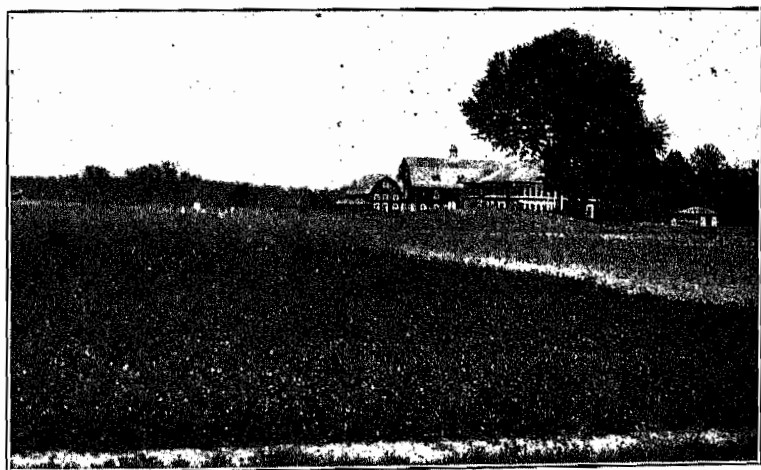


TWENTY-FOURTH ANNUAL REPORT
OF THE
Agricultural Experiment Station
OF THE
UNIVERSITY OF TENNESSEE
FOR 1911



ALFAFA AT THE WEST TENNESSEE STATION

KNOXVILLE
UNIVERSITY OF TENNESSEE PRESS
1913

The Agricultural Experiment Station

OF THE UNIVERSITY OF TENNESSEE

BROWN AYRES, President

EXPERIMENT STATION COMMITTEE

BROWN AYRES

HUGH C. ANDERSON

T. F. P. ALLISON

HARRIS BROWN

GEO. CAMPBELL 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. MOGERS, Chemist and Agronomist.

C. A. KEEFER, Horticulturist.

S. E. BARNES, Field Expert in Dairying, in cooperation with the U. S. Department of Agriculture.

M. JACOB, Veterinarian.

C. A. WILLSON, 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.

J. F. VOORHEES, Consulting Meteorologist.

W. K. HUNTER, Assistant Chemist.

J. I. HARDY, Assistant Chemist.

J. E. TOOMER, Assistant Chemist.

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, Nashville.

S. A. ROBERT, Superintendent West Tennessee Experiment 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

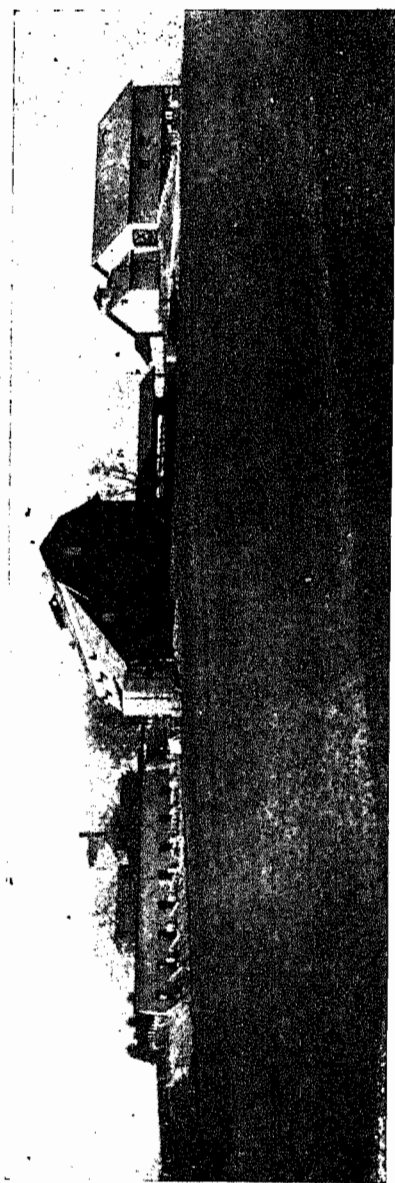
KNOXVILLE, TENN., January 1, 1912.

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 1911. 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.



THE EXPERIMENT STATION BARN, KNOXVILLE

TWENTY-FOURTH ANNUAL REPORT OF THE AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF TENNESSEE FOR 1911

REPORT OF THE DIRECTOR

To President Broten Ayres:

From the reports of the various departments of the Experiment Station for the year 1911, submitted herewith, it will be seen that the organization of the work has been maintained along practically the same lines as for the preceding year, but very much strengthened by greater maturity of plans and the results obtained from another year of active work.

Soil and crop investigations at the Stations at Knoxville and Jackson, and throughout the Middle Division of the State, have been increased so as more completely to embrace the soil and climatic areas of the State. The studies of the Consulting Meteorologist have given a wider application to the results of these investigations and indicate the necessity of relating the type of agricultural activity to soil and climatic conditions.

The permanent experiment ranges and plots of the West Tennessee Station have been located, and systems of comprehensive and technical experiments, in connection with different forms and combinations of plant food, various systems of cropping and rotations, and all important varieties of plants, have been inaugurated. The results of these experiments carried to the farms of the Western Division of the State, and put into practice, will greatly assist in soil restoration and in the working out of better methods of crop rotation and more economical farm practice. Systems now in vogue are too expensive and tend to increase single-crop systems and reduce soil fertility and production, and are more or less responsible for an increased system of farm tenancy and a general lack of permanency and confidence in rural operations.

Trice cotton, selected and introduced by Prof. S. M. Bain, has proved a variety of very great merit. It has increased the yield of cotton over thousands of acres in the State and is rapidly becoming the leading variety of the cotton belt.

In September, 1911, a herd of Holstein cattle was placed upon the West Tennessee Station. Already this breed is proving its dairy merit for this section of the State. By the use of silage and Japan clover, dairy products can be produced with high-producing annuals as cheaply as in any section of the country. It is not unreasonable to expect that this herd will prove the western portion of Tennessee to be admirably adapted to dairy activity, and through this branch of

live stock industry transform an area now given over to a single system of crop production and limited markets to one of liberal rotation, soil restoration, and diversified markets.

