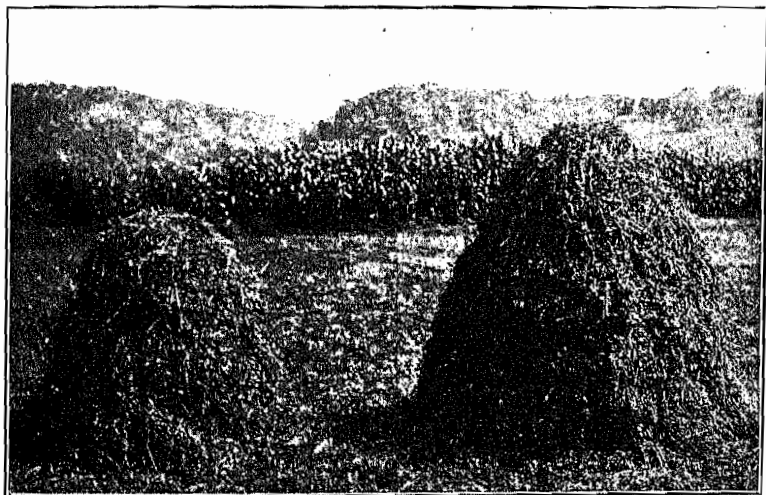


TWENTY-FIFTH ANNUAL REPORT
OF THE
Agricultural Experiment Station
OF THE
UNIVERSITY OF TENNESSEE
FOR 1912



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KNOXVILLE
UNIVERSITY OF TENNESSEE PRESS
1913

The Agricultural Experiment Station

OF THE UNIVERSITY OF TENNESSEE

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MAURICE MULVANIA, Bacteriologist

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L. G. WILLIS, Assistant Chemist (Fertilizers and Feeds)

W. A. CAMPBELL, Farm Foreman

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

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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

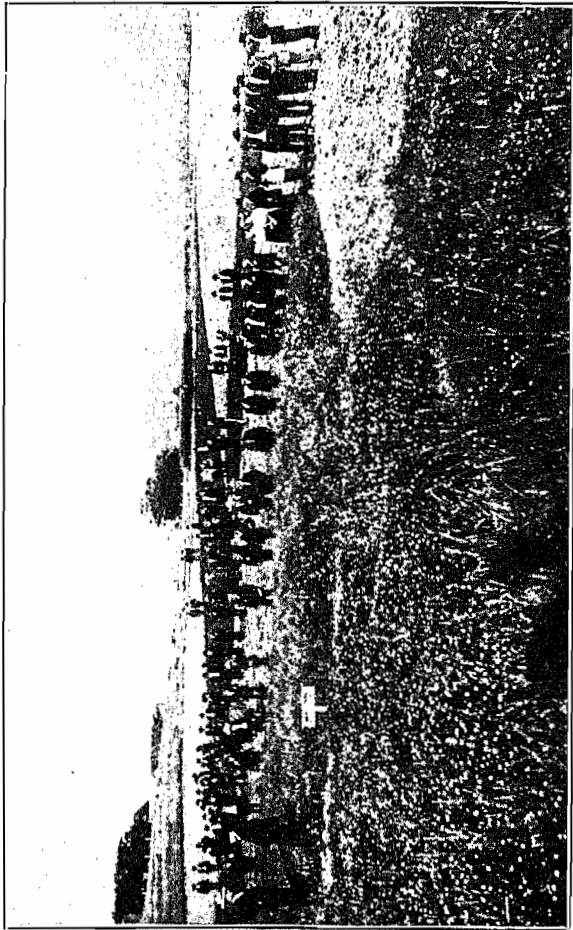
KNOXVILLE, TENN., January 1, 1913.

To His Excellency, Ben. W. Hooper, 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 1912. This report is submitted in accordance with 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.

Very respectfully,

BROWN AYRES, President.



DELEGATES OF EAST TENNESSEE FARMERS' CONVENTION EXAMINING CLOVER
PLOTS, EXPERIMENT STATION FARM

TWENTY-FIFTH ANNUAL REPORT OF THE AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF TENNESSEE FOR 1912

REPORT OF THE DIRECTOR

To President Brown Ayres:

Notwithstanding the fact that the results of experiment station work in this and other states have given ample evidence of the influence of a single-cultivated-crop system upon the soil, and that warnings concerning the disasters that may be expected have been sounded, corn, cotton, and tobacco are still grown to the exclusion of other crops in certain sections of Tennessee. Connecting scientific investigations in agriculture with sections of the State where the one-summer-crop predominates is an important problem at this time. Its solution seems possible only through the medium of more active and systematized rural education, in which the Experiment Station, the College of Agriculture, the public rural schools, the churches, and all the people must unite.

A study of census statistics for Tennessee shows a marked relation between the one-crop system of farming and the number of renters. This was brought out through a study of the three crops named, corn, cotton, and tobacco.

Each of these three crops is grown for a money crop, and is largely, or entirely, sold from the farm or used to pay rent, and each is a cultivated crop, causing waste of soil fertility. Therefore they may very properly be studied in a group or as one crop. It has been found that most counties devoted largely to one or more of these crops have a large number of rented farms, while those counties in which the proportion of land used for these crops is small have a small number of rented farms.

The reason for this state of affairs is found in the system of renting. The man who rents a farm for one year only will naturally grow the crop that will give him the largest return for his labor without regard to the effect upon the farm and subsequent crops, in which he has no interest. He can not be expected to sow a cover crop for the next man to harvest.

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

So, the renting system, the one-crop system, and the present burdensome credit system, naturally encourage one another. They unite in discouraging live stock and winter cover crops and in robbing the soil of its fertility.

In connection with grain production in Tennessee, and particularly winter wheat, an interesting phase of live stock has developed, that of sheep and lamb production. The archenemy of sheep is the stomach worm. Its control has consisted in rotation of pastures purposely planned. In the Middle Division of the State lamb production has had a remarkable growth, due in great measure to the use of winter wheat as a winter and early spring pasture. Thirteen of the principal wheat-growing counties of Middle Tennessee grew, in 1909, 178,382 acres. These same counties carried 2.5 sheep per acre, or a total of 456,356. The sheep were pastured on the wheat in winter and spring, decreasing the cost of maintenance without materially decreasing the yield of grain. Obion and Weakley, the largest two wheat-growing counties in the Western Division of the State, also lead in sheep production. The Station has for a number of years been emphasizing the value of winter cover crops and has developed strains of oats, wheat, and barley of unusual merit as cover, pasture, and grain crops. When cereals are given more serious consideration in East Tennessee as winter pastures for sheep, the 200,000 acres now devoted to wheat will give winter pasture to approximately 500,000 lambs and ewes instead of the 60,000 now pastured. When this is accomplished the stomach worm will be more economically controlled, live stock interests will be augmented, and the soil will be less impoverished.

