THIRD ANNUAL REPORT

OF THE

AGRICULTURAL EXPERIMENT STATION

OF THE

UNIVERSITY OF TENNESSEE

TO THE GOVERNOR

1890.

KNOXVILLE, TENNESSEE.
1891.

OGDEN BROS. & CO.,
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KNOXVILLE, TENN., Jan. 30th, 1891.

To His Excellency, JOHN P. BUCHANAN,

Governor of Tennessee:

SIR:—We have the honor to submit herewith the Annual Report of the Agricultural Experiment Station of the University of Tennessee. This Report is made in accordance with the Act of Congress, approved March 3d, 1887, commonly known as the "Hatch Experiment Act," and the Act of the General Assembly of Tennessee, approved March 28th, 1887, accepting the same and bestowing them upon this Experiment Station. Section 5 of the first mentioned Act contains the following: "It shall be the duty of each of said Stations, annually, on or before the first day of February, to make to the Governor of the State or Territory in which it is located, a full and detailed report of its operations, including a statement of receipts and expenditures; a copy of which report shall be sent to each of said Stations, to the said Commissioner of Agriculture, and to the Secretary of the Treasury of the United States."

Hoping that the report will prove satisfactory to your Excellency, we remain, with great respect,

Your obedient servants,

O. P. TEMPLE, *Chairman of Board of Control.*

CHAS. W. DABNEY, JR., *President.*

J. W. GAUT, *Secretary of the Board of Trustees of the University of Tennessee.*

REPORT OF THE TREASURER.

The Agricultural Experiment Station of the University of Tennessee, in account with the United States:

Dr.		*Cr.*	
1889 and 1890—from July 1st to June 30th. To appropriation for the fiscal year ending June 30th,	$15,000 00	Salaries	$ 7,871 64
		Labor account	949 14
		Heat, Light and Water	556 12
		Library account	338 33
		Experiment Farm	1,047 36
		Chemical Department	180 27
		Botanical Department	156 94
		Publishing and Printing	575 80
		Entomological Division	48 90
		Traveling Expense	270 55
		Apparatus and Supplies	1,446 92
		Stationery and Postage	57 72
		Contingent account	229 21
		Building account	750 00
		Furniture account	521 10
	$15,000 00	Total	$15,000 00

JAMES COMFORT, *Treasurer.*

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, 1890, and find them correct; that the above is a true balance sheet corresponding with said accounts; that the said accounts show that the sum of seven hundred and fifty dollars was expended for building, and no more, and that there is no cash balance. And we further certify that H. L. McClung is too ill to act with us.

S. B. LUTTRELL,
F. A. R. SCOTT.

We hereby certify that Messrs. Hu. L. McClung, S. B. Luttrell and F. A. R. Scott, are the authorized Auditing Committee of this Board of Trustees, and that as a majority of said Committee said Luttrell and Scott are authorized to act for it.

CHAS. W. DABNEY, JR., *President.*

J. W. GAUT, *Secretary.*

Subscribed and sworn to before me this January 31st, 1891.

[SEAL]. W. W. LEE, *Notary Public.*

REPORT OF THE DIRECTOR.

To the Honorable the Board of Control of the Agricultural Experiment Station, and the Board of Trustees of the University of Tennessee :

GENTLEMEN :—I have the honor to present herewith, in compliance with the law establishing the Agricultural Experiment Station, the third annual report of its operations in detail for the calendar year ending December 31, 1890, together with the Treasurer's report for the fiscal year ending June 30, 1890.

The working divisions of the Station are the same as reported last year, namely :

Division of Field and Feeding Experiments.
Division of Chemistry.
Division of Botany and Horticulture.
Division of Entomology.

The present staff of the Station is as follows :

F. Lamson-Scribner, *Director and Botanist.*
C. W. Dabney, Jr., *Chemist.*
H. E. Summers, *Consulting Entomologist.*
Paul F. Kefauver, *Agriculturist.*
R. L. Watts, *Horticulturist.*
J. R. Cummings, *Farm Superintendent.*
E E. Morris, *Clerk to Director.*

Provision has been made for an Assistant Chemist, and Mr. C. C. Moore, one of the senior students in the University, has been acting in that capacity during the past few months. The present Director assumed the duties of his office August 1st., his appointment having been made upon nomination of the President of the University. The positions of Agriculturist and Horticulturist were not filled until October 1st. The former of these positions was rendered vacant early in the year by the resignation of Prof. C. S. Plumb—a circumstance which seriously retarded the work in the Division of Field and Feeding Experiments. The present incumbent, Mr. Kefauver, is an energetic and thoroughly practical young man, a native of this State, and already well known to our community of active farmers. He has taken hold of his division in a manner which leads us to expect much from him. The Horticulturist, Mr. R. L. Watts, who came to us from the State College of Pennsylvania, where he was engaged in Station work, has entered upon the duties of his office with a zeal which promises the best results. Both Mr. Kefauver and Mr. Watts have already published bulletins of much merit in

their respective departments, the demand for them being very considerable throughout the State.

At the time of the appointment of the undersigned as Director and Botanist, the College farm, with its equipment of tools, stock and fixtures was turned over to the charge of the Station under the following terms and conditions:

(1) The Experiment Station is to keep up the land, apparatus, tools and stock to a condition fully equal to that in which they receive it. The University is to have the privilege, after six months' notice to take the farm back under its present management, in which case the Experiment Station must return an equivalent amount of stock, produce, implements, etc.

(2) The Professor of Agriculture and his classes are to have all the privileges of the farm as heretofore, the farm being kept up so as to fitly illustrate farm methods and practices. Everything is to be maintained there on the present basis, and in accordance with the instructions of the Board, as they may be given from time to time.

(3) The Experiment Station shall conduct the farm as a purely experiment farm, under the above conditions. It will defray all the current expenses of the farm, but shall have with it all stock, implements, etc., free of rent, with the following exceptions:

The proceeds of the sale of farm produce, increase of stock, etc., shall be paid to the Treasurer and deposited by him to a separate account. Of the fund so created, one-half is to go to the general treasury of the University, the Experiment Station guaranteeing the University at least $1,000.00 per annum; the other half is to go to a special fund for repairs, buildings, and improvements on the farm, the Agricultural Department building, greenhouse, or horticultural grounds.

(4) The Experiment Station shall maintain the Agricultural Department building, pay all the expenses of water, gas, fuel lights etc., and shall defray the expenses of labor, plans, improvements and so on, on the Horticultural grounds and on the grounds about the Agricultural building up to the south road running around the hill.

Since August 1st., the Station has conducted its operations in relation to the College farm in accordance with the above. At that time also, a complete inventory of the farm stock, implements and equipments, was made out and placed in the hands of the Director.

BULLETINS:—During the year the Station has published six regular Bulletins and four specials, as follows:

(1) From the Division of Field and Feeding Experiments, on "Experiments in Growing Potatoes." This report is on

experiments made by the Division in 1889, the subject being treated under the following headings :

(*a*) Concerning the influence of the amount of seed tuber planted upon the resulting crop of Irish potatoes.

(*b*) Trial of the *Rural New Yorker* "Trench System" of Potato Culture.

(*c*) Test of Varieties of Irish Potatoes.

(*d*) Early vs. Late Culture for Sweet Potatoes.

(2) From the same Division as No. 1, on "Tests of Varieties of Barley, Corn, Oats, Wheat, and Sorghum;" on "Methods of Culture of Wheat, and Effects of Fertilizers on Oats and on Clover."

(3) "Points about Country Roads," by Prof. W. W. Carson, Professor of Civil Engineering in the University. Every farmer in the State is directly interested in country roads. There are sections within our territory where the condition of these roads is such as destroy all possible profit on farm produce which must be hauled over them to market. Anything which will help or lead to an improvement in our country roads will directly promote our agricultural development. The Bulletin in question points out the ways and means for accomplishing this.

(4) "Practical Experiments in Reclaiming 'Galled' or Washed Lands; with Notes on Mulch and Mulch Materials," by Paul F. Kefauver. Where there are so many steep hillsides as there are in East Tennessee, and where the soil is by nature especially liable to "wash," as it is here, the practical value of a Bulletin on this subject is sufficiently evident. The experiments made determined the possibility of securing a stand of grass upon the bare red earth and of preventing further washings.

(5) "Fruit-Trees at the Experiment Station," by Mr. R. L. Watts. In this Bulletin the 182 varieties of fruit-trees on the Horticultural grounds are each briefly characterized and their present condition noted. Besides this, the report covers: (1) General observations upon the fitness or adaptability of our State for fruit-growing. (2) Timely remarks upon the subjects of Harvesting, Packing and Marketing our fruits.

(6) Bulletin 6 is an Index to the Bulletins of the Station during the past two and a half years, which form Volumes I, II, and III. A brief synopsis of the contents of the Specials is also given.

The Special Bulletins which have been published during 1890 are C—(Issued May 10) "On the Treatment of Certain Fungous Diseases of Plants," by the Botanist. It deals with the nature and habits of parasitic fungi and how their attacks may be prevented.

D—(Issued July 10). "On Potash and Paying Crops." The edition of this was furnished the Station by the American Agent of the German Kali Works.

E.—(Issued July 20). "On the Cotton Worm and Hessian Fly," by the Entomologist. The habits of these insects are described and practical methods of destroying them or preventing their ravages, are suggested.

UNPUBLISHED MATERIAL.—Besides the matter published, referred to above, there is now in hand, ready for publication, the following:

(1) "On the Rots and Mildews of the Vine," by the Botanist. It was designed to publish this report early in 1890, but owing to delays in procuring certain plates designed to illustrate it, the season for its greatest usefulness passed and it was thought best to substitute, for the time, other matter.

(2) "Peanut Culture and Products," by L. P. Brown.

(3) The January Bulletin for 1891, which contains the following papers, each Division contributing:

Crab-grass Hay.
Sorghum as a Forage Plant.
Feeding Steers with First and Second Crop Clover.
Pasture Grasses.
Black-Knot of the Plum and Cherry.
Pruning Fruit-Trees.
The Glassy-winged Soldier-Bug.
Diseases of Cattle.

There will be distributed with this January Bulletin, "Farmer's Bulletin No. 2," or "The Work of the Experiment Stations," over 3,000 copies of which having been furnished us by the Secretary of Agriculture for distribution in this State to those on our mailing list.

Bulletins in preparation and work now in progress are referred to in the reports of the Division officers appended.

It was found advisable to revise our State mailing list, and in doing this we have tried to get into closer relation with the farmers of the State and learn more definitely their wants and their individual interests. We have secured a most valuable list of names, and now have recorded the special line or branch of Agriculture each one is directly interested or actively engaged in. This record will be of great service to the Station.

I cannot close this Report without referring to the close attention to duty, and the cordial and hearty support afforded me by the several members of the Station staff.

Respectfully submitted,

F. LAMSON-SCRIBNER,
Director.

REPORT OF THE CHEMICAL DIVISION.

To Prof. F. Lamson-Scribner, *Director:*

Sir:—The following brief report of the work of the Chemical Division of the Experiment Station for the year 1890, is respectfully submitted:

Mr. L. P. Brown had charge of the operations of this Division, as acting chemist, until the 1st of July. The undersigned was appointed chemist-in-charge at that time, and the position of assistant chemist was created. The latter position was, however, not filled until recently, when Mr. J. B. McBryde, C. E., recently chemist of the South Carolina Experiment Station, was appointed. Mr. Charles C. Moore, Jr., a member of the Senior class of the University, and an advanced chemical student, has rendered valuable assistance in the laboratory during the six months ending January 1st. Considering that he was only able to give a small fraction of his time to this work, he accomplished very satisfactory results.

When Mr. Brown resigned, on the 1st of July, it was with the expectation that he would go on with work commenced early in the year, upon the methods of determining butter-fat in milk, and especially those which could be used in the dairy. This work Mr. Brown is still prosecuting at his home in Maury county, and will bring to a conclusion. There are two leading objects in this investigation. The first one was to make a comparison of all the different, simpler forms of apparatus for determining butter fat in the dairy; the second was to ascertain, if possible, the explanation of the very common difference between the churn and the laboratory. Incidentally Mr. Brown has been making some very interesting tests of registered Jersey cows belonging to some of the most distinguished herds in Middle Tennessee. We have reason to expect that this report will be both interesting and valuable.

A great deal of time has been devoted during the year by Mr. Brown to an investigation of the peanut crop of Tennessee, its statistics, cultivation, and especially its chemistry. Specimens of all the different varieties and parts of this plant were collected and analyses made, both for the purpose of determining their feeding value and ash ingredients. This crop has been strangely neglected heretofore, there being no mention of it in any of the Census Reports, and only two brief notices in the reports of the United States Department of Agriculture, for the entire period of its existence. As it is the leading money crop in six or seven counties in this State,

and as many in Virginia, North Carolina and Georgia, it was considered worthy of thorough investigation. The analyses have been completed and the report is now ready for publication. It will contain the statistics of this crop, as far as they can be obtained, and a discussion of the soils on which it is grown, the manures and fertilizers suitable for it, as far as the analyses or practical experience teaches us anything on this subject, and a compilation of the experience of the best farmers with regard to the methods of cultivating, curing and marketing it. The attention is especially directed to the cured vines, which make a hay almost, if not fully, equal to clover hay. It will prove, we believe, a valuable report upon this rather unique and interesting plant.

At your suggestion, the facts have been collected and the matter written out in part for a popular report on fertilizers, manures, and materials occurring in Tennessee, from which they can be prepared. Though this is a comparatively old subject in many of the States, fertilizers are really just beginning to be extensively used in Tennessee. It is necessary that our farmers have a clear exposition of the subject of soils, methods of making soil tests with fertilizers, and the best plans for mixing fertilizers, or making composts at home. The letters we receive indicate that such information will be welcomed by them, because it will supply a need which is felt at this time.

A Bulletin is now in course of preparation on the chemistry of the cotton plant. This Station has already published a Bulletin on the cotton-seed and its products, and it proposes now to issue one which will discuss in a thorough manner the chemical composition of the entire plant. Analyses have been made of the different parts including roots, stem, leaves, boll seed and lint, and careful determinations made of the proportions of these parts to the entire plant. It is proposed to write up the results from a practical standpoint, showing what the plant requires in the way of nitrogenous and mineral food, its relations to the various kinds of soil and especially its relation to the question of the exhaustion of the soil. The data for this paper have been in course of preparation for a considerable time, and our newly appointed assistant chemist, Mr. McBryde, will make valuable contributions to them which will enable us to complete it, ready for publication, at an early day.

This Division has made a number of tests of the butter sold in the largest cities in Tennessee, with special reference to the presence of oleomargarine. The butter samples from Memphis, Tennessee, have been analyzed and samples taken from leading dealers, hotels and restaurants in other cities,

will be examined in a similar manner, as fast as they can be obtained. This work was undertaken in connection with the Agriculturist of the Station, and its purpose is to show what an excellent market we have here at home for butter, and how profitable its production can be made.

Some of the routine work of this Division may be summarized as follows:

MISCELLANEOUS CHEMICAL ANALYSES MADE DURING THE YEAR.

Those analyses which form a part of systematic work are omitted.

Grasses and fodders analyzed	11
Grain and feeds "	3
Commercial Fertilizers "	7
Phosphates "	12
Manures and composts "	2
Vegetable products and parts of plants analyzed	5
Ash Analyses	4
Dairy products analyzed	15
Minerals "	2
Mineral waters "	1

In addition to the work mentioned above, which is still incomplete, I would suggest the extension of our investigations of dairy questions, to include a study of milk produced by different rations, especially that resulting from the use of cotton-seed meal and other feeding stuffs peculiar to our State; investigation of typical virgin soils common to the State; and a systematic chemical examination of another one of our leading crops, similar to that made of the peanut and the cotton plant, as described above.

Although the work of this division has been greatly interrupted during the year, we believe that some excellent results have been obtained, whose publication will be of material benefit to the farmers of the State.

Yours respectfully,
CHAS. W. DABNEY, JR.,
Chemist.

DIVISION OF FIELD AND FEEDING EXPERIMENTS.

PROF. F. LAMSON-SCRIBNER, *Director:*

SIR:—I assumed charge, by appointment, of this Division, Oct. 1, 1890. During the year considerable work has been done in the department, some of which has already been published in our Bulletins, while some, being as yet incomplete,

will be published later. The herd of Jersey cattle has been increased and improved by the purchase of several well bred cows, and it is intended to make this a model dairy herd.

A strict account of expenses and receipts will be published with our next annual report. By this we hope to demonstrate, in a practical manner, just how much there is in the dairy business for our farmers, when properly managed. The dairy is also being equipped with the latest and most improved implements, and will be kept in exhibtion order. This dairy will be very valuable also in the college work.

FIELD EXPERIMENTS IN GRASSES AND CLOVER.—A valuable collection of exhibition grass plots, in pure cultures, has been made. These are arranged so as to illustrate, as far as possible, the difference in the different families, as also in the different varieties of the grasses and clovers of the same family. An effort is being made to include all native and foreign varieties of promise in this collection during the coming season.

The most important experiments for some time to come will be made in the grasses.

FIELD EXPERIMENTS IN TILE DRAINING.—Some very important experiments are now being made, however, in tile drainage. The object in this is not only to test the increased productiveness, but the comparative earliness of vegetation on land drained and not drained. The importance of this latter feature would seem to be very great, since the growth of new markets at home, and the increased shipping facilities to northern markets, is giving truck farming an impetus never before experienced. Tile draining to produce earliness would seem also to be especially adapted to our State on account of heavy spring rains.

EXPERIMENTS IN THE STUDY OF MICRO-ORGANISMS.—Investigations are being made relative to the work of certain micro-organisms in producing nitrification in the soil, and the value of certain leguminous plants, and certain kinds of mulch in innoculating the land with these organisms.

OTHER EXPERIMENTS.—Experiments have been made in growing alfalfa, in growing corn from seed procured from different localities, from New York to Louisiana; in growing Irish potatoes; and in top-dressing meadow—reports from which will be issued in due season.

FEEDING EXPERIMENTS.—The most important of these, made by Prof. Plumb—testing the comparative feed value of ensilage and dry fodder; also in feeding first and second crop clover hay, which last has been reported; also in feeding al-

falfa and crab-grass hay, and in pig feeding, which have not yet been reported.

Experiments are also in progress for testing the comparative value of raw, boiled, roasted and steamed cotton-seed in a milk, and also in a butter ration.

Respectfully submitted,

PAUL F. KEFAUVER,

Agriculturist.

ENTOMOLOGICAL DIVISION.

PROF. F. LAMSON-SCRIBNER, *Director:*

DEAR SIR:—The work of the Consulting Entomologist during the past year has been largely devoted to increasing and classifying the collection of insects owned by the station. This collection now contains about 10,000 specimens, representing fairly well, it is believed, the insect fauna of Eastern Tennessee. All the orders have been more or less worked upon, but chief attention has been devoted to the heteroptera. A Bulletin is being prepared upon this order, which will contain several original synoptic tables. These tables, although they will occupy but a comparatively small space in the Bulletin, have necessitated a large amount of study upon this order of insects

A Bulletin upon one of the heteroptera, *Hyaliodes vitripennis*, the Glassy-winged Soldier-Bug, containing drawings, a description and account of the habits of that insect, has been presented for publication; also, a Bulletin on the Hessian Fly and Cotton-Leaf Worm has been published. The last contained no original descriptive matter, but one original figure. Some correspondence regarding insects doing injuries in various parts of the State, has been answered.

Some larvæ, apparently dipterous, living in the gum exuding from peach trees, on account of injuries done to the trees by the peach borers, are being studied.

Respectfully.

H. E. SUMMERS,

Consulting Entomologist.

DIVISION OF BOTANY AND HORTICULTURE.

PROF. F. LAMSON-SCRIBNER, *Director:*

DEAR SIR:—My present duties began October 1st, 1890. Owing to the limited time that I have been engaged by the

Station, no experiments have been completed, and hence only a statement can be given of future plans and experimental work now in progress.

Perhaps the most important field of investigation for the Horticultural Department is the testing of large fruits. One hundred and eighty-three trees of apples, pears, peaches, nectarines, apricots, cherries, plums, and figs, are being tested in the Station orchard, with a view to ascertaining the varieties best adapted to our soil and climate. Most of the above named stock was obtained from northern nurseries; but a large number of native grown trees, chiefly apples of southern origin, will be planted on our grounds in the Spring, thus making a comparative test with the northern sorts. Plans are also being prepared to graft the more promising apples, both of southern and northern origin, on native stock growing on the Cumberland plateau. We regret that there is no stock in the orchard that could be used for grafting purposes, but we hope soon to be able to secure some trees that may be worked after they become firmly established.

A small plot east of the orchard has been prepared for an experimental vineyard, in which we desire to test a large number of varieties of grapes, illustrating the different methods of training, and treat the various diseases to which the vine is subject. Variety tests will also be made with raspberries, strawberries, blackberries, currants, gooseberries, and vegetables. The germinating power and purity of all vegetable seeds to be used by the Station, will be determined before planting; also, we desire to make investigations upon the influence of certain conditions effecting the sprouting of seeds.

Respectfully,

R. L. WATTS,

Horticulturist.

TEST OF FEED VALUE OF FIRST AND SECOND CROPS OF CLOVER.

BY C. S. PLUMB.

On November 1, 1889, the experiment recorded below was commenced. The object was to compare the feeding value and effect of the first and second crops of clover hay upon fattening steers.

The four animals fed were divided into two equal lots. They were grade shorthorns, each two years old, very docile, and, under ordinary conditions, excellent animals for fattening. While salivation always attended the use of the second crop of clover, markedly so at times, in no other way were the steers changed from the normal condition of health.

The animals were fed twice daily, and excepting an hour's airing each day in an inclosure where no food could be secured, they were kept in the stalls. The experiment was continued for 140 days, and was divided into periods of ten days each. The periods alternated, lot 1 (Nos. 44 and 45) receiving first-crop clover ten days, and lot 2 (Nos. 46 and 47) receiving second-crop clover during the same period. Beginning with the eleventh day, the clover fodders were changed for the two lots, lot 1 receiving second-crop, and lot 2 the first-crop. There were, therefore, fourteen of these alternate feedings. In every case the first crop of clover was well eaten, as can be seen by referring to Table II. The second crop, however, was eaten reluctantly, and its use was accompanied with more or less salivation, the mangers generally becoming quite wet from the abnormal secretion running from the mouth. The thought occurred that possibly the protein was much greater in the second growth than in the first, and that the food was "too rich," as is sometimes claimed. So, in order to somewhat balance this return, cut wheat straw was fed to a limited extent, and was rather relished by the animals.

However, chemical analysis of the clover gave no material difference in composition of first and second crop, excepting in crude fibre. The albuminoids, which it was thought might materially differ in the two crops, did not differ enough to have any special significance in feeding value. The following is the table of analysis:

TABLE I.

ANALYSES OF THE CLOVER AND WHEAT STRAW FED TO THE STEERS.

Averages for two analyses made at different periods.

	Clover.		Wheat Straw
	First Crop	Second Crop	
Moisture	8.91	8.29	5.57
Crude ash	7.69	7.13	4.33
Crude fibre	23.05	31.28	38.54
Ether extracts or fats	3.34	2.26	1.61
Nitrogen, free extract	44.07	37.92	46.45
Albuminoids (N. 6.25)	12.94	13.12	13.50
	100.00	100.00	100.00

Table II. (p. 17) shows the amount of water drank and food eaten throughout the experiment. In this table, animals 44 and 45, (lot 1), during each period, received different clover from animals 46 and 47 (lot 2). Beginning with period 1, Nos. 44 and 45 received first crop clover, and Nos. 46 and 47, second crop.

In Table III. (p. 18) is recorded the number of pounds of each kind of food consumed during the periods of feeding the first crop of clover. It will be seen that the four animals ate the following amounts of food:

First-crop clover	3,401.5 pounds.
Bran	1,010.0 pounds.
Corn meal	2,020.0 pounds.
Total	6,431.5 pounds.

Comparing these figures with Table IV, which gives the number of pounds of each kind of food consumed during the periods of feeding the second crop of clover, we have the following:

Second-crop clover	1,059.25 pounds.
Wheat straw	1,076.75 pounds.
Bran	1,008.50 pounds.
Corn meal	2,316.50 pounds.
Total	5,461.00 pounds.

Comparing these figures with the loss or gain in weight, which is shown in Tables III, IV, and V, (on p. 20) we have the following interesting group of figures:

TOTALS OF FOOD CONSUMED AND GAIN IN WEIGHT IN POUNDS.

Period.	Clover.	Straw.	Bran.	Corn Meal.	Gain.
First crop	3,401.50	....	1,010.00	2,020.00	638.0
Second crop	1,059.25	1,076.75	1,008.50	2,316.50	100.0

According to these figures:

It required of first crop of clover and grain, 10 pounds of food to 1 pound of gain.

It required of second crop of clover and grain, 54.6 pounds of food to 1 pound of gain.

TABLE II.

WATER DRUNK AND FOOD EATEN FOR EACH PERIOD.

	LOT I.										LOT II.									
	No. 44					No. 45					No. 46					No. 47				
Periods	Water	Clover-Hay	Straw	Bran	Corn meal	Water	Clover-Hay	Straw	Bran	Corn meal	Water	Clover-Hay	Straw	Bran	Corn meal	Water	Clover-Hay	Straw	Bran	Corn meal
1	250.8	68.	.....	38.	38.	259.	63.	.....	40.	39.	345.8	59.8	.....	45.	41.8	309.	56.8	..	45.	41.8
2	374.	56.4	.....	20.	81.8	485	64.4	....	23.	82.8	537.8	139.4	.....	25.	65.	543.8	121.12		25.8	67.8
3	526.	123.	.....	32.	73.	467.	105.8	...	32.	73.	514.	48.	51.	37.	80.	475.	42.8	53.	35.	73.
4	442.8	38.8	50.	28.	77.	362.	23.	50.	28.	77.	526.8	142.8	....	34.	80.	521 8	141.	..	34.	80.
5	488.	125.8	.....	25.	63.	421.12	97.8	.....	26 8	60.8	480.4	34 8	44.	30.	81 8	448.	28.8	44.	28.	83.8
6	446.	31.	37.	25.	69.8	405.	32.4	38 4	28.	72.	528.	115.8	.....	31.	69.	567.	119.	..	31.	69.
7	669.	142.4	.....	36.8	70.	552.	115.12	.....	37.	72.	613.	48.8	50.4	42.8	91.8	624.	44.8	48 4	42.8	92.
8	413.	28.	45.8	35.	75	440.	29.	44.	35.	75.	628.	136.		39.	71.8	623.	143.4	.....	39.	71.8
9	548.	124.12	.....	39.8	78.8	426.	97.	.....	40.	81.	486.	29.	39.	40.	89.	457.	28.	38.8	40.	89
10	524.	43.	50.	39.8	89.	524.	36.8	51.4	44.	93.	678	132.12	.....	44.	90.8	641.	133.8	.....	44.	90.8
11	558.8	134.4	.....	40.	80.	539.	117.4	.....	40.	80.	466.	32.12	43.	40.	98.8	512.	24.	39 8	40.	98 8
12	491.	24.12	42.8	40.	94.	529.	24.12	44.	40.	94.	578.	117 12	.....	40.	81.	651.8	140.8	.....	40.	81.
13	519.	130.	.....	39.	63.	457.	125.	.....	40.	72 8	460.	35.	57.	39.	83 8	514.	47.4	49.8	39.	94 8
14	432.	32.4	29.12	40.	99.8	502.	37.4	37.8	40.	100.	540.	105.12	.....	40.	80.	622.	144.4	.....	40.	80.

To show more clearly the effects of each kind of fodder, that is if it is possible to assign any marked differences to the clover, these foods are separated into two classes, based on the clover.

TABLE III.

POUNDS FOOD EATEN DURING FIRST-CROP CLOVER FEEDING PERIODS AND POUND-GAINS IN WEIGHT.

Periods	No. 44.				No. 45.				No. 46.				No. 47.			
	Clover-Hay	Bran	Corn meal	Gain or Loss in Weight Animal	Clover-Hay	Bran	Corn meal	Gain or Loss in Weight Animal	Clover-Hay	Bran	Corn meal	Gain or Loss in Weight Animal	Clover-Hay	Bran	Corn meal	Gain or Loss in Weight Animal
1	68	38	38	37½	63	40	39	35								
2									139¼	25	65	35	121¾	25½	67½	50
3	123	32	73	37	105½	32	73	60								
4									142½	34	80	25	141	34	80	32½
5	125½	25	63	8	97½	26½	60½	27								
6									115½	31	69	25	119	31	69	33½
7	142¾	36½	70	35	115¾	37	72	20								
8									130	39	71½	32½	143¼	39	71½	30
9	124¾	39½	78½	30	97	40	81	10								
10									132¾	44	90½	20	133½	44	90½	20
11	134¼	40	80	15	117¼	40	80	30								
12									117¾	40	81	45	140½	40	81	35
13	130	39	63	15	125	40	72½	25								
14									105¾	40	80	0	144¼	40	80	15
Total	847¾	250	465½	Gain 102½	721	253½	478	Gain 137	889½	253	537	Gain 182½	943¼	253½	539½	Gain 216

TABLE IV.

POUNDS FOOD EATEN DURING SECOND-CROP CLOVER FEEDING PERIODS, AND POUND-GAINS IN WEIGHT.

Feeding period	No. 44.					No. 45.					No. 46.					No. 47.				
	Clover-Hay	Straw	Bran	Corn meal	Gain or Loss in Weight Animal	Clover-Hay	Straw	Bran	Corn meal	Gain or Loss in Weight Animal	Clover Hay	Straw	Bran	Corn meal	Gain or Loss in Weight Animal	Clover-Hay	Straw	Bran	Corn meal	Gain or Loss in Weight Animal
1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	59½	....	45	41½	22	51½	.....	45	41½	55
2	56¼	.....	20	81½	20	64¼	.....	23	82½	35	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	48	51	37	80	15	42½	53	35	73	25
4	38½	50	28	77	5	23	50	28	77	25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	34½	44	30	81½	25	28½	44	28	83½	37½
6	31	37	25	69½	10	32¼	38¼	28	72	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	48½	50¼	42½	91½	25	44½	48¼	42½	92	36½
8	28	45½	35	75	10	29	44	35	75	20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	29	39	40	89	2½	28	38½	40	89	15
10	43	50	39½	89	10	36½	51¼	44	93	20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32¾	43	40	98½	17½	24	39½	40	98½	25
12	24¾	42½	40	94	22½	24¾	44	40	94	20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	35	57	39	83½	12½	47¼	49½	39	94½	5
14	32¼	29¾	40	99½	2½	37¼	37¼	40	100	17½	.....	.....	..	.....	.....	.....	.....	.....	.....	.....
					Gain					Gain					Loss					Loss
Total	253¾	254¾	227½	585½	45	247	265	238	593½	85½	287¼	284¼	273½	565½	14½	271¼	272¾	269½	572	16

TABLE V.

WEIGHTS OF STEERS FOR EACH PERIOD, WITH POUND-GAINS FROM PERIOD TO PERIOD.

Period	LOT I.				LOT II.			
	No. 44.		No. 45.		No. 46.		No. 47.	
	Weight	Gain	Weight	Gain	Weight	Gain	Weight	Gain
1	942½	.....	865	.....	972	.....	1030	.....
2	905	—37½	830	—35	950	—22	975	—55
3	925	20	865	35	985	35	1025	50
4	962	37	925	60	1000	15	1050	25
5	957	— 5	900	—25	1025	25	1082½	32½
6	965	8	927	27	1000	—25	1045	—37½
7	975	10	925	— 2	1025	25	1078½	33½
8	1010	35	945	20	1050	25	1115	36½
9	1000	—10	965	20	1082½	32½	1145	30
10	1040	30	975	10	1080	— 2½	1130	—15
11	1050	10	1000	25	1100	20	1150	20
12	1065	15	1030	30	1082½	—17½	1175	25
13	1087½	22½	1050	20	1127½	45	1210	35
14	1102½	15	1075	25	1140	12½	1215	5
15	1100	— 2½	1092½	17½	1140	0	1230	15

SUMMARY.

A careful examination of the data bearing on this experiment apparently shows that:

1st. First crop of clover is more relished by steers than is the second crop.

2nd. That where the first crop of clover was fed, it required only about 10 pounds of food to make 1 pound of gain, but when the second crop of clover was fed, 54.6 pounds of food were required to make one pound of gain.

3d. Feeding second crop of clover caused salivation, and the food was not relished.

4th. Chemical analyses of the clovers fed show no material differences in composition such as might reasonably be supposed to exist and might account for the salivation. An excess of nitrogenous matter has been supposed to cause this, but such does not exist here.

5th. That while wheat straw was relished when fed with the second crop of clover, it did not, as fed, tend to lessen the injurious effects of the latter.

The work outlined above was carried on, under my direction, by Mr. W. N. Price, to whom I am indebted for the weighings and feedings.



TEXAS BLUE-GRASS—POA ARACHNIFERA.

DIVISION OF BOTANY AND HORTICULTURE.

I. PASTURE GRASSES.

BY F. LAMSON-SCRIBNER.

Texas Blue-grass.—*Poa arachnifera.*

(PLATE I.*)

Those desiring a permanent pasture-grass for fall and winter grazing, especially in the middle and western parts of the State, will hardly find anything superior to Texas blue-grass. It is deep-rooted, with strong creeping rhizomes, and consequently forms a dense turf; it stands, without injury, the hottest and dryest summers, and the cold of our winters appears not to effect it in the least. There is no grass in our trial plots which at this season (middle of January) is so green and fresh in appearance. Its dense mass of root-leaves, now fully two feet long, are of a deep rich green, and stand in striking contrast with those of Kentucky blue-grass close by, these being short, and seared by frequent frosts.

Texas blue-grass is strictly an American grass, and was discovered just forty years ago near the head waters of the Trinity river in northern Texas. Its near botanical relation with our Kentucky blue-grass suggested the name by which it is designated. It is a Poa, and specifically *Poa arachnifera*, the specific name having reference to the long and dense growth of cobwebby hairs which usually surround the flowers. The presence of these hairs renders it practically impossible to sow the seed in the ordinary way; if used, they have to be planted like garden seed, which is a tedious way to sow grass. A better and more certain way of propagation is by sets or sod cuttings. These may be set out, as one would sweet potato slips, in February or March, in rows two and one-half feet apart, and ten inches distant in the rows. By the autumn following, the grass will generally cover the whole ground.

Mr. George H. Hogan, of Ennis, Texas, was among the first to cultivate this grass, and after a dozen years' experience with it he says: "Of all the grasses indigenous to our country, the *Poa arachnifera* stands first as a winter grass. With each succeeding year I am more and more convinced of its merits."

*Plates I and II are from "The Grasses of North America," by Dr. W. J. Beal.

It is a very early grass, blossoming here in April, and seeding during the following month.

Mr. J. L. Thomas, of this city, has had this grass under cultivation for four years, and he has very kindly stated to us his experience with it. He planted by root cuttings; tried seed with but poor results. The grass was readily established by the roots, and held its own well against weeds and other grasses, "taking the ground." It has remained green through summer and winter, appearing to grow best during the fall and winter months. It is a grass of no value for hay, not being at all adapted for cutting; it is, however, of special value for winter grazing, horses and calves (the only stock tried) appearing to like it quite as well as other grasses.

We would be very glad to hear the experience of others in the State who have cultivated this Texas blue-grass.

Chemical analysis of Texas blue-grass, made by Dr. Clifford Richardson, from Report of U. S. Department of Agriculture:

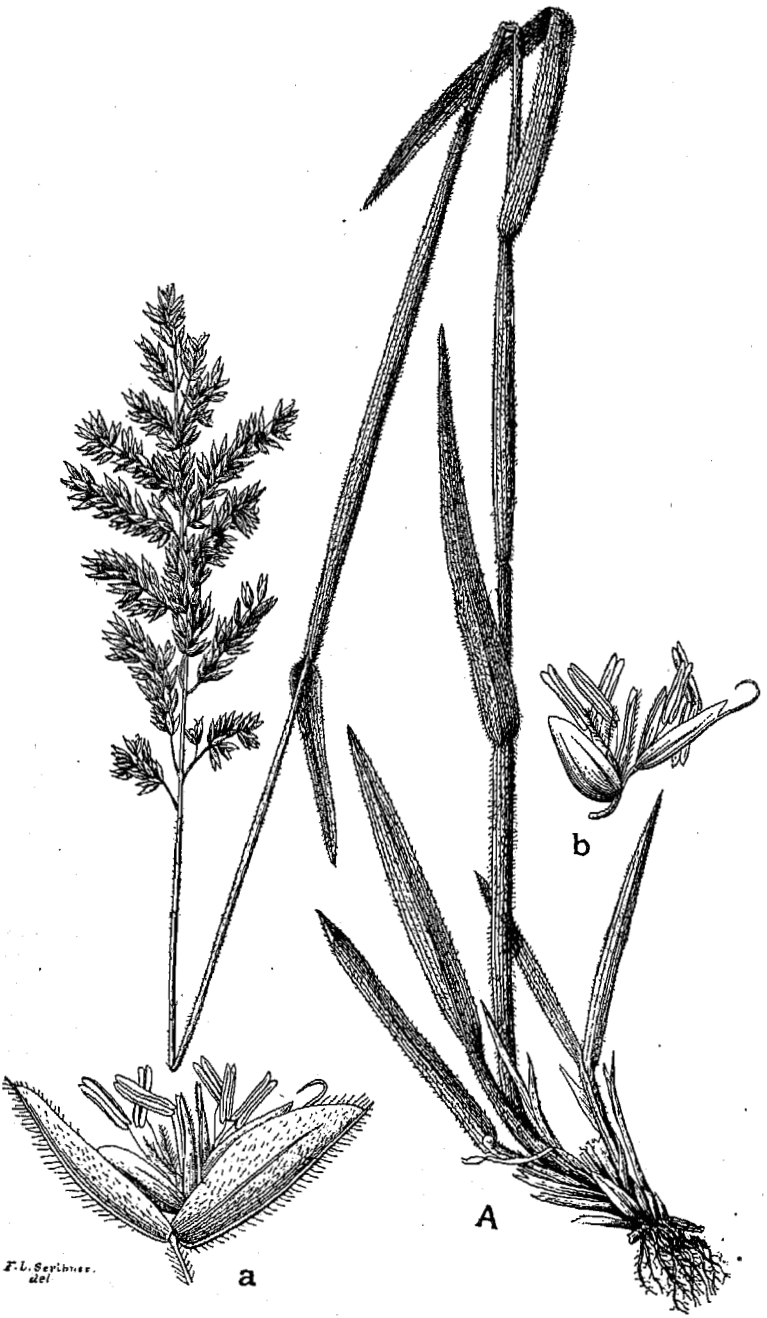
COMPOSITION OF DRY MATTER.

Ash	11.62
Fat	3.71
Nitrogenous free extract	42.16
Crude fibre	31.89
Albuminoids	10·61
Total nitrogen	1.70
Non-albuminoid	
Per cent. of nitrogen as non-albuminoids	

COMPOSITION OF FRESH SUBSTANCE OR HAY.

Water	14.30
Ash	9.96
Fat	3.18
Nitrogenous free extract	36.13
Crude fibre	27.33
Albuminoids	9.10
	100.00

Figure A, in our plate illustrates an entire plant, showing the strong creeping rhizomes. a, is an enlarged figure of one of the spikelets, and b, shows one of the florets, with the long, interlaced and webby hairs at the base.



VELVET GRASS—HOLOUS LANATUS.

Velvet Grass.—*Holcus lanatus.*

(PLATE II.)

Last summer a correspondent sent us specimens of this grass under the name of Hungarian blue-grass, and stated that his neighbors were collecting the seed from plants which were growing spontaneously in his locality, with the view of cultivating it. We have seen this grass growing on Roan Mountain, doubtless introduced there with other cultivated grasses, for it is not a native, although it has become fairly common in the eastern part of the State, so we are told.

Velvet-grass is of a peculiar and striking appearance, and likely to attract the attention of the most casual observer. All its parts—stem, leaves and flowers—are clothed with a whitish, soft down, so that to the touch it is like velvet; whence the common name, Velvet-grass. For the same reason we hear it sometimes called Wooly Soft-grass, or Meadow Soft-grass. It is much paler in color than most grasses, particularly the flowers, for which reason it is sometimes called White Timothy. The name Velvet Mesquit is that by which it is well known in regions to the south of us.

Velvet-grass is a perennial which has come to us from Europe, making itself quite at home in the eastern portion of our country. It makes a rank growth on rich, moist lands, but its cultivation, especially alone, is not recommended except on peaty soils or sandy lands where better sorts will not thrive. It is an early grass, and its perennial character has caused it to be used to some extent in mixtures for permanent pasture. Its habit of forming tussocks renders it objectionable in meadows, both because it becomes unsightly in appearance and difficult to mow; and for the same reason it is to be avoided in the lawn. The published opinions respecting this grass vary considerably, some commending it highly, others, and among these are included our best authorities, pronouncing it a worthless grass on all good soils, where better plants may be grown. Except for rare and special purposes, as in certain mixtures, or on particular soils, it is best not to use it at all.

In our plate A. shows an entire plant, somewhat reduced in size. a, a single spikelet; b, a spikelet with the outer glumes removed.

Tennessee Fescue or Glaucous Creeping Fescue.

Festuca rubra, var. glaucescens.

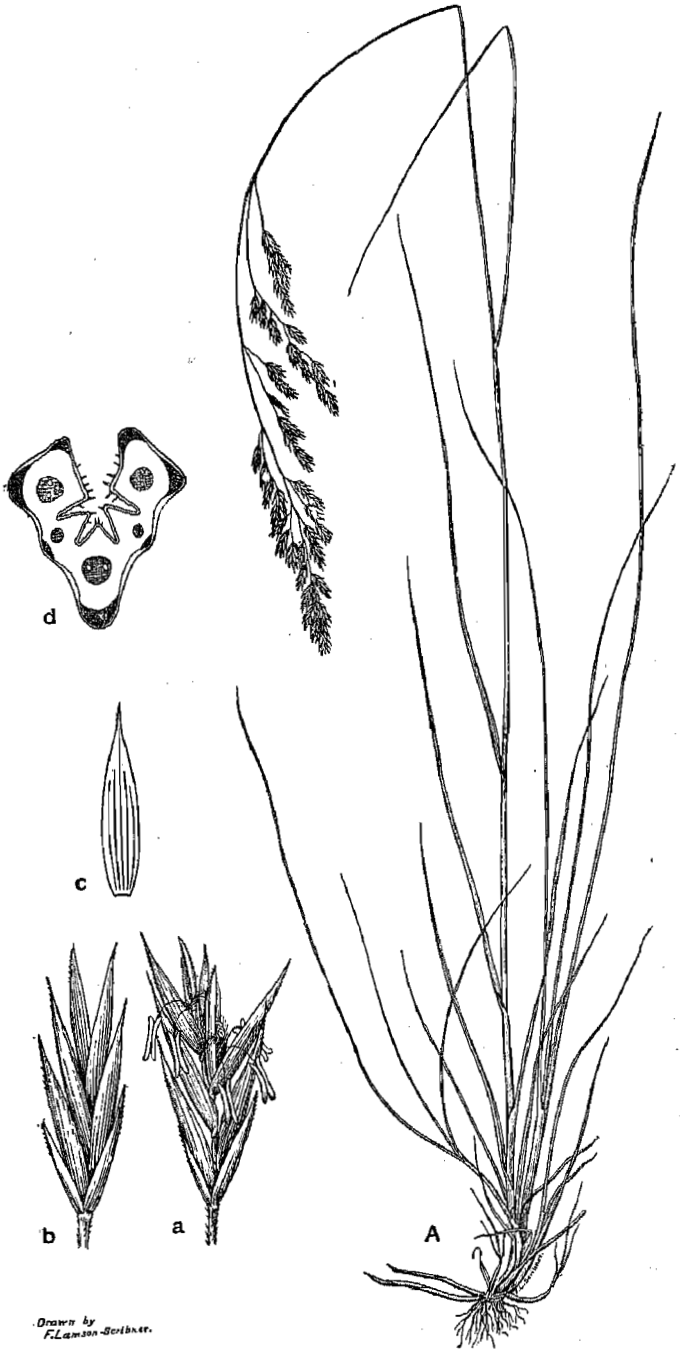
(PLATE III.)

The genus *Festuca* furnishes a number of species which are valuable either for hay or grazing. The one most highly prized and widely cultivated is the Tall Fescue, better known as Randall grass, or English Blue-grass. It is a species well adapted to deep, rich soils, and on such yields abundantly. We will at some future time treat this grass more fully, as it deserves, but now we wish to call special attention to a native species, illustrated on the plate opposite, which we believe possesses special merit as a permanent pasture grass, and well worth the attention of our farmers, at least in the middle and upper districts.

This grass was first discovered growing on the limestone cliffs along the Cumberland river, near Nashville, in 1867, by our good friend Dr. A. Gattinger, the veteran botanist of the State, and to whom the State owes much for his untiring zeal in developing and bringing to the knowledge of the world her botanical resources. Of the grass in question Dr. Gattinger writes, "I have never seen it in the mountains and valleys of East Tennessee. It seems also to be restricted here in Middle Tennessee to the *immediate borders* of water courses. I have often thought that its broader habitat must be along the upper course of the Cumberland river and its upper tributaries."

Just what the natural range of this grass is in the State remains to be determined, but it is enough for us now to have found it, and to have secured, through the kind assistance of the discoverer, a quantity of the roots, in the form of sods, for a trial culture here at the Station. We shall test it here along with other native and cultivated grasses, and although our soil is not like that in which we believe it will prove most valuable, we hope to be able to pass judgment more definitely upon its merits through our experiments.

This grass, which we have ventured to call Tennessee Fescue, because it is here brought to the attention of the farmers for the first time (not because this particular variety is limited to our State, although it has not elsewhere been noted in this country even by botanists) is a near relative of the Red or Creeping Fescue of Europe, and, like that, has a creeping or stoloniferous root. It is therefore an excellent turf-forming grass with good *staying* qualities, and will doubtless withstand well the tramping of stock. In our latitude



TENNESSEE FESQUE—FESTUCA RUBRA VAR. GLAUCESCENS.

it remains green the year round, being little affected by drought or the severe cold of winter, and its great mass of fine root-leaves will yield rich grazing wherever it is allowed to become well established. Its flowering stems grow to the hight of two feet or more; it blossoms in May, maturing its seed in July. It is to be recommended only for pastures, but there, especially upon worn out soils and hill-slopes, we are confident that it will prove of great value.

Referring to the plate: A, illustrates, much reduced in size, a single flowering stalk, with some of the root leaves and sterile shoots; a, and b, are enlarged representations of the spikelets or flowers; c, is a magnified view of a transverse section of a leaf from one of the sterile shoots.

II. BLACK-KNOT OF THE PLUM AND CHERRY.

Plowrightia morbosa

(PLATE IV *)

The black-knot of the plum and cherry is one of the most striking and familiar of the fungus diseases which attack our cultivated plants. That it is a fungus disease there is no longer any question, although for a long time the trouble was thought by many to be due to the attacks of insects. It is a parasitic plant, belonging to the great group of plants called fungi, that causes the development of the black knots, and its characters and habits have been closely studied by mycologists, and are now very well understood.

In the Eastern and Middle States this disease is of common occurrence and is often very destructive. Here it is much less frequent. In the vicinity of the Station we have seen very little of it, but we have heard of the disease in other parts of Tennessee, with reports that it was becoming more and more abundant and destructive each year Wild plum and cherry trees are attacked by the disease, and from these it may spread to the cultivated sorts; the disease may also be carried to new localities by the introduction of unhealthy nursery stock.

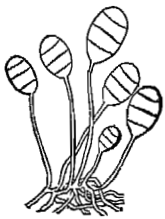
The general and outward appearance of the fully developed knots is shown in figure A, Plate IV. The bent condition of the more slender branch in the figure is due to the more rapid growth of the tissues on the affected side. The knots are often very much larger than those shown in the plate, and not infrequently they completely surround the branches. The surface of the knots is black, more or less irregular, and free from bark excepting perhaps, here and there a fragment which has been carried up with their growth. Around the base of the knots one will find the raised and broken edges of the bark of the branch, showing that they (the knots) originated beneath it. If closely examined, the surface of the mature knots will be seen to be studded with slightly elevated and rounded projections, imparting to it a pimply appearance. Each one of these little pimples represents a fruit of the fungus, which is many, many seeded.

In figure c, are shown three of these little fruits as seen in section and considerably magnified. They have thick, black walls, and at the top of each is a small opening (o, in the figure) through

*Figures A, c, and d are from "Orchard and Garden;" a, e, and b are after Farlow.



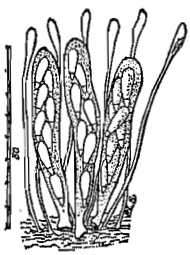
e



b



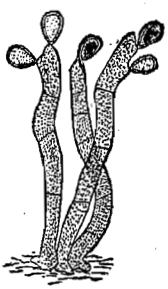
c



d



A



a

BLACK-KNOT OF THE PLUM AND CHERRY.

which the seeds, or *spores*, as the seeds of fungi are called, escape when ripe. In the interior or cavity formed by the fruit walls there are a great number of delicate, elongated sacks, and it is within these that the minute spores are formed, usually eight in each sack. Three of these sacks, within which the spores may be seen, as their walls are perfectly transparent, are shown, very highly magnified, in figure d; in reality each sack is hardly more than one-three hundredths of an inch long or high. The spores, which consist of two cells of very unequal size, are, of course, exceedingly minute. Five of these spores, two of which are germinating, are shown in figure e.

The description just given is that of the mature stage in the development of the fungus. There are other and earlier stages, in which spores or reproductive bodies, quite unlike those just described, are produced. One kind is borne on dark olive-green stalks which, during the period of their formation, cover the knots so thickly that their surfaces resemble silk plush or velvet. Figure a, illustrates three of these stalks with the spores attached; they are, as shown, very much magnified.

Other spores, supposed to belong to this fungus of Black-knot, represented by figure b, are formed within cavities in the substance of the fungus similar to those in which those of the mature stage are produced. These are termed stylospores.

Sometime during the summer the spores of the Black-knot fungus, which have found lodgment in the crevices of the bark of the trees, germinate and push their germ-tubes into the cambium or growing layer just underneath the bark, and the action of the fungus growth upon the living cells of the cambium excite these into rapid and irregular development, resulting finally in the production of the well-known knots. By autumn the increased growth of the cambium is often externally manifest as a slight swelling along the branches; little change occurs during the winter, but in the spring following, the swellings begin to enlarge rapidly, and often attain their full size in a few weeks.

The bark covering the forming knots expands for a time with their growth, but is finally burst asunder, exposing the diseased tissues composing them. The fungus itself continues alive and active throughout the summer and following winter, when the spores of the mature stage, referred to above, are produced, after which the parasite dies, and there is left a mass of open, dead tissues which offer protection and support to various insects that are likely to add to the injury already occasioned.

The fungus of Black-knot is remarkably well supplied with means for reproduction, each spore produced being capable of developing a new fungus growth and consequent "knot," if it falls

under proper conditions. To prevent this spread of the disease we ought to remove and destroy at once the knots wherever they may appear, both from our orchards and from all wild trees that may be growing in the vicinity.

The knots on a single wild tree may yield spores enough to infect the cultivated trees of an entire county. Badly diseased trees of either sort should be cut down and the knots burnt, or otherwise destroyed, at once. When there is only here and there a branch that is diseased, these alone may be removed with a saw or knife, the knots destroyed, and the trees then disinfected by a thorough washing with the Bordeaux mixture, or, if the work be done in the winter, with a very strong (30 to 50 per cent.) solution of sulphate of iron. These solutions, if well applied with a strong force pump, will doubtless destroy, or at least prevent the germination of, any of the fungus spores that may be resting on the bark awaiting suitable conditions for development. The same solutions, if applied directly to the newly developed knots, would probably prevent the formation of the spores, but would not be likely to check the growth of the fungus occupying the deeper tissues. The spread of the disease might thus be prevented, but the injury then going on could not be checked. The knots ought to be removed on account of the attraction they offer to insects, if for no other reason. When the swellings appear on the larger limbs and trunks of the trees, cut them carefully out, extending the cut from two to three inches above and below the knots, and then paint the wounds, first with a strong solution of iron sulphate, and then with some oil paint.

From the contagious character of the disease it can be stamped out only by concerted action, and the extent of the losses which it may occasion, when well established, make it a subject for State consideration. Now is the time to take action on this matter in Tennessee. Her fruit interests are too important not to demand the protection which the State can give by stamping out the disease in the sections where it now exists, and by preventing its further introduction through diseased nursery stock.

III. PRUNING FRUIT TREES.

SIR:—In complying with your request for a brief report from me illustrative of some feature of the work of the horticultural department of the Station, I owe it to myself to state that it is scarcely more than two months since I entered upon my present duties. You will, therefore, readily understand how difficult it is for me to select a subject directly conected with the Station work that will be of general interest.

In Bulletin No. 5, recently issued, I gave an account of the young trees in the Station orchard, together with brief descriptions of the varieties represented. This orchard was plowed during the fine weather in November; the trees were mulched with well-rotted manure, and carefully pruned soon after the leaves had dropped. This last operation has suggested that a brief chapter here on the principles and practice of pruning may be of some service to those who possess fruit-trees demanding immediate attention, and I respectfully present the following:

Pruning Fruit Trees.

Pruning is one of the most important operations connected with the management of fruit-trees. From the time the graft produces its first shoots, through all the successive stages of growth, in the nursery and orchard, pruning, to some extent, is necessary, in order to secure healthy, well-formed, and productive trees. It is by no means difficult, if a careful study is made of the habits of growth, and the mode of fruit-bearing of the various trees with which we have to deal. When this knowledge is acquired, the only things essential to rapid and judicious trimming are, a pruning saw, knife, shears, and good judgment, or practical common sense.

PRUNING YOUNG TREES AT TRANSPLANTING.

When young trees are dug from the nursery, the roots are always more or less bruised and broken. These bruised and torn parts should be entirely removed, or pared smooth with a sharp knife, to avoid decay, and to induce healthy and vigorous growth. A proper pruning of the top, at the same time, is also essential. In digging the trees from the ground, most of the roots and small feeding fibres are necessarily severed and left behind, and if the top is not correspondingly pruned, a proper balance cannot be restored, and the tree will become stunted and sickly from an insuffi-

ciency of plant-food that the few, feeble, broken roots are able to supply. Judgment must be exercised in this operation, for if too many healthy and vigorous branches are removed or cut back too much, the roots will not spread and penetrate freely through the soil. Some trees may be cut back and pruned more severely than others. The peach, for example, may have at least two-thirds of its growth cut away without detriment at the time of transplanting; but this amount removed from the cherry would result, very probably, in the destruction of the tree.

PRUNING AFTER TRANSPLANTING.

Previous to the time of transplanting, the fruit-culturist, if he has not raised his own stock, has had no control whatever on the training of the young trees. But now he has sole charge of them, and by the proper use of the knife and pruning shears, may mould them into almost any desired form.

There are several objects in pruning. In young trees, we prune to reduce the vigor in one part of the head, and to encourage growth in another and weaker part, thus securing a symmetrical form. We prune to remove superfluous and useless shoots, so that air and light may freely penetrate the top, producing a more vigorous and desirable growth. We prune to remove all dead and diseased branches, which are always detrimental to young trees. We prune to secure an even distribution of branches upon the main limbs. An immediate effect of pruning is to direct the course of the sap, which has been previously used in the branches removed, into those limbs which are designed to form permanent and fruit-bearing branches of the tree. It is important that such a diversion of the sap be accomplished before the shoots to be removed attain any considerable size. The sap utilized in these unnecessary limbs is not only wasted, but the whole tree is checked in growth, to a certain extent, when such large branches are severed. This immediate result may be obviated by summer pruning, which is effected by pinching off the soft ends of the shoots disposed to take the lead, and by rubbing away all other shoots as soon as they appear. A large number of trees may be treated in the above manner at a very small expenditure of time and labor.

PRUNING BEARING TREES.

Most of the points referred to under the previous headings apply equally well in the pruning of bearing fruit-trees. In old trees, we not only prune to secure equality and symmetry, to remove all dead and diseased branches, but we prune to induce or diminish fruitfulness. If the orchard has been properly and frequently pruned during the earlier stages of growth, trimming at this time will consist in simply rubbing off the succulent shoots as soon as they

form. But such perfectly pruned orchards are rare. Trees may be seen all through the country that have never been touched with the shears or saw, and if the work has been done, it was accomplished with a common axe, very probably, little care being exercised in forming a symmetrical and well-balanced head. Large branches should not be cut away, except when it is absolutely necessary. But the compact heads found in some old neglected orchards necessitates the removal of a few large limbs. It is sometimes difficult to select the proper limbs to be removed. In such cases the tree should be carefully studied before commencing operations. An ordinary pruning saw may be used in making the incisions. The limb should not be cut so that a large portion of its base remains which will require a second pruning, nor so close to the main stem as to injure its wood. A little practice in trimming will soon enable one to make a judicious selection of the limbs, and to effect their removal in the proper manner. When large branches are severed, the surface of the cuts should be pared smooth with a knife to facilitate healing, and to prevent water from soaking in, which is liable to cause decay that may spread to the branch or main limbs, thus resulting in a serious injury to the tree.

WHEN TO PRUNE.

Many theories have been advanced as to the best season to prune. Some growers advocate pruning whenever the knife is sharp. But a careful study of the physiology of fruit trees is sufficient to show that this is an undesirable practice, unless the knife happens to be sharp only during the dormant state of vegetation. Summer pruning, or pinching is necessary, to some extent, in order to secure well-pruned heads; but to give an old bearing orchard a severe trimming at this season is certain to result in a material check of growth. Large limbs should not be removed when there is a full flow of sap, for adventitious buds are now easily excited into activity, and many small shoots will be produced by the severing of the wood, thus defeating the objects of our work. Pruning in this mild climate may be performed any time after the leaves drop, until vegetation begins, in the spring.

Respectfully,

PROF. F. LAMSON-SCRIBNER,
Director.

R. L. WATTS,
Horticulturist.

DIVISION OF ENTOMOLOGY.

THE GLASSY-WINGED SOLDIER-BUG.

BY PROF. H. E. SUMMERS.

An insect often seen by the grape-grower upon the leaves of the vine, but not so frequently recognized by him as a friend, is the Glassy-winged Soldier-Bug (*Hyaliodes vitripennis* Say). This insect belongs to the suborder Heteroptera, or true bugs. Its form is well shown in the accompanying figures. Figure 2 shows the nymph, or immature bug, and figure 3 the imago, or adult. The colors are quite variable; figure 3 shows the most common pattern. Here the head is reddish, with the eyes, a band across the hinder part, and two spots, one on each side, near the front corners of the eyes, black. The antennæ (the two "horns" attached in front of the eyes) usually have the first joint deep red, the other three joints dark brown or black; usually the base of each joint is paler.

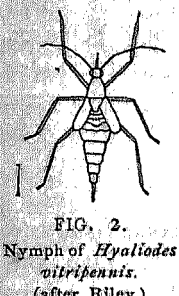


FIG. 2.
Nymph of *Hyaliodes vitripennis*.
(after Riley.)

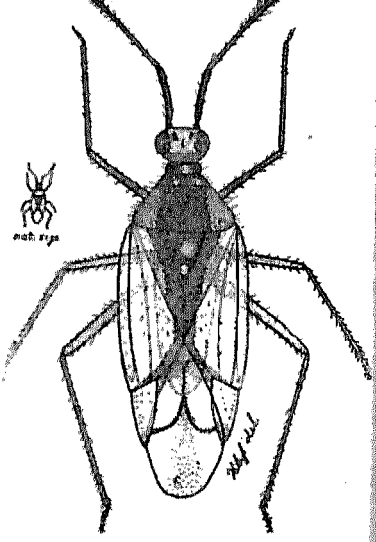


FIG. 3.
Hyaliodes vitripennis.

The *pronotum* (the upper part of the body just behind the head, and extending back to the bases, or points of attachment, of the wings) is black in front, and red or greenish yellow, with usually a broad black band along the middle, behind; the middle black band varies much in width, and is sometimes entirely absent.

The *scutellum* (the triangular piece just behind the pronotum, between the bases of the wings) is black, with a yellow patch near its hinder angle; this patch is sometimes enlarged until it covers nearly the whole scutellum.

The legs, with the exception of the front thighs, which are partly dark brown or black, and nearly the whole underside of the body, are pale greenish yellow.

The *hemelytra* (upper or front wings) are nearly transparent (whence the name "glassy-winged") with a dark band along the inner margin in front, which becomes narrower and crosses the wing to its outer margin at about its middle. There are also rose-colored patches at the tips of the hemelytra.

The majority of the species of the family *Capsidæ*, or plant bugs, to which this insect belongs, are vegetable feeders, and hence usually enemies of the farmer; but a few, of which this species is a prominent example, are carnivorous, or animal feeders.

The Glassy-winged Soldier-bug is found not only on the grape, both wild and cultivated, but on various species of oak. Its habits on the cultivated grape were first described by Riley, in the 3rd Missouri Report, p. 137. It is found mostly running about on the under side of the leaves, feeding freely on the numerous leaf-hoppers that infest the vine. The nymph and imago are equally voracious, and the dried skins of their victims may often be found in great numbers still clinging to the leaves. Often when the leaf-hoppers have become abundant, and are beginning to seriously injure the vines, the little soldier-bugs will suddenly appear in increasing numbers, and begin their work of extermination. In such cases it is better to let them perform their work undisturbed, and not to attempt the destruction of the hoppers by artificial means, which would probably be less effectual, and destroy friend and foe alike.

DISEASES OF LIVE STOCK.

PROF. F. LAMSON-SCRIBNER, *Director*,
AGRICULTURAL EXPERIMENT STATION,
KNOXVILLE, TENNESSEE:

SIR:—In response to a telegram from you. I visited Tennessee for the purpose of investigating a disease of horses and cattle reported as causing great loss in different sections of the State. In order to acquaint myself with the nature and cause of the trouble, I visited Monroe county, on January 2nd, where many cases were reported to have occurred in November and December. From the citizens of Sweetwater and the surrounding country, I learned that during the fall and early winter, (about the time cattle were turned into corn-stalk fields, and new corn was being fed), several cases of what the people called "Staggers," had occurred in horses, mules and cattle. At the time of my visit the disease had about ceased to be heard of. I could find no acute cases, and no opportunity occurred for holding a post-mortem examination. The symptoms in horses and mules, as described to me, indicate that the disease was what is annually met with in Virginia, North and South Carolina, and some other States, and called by the stockmen "Staggers," or sometimes "Blind-Staggers." The symptoms are those of an acute inflammation of the brain and spinal cord. More cases occurred in cattle than in horses or mules, and in these animals the symptoms indicate more acute disease of the spinal cord than of the brain. In horses and mules the disease was almost uniformly fatal; in cattle, most of the affected animals recovered. I was told that in some portions of the county the disease had been very prevalent, and that a great loss had been reported through the papers in White county. Dr. Sims, of the State Board of Health, informed me that several cases had occurred on his farm in the vicinity of Chattanooga, and from a circular letter, sent out by the Board to different counties, requesting that specimens of tissue taken from animals having the disease be sent to Dr. J. E. Reeves for microscopical examination, I learn that the disease has occurred in most sections of the State.

After conversing with parties in Sweetwater and vicinity who had lost animals, and considering the reports from different parts of the State, I am convinced that the disease affecting horses and mules is the same as the disease called "Staggers" in the States previously mentioned. The disease affecting cattle appears to be

a different trouble, and is very probably the same as the trouble which annually appears in some of the northwestern States, and which is by some called the "corn-stalk" disease. This is caused by turning cattle into stalk-fields, and is more prevalent some years than others. In some sections of the country the loss is often severe. As many stalk-fields contain great quantities of corn-smut, and cattle seem to be very fond of it, it has been, by many, supposed to be the cause of the disease. I found that many farmers in Tennessee hold this view. I was told by every one of whom I inquired, that smut was present in much greater quantities than usual on corn, and some also stated that crab-grass was affected. It has never been definitely determined what effect smut has upon the animal economy, when taken in large quantities. This question having arisen in connection with a cattle disease in 1869, Prof. John Gamgee, who was then in the employ of the Department of Agriculture at Washington, undertook some feeding experiments with this end in view. He fed 42 pounds of smut to two cows in three weeks, i. e., 21 pounds of smut to each cow, without any bad effects being shown. As we cannot conceive of an animal being able to obtain that amount of smut in a stalk-field, this experiment tends to prove that smut has nothing to do with the cause of the disease. It is generally accepted by veterinarians that smut, if at all detrimental, simply acts mechanically, by producing, on account of its dryness, constipation. Dr. F. S. Billings, while at the University of Nebraska, published an article, in which he states that the disease in question is due to a micro-organism which cattle get by eating the corn-blades, etc. No other investigation has as yet confirmed this view, and the correctness of it remains to be determined.

The "Staggers" of horses and mules, I found, by men with whom I conversed, attributed to the feeding of "rotten" or damaged corn. Most of the cases occurring in South Carolina are supposed to be due to the same cause, and in all cases damaged food of some kind is supposed to be the origin of the trouble.

After carefully examining the literature at my command, and considering the many letters which I have received in the past three years, and conversing with parties who have lost animals,—in fact, after learning what I can about the disease without holding post-mortem examinations and conducting experiments, I am of the opinion that the exciting cause is a cryptogamic plant which develops on or in the food which the animals eat. This fungus may resemble the moulds, or may be some micro-organism (*bacteria*). I do not think that corn-smut plays any part in causing the disease, but as both "Staggers" and the "corn-stalk" disease can usually be traced to bad food, we can safely conclude *that the path-*

ogenic principle must be looked for in the food. Whether the disease symptoms are produced by the development of a pathogenic fungus in the body of the sick animal, or whether the symptoms are due to a poison (*ptomaine*) which is produced during the growth of the fungus on the food (grass, corn-stalks, blades, etc., kernels and cob of ear, and possibly oats), we are not at present able to say. In some cases the symptoms would seem to indicate that the animal suffered from the effects of a narcotic poison. This would lead to the supposition that the disease is due to a vegetable alkaloid or *ptomaine.* In order to arrive at any definite conclusions in regard to this matter, the whole subject must be thoroughly investigated.

Feeding experiments should be performed by feeding the suspected food to healthy animals, and such food should be examined microscopically to detect the presence of fungi, and also examined chemically to detect the presence of alkaloids or ptomaines. If the disease is produced by feeding suspected food, then careful post-mortem examinations should be held, specimens of tissue examined microscopically to detect organisms, and cultures should be made for the purpose of obtaining the organism, if any be present. Until this work can be done we can hope to learn but little in regard to the trouble. As no work of this kind could be done while I was in Tennessee, nothing new was learned.

To sum up, we may say that all we know in regard to the disease is, that in some years, usually in November and December, horses and mules (principally horses), when fed damaged corn or hay, are liable to contract a fatal form of brain trouble; that cattle, when turned into stalk-fields, or fed on fodder, are also liable to a form of disease which usually proves fatal. Prevention is easier than a cure; most of the cases prove fatal, and consequently medical treatment is not of much value. In horses and mules, early abstraction of blood from the jugular vein, the application of ice to the head, and the administration of a brisk cathartic, consisting of six or eight drachms of aloes, sometimes does good, and may save animals having the disease in a mild form. In cattle, about the same treatment is applicable, except that instead of aloes one pound of Epsom salts should be given. If food which is thought may cause the disease has to be fed, the bowels should be kept loose by feeding bran mashes, and by giving an occasional dose of aloes to the horse and mule, and Epsom salts to cattle.

The only and proper way to entirely prevent the great loss which often occurs is, *not to feed damaged food of any kind.* It is to be hoped that this disease will be so thoroughly understood that proper steps can be taken to prevent its occurrence. Respectfully,

W. B. NILES, D. V. M., *University S. Car.*

APPENDIX.

EXPERIMENT STATION RECORD.*

History and Reorganization.

BY THE DIRECTOR.

Bulletin No. 1, *April* 1888—(*pp* 1–5).

The Agricultural Experiment Station of the University of Tennessee grew out of its School of Agriculture, Horticulture, and Botany. The experimental work of this School was inaugurated by Prof. J. M. McBryde, who was at its head from June, 1879, to June, 1882. Three reports, 150 to 200 pages each, on experimental work, for the most part field and feeding experiments, were published during this period.

The Station never enjoyed any fixed or settled income until the present year. The trustees of the University voted it such funds as they could spare, from time to time, from the general treasury. The amount from this source, not including salaries, which the officers received as professors, was necessarily very limited. In spite of these difficulties considerable and valuable work was done, chiefly field and feeding experiments.

From 1883-87 the Station published a number of Bulletins and reports.

Dehorning Cattle.

BY CHARLES S. PLUMB, B. S.

Bulletin No. 1, *April* 1888.—(*pp.* 5–16.) (*Illustrated*)

The following are the conclusions drawn from the experiments made at this Station:

1. The most desirable method of fastening an animal for dehorning, so as to keep it satisfactorily quiet, is to cast it, bind the feet firmly together, and hold the head in a halter, close to the ground, either by the hands, or by placing a plank across the neck. To then remove the horn uppermost, and by means of a rope of sufficient length, fastened where the feet come together, to turn the animal upon the other side, and remove the remaining horn.

2. For removing the horns, an ordinary meat saw, with a set screw in the end of the blade furthest from the handle that will enable the blade to be tightened, but not to turn from side to side, is perfectly satisfactory. A strong running-noose rope halter, and

*Taken from the official Reports of the United States Department of Agriculture, office of Experiment Station.

about twenty feet of five-eighths and ten feet of three-eighths inch rope are also necessary.

3. The horns should be removed as close to the head as possible, without cutting the skull proper. It is best to cut down from one-fourth to one-half inch of flesh, at the base of the horn. The sawing should be done rapidly, and with long sweeps of the arm, if possible.

4. Animals one and two years of age appear to suffer considerably in dehorning. The painful effects decrease with increase of age, so that an animal ten years old may suffer but very little. This is owing to the layer of flesh surrounding the base of the horn, which is much thicker in young than old animals. Dehorning causes an abnormal increase of pulsation and temperature, which extends over several days. The appetite is also affected during the twenty-four hours succeeding the operation.

5. Dehorning is more especially to be recommended for those animals that are of vicious temperament, that are what are termed "masters;" to be applied to bulls, and to beef animals that are to be kept quiet and closely stabled or shipped.

6. From evidence quoted from other sources, it appears that dehorning is not necessarily a cruel practice, but may be conducted to promote ends that are both humane and desirable in live-stock breeding.

The Experiment Station, Building and Laboratories.

BY THE DIRECTOR.

Bulletin No. 2, *July* 1888, (*pp.* 17–20) (*Illustrated*).

An account of the excellent Station building, which was completed in November, 1888.

Germination of Seed-corn.

BY C. S. PLUMB, B. S.

Bulletin No. 2, *July* 1888, (*pp.* 20–25).

On December 1, 1887, circulars were sent to farmers in Tennessee whose addresses could be obtained, requesting them to favor the University as follows: To send central sections, about an inch in length, from about five ears of corn, such as would be used for seed the next year, either from crib, field, or wherever the seed-corn might be stored. Particulars were also requested concerning the location of the corn-field, soil upon which grown, method of harvesting, preservation, etc.

The plan was to secure seed from as many persons as possible, and germinate. Every year many acres of corn have to be replanted, owing to improper methods of preserving seed. It was thought that by securing seed from various parties and germinating we could get a fair general idea, from information furnished, of the

best practical plan in use of keeping corn over winter for spring planting.

Seed was received from sixteen different counties and seventeen persons.

The article contains extracts from the letters of parties sending seed, and tables giving in detail the results of the tests made. The following are the conclusions drawn:

1. That, so far as sample seed-corn from sixteen different counties in Tennessee give a fair average of the condition of the seed of the State, the vitality of that produced by the crop of 1887 is high.

2. The evidence is in favor of storing ear-corn without the husk for seed purposes, though the results coming from the two methods differ very slightly and to no practical extent.

3. That it is customary for farmers to preserve their seed-corn in as dry condition as possible under shelter, preferably in a high airy place.

Analyses of Commercial Fertilizers.

Bulletin No. 2, July 1888, (pp. 25–27).

The article contains tables showing the results of the twenty analyses made in the season of 1887–88.

Preliminary Report on the Weeds of the Farm.

BY F. LAMSON-SCRIBNER, B. S., AND C. L. NEWMAN, B. S.

Bulletin No. 3. October, 1888, (pp. 29–52).

The Bulletin contains a list of the weeds found on the University farm, with a description of each variety, and illustrations of some of the more common species.

Notes on Fertilizers and Fertilizing Materials.

W. E. STONE, PH. D.

Bulletin Vol. II, No. 1, January, 1889.—(pp 3–24).

This contains analyses of fertilizing materials available to farmers of Tennessee, made with the purpose of pointing out their "characteristic and valuable features," in order that farmers may have a "basis for the more intelligent purchase and use of fertilizers." The samples analyzed were either sent to the Station by the Commissioner of Agriculture, or inquiring farmers, or furnished by dealers and manufacturers. The nature and uses of fertilizers are explained, and the trade values for 1888, as adopted by the sta-

tions in Connecticut, New Jersey and Pennsylvania, stated. Results are given of the analyses of twenty-four kinds of commercial fertilizers, and of cotton-seed meal, cotton-hull ashes, plaster, marl, Thomas-slag, tankage, animal manures, and tannery waste. According to the State Act regarding the sale and inspection of commercial fertilizers, the full text of which is printed in the Bulletin, all fertilizers sold within the State are to bear, plainly printed on the bag or package, a statement of their chemical composition. The State law also provides that the Commissioner of Agriculture shall prescribe a given per cent. of ammonia, potash, and available phosphoric acid, which the fertilizers must contain. At present the requirement is, "that acid phosphates, or dissolved bones (not ammoniated), must contain not less than twelve per cent. of available phosphoric acid; and all ammoniated superphosphates must contain not less than eight per cent. of available phosphoric acid, two per cent. of ammonia and one per cent. of potash; or if they contain less than two per cent. of ammonia, or less than one per cent. of potash, they must then contain not less than ten per cent. of available phosphoric acid." Attention is called to the necessity of utilizing all available waste products. "It is not good economy to buy commercial fertilizers at $25 to $40 per ton, and allow the manure piles of the farm to lie exposed to the leaching effect of every rain-storm." The great and rapid growth of the cotton-seed oil industry, and the utilization of the cotton-seed hulls and meal, are used to illustrate the value which may be found in what are thought to be waste materials. A ton of cotton-seed meal has, at a low estimate, a trade value of $23.50, while a ton of cotton-hull ashes is worth $29.97. The chief value of the latter consists in their large percentage of potash.

These ashes are sent to the Northern States in large quantities, where farmers have been quick to recognize their value, and where they have become, to a certain extent, a substitute for Canadian wood ashes. As the result of rather limited inquiry, they have not been found on sale in this State. A manufacturing firm in West Tennessee, which produces them in large quantities, writes: "They are little, if any, used in the neighborhood of the mills, where they are produced, but the market for this product is found in the New England States, where it finds a ready sale at good figures."

A point to be learned from a study of these facts is, that Tennessee farmers cannot afford to let a pound of these materials go beyond the borders of the State. Why send this nitrogen, this phosphoric acid and this potash away to the North, and then purchase the same articles in fertilizers, the costly materials for which have been imported from the coasts, or perhaps from beyond the seas?

Diseases of the Irish Potato.

F. LAMSON-SCRIBNER, B. S.

Bulletin Vol. II, No. 2. April, 1889.—(*pp* 27–43).

POTATO ROT (*Phytophthora infestans*)—(pp. 27–37).—This contains an account of the life-history of the fungus which causes potato rot, and advice regarding the treatment of the disease.

1. The life history of the fungus, briefly stated, is as follows:

The spores lighting upon the leaves of the potato, germinate in drops of dew or rain, and the product of germination—the zoospores—penetrate to the interior tissues of the plant, and after growing for a time through these tissues, the mycelium sends out, chiefly from the under surface of the leaves, slender fruiting branches whereon are produced a new crop of spores. These may carry the disease to the other plants in the field, or to other parts of the same plant; that is, they may serve to spread the disease in the tops, which we term blight, over the entire field, or by being washed into the ground they may reach the tubers and cause the rot. The fungus, once having gained entrance to the tubers, may or may not vegetate rapidly. Its presence, however, is soon made evident by a browning of the flesh underlying the skin and by a more or less extensive discoloration and depression of the latter. Under certain conditions the disease in the tubers may make no further progress throughout the winter, but the mycelium of the fungus remains alive and ready to renew its activity upon the first favoring circumstances. Such potatoes may often be found in the markets and are used for food every day, and it is too frequently the case that they are preserved for seed. Used for this latter purpose they will hardly fail to affect the new crop and bring about a new development of spores.

2. Treatment:

Select for planting a light, sandy loam or a soil which is well-drained; plant only perfectly sound or disinfected seed; spray the tops with Bordeaux mixture, or some preparation containing sulphate of copper; store in a cool dry place and keep dry.

A NEW DISEASE OF THE IRISH POTATO (pp. 37-43).—The new disease was discovered among the potatoes obtained from the University farm, and is described as causing the tuber to wither, then dry up and become hard. The skin is only partially discolored, but the surface is covered with small pimples, each surrounded by a depression. Sections through a diseased tuber revealed the fact that the flesh was apparently sound, but slightly wilted. The only discoloration of the flesh was immediately under the pimples; here the tissues were brown. Under the microscope it was seen that the brown areas were filled with numerous little worms of various sizes and in all stages of development.

"These little worms," says the writer, "were at once recognized as nematodes or thread-worms, and were evidently the cause of the disease."

How did these worms get into the potatoes? Probably from the soil in which they were grown, for it is known that many of the parasitic nematodes spend a certain period of their existence under ground. It is very likely that they were first introduced into the University farm through planting infected seed. The potatoes infected were being saved for seed, and were these to be planted they would certainly carry the worms to the new crop, and thus perpetuate the disease.

Owing to the limited knowledge of the life-history of the nematode, the author says it is impossible to indicate any definite course of treatment.

Cotton-Seed Hulls and Meal as Food for Live Stock.

W. E. STONE, PH. D.

Bulletin Vol. II, No. 3, July, 1889.—(*pp.* 47–56.)

This contains an account of the results of inquiries concerning the use of cotton-seed hulls and meal as food for live stock, as practiced in the vicinity of oil mills at Memphis, New Orleans, Houston, Raleigh, Little Rock, Atlanta, and elsewhere in the South. Analyses of the hulls and meal, and of manure from animals fed on hulls and meal, are also given. The practice of feeding cotton-seed hulls to live stock seems to have begun as early as 1870, soon after the introduction of the oil industry. "But probably the first attempts at systematically feeding an exclusive ration of hulls and meal on a large scale have been made within four or five years." Thousands of cattle are now fed on these materials in the vicinity of the oil-manufacturing centers. "The hulls consist of fragments of seed-coats, one-sixteenth to one-fourth inch in diameter, of dark-brown color, very tough and leathery, and entangled in a mass of cotton fibers which still adhere to the outside of the hulls, and which the ginning process fails to entirely remove. It is apparently the dryest and most tasteless form of animal food which could be found. In spite of this, it is said that animals which have never seen the hull or meal before soon acquire an eager appetite for them, and after a few days prefer such a diet to one composed of hay and corn. Probably this is due to the meal rather than the hulls, which, as already noted, are well-nigh tasteless."

The chemical analyses show that the hulls contain a large excess of non-nitrogenous matter, while in the meal there is an equally large excess of protein; therefore when combined, the

hulls and meal make a much better ration for stock than does either used alone.

The manure obtained from this method of feeding is quite rich in nitrogen, phosphoric acid, and potash. Gardeners and planters in the vicinity of the stock-yards are loud in their praise of its value.

Our investigations seen to justify the following conclusions:

1. The practice of feeding cotton-seed hulls and meal as an exclusive diet is well established, and increasing in the vicinity of the centers of the cotton-seed oil industry. All the information available indicates that the practice is economical and profitable.

2. It seems in no way harmful to the health of the animal, nor to the healthfulness of the products (beef and milk) resulting.

3. The diet seems adapted both to the production of beef and mutton as well as milk.

4. The average ration should consist of 25 to 35 pounds of hulls, and 5 to 8 pounds of meal daily.

5. The hulls are a cheap and effective substitue for hay.

6. The manure produced by this system of feeding is an important factor in considering its profitableness.

Grasses of Mountain Meadows and Deer Parks.

F. LAMSON-SCRIBNER, B. S.

Bulletin Vol. II, No. 4, October, 1889.—(*pp.* 59–67).

The high nutritive value of the pasturage on the elevated meadows along the slopes of the mountains of Eastern Tennessee and Western North Carolina is well attested by the fat and sleek appearance of the thousands of horses, cattle and sheep which range over these meadows from May to October. Similar conditions exist in the mountain meadows among the Rocky Mountains (where such meadows are called "deer parks"), and the Alps.

In July, 1889, the author visited Roan Mountain, situated on the border line between Tennessee and North Carolina, and found on or near the summit of the mountain twenty-five species of grasses, a list of which is given in the Bulletin. Notes on a number of these grasses are given, but especial attention is called to Tennessee or Mountain Oat-grass (*Danthonia compressa*). Analyses of samples of *D. compressa* were made by the Station chemist, and compared with those of *D. spicata*, Orchard grass (*Dactylis glomerata*), Timothy (*Phleum pratense*), and Herd's grass (*Agrostis vulgaris*), made elsewhere.

The two species of *Danthonia* make a most favorable showing beside the others, and of the two, *D. compressa* is evidently the better. In protein and fat it shows a higher percentage than any of the others, standing much higher than Timothy, while with only one

The Treatment of Certain Fungus Diseases of Plants,

F. LAMSON-SCRIBNER, B. S.

Special Bulletin C., May 10, 1890.

Practical directions for the treatment of black-rot of grapes, apple scab, downy mildew of the vine, brown-rot of grapes, powdery mildews, leaf brownness of the pear and quince, potato rot, and smuts of oats and wheat.

Experiments in Growing Potatoes.

C. S. PLUMB, B. S.

Bulletin Vol. III, No. 1, *January*, 1890.—(*pp.* 24.)

The experiments with potatoes at this Station in 1889, are discussed in this Bulletin under the following heads: (a) Concerning the influence of the amount of seed tubers planted upon the resulting crop of Irish potatoes; (b) trial of the *Rural New Yorker* trench system of potato culture; (c) tests of varieties of Irish potatoes; (d) early vs. late culture for sweet potatoes. The soil used in all the experiments was a clay loam with heavy clay subsoil.

Influence of the amount of seed tuber planted upon the resulting crop. Under this head three different experiments with Early Rose potatoes are described.

1. Comparison of whole tubers of different weights for seed. Eight different lots of whole tubers of Early Rose potatoes were selected; each lot, with one excetion, consisting of 100 tubers. Each potato of each lot was weighed on a Fairbanks silk scale, and each lot was planted in a row by itself, the rows being three and one-half feet apart, and the tubers two feet apart in the row, with the exception of one row, in which they were three feet apart. A table gives for each row the weight and number of tubers planted, the date of vegetation, blooming and ripening, number of tubers vegetated, and the height of plants June 20. From the data reported it appears that: (1) The largest tubers bloomed first and produced the highest (and also largest) growth of plants; (2) the smallest tubers bloomed last and produced the lowest (and smallest) plants, and ripened one day earlier than the largest; (3) large size apparently favored earliness of bloom, height, and size of plant, and, to a certain extent, delayed ripening; (4) plants from tubers, weighing from 4 to 8 ounces, ripened earlier than those from tubers of greater or lesser weights.

Two other tables give the yield of merchantable and unmerchantable potatoes in each row, and the average yield per hill for the different lots. The highest yield of merchantable potatoes from 100 tubers was 623 potatoes, weighing 102¾ pounds, from tubers averaging 8 to 10 ounces; the lowest was 363 potatoes, weighing 62 pounds, from tubers averaging 1 to 2 ounces. The highest

average yield, per hill, of merchantable potatoes was from seed which weighed from 8 to 14 ounces per tuber. From seed tubers weighing 1 to 2 ounces the average yield was only 3.6 merchantable tubers, weighing 10 ounces. In general, the productiveness per hill was greater with the largest tubers and decreased quite constantly with a decrease of weight in the seed. The relation of the size of the seed tuber to the amount of the crop is illustrated by a diagram. Calculations are reported which show that while 81 bushels of 10 to 12-ounce tubers would be required to plant an acre, at the rate employed in this experiment, only 11 bushels of 1 to 2-ounce tubers would be required for the same area.

The table herewith gives calculated results per acre, merchantable and unmerchantable potatoes being classed together in the total yield.

ESTIMATED YIELDS, COST OF SEED, VALUE OF CROP, AND BALANCE IN FAVOR OF CROP PER ACRE.

Weight of Seed.	Distance Plant'd	YIELD		Cost of Seed per Acre, at 75c. per Bushel.	Value of Crop per Acre, at 40c. per Bushel.	Balance in Favor of Crop
		Bushels	Tubers			
Ounces	Feet					
12–14	3	146	90,980	$48 00	$58 40	$10 40
10–12	2	220	135,075	60 75	88 00	17 25
8–10	2	195	118,102	49 50	78 00	28 50
6–8	2	168	115,273	39 00	67 20	28 20
4–6	2	158	108,908	27 75	63 20	35 45
3–4	2	146	104,665	19 50	58 40	38 90
2–3	2	141	81,328	13 50	56 40	42 90
1–2	2	128	67,184	8 25	51 20	42 95

It appears that in this experiment, with one slight exception, the larger the tuber planted the smaller the profit, and vice versa.

2. Comparison of large and medium-sized whole tubers, halves, quarters, and single eyes. Potatoes were planted on six plats, each one-fourth acre. The results are stated in two tables, which give data for the season of growth, and the yield and value of crop for each amount of seed used. The largest yield, and next to the largest profit, were with whole potatoes. The largest profit was with quarters. "Large whole tubers produced a larger crop and greater value over cost of seed than did the medium-sized tubers. Single eyes from large tubers gave a larger and more valuable crop than single eyes from medium-sized tubers."

3. Comparison of whole tubers with halves from wholes of the same weight: "This experiment had two objects: (a) To note the difference in yield between a certain number of tubers of the same size, planted whole, and twice that number of halves from potatoes of the same size as the wholes; (b) to note if the eyes on the under side of the whole potatato materially increase the yield over the half potato planted with the eyes facing outward or upward."

Five hundred and forty Early Rose potatoes, weighing 6 to 7 ounces each, were planted in two lots of 270 each. Lot I, the wholes, was planted in three rows, and Lot II, containing 540 halves, in six rows. The total and average yields are given in a table.

(a) "The half tubers produced a greater number and greater weight of merchantable potatoes per hill than did the whole tubers; (b) the whole tubers produced very nearly twice as many unmerchantable tubers per hill as did the half tubers; (c) the average weight of one hill grown from a whole tuber was 19.5 ounces, while that from half tubers was 16.4 ounces, or an increase per hill of 8.4 per cent. by using whole tubers for seed; (d) the size of the potatoes grown with half seed is somewhat larger than those of the whole seed."

The following is the summary taken from the Bulletin :

1. The larger the potato planted, the larger the plant produced, and the more abundant the harvest in tubers.

2. Other things being equal, the fewer the number of eyes in a piece of seed potato, or the smaller that piece of seed, the smaller the crop.

3. The larger the quantity of whole tubers placed in a hill for seed, the greater the cost per acre of planting, and the smaller the profit on the crop.

4. Large and whole tubers produced smaller and poorer merchantable ones, than did half or quarter tubers, or single eyes.

5. Large and whole tubers yielded appreciably more small unmerchantable potatoes than did parts of medium tubers or single eyes.

6. Given two potatoes of equal size, one planted whole will not yield so large nor so good a crop as will the other tuber cut into halves and each part planted in a separate hill.

7. The investigation, as carried out, suggests that, in view of the fact that the whole tuber produced comparatively more small, inferior potatoes than did the halves planted, the source of these inferior tubers may be from those eyes located on the under side of the whole potato planted. This because the eyes and shoots thus located are repressed in growth to a certain extent, owing to the pressure upon them and reversal of position.

It is to be remembered that the above conclusions are the result of the investigations recorded, and are based on nothing else. Neither in farm practice nor experimental work do we consider

that they will always find indorsement. Yet as the result of much experimental work with seed potatoes, it is confidently believed that these conclusions will generally be fairly accurate.

Trial of the New York Trench System of Potato Culture.—This is a brief account of an experiment with this system with Early Rose potatoes on an acre of clay loam soil to which a ton of commercial fertilizers was applied. The yield was 188½ bushels of potatoes, which were grown at a loss of $25.50. The author is, however, inclined to attribute the smallness of the crop to the fact that the fertilizer used did not prove available to the plants

Tests of Varieties.—Seventy-four varieties of potatoes were tested, and the yields from whole tubers, halves, quarters, and single eyes recorded. There are also brief descriptive notes on each variety, a record of their keeping qualities, taken February 14, and notes on the development of the plants during the season of growth. "While in each class of plantings the yield is variable, often to a considerable extent, an average of all the hills in each class of seed planted of seventy-four varieties, shows a continual decrease in yield and number of tubers per hill, from the whole potato down to the single eye. In brief, the experiments at this station on the relation of size of seed tubers to crop-yield, demonstrate that the larger the piece of seed potato planted, the greater will be the yield. This, it may be said, is also the result very generally arrived at at other stations that have done similar work."

Early vs. Late Culture for Sweet Potatoes.—Six plats of light clay loam, each one-twentieth of an acre in size, were planted to sweet potatoes at weekly intervals from April 27 to June 1. The variety used was Southern Queen. The yields from each planting are given in a table.

1. The largest yield was produced from the planting of May 4.

2. Many more unmerchantable potatoes were produced from the first three than from the last three plantings.

3. The average yield for the first three plats, or early planted, is 489 pounds; of the late planted, or last three plats, 510 pounds, or a difference of 21 pounds in favor of later planting.

4. The average yield of the plantings from April 27 to May 11 was smaller than of those planted from May 18 to June 1, and each plat contained, on an average, 37 pounds more of unmerchantable tubers than did the several late plantings.

Field Experiments with Barley, Corn, Oats, Wheat, Sorghum and Clover.

C. S. PLUMB, B. S.

Bulletin Vol. III, No. 2, April 1890 (*pp.* 3–16)

BARLEY, TEST OF VARIETIES, (p. 3)—Tabulated notes on five varieties. Manshury gave the best results. Scotch Chevalier, the only two-rowed variety tested is recommended as a strong, robust, productive variety, and especially exempt from disease. It rarely lodges and produces a large seed.

CORN, TEST OF VARIETIES, (pp. 3–7).—Tabulated notes on thirty-eight varieties of dents, thirteen of flints, and fifty-four of sweet-corn.

The following varieties are recommended for this region for productiveness, quality, and vigor of growth:

Dents—Adams's Early, Golden Beauty, Maryland White Gourd Seed, Shannon's Big Tennessee White, and Southern Horse Tooth. Adams's Early is probably the best variety for table use, as its ears are not large, and it is suitable for eating earlier than most corn.

Flints.—Compton's Early, King Philip, Sanford, and White Flint Thoroughbred. However, we do not especially recommend flint corn for Tennessee. The yield of fodder is very small, and the corn is not nearly so productive as the dents.

Sweets.—We do not feel disposed to recommend any of these sweet varieties for this region, as they have been a failure, almost completely, for two reasons: first, the corn-worm has infested the ears so badly as to make them unfit for eating; second, this class of corn develops very poorly here. Varieties of sweet corn that make vigorous, robust growth in the North, have with us been small and spindling—almost dwarfs. The climatic conditions are evidently not favorable to successful culture of most sweet varieties.

OATS, TEST OF VARIETIES, (pp. 7–11).—Tabulated notes on forty-three varieties, with descriptive notes on thirty of these varieties. "Early Ewing was the first to mature, being ripe on June 26. Next earliest were the several rust-proof varieties. For this locality the rust-proof varieties are best, as they ripen early, have strong straw, and are not so badly affected with rust as are other varieties of a large, coarse character." Black Tartarian, Clydesdale (synonyms: Welcome, Centennial, White Australian, White Wonder), Probsteier, Winter Grazing, and Winter Turf are especially recommended.

OATS, EXPERIMENT WITH FERTILIZERS, (p. 11).—Muriate of potash, cotton-seed meal, nitrate of soda, acid phosphate and kainit singly, and the last three in combination, were compared with each other, and with no manure, for Kansas rust-proof oats on twelve twentieth-acre plats, on light, clayey loam. The highest yields

were with muriate of potash and kainit, and the average yield of three plats, where potash was used, was higher than any of the yields from other forms of fertilizers. The smallest yields were with no manure, and with nitrate of soda, acid phosphate, and kainit combined.

WHEAT, TEST OF VARIETIES, (pp. 11–13.)—Tabulated notes on thirty-six varieties, tested on ninetieth-acre plats, on clay-loam soil, which was "rather poor." The best results were with Tasmanian Red, Nigger, New Golden, German Emperor, and Michigan Amber.

From several years' experience with Tasmanian Red and Nigger we can especially recommend them for this locality. Both are bearded varieties, very hardy and productive. Nigger wheat is especially adapted to this region, having originated in Kentucky, so far as is known. Diehl-Mediterranean, Mediterranean Hybrid and Michigan Bronze are the same variety under different names. It is well worth a trial.

Fulcaster, one of the newer varieties, while not doing well with us in this test, can nevertheless be recommended for hardiness and strong growth. As a rule, it is a good yielder compared with other varieties.

WHEAT, METHODS OF CULTURE, (pp. 13–14).—Four methods, (1) planting in rows by hand and cultivating with the hoe; (2) sowing in drills, with no cultivation; (3), sowing in drills, with mulching; and (4), sowing broadcast, with harrowing, were compared on eight fourth-acre plats. The results are stated in a table. The average yield per acre of the two plats in each class was as follows: hoed plats, 12 bushels; drilled plats, 19½ bushels; mulched plats, 18⅜ bushels; harrowed plats, 16⅓ bushels.

SORGHUM, TEST OF VARIETIES, (pp. 14–15).—Tabulated notes on forty-four varieties. The following varieties were the earliest to ripen, and were fit to cut at about the same time, September 3d: Chinese, Georgia No. 5, No. 30, Sorghum Saccharatum, White Amber, Duchess Hybrid, Kansas Red, No. 18, Price's New Hybrid, Waubansee, Whiting's Early. A change of chemist at the Station prevented the making of sugar determinations, as was intended.

CLOVER, EXPERIMENT WITH FERTILIZERS, (pp. 15–16).—Various fertilizers (nearly the same as those used in the experiment with oats referred to), were applied to eight half-acre plats of light, clay-loam land, which has been in red clover for two years, and the results compared with those from unfertilized plats. The amounts of fertilizers, and the yield of the first and second crops, are given in a table. Rains seriously affected the curing of the present crop.

If we were to accept the results in this table, as bearing on the first crop, we should see that:

1. The largest yield comes from unfertilized land.

2. The next largest yield comes from a mixture of two-thirds phosphate and one-third potash.

3. The third best results come from cotton-seed meal.

However, experience teaches us two things:

1. That unfertilized lands give us the poorest returns.

2. That the cotton-seed meal could not have been much used as a plant food by the first growth, as the plants were already too advanced in growth to have felt the effects of the decomposition of the meal.

This is a good example of the general uncertainty of the results of plat tests. Such experiments, to have a significant value, should be permanent, extending over many years, under as nearly identical conditions as possible.

Points about Country Roads.

W. W. CARSON, C. E., M. E.

Bulletin Vol III, No. 3. August, 1890.—(*pp.* 43-64).

In an introduction the Director of the Station states that this article was prepared at his request by Prof. Carson, who occupies the chair of civil engineering in the University of Tennessee, with a view to aiding the movement in that State in favor of better country roads.

As the farmer gets the same price for what he sells, whatever distance he has to haul his produce to the railroad station, the cost of hauling comes entirely out of his pocket. It has been estimated that our poor roads cost the farmer at least $15 a year for every horse. The question of improved road-making is thus of great importance.

"For a country road, the question of most importance is the draft; that is, the number of horses needed to draw a given load, or (to state it otherwise) the load that one horse can draw. We need, therefore, to see what effect different grades and road coverings have on draft." Tables are quoted from Gen. Gilmore's work, entitled, "Roads, Streets, and Pavements," to show the relative draft of different kinds of roads and different grades. Calculations based on these tables are given to show how the work by the horse is distributed, and what are the effects of different grades and kinds of roads on the cost of hauling. The author favors the payment of the road-tax in money instead of labor, and the employment of State and county engineers to superintend the making of roads. The location and construction of proper roads are discussed in some detail.

In order to complete this record to date we add the following:

Practical Experiments in Reclaiming "Galled" or Washed Lands, With Notes on Mulch and Mulch Materials.

BY PAUL F. KEFAUVER.

Bulletin Vol. III, No. 4, October 1890, (*pp.* 65–72).

Sixteen experiments made upon galled lands, in Monroe county, with the view to get them down in good permanent sod as soon as possible, are recorded:

EXPERIMENT No. 16.—Becoming convinced of the great value of mulch in saving young grass and clover from being scalded out on raw clay exposures during summer, I had all the sedge-grass weeds, etc., on the place mowed down and stacked up for that purpose during the fall of 1889. During this fall, also, and the winter succeeding, the two-acre piece referred to in experiments 1–7, except the strips referred to in experiment 10, as well as all other galled places on the farm not already under treatment, was leveled, plowed, subsoiled and manured, at the rate of twenty good loads of manure per acre on the surface. In the spring of 1890 this was thoroughly worked in with harrow and the whole seeded to clover six pounds, red-top one bushel, blue-grass one bushel per acre with 100 pounds good, complete fertilizer per acre. This seeding was killed by a March freeze, and it was re-seeded as before, but without any more fertilizers. In May the whole was carefully mulched with sedge-grass.

Result.—A decided success. A rather costly, but altogether, perhaps, the cheapest and most satisfactory method of reclaiming galled hillsides. I have given the plots a good dressing of rough stable manure this fall, and expect to have no more trouble with them.

ON MULCH.—Mulch not only preserves moisture in the soil, for summer use, maintains a good capillary connection up to the very surface, prevents baking and washing, protects it as a blanket in winter, adds vegetable matter (*humus*) to the soil by its decay, and generally livens up the soil, but in the light of recent discoveries it does even more.

Here the value of mulch in inducing the development of "soil microbes," by whose action the soil is rendered more fertile, and its mineral elements more readily available as plant food is explained.

Soil microbes flourish in almost any kind of decaying vegetable matter. Hence when we spread mulch to decay on the land, we inoculate it with these soil microbes, or sow them, as Dr. