so calculated as easily to maintain the desired temperature and allow a liberal margin. These temperatures are 60 degrees, 50 degrees, 43 degrees, and 32 degrees Fahrenheit, respectively. The chambers were constructed with an outer and an inner wall of 7-8 inch matched pine ceiling with four thicknesses of 1-inch hair felt and five layers of waterproof insulating paper between. In one side of each chamber is a door 15 x 15 inches in the clear, in the center of which is a window containing six panes of 8 x 10-inch glass with air spaces between.

The flow of brine through the coils of each chamber is controlled by a balanced valve operated by a thermo-regulator located within the chamber.

The thermo-regulator used is manufactured by a local firm and is based upon the principle of the expansion of gases under the influence of heat. It is simple, powerful, reliable and extremely sensitive.

Peach tree borer Field observations on the peach tree borer were continued and tests of several remedial measures were made in the young experimental orchard. These tests were designed to be continued through a series of years.

Respectfully submitted,

E. C. COTTON, Assistant Entomologist.

The foregoing reports of Mr. Bentley and Mr. Cotton constitute the report of the Entomologist.

Respectfully submitted,

H. A. MORGAN, Entomologist.

REPORT OF THE HORTICULTURIST

Extension short courses and institutes

The Horticulturist assisted in short courses of a week each at Winchester and Dickson in December, 1909. He also assisted in meetings arranged along the line of the M. & O. R. R., in West Tennessee and at the Division farmers' institutes at Jackson, Nashville, and Knoxville. He served as superintendent of the Horticultural Department of the State Fair in Nashville in September.

Protection from frost

The principal experiments of the year were along lines of orchard protection. By means of coal fires 38 x 40 feet apart throughout the orchard the temperature was raised 4 degrees to 6 degrees higher than the thermometer registered outside the orchard. Fires were lighted March 14 and 15.

Spraying

In the peach-spraying experiments of the year, self-boiled lime-sulphur solution was found to be a more valuable fungicide than dilute Bordeaux mixture. The latter remedy does not prevent peach scab, the former reduces it to a negligible quantity. Self-boiled lime-sulphur is more effective than Bordeaux mixture as a remedy for peach rot. Arsenate of lead added to the first spraying, at the rate of 2 pounds per barrel of solution, greatly reduced the loss from curculio. A bulletin will soon appear on the spraying of peaches.

Stocks resistant to woolly aphis

5000 grafts of Northern Spy and Kinnard's Choice were grown, and during the winter were examined for woolly aphis. The Northern Spy was quite free—only a small per cent of the trees showing the insect. Kinnard's Choice, while less infested than many varieties of apple, is too susceptible to be used as a stock for other varieties. Compared with grafts of the Reasor seedlings (propagated in 1908) it is relatively free. In the spring an orchard of over 300 trees was planted to Northern Spy, to be top-grafted to commercial Tennessee varieties to test the immunity of this variety

as a stock. If the aphids can be overcome by top-grafting on resistant stock it will be a great gain to apple orcharding in this State.

At the West Tennessee Station

An experiment orchard of 15 acres was set at the West Tennessee Station in the spring, with cotton as a culture crop. The leading commercial apples, mostly early summer varieties, were planted in sufficient number to admit of extensive experiments in culture and protection. A small orchard of peaches, cherries, plums, pears, and quinces, and a representative collection of grapes and the various small fruits was also planted at this Station.

Respectfully submitted,

CHARLES A. KEFFER, Horticulturist.