From the experiments and observations made in all parts of the State it seems clear that if agriculture in Tennessee is to reach its maximum development the merits of diversity of crops must be taught to the people; silos and live stock must be possessed by them; the relation of climate to kinds of crops and systems of cropping must be acknowledged; the topography of land considered in relation to types of farming; lime used to encourage clover and other legumes; farmers encouraged and helped to own rather than rent small farms; and rural education and cooperation among the people become the ruling rural passion. When this is accomplished the application of experimental data will multiply a thousandfold and the economy of research and investigation of agriculture will be regarded with the same foresight that inspired the men of the Nation and State who have by wise legislation made possible the present fund of agricultural knowledge.

Two regular bulletins and two press bulletins have been issued during the year, as follows:

No. 95. Notes on tomato diseases with results of selection for resistance.

No. 96. Fertility experiments in a rotation of cowpeas and wheat; Parts II and III.

Press Bulletin No. 28. Getting and maintaining a stand of alfalfa.

No. 29. Feeding tables.

The following changes in the staff have occurred:

Mr. W. H. McIntire was appointed Associate Chemist, February 1, coming from the Pennsylvania Station.

Mr. W. K. Hunter, Assistant Chemist, resigned May 31.

Mr. Oscar Campbell was appointed Plot Assistant at the West Tennessee Station, at Jackson, July 1. He was formerly on the labor roll.

Mr. G. L. Herrington was appointed Horticultural Assistant of the West Tennessee Station, August 1.

Mr. J. E. Toomer, Assistant Chemist, resigned September 30.

Mr. L. G. Willis was appointed Assistant Chemist September 1.

From the reports of the departments of the Experiment Station, herewith submitted, it will be observed that most of the projects of investigation previously outlined have been continued and broadened.

Respectfully submitted,

H. A. MORGAN, Director.

REPORT OF THE BOTANIST

But little change has occurred in the lines of investigation pursued by this Department during the past year, and this report must be chiefly of the progress of the several projects.

Resistant clover Continued success has attended the introduction of the anthracnose-resistant clover, though the production of the seed under cultural conditions has been beset by a number of difficulties. Mr. W. P. Ridley, of Columbia, has been signally successful in the production of seed. He placed on the market for 1913 seeding nearly 200 bushels. It is probable that about 1000 acres will be sown to resistant clover in the State in 1913. An effort is being made to keep up with this strain of seed, and especially to keep in touch with those who produce it from year to year. The only cases of failure thus far known were due either to poor preparation of seedbed, or to bad weather conditions following, resulting in a poor "catch," or to a lack of lime in the soil.

The breeding experiments with resistant clover, having in view its further improvement for pasture and hay, are being continued, but it is not practicable at present to forecast the results of these efforts.

Fusarium wilt of the tomato Mr. Essary, the Assistant Botanist, has continued his investigations of the tomato wilt disease, which has been the cause of so much injury to the trucking interests of West Tennessee. His experiments of this year have brought to full realization all the success indicated by the first year's selection for resistance.

If favorable weather conditions are maintained during 1913, it is quite probable that the Station will have sufficient seed of these resistant strains for supplying a small stock to every trucker in the State where this disease has been prevalent.

Apple and pear blight The experiments with seedlings of apple and pear for breeding purposes have met with serious difficulties, but some progress has been made. The chief difficulties have been in securing stands of seedlings and in testing for susceptibility to the disease.

Disease-resistance in plants Fair progress has been made in the study of disease-resistance in general, the experiments here being confined at present to clover anthracnose, tomato Fusarium wilt, and pear blight. Most of the effort of the past year has been directed toward the histological study of resistant and non-resistant strains. A large, low-temperature incubator of Altmann manufacture has been purchased and installed for use in this investigation.

Breeding experiments with Japan clover Mr. Essary has begun a new project looking toward improvement of the Japan clover for cultural purposes. This has already become an important hay and pasture crop in much of the western part of Tennessee. If it can be improved so as to make larger yields on certain soils throughout the State it will become a very important forage crop and source of nitrogen.

Respectfully submitted,

SAMUEL M. BAIN, Botanist.

REPORT OF THE CHEMIST AND AGRONOMIST

AGRONOMY

Bulletins During the past year one bulletin has been issued from this Department, No. 96, on "Fertility experiments in a rotation of cowpeas and wheat; Part II, The effect of liming on the crop production; Part III, The effect of liming and of green manuring on the soil content of nitrogen and humus."

Part II is of direct practical interest, as it gives the results of five years' experiments at the Station farm, of four years' at the Ford farm, in Knox County, and of three years' at the Weaver farm, in Warren County. In each of the three series the soil used was strikingly different from either of the others; also every soil was a representative of a large area in the State. In every instance liming proved to be highly profitable and to increase the yields of both cowpeas and wheat. Liming was found to affect the relative standing of different phosphates, in particular by reducing the value of phosphate rock as a source of phosphoric acid. Under liming, acid phosphate was easily the most profitable of the various phosphates tested.

Part III reports the first five years' results of the chemical investigation of the 20 plots used in this rotation at the Station farm. The land had been in grass for several years previous to the experiments and had accumulated a fair supply of both nitrogen and humus, each of which suffered considerable loss wherever both crops were removed each year. On the other hand, where the cowpea crop was turned under annually the humus supply was increased on the unlimed sections and maintained where the lime was applied. Under all of the experimental conditions, however, the soil supply of nitrogen decreased, but more where the lime was applied than where none was used. As nearly all of the Tennessee soils are deficient in nitrogen and humus, quantitative results of this character are of special interest from both practical and theoretical points of view.