The silo, too, has given a permanent interest in better and more profitable wintering of live stock, and the fattening of beef animals for local and western markets. Animals fattened upon the Station farm largely by means of silage and cotton-seed meal, produced profitable gains and made a most creditable showing upon the St. Louis market in comparison with cattle from areas where beef production has been long established.

Studies have been continued in connection with the life and habits of the cattle tick and practical methods of eradicating this pest of the Southern cattle breeder and feeder have been developed and published.

Mr. Essary, Assistant Botanist, has, by methods of selection and breeding, developed many strains of tomatoes resistant to blight, which has proved the principal obstacle to tomato culture in the most favored trucking sections of the State. Large quantities of seeds of resistant strains have been procured and distributed. So successful have been the studies of the Station in connection with the disease that it is no longer considered a menace to commercial tomato production.

Active cooperation with the U. S. Department of Agriculture, Bureau of Entomology, in the study of tobacco insects has been continued with gratifying results. Through the courtesy of the Bureau of Entomology, Mr. A. C. Morgan has prepared an extended report on tobacco insects in Tennessee for the biennial report of the cooperative experiments of the Middle Division of the State.

The soil bacteria studies, in connection with humus formation, are indicating practical lines of application to soil improvement. This is a new field of investigation, and much of the apparatus used in the investigation has to be devised and constructed before much headway can be made.

Four regular bulletins and four press bulletins were issued during the year, as follows:

No. 91. Relation of temperature and rainfall to crop systems and production.

No. 92. Experiments with fertilizers and field crops on important soil types of Middle Tennessee.

No. 93. Tobacco insects of Tennessee. Tobacco culture in Montgomery County.

No. 94. The cattle tick as affected by climate.

Press Bulletin No. 25. Cattle ticks frozen.

No. 26. Bulletins issued by the Tennessee Experiment Station.

No. 27. Rates and dates of seeding for farm and garden crops for the State of Tennessee.

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

The following changes in the personnel of the Station staff have occurred:

Mr. W. H. Maynard, Assistant Chemist, resigned February 17, to go to a fertilizer manufacturing company.

Mr. Sherman Leavitt, Soil Chemist, resigned August 31.

Mr. J. I. Hardy was appointed Assistant Chemist, for soil investigation work, September 1.

Mr. J. E. Toomer was appointed Assistant Chemist, for fertilizer and feed work, October 1.

Mr. S. E. Barnes, Field Expert in Dairying, resigned to accept a position with a dairy separator company, and his connection with the Station terminated December 31.

Respectfully submitted,
H. A. MORGAN, Director.

REPORT OF THE BOTANIST

The record of the operations of the Botanical Department for the year 1911 is merely of progress, for no new lines of investigation have been started.

The Botanist has continued to do a small amount of seed analysis for the dealers of the State, who have required such service, as an aid toward complying with the State Pure Seed Law.

Several additional counties have been entered with the anthracnose-resistant clover. It is not possible at this date to make a definite statement as to the acreage at present in Tennessee, but success, so far as known, has attended every effort to cultivate the strain, except in two cases in the same locality. One of these cases partially succeeded, and the present indications are that the soil needed lime. In the future this seed will be let out only to those farmers who will agree to lime the plots. That the strain has lost nothing of its disease-resistance up to the sixth generation was demonstrated in plots at the Station farm the past year. The plots contained checks of non-resistant parentage, which succumbed almost to a plant, while the resistant strains continued healthy to the end of the season and produced a good crop of seed. It has been thought best to withhold awhile longer a final publication of the field experiments with resistant clover, so that the subject may be exhaustively treated from the practical point of view.

Some progress has been made in the study of the physiological aspects of clover resistance, especially in establishing lines of known resistance and susceptibility. This work is mainly of a preliminary character. In connection with the resistance studies further investigation is being made of the life-history of the fungus causing the anthracnose. In the experiments with the progenies of the resistant strain of clover the effort is also being made to improve further the existing strain.

**Blight-resistant
tomato**

Mr. Essary, the Assistant Botanist, has been signally successful in his effort to breed up a strain of tomato resistant to the "blight," which has been very destructive to this crop in the trucking region of West Tennessee. The results of the season's work will be fully summed up in Bulletin No. 95, which will come from the press the first of the year. In this bulletin Mr. Essary points out a plan of rotation so as to avoid the *Fusarium* fungus causing the disease. It seems probable that his experiments may soon result in the distribution of seed of superior resistant strains of tomatoes among all truck growers in the State.

**Experiments with
pear and apple
blight.**

Preliminary plantings of pear and apple seeds were made in the spring of 1911. Two serious difficulties were encountered in this work. In the first place, it is quite difficult to obtain seeds of desirable varieties of these fruits in any considerable quantity; then, but few of the seed obtained germinate when planted by the method usually followed in this country. It is believed that these difficulties may be largely overcome during the next season. These experiments, as stated in the last report, are in co-operation with the Horticulturist.

In the course of the experimental work of the past year several important pieces of apparatus have been added to the equipment of this Department.

For the future prosecution of several phases of the projects now under way in the Botanical Department, a greenhouse is indispensable, and it is hoped that funds may, in the near future, be available for such equipment.

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. 92, on "Experiments with fertilizers and field crops on important soil types of Middle Tennessee." This is a bulletin of 71 pages, and is the second biennial report of experiments in agronomy in Middle Tennessee. The results are of much value, however, to the farmers of the other two sections of the State, especially as the types of soil found in Middle Tennessee embrace, for practical purposes, many of the important types of the entire State. Parts II and III of "Fertility experiments in a rotation of cowpeas and wheat" are nearly ready for publication. They will conclude the results of the first five years of these experiments at the Station farm, four years at the Ford farm (Knox County), and three years at the Weaver farm (Warren County). In these bulletins the effects of liming both on

crop production and on the nitrogen and humus content of the soil have been considered.