REPORT OF THE CONSULTING METEOROLOGIST

Relation of weather to crop production

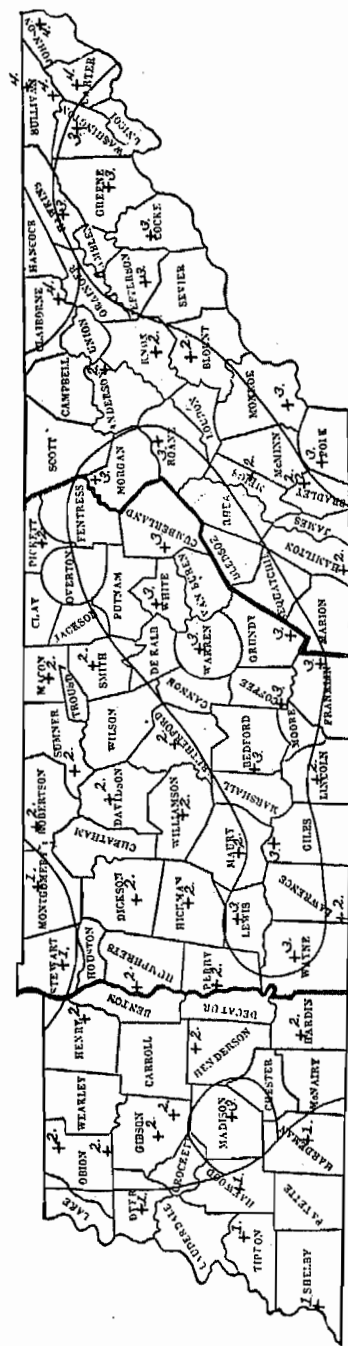
A study has been made of the temperature and rainfall conditions of the State with reference to crop production and results have been published in Bulletin No. 87, entitled "The Relation of the Weather Service to the Farmers of Tennessee." The data used were obtained from the records of the United States Weather Bureau. An effort was made to show the farmer that he must study the climate of his locality as shown by records covering long periods before he can plan his rotations or choose his crops to the best advantage. A study of the rainfall over the State for 1909 strongly enforces this point, as shown by the accompanying charts.

Types of rainfall

The first chart shows the State divided into areas having different types or a different distribution of rainfall through the year. These areas are numbered 1, 2, 3, and 4. The second chart gives four diagrams representing the four types of rainfall distribution by a solid line and the rainfall for 1909 by a broken line. While every year will show more or less variation from the type, the variation in 1909 was very unusual. From February to June, inclusive, it was unusually wet at most stations and planting, haying and harvesting operations were seriously hindered. From August to December it was unusually dry and again the plans of the farmer were interfered with. Those who were using the double-crop system found it difficult under the circumstances to get a stand of their fall-sown crops.

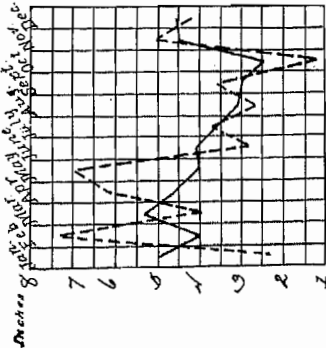
Unusual rainfall

Many farmers will be inclined because of this one difficulty to abandon the double-crop system. This will be especially true of those who tried it for the first time this year. Now is the time for the discouraged farmer to study his weather records. For example, if he is in the vicinity of Knoxville he will find that the period from April 1 to July 31, 1909, was, with one exception, wetter than the same period had been in 39 years. The period from August 1, 1909, to March

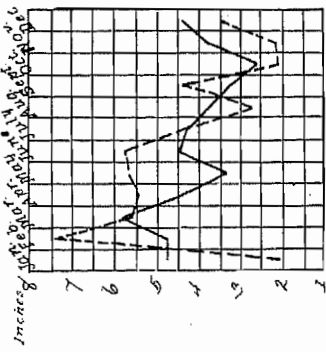


AREAS COVERED BY DIFFERENT TYPES OF RAINFALL IN TENNESSEE

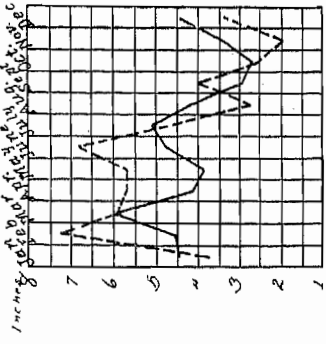
1. Clarksville Type.