Variety trials As in the past, numerous variety trials with the common farm crops have been conducted. The crops included are corn, wheat, oats, sorghum, grass, clover, alfalfa, cowpeas, soy beans, peanuts, and cotton. These trials have been conducted in different parts of the State, but in particular at the Station farm, at Knoxville, and at the West Tennessee Station farm, at Jackson. Certain varieties have been in the lead for some time, but new varieties of merit are constantly appearing, and no group of plants seem to be excepted in this respect. During the past season, a variety of corn, No. 182, from the U. S. Department of Agriculture, has shown up especially well on poor uplands. For two years past "Honey" sorghum, also called "Japanese Ribbon Cane," has not only yielded about the best of all the varieties, but has stood up better than any other kind. If these qualities should hold good this variety would be expected to displace all others in common use except for the higher sections of the State, where the season might be too short.

Two annual grasses of much promise were received during the past year from the U. S. Department of Agriculture. One called Sudan grass is a dwarf sorghum, which resembles Johnson grass very closely, except that it does not produce underground root stalks, and is therefore propagated like other sorghums, only by seed, which must be sown each year. This grass promises to be of importance to take the place of millet, both alone and when mixed with cowpeas for hay. The other annual is Rhodes grass, which is a perennial along the Gulf coast, but is killed here by the first heavy frost. This grass grows thicker and is more leavy than the Sudan grass and makes a splendid soil binder, as well as making a high yield of excellent hay. Much more extensive trials of both of these grasses are planned for another season.

Plant improve- ment

The beardless winter barley mentioned in the report of last year as having been obtained by crossing Tennessee winter barley and spring beardless barley, has proved to be very promising up to the present time. In fact, several selections of promise have been obtained from the large number of crosses made in 1909. A barley of this kind should prove valuable for early pasturage in the fall. As a grain crop and, when sown with either red or alsike clover, a highly nutritious and heavy-yielding hay may be obtained.

The breeding of Hickory King corn for increased grain yield has been continued with some evident success. Several promising strains of soy beans have been isolated from the best varieties as determined in the variety trials of the past eight years. It is hoped that some farmers will be found who will grow the various kinds of improved crops for seed so that their distribution throughout the State will be assured at an early date.

Soil improve- ment

Soil fertility experiments form a prominent part of the work of this Department. A bulletin on liming has been prepared for publication and will give considerable data on various phases of this subject, which is of great practical interest throughout the State at this time.

Middle Tennes- see cooperative experiments

The Middle Tennessee cooperative experiments have been conducted on much the same lines as in the past. There are available at this time the results of six years of work, which has to do largely with the fertilizer and lime experiments on various soils; also with variety trials and adaptability of various crops especially for the poorer areas. A great deal of credit is due to Mr. J. E. Converse, who has superintended this work in Cumberland, Putnam, Overton, and Wilson Counties; to Mr. W. N. Rudd, the bulk of whose work has been in Warren and Coffee Counties; and to Mr. L. R. Neel, who has had oversight of numerous experiments in the Central Basin part of the State, also in the tobacco and peanut sections of the Highland Rim. In addition, Mr. Neel has attended numerous agricultural meetings and taken an active interest in corn clubs, etc.

As a result of all this work a report, which discusses various topics of practical interest, and which includes a number of definite recommendations, is in process of preparation for each of several well-defined areas of Middle Tennessee.

West Tennessee Station

The experimental work at the West Tennessee Station has progressed very favorably up to the present time. The plot and range experiments have been conducted in a specially commendable manner by the Superintendent, Mr. S. A. Robert. There is now available for publication a large amount of data relating to farm crops, fertilizers, etc., which have been gotten in the four years since the Station was established.

CHEMISTRY

The chemical work of the Department has continued along the lines previously inaugurated, and is almost entirely confined to soil-fertility problems. Mr. W. H. McIntire, who came as Associate Chemist in February, has greatly strengthened the Department. Mr. McIntire, as Chemist to the Department of Agronomy at Pennsylvania State College, did a large amount of investigational work on soils, so that his past experience is very valuable to us here.

Drainage cans An extensive soil investigation by means of drainage cans, each 1-5000 acre in surface area, was started in 1909, but proved to be a very laborious undertaking, so that the entire plan was changed in 1911, and a large concrete pit constructed, around which the cans were placed. This change not only gave needed protection to workers, but also premitted a number of desirable changes in important details. Owing to necessary delays, the complete change was not effected until this year.

Estimation of soil acidity A new and promising line of investigation has been started by the Associate Chemist, Mr. McIntire. The object is to find out the value of laboratory methods in the determination of soil acidity. Numerous pot experiments are being made as a basis for the analytical determinations. Special attention will be given to the Veitch Method, which has been favorably mentioned by a number of investigators.

Fertilizer work The analyses of fertilizers for the State Inspection have been made as in the past. The Department is very fortunate in having secured the services of Mr. L. G. Willis to take the place of Mr. J. E. Toomer, who resigned at the end of his year. Mr. Willis is a graduate from the Massachusetts Agricultural College, and has had ample experience in the fertilizer laboratory at Pennsylvania State College.

Respectfully submitted,
C. A. MOOERS, Chemist and Agronomist.

REPORT OF THE HORTICULTURIST

The experiments in horticulture during the year were devoted to three principal lines:

Root development of apple In this investigation root-grafted trees of different ages and in different soils are being excavated to map the entire root system of each tree, with a view of determining the extent and direction of root growth, the influence especially of depth of soil on root development, and the relation of the extent of the root system to the productiveness of the tree. The work is necessarily slow, but good progress is being made, and it is hoped a progress report can be made in 1913.

Summer-pruning the peach This investigation, begun in the spring of 1912, will be continued through several years. The early varieties of the peach can be pruned after the crop of the year is gathered and the new growth with its setting of fruit buds for the following year can thus be placed low on the tree, keeping the crown low enough to make the work of spraying and harvesting easier and more effective.

Beginning with Greensboro, the earliest commercial variety in the Experiment Station orchard, each variety was pruned in varying degrees of severity after its crop was harvested.

In another set of trees that had been dehorned in 1911 summer pruning of a similar character was done in 1912. The results indicate that no variety later than Carmen can be pruned after its fruit is harvested and set a crop of fruit buds the same summer. A bulletin detailing this work will be issued in 1913.

Soil improvement for truck crops An old field of DeKalb clay loam on Knox shale foundation, characteristic of many of the light-colored thin soils of this section of the State, is used in this investigation. The field had long been in cultivation and the land is much reduced in fertility. During the past ten years it had been devoted to legume hay crops and strawberries. In 1911, after cutting a crop of soy-bean hay, the field was sown to rye, which was turned under when in bloom in May 1912. The field was drilled to soy beans, which were cultivated twice and plowed under in early August. The land was thoroughly prepared by plowing, disking, and planking, and was then laid off in $\frac{1}{4}$ -acre plots in series. One-half of each plot was limed. One series will be treated with commercial fertilizers and manures (green) and the other with green-manure crops alone, and check plots will be kept in each.