Miscellaneous data Considerable information has now accumulated as the result of miscellaneous field experiments at the Station farm. The majority of these experiments were made in order to answer simple questions in regard to the best varieties of the general farm crops, the best dates of planting, cultural methods, etc. Undoubtedly there is much to learn on these subjects. In fact, some questions, such as those relating to varieties, will continue to require field experiments for an indefinite period in order to be answered satisfactorily, in particular as new and "improved" varieties are constantly being received.

Plant improvement Attention is still being given to the improvement of varieties, both by selection and breeding. A selection of Culberson oats made some years ago is proving of considerable value and offers certain distinct advantages over the common Gray Turf winter oat. This new Culberson is especially well suited to the better class of soils, on the best of which it seldom lodges. Its rapid growth enables it to be sown later in the season than the Gray Turf, and as it ripens nearly two weeks earlier than the latter, its desirability is evident. The breeding for a hardy winter beardless barley is meeting with success. Some of the crosses of the spring beardless on the Tennessee winter are passing through the third winter with evident show of great resistance to cold. Valuable selections have been made from Poole wheat, and from tall oat grass. The latter has proved under our conditions to be capable of making extra large yields, is considerably hardier than orchard grass, can be sown over a great range of season from late summer to well into the fall, and also in the spring, with more than average certainty of success as compared with Timothy and red-top. The culture of this grass is recommended. Attention is also being given to the improvement of the most promising of the varieties of soy beans by selection.

Soil investigations However important variety trials, plant improvement, and cultural methods may be, the problems in connection with soil fertility are considered to occupy first place, so that more attention is being given to them than to anything else. The experiments in cylinders and cans, started two years ago, are progressing well. The yields of the crops grown, their nitrogen content, and the effects of the lime, fertilizers, etc., on the nitrogen and humus content of the soils under investigation are being gotten as far as possible. In consideration of the great interest taken by the farmers in the subject of liming, and in view of the possible disastrous effects of lime, when used without farmyard manure or green crops turned under, the immediate value of the results of these investigations is evident.

Middle Tennessee cooperative experiments The cooperative experiments in agronomy conducted in Middle Tennessee have continued to furnish valuable data, which are embodied in Bulletin No. 92, already alluded to. The results of five years of these experiments are now at hand, so that the probable immediate response to the various fertilizer materials, including lime, has been fairly well determined for several prominent types of soil. The outcome of the past two years' work in alfalfa culture has been so favorable that if the methods recommended by the Station be followed the success of this crop is practically assured.

West Tennessee Station The West Tennessee Station has afforded a fine opportunity for soil investigations, among which are numerous comparisons between burnt lime and ground limestone. Up to the present time two tons of the latter per acre have done as well as one ton of the former, or better. A very important comparison between some half dozen different crop rotations is being made at this Station. These rotations include the majority of the important farm crops. Also consideration is had to the place in the rotation for the crops grown by the truck growers. The season of plant growth is appreciably longer in West Tennessee than in the eastern part of the State; also the soils are decidedly different; so that results are obtained which could not have been gotten without the help of this Station. Sufficient data have accumulated to make possible at least a preliminary report on several lines.

CHEMISTRY

Chemical studies have gone hand in hand, not only with the experiments in cylinders and cans, but also with the most important of the field experiments in soil fertility. Four soils, one from the vicinity of Gallatin, another from Cookeville, a third from near Crossville, and the fourth from the Station farm at Jackson, are now under investigation and furnish a very large amount of analytical work, which includes analyses of crops, soils, and drainage water.

A number of improvements have been made in the laboratory equipment, and the prospect is favorable for more valuable work in the future than at any time in the past.

The amount of miscellaneous work not along research lines has been cut down to the minimum, and consists chiefly of the analyzing of fertilizers for the State Inspection, which require the services of one man during a large part of the year. Mr. W. H. Maynard did this work in a most satisfactory manner up to the time of his resignation in February to take a more remunerative position with a large fertilizer manufacturing company. Mr. J. E. Toomer, of Clemson Agricultural College, was appointed to the position, and has been serving since October 1.

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

REPORT OF THE ANIMAL HUSBANDMAN

The duties of the Animal Husbandman are divided equally between instructional and experimental work. Both branches are growing.

During the past year, at the Experiment Stations at Knoxville and Jackson, there were on experiment 136 steers. These were divided into 24 groups, and were used for the testing of as many different kinds of rations.

FEEDING AT THE WEST TENNESSEE STATION

The larger number of the steers were fed at the West Tennessee Station, at Jackson, under the supervision of Mr. S. A. Robert, the Superintendent. The work was made possible largely through the support given by the citizens of Jackson, who assisted in financing the feeding operations. Of the 136 steers fed, 100 were divided into groups of 4, 6, and 8 head, and fed in lots in the open, as were some of the groups the previous year. The results of 1909-10 showed that the steers fed in the open, in comparison with those fed under sheds, made as good gains. During the past year those results were corroborated. It has been conclusively shown that expensive equipment is not needed in order to feed steers successfully. The feeding of fattening steers in the open requires the minimum expenditure for equipment and results in minimum loss of fertility.

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

Rations tested at the West Tennessee Station

Lot No.	No. of steers	Ration	
		Pounds per head per day	
I	4	30 silage; 20 soy-bean hay	
II	4	30 silage; 20 Japan clover hay	
III	8	50 silage; 5, 6, 7 cotton-seed meal	
IV	8	25 cotton-seed hulls; 5, 6, 7 cotton-seed meal	
V	8	60 silage; 7, 8, 9 cotton-seed meal	
VI	8	60 silage; 3, 4, 5 cotton-seed meal	
VII	6	20 silage; 20 corn stover; 6, 7, 8, cotton-seed meal	
VIII	6	20 silage; 20 soy-bean hay; 6, 7, 8 cotton-seed meal	
IX	8	30 silage; 10 oat and vetch hay; 4, 5, 6 cotton-seed meal	
X	8	30 silage; 10 corn stover; 4, 5, 6 cotton-seed meal	
XI	8	30 silage; 10 soy-bean stover; 4, 5, 6 cotton-seed meal	
XII	8	30 silage; 10 oat and barley stover; 4, 5, 6 cotton-seed meal	
XIII	8	30 silage; 10 cotton-seed hulls; 4, 5, 6 cotton-seed meal	
XIV	4	40 silage; 6, 8, 10 corn-and-cob meal; 6, 5, 4 cotton-seed meal	
XV	4	40 silage; 6, 8, 10 corn-and-cob meal; 6, 5, 4 soy-bean meal	

High versus low cotton-seed meal ration The most economical gains were made with the silage and cotton-seed meal groups when the meal was fed in moderate quantities. These results were in accordance with the results of the previous year. The most economical ration seems to

be silage and cotton-seed meal when the meal is fed in the proportions of 4, 5, and 6 pounds per head per day—4 pounds the first 30 days, 5 pounds the second 30 days, and 6 pounds the third 30 days.