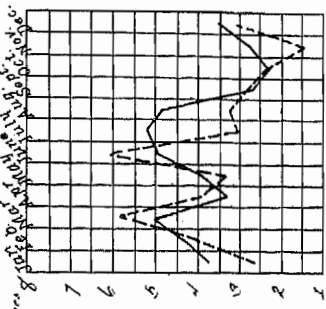
2. Nashville Type



3 McMinnville Type.



4. Bristol Type.

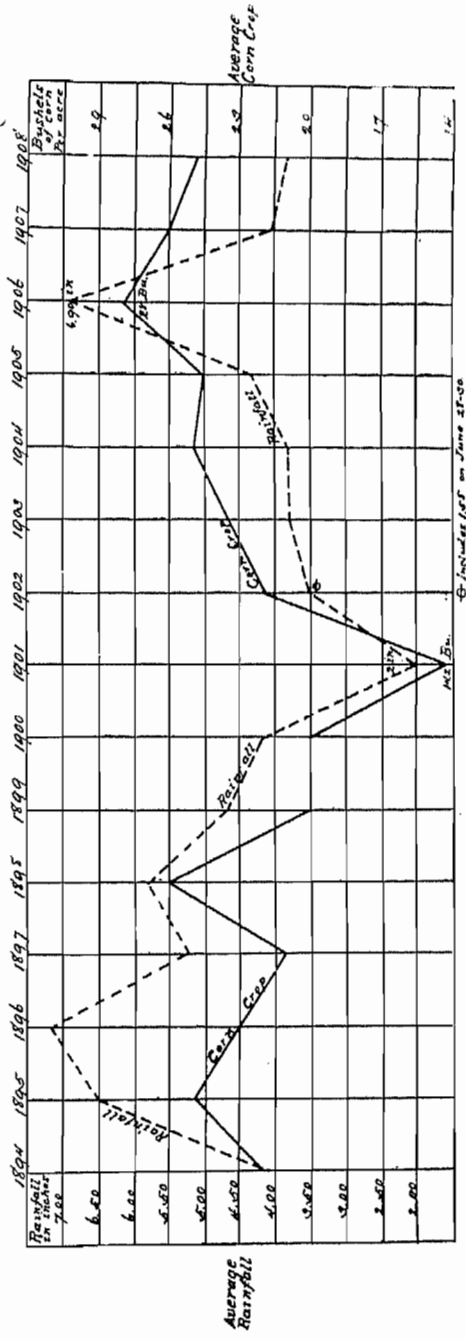


COMPARISON OF TYPES OF RAINFALL (SOLID LINE) WITH RAINFALL FOR 1909 (BROKEN LINE)

31, 1910, was the dryest for 39 years. He will find two extremes occurring in one twelve months, a combination that is not likely to occur again in an ordinary lifetime. He will find very similar conditions at almost every point in the State. But even with these extreme adverse conditions all did not fail, and surely under ordinary, or average, conditions the majority should succeed.

Relation between July rainfall and corn crop

In the course of the study of the climate of Tennessee in its relation to crop production a great many diagrams have been made, and among them is one which is worthy of careful study because it illustrates most strikingly a truth that all farmers will appreciate. The third chart was drawn to show the relation between the July rainfall and the corn crop. The numbers at the top of this chart represent the years 1894 to 1908, the records of which were used in this study. The broken line represents the rainfall for the State for the month of July in each year, as shown by the figures at the left of the chart and at points along the line. These amounts were obtained by taking the average of the rainfall recorded at about sixty Weather Bureau stations distributed through this State. To find the amount of rainfall for, say, the year 1900, we run down the column headed "1900" till we come to the broken line. From this point we run out to the figures on the lefthand margin and we find that we are about half way between the lines representing 4 inches and 4 1-2 inches of rainfall. We have found, then, that the July rainfall for 1900 was about 4 1-4 inches. In the same way we can find the July rainfall for any year. The solid line represents in the same way the corn crop for the State for each year in bushels per acre, as shown by the figures on the right-hand margin. These amounts were taken from the Yearbook of the U. S. Department of Agriculture. Comparing these two lines we find a very close agreement between them. In the years when July was dry the corn crop was small, while in the years in which July was wet the crop was larger. These lines do not agree in every case because temperature and other conditions also have an effect on the crop, but the agreement is close enough to show that the July rainfall is the most important factor in determining the annual yield of corn per acre for the State. The rainfall for the other months shows no such relation to the corn crop. They may be either very wet or very dry and influence the crop little or not at all. The great influence of the July rainfall is due to the fact that this is the time of tasselling and starting of the grain and an abundance of moisture is necessary at this time to produce large yields.



RELATION BETWEEN JULY RAINFALL AND CORN CROP

Climate of Tennessee favorable for corn

While Tennessee is often looked upon as outside of the corn belt, and the average yield per acre is very low, the climatic conditions are most favorable for corn production. During the six months from March to August, inclusive, Tennessee has more rainfall than any of the great corn-growing states, and it is just as evenly distributed. The growing season is longer than in any of the states further north and the experience of our best farmers proves that with the best methods of farming just as many bushels of corn can be produced on an acre in Tennessee as anywhere else in the country, if not more.