Orchard in grass The orchard in which grass culture is being tested made excellent growth. The trees have been set four years and have been top-worked so that no fruit can be expected for two years, at least. A very good stand of tall meadow oat, red-top, alsike, orchard grass, and alfalfa forms the ground cover. This grass was mowed twice during the season and left where it fell from the mower except in small areas where the first cutting was so heavy as to threaten the smothering of the plants. In steep lands, where erosion under tillage would be probable and the soil is good enough to support a perfect stand of mixed grasses and clovers, this treatment would seem to be more advisable than tillage.

Fertilizers for orchards At the West Tennessee Station, at Jackson, the orchard of 12 acres in apple has been divided into plats of one-third acre each for experiments in the use of commercial fertilizers for apples. In one series one heavy application of phosphates (raw ground rock and acid) and muriate of potash was applied, and in the corresponding

series the same total amount is to be applied in equal parts annually for a period of ten years. In both, the value of lime is to be determined.

The use of Japan clover as a cover crop in orchards is also being tested at the West Tennessee Station. An investigation of the effect of various rotations and the use of green manures and fertilizers in trucking was begun at that Station during the year.

Respectfully submitted,

CHARLES A. KEFFER, Horticulturist

REPORT OF THE ANIMAL HUSBANDMAN

Following is a brief report of the Animal Husbandman for the year 1912:

The work in animal husbandry and dairying has grown to larger proportions than have been known before. During the year there were on experiment 146 steers. During the past three years the Tennessee Experiment Station has had upon experiment 409 steers, 309 of which have been fed at the West Tennessee branch, at Jackson. These steers have been divided into a total of 33 groups, and extensive experiments have been made with feeds common to Tennessee and to the South. In most of the experiments the basis of the ration has been silage and cotton-seed meal, while in some, cotton-seed hulls have served as a check for comparison.

The rations tested at the West Tennessee Station for the year are as follows:

Rations tested at West Tennessee Station

Lot No.	No. of steers	Ration: Pounds per head per day
I	8	Cotton-seed hulls; 4, 5, 6 lbs. cotton-seed meal.
II	8	Silage; 4, 5, 6 lbs. cotton-seed meal.
III	8	Silage; 3, 4, 5 lbs. cotton-seed meal.
IV	8	Silage; 7, 8, 9 lbs. cotton-seed meal.
V	8	Silage alone first 45 days; 7, 8, 9 lbs. cotton-seed meal last 45 days.
VI	8	Silage; 7, 8, 9 lbs. corn-and-cob meal; 3, 4, 5 lbs. cotton-seed meal.
VII	8	8 lbs. soy-bean hay; 8 lbs. soy-bean straw; 7, 8, 9 lbs. corn and cob meal; 3, 4, 5 lbs. cotton-seed meal.
VIII	10	10 lbs. soy-bean straw; 30 lbs. silage; 3, 4, 5 lbs. cotton-seed meal.
IX	8	10 lbs. soy-bean straw; 30 lbs. silage; 3, 4, 5 lbs. soy-bean meal.
X	8	10 lbs. Japan clover; 30 lbs. silage; 3, 4, 5 lbs. cotton-seed meal.
XI	8	Silage; 3, 4, 5 lbs. cotton-seed meal.
XII	13	Cotton-seed hulls; 3, 4, 5 lbs. cotton-seed meal.
XIII	13	Cotton-seed hulls; 7, 8, 9 lbs. cotton-seed meal.

Comparisons were made between silage and cotton-seed hulls with low, medium, and high cotton-seed meal rations; various combinations of cotton-seed meal were studied; silage was compared with soy-bean hay; and the value of soy-bean straw and Japan clover when fed with silage was studied.

High, medium and low meal rations The results from the experiments thus far indicate that low to medium cotton-seed meal rations are equally as efficient for a 90-day feeding period as large amounts of cotton-seed meal. The same rate of gain was obtained when cotton-seed meal was fed at the rate of from 4 to 6 pounds per day as when it was fed at the rate of 7 to 9 pounds per day. Feeders are rarely if ever justified in feeding large quantities of cotton-seed meal per day.

Silage versus cotton-seed hulls The experiments for the past year have shown that larger gains are made through the use of silage with cotton-seed meal than can be made through the exclusive use of cotton-seed hulls for the roughage part of the ration. Thousands of acres of corn stalks stand each year throughout the winter on Tennessee farms that would return a handsome profit to the owners if they had been put into silos and utilized with cotton-seed meal for feeding steers. Silage may be produced on the farm at a much less cost than the purchasing price of cotton-seed hulls.

Influence of type and breeding upon rate of gain As in previous years the steers on experiment were classified according to type and breed characteristics. The results checked with former years in that it was found that steers of best feeder type and with the greatest percentage of beef breeding made the most gains.

Influence of breeding on gains, 1912

	No. of steers	Total gain Lbs.	Average gain Lbs.
Beef breeds.....	95	11131	117.2
Scrubs	21	2250	107.1

Steers that showed one or more crosses of some beef breed made 15 per cent greater gains than steers that did not show some blood of any of the beef breeds.

Influence of type on gains, 1912

Feeder type	No. of steers	Total gain Lbs.	Average gain Lbs.
Very good.....	7	1006	143.7
Good	28	3686	131.6
Medium	53	5868	110.6
Poor	28	2826	100.9

Steers that were of very good type made 23.6 per cent greater gains than steers of poor feeder type. It is plain that type as well as breeding must be considered in the selection of feeder steers. It is then of great importance that the bull that is to be used in the production of beef steers be of the purest breeding and of the best type.

The experiments at the University of Tennessee Experiment Station have been conducted along the lines outlined in previous years. The amount of beef that was produced from the feeding of the crops produced on each acre was as follows:

Acre experiments

Acre	Crops grown and fed	Beef produced, Lbs.
I	Soy beans and barley.....	387
II	Cowpeas and barley	364
III	Corn and barley	332
IV	Soy-bean hay and barley	365
V	Soy beans and wheat	654
VI	Soy beans and oats.....	574
VII	Alfalfa	300

The amount of beef produced on each acre was somewhat lower than for former years; yet the ranking of each acre remained about the same, except for the alfalfa acre, which is lower than usual. The results from the wheat and oat acres are the first that have been obtained, and no conclusions regarding them can as yet be drawn.

Breeding experiments are being conducted with the dairy herd, in which the influence of the sire upon the offspring is being studied. The dairy herd at Knoxville is headed by three high-class Jersey sires, whose offspring are being tested. Complete data are kept upon all the cows of the herd, and many are making high records.

The live stock interests of the State will be greatly advanced through the completion of the Oliver Perry Temple Convention Hall by the East Tennessee Farmers' Convention on the Experiment Station farm, where meetings of the Convention and live stock breeders and pure-bred sales may be held.

Respectfully submitted,

C. A. WILLSON, Animal Husbandman.

REPORT OF THE BACTERIOLOGIST

During the past year the work in this Department has been in the main a continuation of that reported the previous year. The determination of the enzimical effect of a mature crop of soy beans on wheat following it was practically completed last year, and this subject has received no attention this year.

**Effect of humus
on azotobacter**

The humus experiments have been continued and extended, and satisfactory progress has been made. During the year considerable attention has been given to a study of the effect of humus on nitrogen-gathering bacteria of the soil. In this connection it was found necessary to accumulate the humus in sand in order to maintain control conditions and eliminate variability of other factors than the per cent of humus. This line of work seems to have considerable promise, and enough has been done to show that variations in the humus-content of sand may be regulated by varying the amount of organic matter supplied to it. The effect of humus on the nitrogen-transforming bacteria is to be taken up in connection with the assimilating types.

**Pure-culture
experiments**

The study of the capacity of pure cultures of various species of bacteria to produce humus from organic matter has been continued, but definite results have not been secured as yet.

**Effect of fertilizers
on nitrogen-trans-
forming capacity
of soils**

An effort has been made to determine the effect of various fertilizer applications on the nitrogen organisms of the soil. This is made to include three distinct types of Tennessee soils. So far the results have not been in sufficient accord to warrant the formulation of any sort of conclusion. Our best methods for investigations of this kind leave much to be desired, and improvements would undoubtedly be welcomed by all soil bacteriologists.

The efficiency of this Department would be greatly augmented by more systematic laboratory assistance.

Respectfully submitted,

MAURICE MULVANIA, Bacteriologist.

REPORT OF THE STATE ENTOMOLOGIST

In general

The lines of work conducted during the year 1912 have been similar to those of the previous year.

The increased appropriation has made it possible to do very thorough inspection work, in connection with the 351 nurseries of the State. Some 500 orchards have been carefully inspected for harmful insect pests and plant diseases. Where trees have been found beyond remedial treatment the owners have willingly taken them out and replaced them with young, vigorous trees. Pruning and spraying of the orchards in the State are being rapidly adopted with highly beneficial results. The nurseries and orchards of the State have increased both in number and acreage. The inspection of the nurseries require full time of three inspectors during the months of July, August, September, and October. The orchard interests of the State are rapidly reviving, due in part to the orchard demonstra-

tions given by the Entomologist and his assistants. Much emphasis has been placed on the reclamation of the older orchards—those representing desirable varieties, but neglected in regard to pruning and spraying. During the months of July and August continuous time of the Entomologist was devoted to giving talks and making demonstrations in connection with the Agricultural Special Train, which was run over the railroads of the State. Many talks have been made at farmers' institutes in the different parts of the State, and a class in Economic Entomology in the University of Tennessee has been conducted.

Today thousands of farmers, fruit growers, nurserymen, florists, beekeepers, and persons living in towns and cities are deriving information from this office. The correspondence has greatly increased during the past year. Full time of one stenographer and occasionally extra help are necessary in handling the correspondence.

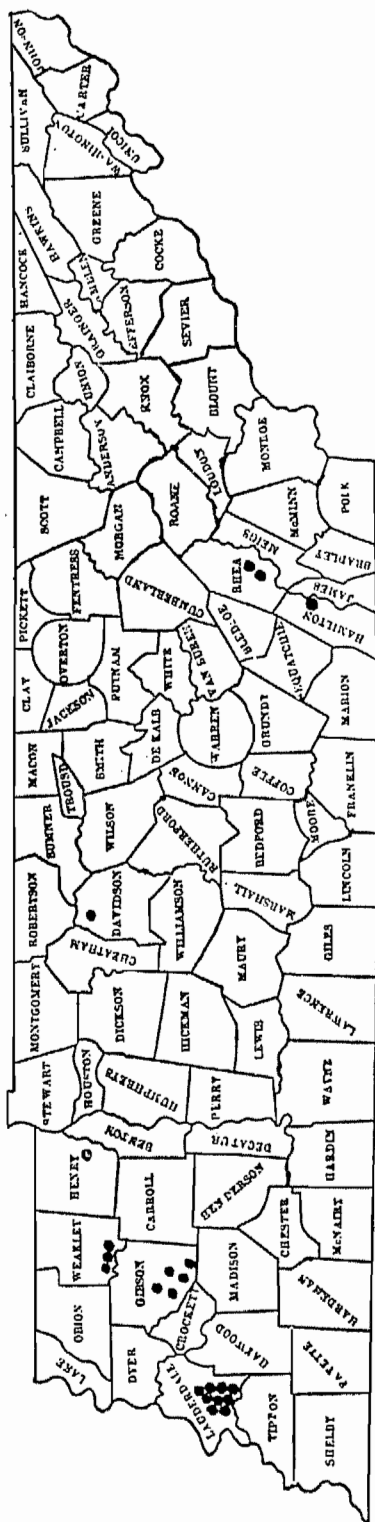
The strawberry root-louse For the first time in Tennessee the strawberry root-louse has been found doing appreciable damage to the strawberry plants. The discovery was made in September, during the strawberry-plant inspections in Henry County. To avoid any possible mistake in determination, specimens were sent to Dr. L. O. Howard, Chief of the Bureau of Entomology, Washington, D. C. The accompanying map shows the extent of the present infestation of the strawberry root-louse in Tennessee. Due to infestations ranging from 5 per cent to 75 per cent, there are 15 plant growers who were not granted certificates of inspection. Until this year the strawberry root-louse had not been listed with the quarantined insects of the State.

Because of the small size of this aphid and the general appearance to other plant lice little notice has been directed to this pest, which has, doubtless, in limited quantities, occurred in the State for some years.

When bare spots occur in strawberry patches and the condition of close-by plants indicate lack of vigor, it is safe to conclude that the strawberry root aphid is getting in its work. To determine this you have only to pull up several plants and examine the stems, crowns and roots. Finding greenish-black lice, about one-twelfth inch long on plants more or less wilted, should be occasion for sending specimens for determination to your State Entomologist.

The root-louse passes the winter in egg stage in certain, if not all, parts of the State. Further investigations may prove that this louse passes the winter as adult on the roots in parts of Tennessee. Very small, shiny, black eggs are deposited on the stems and ribs of leaves of the strawberry. These eggs hatch in March or April, depending upon the earliness of spring.

The young feed for a time on the leaves and later seek the more tender leaves of the crown. In about 15 days their growth is attained



BLACK SHOTS LOCATE THE PRESENT RECORD OF THE STRAWBERRY ROOT-LOUSE (*Aphis Forbesi*, Weed) IN TENNESSEE

and they begin to produce from 15 to 20 living young, all of which are wingless. It is common to find these wingless aphids accompanied by ants. They are seeking the honey-dew produced by the aphids. Ants actually carry this strawberry root-louse to the roots of the plants. They also carry them from plant to plant. For this generation of the root-louse, wingless as it is, the ant is the only distributing agent. This second generation of aphids in turn produces a third generation, part of which is winged and part wingless. These forms may, in like manner, produce living young, partly winged and partly wingless. There may be several generations, but at the approach of cold weather true males and females result, and the overwintering eggs are laid.

It is easy to detect the presence of the strawberry root-louse by the condition of the plants. On the roots the lice gather and pierce them, sucking out the juices. The plants soon show lack of vigor and wilt, and when highly infested die out. Other plants near by start the same way and the berry field may be spotted over with infested areas.

Remedy As to methods of control—in order to prevent its attack, great emphasis should be placed upon getting plants free from the aphids and then placing them in land not already infested by this pest. It is not safe to replant berries on infested land until it has been in some other crop, preferably two years. As this aphid and its eggs are readily transported on plants, it is important that plants be obtained from sources known to be free from the attack of this insect. In case there is any doubt, the plants should be either dipped for a few minutes in strong tobacco solution or diluted "Black Leaf 40," or fumigated with hydrocyanic acid gas at the rate of 1 oz. potassium cyanide, 2 oz. sulphuric acid, and 4 oz. water, per 100 cu. ft., for a period of 10 minutes.

If your fields are highly infested, plow, and do not plant again for two years. If only slightly infested, the tops may be burned over in the early spring. Do not plant a new field near an infested one. Buy only strawberry plants which have been inspected, and which have a certificate accompanying each order.

Inspection of State nurseries The number of inspections made this year is 366, an increase of 1 over last year. In 1905 there were only 194 nurseries in the whole State. Today Tennessee stands foremost of all the Southern States and ahead of many of the Northern States, the annual business aggregating \$3,500,000.00.

Fifteen nurseries were condemned this year. The total number of nurserymen now holding certificates of inspection is 351. The strawberry root-louse has caused the greater number of the certificate withdrawals.

Inspection of outside nurseries A large per cent of the stock coming into Tennessee from nurseries outside the State has been looked over. The requirements making it necessary for all nursery firms intending to ship into the State to file in the office of the State Entomologist and Plant Pathologist their certificates of inspection, signed in person by the State Entomologist, or official inspector, and their agreement to fumigate all stock with hydrocyanic acid gas, attaching fumigation tag to each shipment, has given excellent results.

Inspection of foreign nurseries Some twenty of the Tennessee nurserymen have purchased seedlings and propagating material from foreign countries, chiefly France, Germany, Holland, and Belgium. All of this material has been carefully inspected for crown gall, white pine blister rust, San Jose scale, brown tail moth winter nests, and gypsy moth egg masses. This year the foreign shipments have been exceptionally free from insect pests and plant diseases. In no shipment has any trouble been found. The foreign inspection tags have been carefully filled out and were intact in each case.

Apiary inspection The Apiary inspection work has proved of great benefit to the beekeepers of the State. From the inspections made several cases of foul brood, a dangerous bacterial disease of bees, have been located and eradicated. Without the bee inspections it would be only a short time before the beekeeping interests of the State would be greatly reduced. Although there has been but two years devoted to the apiaries of the State, this work has already effected the introduction of more modern methods and improved equipment. A careful survey of the beekeepers has been made, resulting in the listing of 2,500 beekeepers in Tennessee, together with valuable data as to number of colonies, race of bees, hives used, and yields of honey.

Bulletins Since February 21, 1912, the bulletins and reports of this office have been published quarterly and entered as second-class mail matter. This saving of postage has made it possible to issue more publications than heretofore. During the year the following have been published: Seventh Annual Report of the State Entomologist and Plant Pathologist; Bulletin No. 6, "Amended Laws Creating the Tennessee State Board of Entomology;" and Bulletin No. 7, "The Inspection and Transportation of Nursery Stock in Tennessee, Other States and Canada."

State collection of insects The insect fauna of the State has been studied in regard to distribution, and many additions have been made to the State collection. Recently from Fentress County 1,000 different specimens have been sent by one of the county correspondents. This State collection furnishes a valuable aid in determining species from the different parts of the State.

County
correspondents

In order that we may keep closely in touch with the outbreaks of injurious insects in the different counties of the State, correspondents, numbering from two to six in each of the 96 counties of the State, have been selected. Their work has been of great value to their communities and to our work. Printed blanks are sent to the correspondents each month for filling out and returning. Thus we are able at all times to know the existing conditions regarding crop and orchard pests.

Respectfully submitted,
G. M. BENTLEY, State Entomologist.

REPORT OF THE ASSISTANT ENTOMOLOGIST

Our work during the past year has been a continuation of that of 1911, except that another project, "A study of the hog louse," has been added.

The North American fever tick
Early in the year we became fully convinced that we could make no further progress in our study of the effect of climate upon the fever tick until we had some positive information as to the exact influence which high and low temperatures exert on the life activities of the various stages of the tick. It was also deemed essential to determine the influence of moisture, measured as relative humidity, upon these same stages. For this reason a considerable portion of our time during the year has been devoted to the perfecting of our temperature-control plant, which has also been given a thorough overhauling. Important changes have been made which better adapt it to our present needs.

A much larger chamber has been constructed and provision made for tempering the air before introducing it into the chamber, for our earlier work demonstrated the utter futility of attempting to maintain the temperature of a chamber constant to within one degree for an indefinite period of time, when the cooling agent was a cold fluid or gas circulating through iron pipes within the chamber itself. Under such conditions, unless the temperature of the air in the chamber was but a few degrees higher than that of the cooling agent, the residual cooling effect of the considerable mass of iron pipe, the temperature of which had been reduced several degrees below that of the air in the room, would continue the cooling for some time after the thermostat had closed the valve, shutting off the supply. Under our present plan this residual effect has been entirely eliminated, for nothing but tempered air is introduced.

We have further provided for the circulation of the air within the chamber, collecting it near the floor and delivering it at the ceiling, the circulating fan being of such capacity as to pass all of the air in the chamber through it once each ten minutes. Fastened to the middle of the ceiling of the chamber is a "mixer" into which both the tempered air and that from the circulating fan are delivered and from which

after being thoroughly mixed it is thrown against the ceiling, thus displacing the warm air, which tends to accumulate there by air collected from near the floor.

Provision is also made for delivery to this same mixer, through another small fan, of the air from the humidity-control apparatus.

Cooling is effected by drawing the air from the chamber through a copper coil submerged in the brine tank while the heating is by means of electrical resistance, both being closed circuits. These two pieces of apparatus are located outside of the chamber, while all of the remainder is inside. Arrangements have also been made for the continuous introduction of a small quantity of fresh air, from outside the chamber, through the circulating fan.

The peach tree borer The work on the peach tree borer has been continued along the same lines as during the past two years, consisting chiefly of the testing of remedial measures.

The hog louse Work on the hog louse has gone no further than the preparation of a comprehensive outline for the study of this pest in all of its relations to both its host and environment. A beginning has been made in the accumulation of the literature dealing with this species.

Respectfully submitted,

E. C. COTTON, Assistant Entomologist

REPORT OF THE CONSULTING METEOROLOGIST

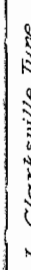
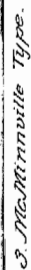
The accompanying chart shows the rainfall of Tennessee for 1912 compared with the normal rainfall.

The solid line represents the normal or average rainfall, while the broken line represents the rainfall for 1912. In a general way the rainfall distribution for 1912 was similar to the normal distribution, but was much exaggerated. The wet periods were unusually wet, and the dry periods unusually dry. This was markedly true in the spring wet period and the fall dry period. July was also abnormally wet.

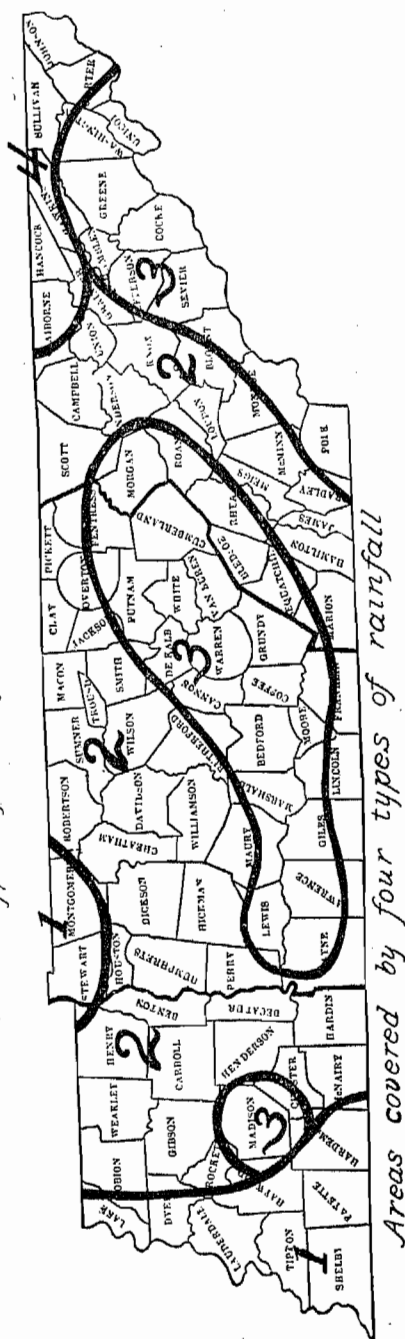
Just as in previous years, the rainfall distribution furnishes new arguments in favor of the double-cropping system.

Oats and other crops sown in the fall grew luxuriantly under the heavy spring rains, while the farmer who expected to sow oats in the spring was in many cases prevented from doing so by the wet weather. Again, the wet July, followed by the unusually dry fall, shows the opportunity for and the need of tillage methods that will conserve rainfall.

In a study of the relation of weather conditions to the growth and maturity of the soy bean it was observed at once that the length of time required for maturing this crop was materially shortened by



Four Types of Rainfall.



increase of temperature. In addition to the data from Tennessee, data have been obtained during the last three years from Virginia, Wisconsin, Kansas, Texas, Louisiana and Mississippi, and the results obtained are shown in the following tables.

TABLE I—*Effect of temperature on length of period from planting to blooming of three varieties of soy beans*

Variety	Number of observations	Average number of days in period	Standard deviation in days	Per cent of standard deviation due to differences in temperature
Ito San	13	43	12.8	59
Medium Yellow	18	50	10.9	80
Mammoth Yellow	25	80	23.9	72

TABLE II—*Effect of temperature on length of period from planting to ripening of three varieties of soy beans*

Variety	Number of observations	Average number of days in period	Standard deviation in days	Per cent of standard deviation due to differences in temperature
Ito San	32	93	13.6	83
Medium Yellow	25	111	21.2	36
Mammoth Yellow	22	140	27.8	32

In the tables the first two columns are sufficiently explained by the headings. The third column, headed "Standard deviation in days," represents the average departure for each variety from the value given in column two, headed "Average number of days in period." For example, taking the variety Ito San, in Table I, there were 13 observations and the average length of period from planting to blooming was 43 days. Most of the observations, however, were longer or shorter than 43 days, and the average of these departures was 12.8 days. Column four is really a correlation coefficient and shows the relation between temperature and length of the period under consideration. In other words, 59 per cent of the variation from the average, as shown in column three, is due to variation in temperature. Or, if temperature were uniform, we would expect to find a variation of only 5.2 days from the average due to other causes as moisture, method of cultivation, etc.:

Respectfully submitted,

J. F. VOORHEES, Consulting Meteorologist.

REPORT OF THE LIBRARIAN

LIBRARY

Bound volumes	4,625
Accessions during the year.....	141
Purchased	18
Obtained by exchange and gift.....	51
Bound by the Station	72
Volumes complete, ready for binding.....	74
Bulletins and pamphlets	17,874
Journals subscribed for	86
Agricultural papers received in exchange for bulletins.....	147

MAILING LIST

U. S. Dept. of Agr. and Exp. stations.....	2,007
Tennessee newspapers	193
Exchange list	240
Individuals in Tennessee.....	10,517
Other states	490
Foreign, other than exchanges	77
	18,524

Respectfully submitted,

F. H. BROOME, Librarian.

TREASURER'S REPORT

JULY 1, 1911, TO JUNE 30, 1912

The Agricultural Experiment Station of the University of Tennessee IN ACCOUNT WITH THE UNITED STATES

HATCH FUND	<i>Dr.</i>	<i>Cr.</i>
To unexpended balance on hand July 1.....	\$ 18.34	
To United States Treasury Draft, July 15, 1911....	3,750.00	
To United States Treasury Draft, October 16, 1911..	3,750.00	
To United States Treasury Draft, January 20, 1912	3,750.00	
To United States Treasury Draft, April 20, 1912..	3,750.00	
By Salaries		\$8,940.00
Labor		2,466.45
Publications		966.28
Postage and Stationery		350.33
Freight and Express		71.20
Heat, Light, Water and Power.....		386.24
Chemicals and Laboratory Supplies.....		79.98
Seeds, Plants and Sundry Supplies.....		342.32
Fertilizers		116.90
Feeding Stuffs		561.22
Library		173.95
Tools, Machinery, and Appliances		35.89
Furniture and Fixtures		242.46
Scientific Apparatus		19.52
Live Stock		
Traveling Expenses		85.70
Contingent Expenses		25.00
Buildings and Land.....		136.56
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 30th, 1912, and find them correct; that the above is a true balance sheet corresponding with said accounts; that the said accounts show no more than \$136.56 was expended for building and repairs, and that there is \$18.34 cash balance.

BROWN AYRES,
HU. L. MCCLUNG,
JAMES MAYNARD, Auditing Committee.

We hereby certify that Brown Ayres, Hu. L. McClung, 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 } tary 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 2nd day of January, 1913.

THOS. D. MORRIS, Notary Public.

TREASURER'S REPORT

JULY 1, 1911, TO JUNE 30, 1912

The Agricultural Experiment Station of the University of Tennessee IN ACCOUNT WITH THE UNITED STATES

	ADAMS FUND	Dr.	Cr.
To United States Treasury Draft, July 15, 1911....	3,750.00		
To United States Treasury Draft, October 16, 1911.	3,750.00		
To United States Treasury Draft, January 20, 1912.	3,750.00		
To United States Treasury Draft, April 20, 1912...	3,750.00		
By Salaries			\$10,568.31
Labor			911.71
Publications			
Postage and Stationery			14.70
Freight and Express			89.53
Heat, Light, Water, and Power.....			109.22
Chemicals and Laboratory Supplies			1,021.24
Seeds, Plants and Sundry Supplies.....			148.21
Fertilizers			11.75
Feeding Stuffs			
Library			236.32
Tools, Machinery, and Appliances			58.75
Furniture and Fixtures			185.40
Scientific Apparatus			1,130.73
Live Stock			
Traveling Expenses			155.42
Contingent Expenses			
Buildings and Land.....			358.71
Balance			
		\$15,000.00	\$15,000.00

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 30th, 1912, and find them correct; that the above is a true balance sheet corresponding with said accounts; that the said accounts show no more than \$358.71 was expended for building and repairs, and that there is no cash balance.

BROWN AYRES,
HU. L. McCLUNG,
JAMES MAYNARD, Auditing Committee.

We hereby certify that Brown Ayres, Hu. L. McClung, 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,) Before me, Thos. D. Morris, a No-
County of Knox) tary 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 2nd day of January, 1913.

THOS. D. MORRIS, Notary Public.

BULLETINS AVAILABLE FOR DISTRIBUTION

(Of the early issues, which were numbered by volumes, Volume I contained three bulletins; Volume III contained six; Volume IV contained five; all other volumes contained four.)

REGULAR SERIES

- IV. 3. The true bugs, or Heteroptera, of Tennessee.
- IV. 5. A chemical study of the cotton plant.
- X. 2. Pot culture of lettuce.
- XI. 2, 3, 4. Grasses and forage plants.
- XVIII. 3. Alsike clover.
- 75. Selection for disease-resistant clover.
- 77. The fruiting habit of the grape.
- 78. The soils of Tennessee.
- 81. Tick eradication.
- 82. The soy bean: a comparison with the cowpea.
- 83. Comparison and improvement of dairy herds in Tennessee.
- 84. Sheep and lambs in Tennessee.
- 86. Experiments with soils, fertilizers and farm crops.
- 87. The relation of the Weather Service to the farmers of Tennessee.
- 88. Insuring the peach crop.
- 89. Stand and soil fertility as factors in the testing of varieties of corn.
- 90. Fertility experiments in a rotation of cowpeas and wheat. Part I.
- 91. Relation of temperature and rainfall to crop systems and production.
- 92. Experiments with fertilizers and field crops on important soil types of Middle Tennessee.
- 93. Tobacco insects of Tennessee. Tobacco culture in Montgomery County.
- 94. The cattle tick as affected by climate.
- 95. Notes on tomato diseases with results of selection for resistance.
- 96. Fertility experiments in a rotation of cowpeas and wheat. Parts II and III.
- 97. Liming for Tennessee soils.
- 98. The San Jose scale in Tennessee, with methods for its control.
- 99. Suggestions on preparation and use of spray formulas.

PRESS BULLETINS

- 14. Grades on country roads.
- 20. Cattle tick extermination.
- 21. Preparation of land for alfalfa.
- 22. Importance of testing and keeping records of dairy cows.
- 23. How to save the soy-bean crop.
- 24. Spraying the peach.
- 25. Cattle ticks frozen.
- 27. Rates and dates of seeding.
- 28. Getting and maintaining a stand of alfalfa.
- 29. Feeding tables.
- 30. Resistant red clover: Preparation of land and time of seeding.