Results with different roughages. Experiments with Groups IX, X, XI, XII, and XIII seem to show that when 10 pounds of dry feed is added to the silage ration it makes but little difference what roughage is added, provided it be palatable. Lots I to XIII, inclusive, that were

Average gains fed a low grain ration of cotton-seed meal with silage and some dry roughage, made an average gain per steer of 148.6 pounds, or 1.65 pound per day, at a cost of 9.1 cents per pound. The heavy grain ration fed steers of Lots XIV and XV made an average gain per steer of 200.9 pounds, or 2.23 pounds per steer, at a cost of 9.3 cents per pound.

Effect of breed on gains At the beginning of the experiment the steers were divided into groups as nearly equal in type and quality as possible and then each steer was described in the notes according to color, breed characteristics, and feeder type. If a steer appeared to have one or more crosses of some pure breed, it was described as belonging to that breed. If no breed characteristics seemed to predominate it was described as a scrub. At the close of the experiment, gains of steers belonging to the beef breeds were totaled, as were also the gains of steers belonging to dairy breeds and scrubs, and the following average gains noted, the data being obtained on 80 head:

Breed	No. of steers	Total gain, 90 days Lbs.	Average gain Lbs.
Beef breeds	36	6341	176.1
Dairy breeds	11	1504	136.9
Scrubs	33	4462	135.1

Steers that were the result of one or more crosses of a beef breed made 39.2 pounds more gain than steers in which dairy blood predominated. Beef-bred steers made 41.0 pounds more gain than scrub steers. Not only did the better-bred steers make more gains, but the gains were put on in the more valuable beef cuts and thus made them sell at a wider margin and greater profit.

Effect of feeder type on gains Each steer was also described according to feeder type, regardless of breed characteristics. The following classifications of feeder types were made, viz.: poor, medium, good, and very good.

If a steer possessed heavy quarters, a broad back, and deep heart and digestive capacity, and had good quality, it was described as very good, good, medium, or poor, according as in the estimation of

the judges it would grade. In this classification breed characteristics were ignored as far as possible. The following results were obtained:

Type	No. of steers	Total gain, 90 days Lbs.	Average gain Lbs.
Very good	17	2948	173.8
Good	37	5751	155.7
Medium to poor	26	3603	138.6

Steers of very good feeder type made 18.1 pounds more gain than the next grade lower and 33.2 pounds more than steers medium to poor in type.

When classified according to both breed and type it was found that beef-bred steers of the poorest type made an average gain of 11.1 pounds more than the best type of scrubs. The poorest type of beef-bred steers made 53.0 pounds more gain than the poorest type of the scrubs.

FEEDING AT KNOXVILLE

Beef produced per acre The steer feeding experiments at Knoxville have been carried on according to the plan outlined for previous years. The plan has been to determine the production of definite areas of land,

sown to different crop rotations, in terms of beef produced per acre. Thus far soy beans and barley have given the best results. The barley is sown after the soy beans are harvested in the fall and is harvested as ripe grain in the spring and then sown to soy beans. The average amount of beef produced on the soy-bean and barley acre for the past three years has been 638 pounds. During the year 1910-11 an acre of alfalfa was added to the experiment, and during the year 1911-12 an acre of soy beans and oats and an acre of soy beans and wheat have been added. Three years' work with the double-cropping system has shown that the returns in beef are nearly double those from the single-cropping system.

Ration experiments at Knoxville Four groups of 4 steers each were also fed so as to determine the feeding value of soy-bean and millet hay as compared with cowpea and millet hay, and also soy-bean stover and corn stover.

The cowpea and millet hay gave better results than the soy-bean and millet hay. Soy-bean stover was 50 per cent better than corn stover.

Improvements The work of this Department has been facilitated by the remodeling of the calf barn, with concrete floors and sanitary iron partitions, and the remodeling of the horse barn. Both improvements have made the stables more sanitary.

Much interest is being taken in the work of this Department by farmers throughout the State, and cooperative experiments with them in feeding are being planned for various parts of the State.

Respectfully submitted,

C. A. WILLSON, Animal Husbandman.

REPORT OF THE BACTERIOLOGIST

The work in the Department of Bacteriology has been essentially a continuation and extension of the work connected with soil biology as outlined in previous years and included in former reports, with only such modification and additions as the various aspects of the subject seemed to require.

Mineral fertilizers and nitrogen transformation Stronger emphasis has been placed upon the relation of mineral fertilizers to the transformation of nitrogenous organic matter in the soil than was formerly done. This is a promising field, and has already yielded some conclusive

results. In this connection soils are observed under laboratory conditions in pots, as well as under field conditions. These tests are, of course, comparative and necessitate the detection of minute changes in the soils with respect to their bacteriological capacities. This necessity has encouraged the testing of practically all the methods now in use in connection with bacteriology as related to nitrogen of the soil. These tests show that the methods now in use do not render satisfaction in many particulars and need much modification to make them entirely reliable.

Humus accumulation by individual species The investigation to determine the capacity of different species and combinations of species of bacteria to produce humus in the soil shows that quite decided gains have been made where certain forms have been used. Recently quartz sand

has been used as a medium in which to test the capacity of various bacteria to produce humus from organic matter. Formerly this work had all been done with soil as a medium, but the sand removes many difficulties in connection with the humus estimation and is without serious objection. The sand is washed, extracted with 4-per cent ammonia, and again washed, free from the latter. The organic matter is introduced into this and sterilized, when it is ready for inoculation.