Conservation of moisture

But while conditions are so favorable on the whole, our crop is sometimes cut down by a dry July, as shown by our diagram. Our problem now is to overcome this obstacle. We can not control the rainfall, and in Tennessee very few of us can irrigate, but we can conserve the moisture of the earlier months. If, by filling our soils with vegetable matter (green-manure crops or stable manure), by preparing a deep seed-bed, and by thorough cultivation, we can hold the moisture of the preceding months in the soil until it is needed in July, we can tide over these droughts at tassel-time and produce a good crop in spite of them. This is no idle fancy of a book farmer, but a practical thing that is being done every year by our most practical and most successful farmers. If a few can do this all can do it and by so doing we will not only increase our corn crop in bad years but will increase it in good years also. Not only will we carry our State from near the bottom to near the top of the list of corn-growing states, where Nature intended she should be, but we will increase the yield of all our crops and will double and treble the value of our farms.

Application of results

Investigation has been begun on the relation between weather conditions and the growth of soy beans and other crops, and it is believed that with the additional data that can be obtained in 1910 a scheme may be completed that will assist materially in the application of the results of experiments at the Station to the needs of farmers at other points having different climatic conditions.

Respectfully submitted,

J. F. VOORHEES, Consulting Meteorologist.

REPORT OF THE VETERINARIAN

Increasing usefulness

While the usefulness of the Veterinary Department has been shown this year more than in any previous year, the need of larger financial support has been more than ever apparent, since many requests for assistance could not be granted owing to inadequate facilities.

Hog cholera

As last year, some hog-cholera immunizing serum has been made, and its value in controlling hog cholera has been demonstrated in several herds where this disease appeared. The efficiency of the serum is demonstrated by the following instances of its use:

We took 2 susceptible pigs and immunized them by the serum-simultaneous method. That same day they were sent five miles from the Experiment Station to a farm on which a severe outbreak of hog cholera existed. These 2 immunized pigs were placed in a small pen which contained 9 pigs that were all affected with a most severe attack of cholera. The result was that 7 of the sick pigs died, the other 2 gradually recovered but remained unthrifty for several months, and the 2 vaccinated pigs never lost a meal and continued to fatten even though they were fed and housed with the sick pigs. They have been on that farm now about ten months and are still in fine condition.

Hog cholera appeared on another farm about ten miles from the Experiment Station. This herd was divided and kept in four different lots. One lot in which cholera first appeared contained 85 hogs. Of these, 45 died. In this lot none were vaccinated. Another lot contained 22 pigs. These were all vaccinated by the serum-alone method and immediately placed in the same lot that contained the sick pigs. Of these 22 vaccinated pigs 2 died, and they were showing symptoms of the disease when vaccinated. Another lot contained 14 pigs. These were all vaccinated by the serum-alone method, and none died.

Another lot contained 1 sow and 5 pigs. The sow was vaccinated by the serum-alone method and the 5 pigs were not vaccinated. The sow remained well and the 5 pigs died.

Other and similar good results were obtained from the use of this serum. There has been a constant demand for the serum from all parts of the State, but it could not be supplied, for our limited means prevented the production of a large supply. The State Legislature should by all means make an appropriation of at least \$10,000 for the production of hog-cholera serum and thereby to a great extent check the disease that is producing an annual loss of \$500,000 to the swine industry of Tennessee.

Correspondence

The correspondence in this Department is becoming heavier each year, as citizens throughout the State, especially in the rural districts, are availing themselves of the opportunity to obtain advice as to disease conditions among live stock.

Need of support

Advance work in veterinary science with our present facilities is almost out of the question, and the need of more liberal support is again urged.

Respectfully submitted,

M. JACOB, Veterinarian.

REPORT OF THE LIBRARIAN

The following is a statement of the number of books and periodical publications belonging to the agricultural library :

Bound volumes	3,999
Accessions during 1909	154
Purchased	33
Obtained by exchange and gift	108
Bound by the Station	13
Volumes complete, ready for binding	161
Journals subscribed for	24
Agricultural papers received in exchange for bulletins	110

There are on file a large number of bulletins, reports, and circulars of the U. S. Department of Agriculture and other experiment stations and of miscellaneous pamphlets.

The bulletin mailing list contains 12,602 names, distributed as follows :

MAILING LIST

U. S. Dept. of Agr. and experiment stations	1,983
Tennessee newspapers	228
Exchanges	174
Individuals in Tennessee	9,908
Other States	297
Foreign, not including foreign exchanges	12
	12,602

In addition to the regular list, there are special lists of dairymen, orchardists, and others, to whom bulletins on their respective subjects are mailed.

Respectfully submitted,

F. H. BROOME, Librarian.

TREASURER'S REPORT

HATCH FUND

JULY 1, 1908, to JUNE 30, 1909.

The Agricultural Experiment Station of the University of Tennessee

IN ACCOUNT WITH THE UNITED STATES

	<i>Dr.</i>	<i>Cr.</i>
To Unexpended balance on hand July 1st	\$ 18.34	
To United States Treasury Draft July 16, 1908	3,750.00	
" " " " October 9, 1908	3,750 00	
" " " " January 11, 1909	3,750 00	
" " " " April 10, 1909.....	3,750.00	
By Salaries		\$8,364.99
Labor		2,557.77
Publications		1,143.64
Postage and Stationery		323 61
Freight and Express		99.36
Heat, Light and Water.....		300 12
Chemical Supplies		139.50
Seeds, Plants and Sundry Supplies		161.00
Fertilizers		180 68
Feeding Stuffs		664 10
Library		253.58
Tools, Implements and Machinery		114.11
Furniture and Fixtures		236.24
Scientific Apparatus		79.35
Traveling Expenses		129.30
Contingent Expenses		15 00
Building and Repairs		237.65
Balance		18.34
Totals	\$15,018.34	\$15,018.34

This is to certify, that, as the authorized Auditing Committee of the Board of Trustees of the University of Tennessee, we have examined the accounts of the Treasurer of the Agricultural Experiment Station for the fiscal year ending June 30, 1909, and find them correct; that the above is a true balance sheet corresponding with said accounts; that the said accounts show no more than \$237 65 was expended for building and repairs; and that there is \$18.34 cash balance.

HU L. McCLUNG,
BROWN AYRES,
JAMES MAYNARD.

Auditing Committee.

We hereby certify that Hu L. McClung, Brown Ayres, and James Maynard are the authorized Auditing Committee of the Board of Trustees of the University of Tennessee.

BROWN AYRES, President.
WM. RULE, Secretary.

STATE OF TENNESSEE, COUNTY OF KNOX:

Before me, Thos. D. Morris, a Notary Public in and for said State and County, personally appeared the foregoing signers, personally known to me to be trustees and officers of the University of Tennessee, who made oath, in due form of law, that the above statements are true to the best of their knowledge, information and belief.

Witness my hand and official seal at office in Knoxville, Tennessee,
this 3d day of February, 1910.

THOS. D. MORRIS,
Notary Public.

TREASURER'S REPORT

ADAMS FUND

JULY 1, 1908, TO JUNE 30, 1909.

The Agricultural Experiment Station of the University of Tennessee

IN ACCOUNT WITH THE UNITED STATES

	Dr.	Cr.
To United States Treasury Draft July 13, 1908	\$2,750.00	
" " " " " " October 9, 1908	2,750.00	
" " " " " " January 11, 1909	2,750.00	
" " " " " " April 10, 1909	2,750.00	
By Salaries		\$6,897.75
Labor		502.80
Postage and Stationery		16.87
Freight and Express		212.29
Heat, Light and Water		54.67
Chemical Supplies		232.77
Seeds, Plants and Sundry Supplies		115.56
Library		165.31
Furniture and Fixtures		259.49
Scientific Apparatus		2,445.47
Traveling Expenses		85.42
Building and Repairs		11.60
Balance		
Totals	\$11,000.00	\$11,000.00

This is to certify, that, as the authorized Auditing Committee of the Board of Trustees of the University of Tennessee, we have examined the accounts of the Treasurer of the Agricultural Experiment Station for the fiscal year ending June 30, 1909, and find them correct; that the above is a true balance sheet corresponding with said accounts; that the said accounts show no more than \$11.60 was expended for building and repairs; and that there is no cash balance.

HU L. McCLUNG,
BROWN AYRES,
JAMES MAYNARD,

Auditing Committee.

We hereby certify that Hu L. McClung, Brown Ayres, and James Maynard are the authorized Auditing Committee of the Board of Trustees of the University of Tennessee.

BROWN AYRES, President.
WM. RULE, Secretary.

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