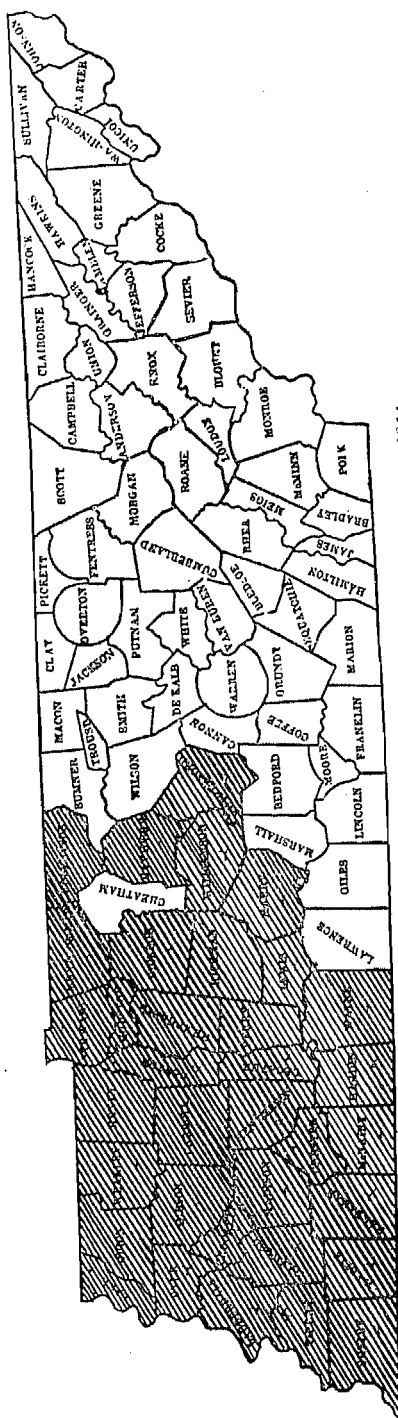
This work has been augmented during the year by the assistance of Mr. H. P. Ogden.

Respectfully submitted,

MAURICE MULVANIA, Bacteriologist.

REPORT OF THE STATE ENTOMOLOGIST

Insect identification Numerous specimens of insects from different parts of the State have been sent in for information as to name, life-history, and methods of control. The insects concerning which the largest number of inquiries have been made are as follows: Hessian fly, squash bug, cabbage bug, green bug, plant lice, woolly aphis, San Jose scale, obscure scale, thirteen-year "locust," pickle worm, cotton-leaf worm, termites, potato beetle, bean weevil, plum curculio, grub-worms, wire-worms, the cucumber beetle and the corn-root worm.



PERIODICAL *Cicada* APPEARED IN SHADED COUNTIES IN 1911

The thirteen-year locust All of West Tennessee and several counties in Middle Tennessee were visited by the periodical *Cicada*, or thirteen-year "locust," in 1911. The accompanying map shows the extent of "locust" outbreak during the year. When the insect was reported as doing its greatest damage, a trip was made through Middle and West Tennessee by Mr. E. C. Cotton and myself. The conditions in twelve counties were studied with reference to numbers and the extent of the injury being done. The insects were carefully studied and found to be the thirteen-year "locust"—*Cicada trediseem* Walsh-Riley, and *Cicada cassinii* Fisher. Many specimens were taken in Cheatham County, furnishing a new record. Advice was given to the orchardists to delay pruning until after the eggs were deposited and then to prune and burn the limbs, thus bettering the shape of the trees and destroying numerous eggs. In many counties the "locust" gathered in the woodlands and low bottoms, and hence caused no appreciable damage. The next occurrence of the thirteen-year "locust" will be in 1916, in Dyer, Lauderdale, Gibson, Madison, McNairy, Stewart and Lincoln Counties.

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

Boiled lime-sulphur solution By means of orchard demonstrations, institutes, short courses, press bulletins, circular letters, and correspondence, the importance of timely and careful spraying has been and is being brought before the public. The boiled lime-sulphur solution has been experimented with, both as a spray in the orchard and upon growing stock, in comparison with the soluble oils at recommended strengths. The results indicate that the soluble oils can not be relied upon to effect cures and frequently do great injury. Hence we can not recommend their use for general spraying. As yet nothing has been found more satisfactory for a winter spray than the boiled lime-sulphur solution. Experiments with the factory-made, concentrated lime-sulphur and the homemade, boiled lime-sulphur have been made in the different parts of the State; the results showing that the factory solutions, testing at 29 degrees to 33 degrees Baume, reduced with ten parts of water, give results comparable to the carefully boiled, homemade solution. Unless good calcium lime is obtainable, and care can be given to the making and straining of the solution, we recommend the user to purchase factory-made lime-sulphur solution.

Self-boiled lime-sulphur solution More extended use of the valuable self-boiled lime-sulphur solution in the orchards of the State as a fungicide has proved its merits, and it is fast becoming generally used in controlling the brown rot of the peach, plum and cherry; the apple blotch; the sooty fungus, and apple scab. As a repellant to the curculio, especially on peach and plum, it has proved a success.

Bordeaux mixture Bordeaux mixture for general spraying is now superseded by the self-boiled lime-sulphur solution. Experiments conducted at three vineyards in the State proved conclusively, however, that the Bordeaux mixture is the better for spraying grapes.

Arsenate of lead Arsenate of lead is fast coming to take the place of Paris green, and its use is strongly encouraged, both in powder and paste form.

Inspection of State nurseries The number of inspections made this year was 368, an increase of 126 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 in the number of nurseries. The annual business represents \$4,000,000.00.

Outside nurseries This year, for the first time, there have been sufficient funds for inspection of shipments of nursery stock coming to this State. Three shipments have been held subject to the order of the shippers; several others have been confiscated. All nursery stock coming to the State is required to be accompanied by both an inspection and a fumigation certificate. The nursery firms shipping into the State must first file their certificates of inspection and their agreement to fumigate with hydrocyanic acid gas all stock shipped into the State.

Foreign nurseries Some twenty of the Tennessee nurserymen purchase seedling 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, and brown-tail and gypsy moths. This year these foreign shipments have been exceptionally free from insect pests and plant diseases, only three small nests of the brown-tail moth and twenty specimens of crown gall having been taken. The foreign inspection tags have been carefully filled out and were intact in each case.

Apiary inspection For the first time in Tennessee an inspection of bees has been made. This was rendered possible through an appropriation of the General Assembly of 1911 (Chapter 50). The number of inspections made during the year, beginning May 1, was 70, embracing a total of 800 colonies. The number of diseased apiaries found was 14; the number of colonies treated 41. American foul brood was located in Hamilton, Giles,

Lawrence, Williamson and Roane Counties. The European foul brood has been discovered in Anderson, Montgomery and Shelby Counties. Most of these cases have been cleaned up and the bees are now in healthy condition. Due to the late beginning of this work it was not possible to make the inspection of the 1200 listed apiaries in the State.

Respectfully submitted,

G. M. BENTLEY, State Entomologist.

REPORT OF THE ASSISTANT ENTOMOLOGIST

The North American fever tick The fever tick has again occupied the major portion of our attention, and valuable information has been gained on the several phases of the project as a result of the year's work.

This project has now been under way five years, during which period we have had a considerable number of lots of adults, eggs and seed ticks exposed to natural conditions out of doors. The great variety of climatic conditions to which the various stages of the tick have been exposed have represented fairly well the extremes that may reasonably be expected in the northern portion of the tick area, except as to the extreme minimum temperatures. But here the temperatures we have experienced have been sufficient to destroy all stages of the tick exposed to them; hence our data may be considered complete. Because of the fullness of our information along this line we have deemed it wise to discontinue this phase of the project. These facts, particularly those with regard to zero temperature, were brought together and the conclusions drawn from them published as Bulletin No. 94 of this Station, during October, under the joint authorship of the writer and Mr. J. F. Voorhees, Consulting Meteorologist. In Part II of this Bulletin Mr. Voorhees has brought out a law of vast importance in life-history work; i. e., that the time of hatching and rate of development of the tick are governed by the initial temperature and the daily rate of increase rather than, as has heretofore been believed, by the total amount of accumulated effective temperature. The author also calls attention to the probability that this law will hold for all insect and plant life.

Pathogenicity tests The pathogenicity tests, carried on cooperatively between this Department and the Veterinary Department, have been continued. During the colder season of the year slight attacks of Texas fever were produced by applying seed ticks reared from eggs laid by female ticks which had become engorged on immune cattle, but until the warmer weather of June we were unable to produce a typical case of fever in this manner. These failures might be attributed to several causes, no one of which is entirely responsible. The fever-producing organism may have been absent from the blood of the immune cattle on which the female ticks became engorged, or the several hundred

seed ticks applied in each instance may not have been a sufficient number to produce a typical case, especially during the winter season, at which time most of these tests were made. Then again the animals used were under two years of age—a fact which might influence the results. In order to eliminate, so far as possible, all of these factors two aged cows were purchased during the latter part of May and the seed ticks applied about June 1. These seed ticks were reared from females that had become engorged on immune cattle near Baton Rouge, La., and were secured through the kindness of Mr. J. B. Garrett, Entomologist of the Louisiana Station. The cows were thrown and the ticks applied to the under side of the body and the inner side of the legs, locations that are probably the most favorable for the attachment and development of the ticks. Fever first appeared in each case on the eleventh day. On the thirteenth day 200 c.c. of trypanblau were injected into cow No. 1, and after a short interval another 200 c.c. were given. In the beginning it was intended that cow No. 2 should serve as a check on No. 1, but on the fourteenth day, when it became clear that the fever in the case of cow No. 1 would prove fatal, an injection of 200 c.c. of trypanblau was made into cow No. 2. That this drug cannot be depended upon to cure Texas fever is indicated by the fact that cow No. 1 died on the sixteenth day and No. 2 on the eighteenth day.

Peach tree borer The investigation of the peach borer was continued along the same lines as during the previous year. In the testing of remedial measures in the experimental orchard the banking of the trees with earth, either with or without a wrapping of paper, has again given the most satisfactory results.

Respectfully submitted,
E. C. COTTON, Assistant Entomologist.

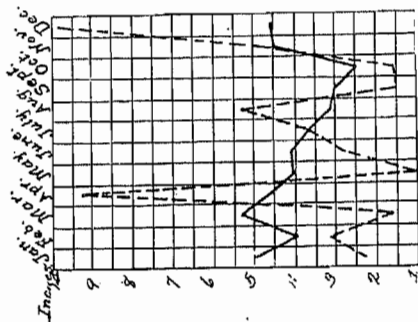
REPORT OF THE CONSULTING METEOROLOGIST

The study of the relation of weather conditions to the Texas fever cattle tick has been continued and the results so far obtained have been published in Bulletin No. 94.

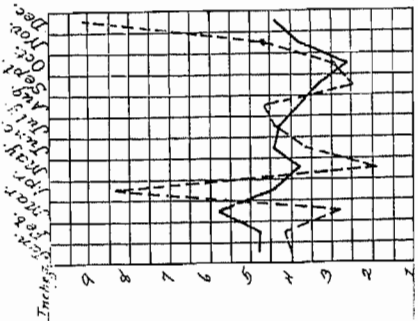
The investigation of the relation of weather and climatic conditions to the soy bean is still going on.

Rainfall for 1911 The accompanying chart shows the 1911 rainfall for Tennessee compared with the normal rainfall. The year 1911 was the hardest for farmers that has been known in this State for many years. Following a dry fall in 1910, which made fall sowing very late and greatly delayed germination of fall-sown crops, the first six months of 1911 were also dry, with the exception of April, which was unusually wet. The wet April helped the fall-sown crops materially, but greatly hindered the spring planting and sowing. Few farmers had their soil in condition to retain the heavy April rains and consequently corn, hay and oats were greatly reduced by the dry weather of May and June. Wheat

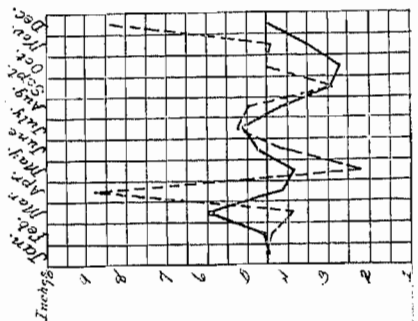
Clarksville Type.



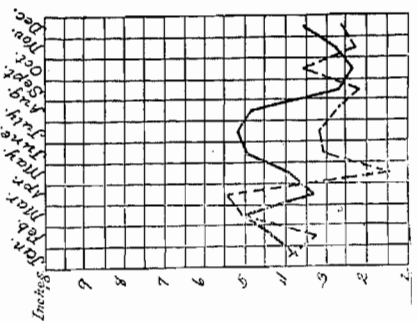
2. Nashville Type.



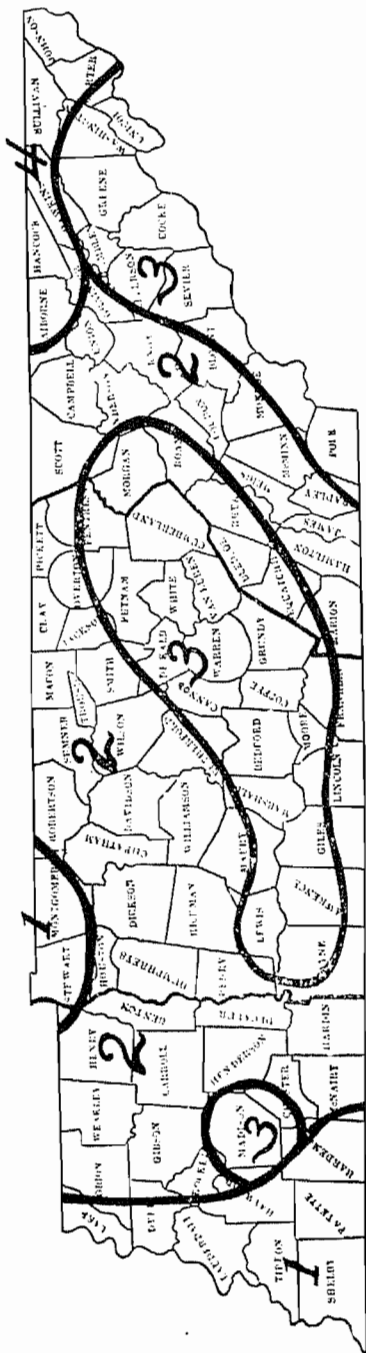
3. Mc Minnville Type.



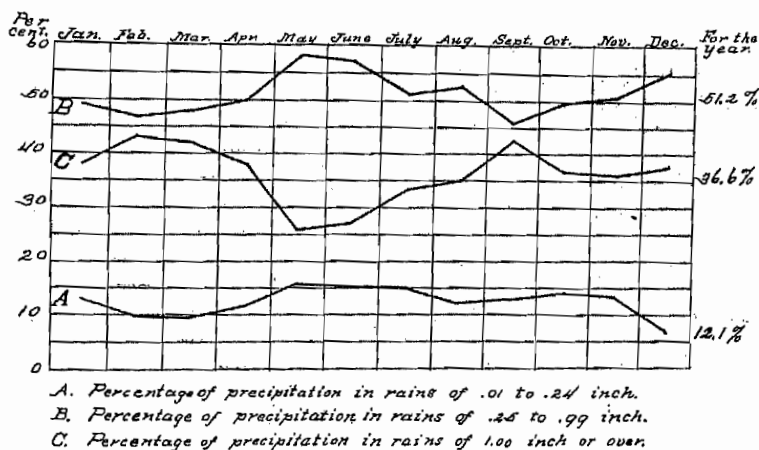
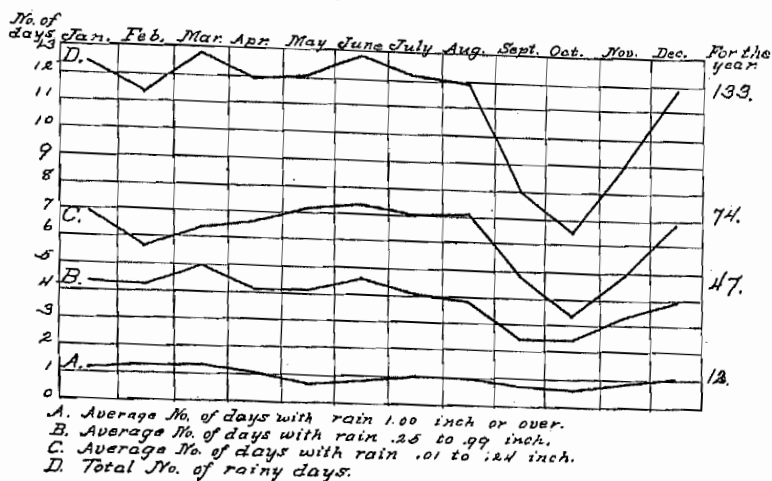
4. Bristol Type.



Four Types of Rainfall (Broken line = rainfall for 1911)



Areas covered by four types of rainfall



was far enough advanced to make a good crop in spite of the dry weather.

Most sections of the State had more than the normal rainfall in July and August and considerable forage was produced. The rainfall during the fall was about normal and December was unusually wet all over the State.

Need for humus As was stated in the report last year, "A study of this chart will emphasize the necessity for tillage methods that will conserve the rainfall of wet periods whenever they may come and make it available during the dry periods that will very likely follow." To catch and retain a heavy rainfall such as that of April, a deep soil well supplied with humus is absolutely necessary.

Rainfall in detail A detailed study of rainfall distribution has been made in order to determine the amount of precipitation that occurs in light, moderate, and heavy rains for the various months and for the year, and also the number of days in each month on which light, moderate, or heavy rains may be expected to occur. For this study the following limits were adopted: A rain amounting to .24 inch or less in 24 hours is called light; a rain of from .25 to .99 inch in 24 hours is called moderate; and a rain of 1 inch or more in 24 hours is called heavy. The Knoxville record of daily rainfall covering 40 years was used for this study.

Number of rainy days From December to August, or during winter, spring, and summer, we may expect on the average 12 rainy days each month. Of these 12 rainy days 3 will probably have so little rain that ordinary farm operations will be hindered little or not at all. On the other 9 days work out of doors will be at a standstill, and for the best economic results, both for the farmer and for the laborer, enough indoor work should be arranged to keep the men occupied at least one-third of the time. The amount of time that must be spent indoors will vary, of course, but will almost always be between one-fourth and one-half of each month. During the fall months the number of rainy days drops to 6 or 8, and less indoor work will be needed to give the men employment.

Light rains Of the 12 rainy days in each month of spring and summer it was found that on 7 of them the precipitation amounted to less than .25 inch for each day and that the total for the 7 days was about 13 per cent of the total rainfall for each month. So large a percentage of the month's rainfall is worth saving, and wherever possible the land should be kept in proper condition to utilize the light rains. This can be done by harrowing or cultivating as soon as possible after the rain.

Moderate rains On 4 of the 12 rainy days moderate rains may be expected or rains of .25 to .99 inch. These rains wet the ground pretty thoroughly unless it is very dry, but will not, ordinarily, wash the soil if it contains a good supply of humus and has been properly tilled. Fifty-three per cent of the total rainfall for the spring and summer months comes in these moderate rains, which can be fully utilized without much difficulty.

Heavy rains On the remaining rainy day in each month 1 inch or more of rainfall may be expected, and it is here that the greatest loss of rainfall and of soil by erosion occurs. It is only by very deep tillage and by keeping the soil in the very best condition for the rapid absorption of water that we can hope to utilize all the water in these heavy rains. On the average 34 per cent of the spring and summer rainfall comes in these heavy rains and if half of this amount is allowed to run off on the surface it reduces the available supply of water very materially.

Besides these rains that are unusual in amount we have rains that may be moderate in amount but in which the rate of fall is unusually rapid. These rains are most frequent in the summer months. The average for this season is a little less than one such rain for each month. The same methods that will retain the water of the heavy rains will also prevent most of the surface drainage in these sudden showers.

Surface drainage should be reduced The average rainfall for this State is ample for six times the average crop produced and every drop of water that is allowed to run off on the surface not only reduces the possible crop production by just that much, but also carries with it material from the soil that it will take money, or time, or labor to replace. Surface drainage not only makes this year's work less effective but robs us of part of the fruit of last year's labor.

Respectfully submitted,
J. F. VOORHEES, Consulting Meteorologist.

REPORT OF THE LIBRARIAN

LIBRARY

Bound volumes	4,484
Accessions during the year.....	252
Purchased	70
Obtained by exchange and gift.....	67
Bound by the Station.....	115
Volumes complete, ready for binding.....	72
Bulletins and pamphlets	17,500
Journals subscribed for	33
Agricultural papers received in exchange for bulletins.....	135

MAILING LIST

U. S. Dept. of Agr. and Exp. Station.....	2,015
Tennessee newspapers	195
Exchange list	235
Individuals in Tennessee	10,330
Other states	450
Foreign, other than exchanges.....	63

 13,288

Respectfully submitted,

F. H. BROOME, Librarian.

TREASURER'S REPORT

JULY 1, 1910, TO JUNE 30, 1911

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

	HATCH FUND	Dr.	Cr.
To unexpended balance on hand July 1.....	\$	18.34	
To United States Treasury Draft, July 13, 1910....		3,750.00	
To United States Treasury Draft, October 13, 1910		3,750.00	
To United States Treasury Draft, January 16, 1911		3,750.00	
To United States Treasury Draft, April 8, 1911....		3,750.00	
By Salaries	\$		8,340.00
Labor			2,686.45
Publications			814.69
Postage and Stationery			325.92
Freight and Express.....			124.51
Heat, Light, Water and Power.....			253.70
Chemical Supplies			81.11
Seeds, Plants and Sundry Supplies.....			260.79
Fertilizers			371.01
Feeding Stuffs			704.58
Library			278.53
Tools, Machinery and Appliances			81.03
Furniture and Fixtures			116.25
Scientific Apparatus			
Live Stock			
Traveling Expenses			80.25
Contingent Expenses			25.00
Buildings and Land			456.18
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, 1911, and find them correct; that the above is a true balance sheet corresponding with said accounts; that the said accounts show no more than \$456.18 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. } 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, Tenn., this 26th day of June, 1913.

THOS. D. MORRIS.
Notary Public.

TREASURER'S REPORT

JULY 1, 1910, TO JUNE 30, 1911

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

ADAMS FUND		<i>Dr.</i>	<i>Cr.</i>
To United States Treasury Draft, July 13, 1910 ...	\$3,750.00		
To United States Treasury Draft, October 13, 1910	3,750.00		
To United States Treasury Draft, January 16, 1911	3,750.00		
To United States Treasury Draft, April 8, 1911....	3,750.00		
By Salaries			\$9,875.00
Labor			529.66
Publications			
Postage and Stationery.....			9.40
Freight and Express			92.61
Heat, Light, Water and Power.....			157.38
Chemical Supplies			465.94
Seeds, Plants and Sundry Supplies.....			302.69
Fertilizers			
Feeding Stuffs			
Library			314.57
Tools, Machinery and Appliances			150.98
Furniture and Fixtures.....			571.97
Scientific Apparatus			1,660.09
Live Stock			
Traveling Expenses			164.30
Contingent Expenses			
Buildings and Land			705.41
Balance			
Totals.....	\$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 30, 1911, and find them correct; that the above is a true balance sheet corresponding with said accounts; that the said accounts show no more than \$705.41 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, }

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, Tenn., this 26th day of June, 1913.

THOS. D. MORRIS,
Notary Public.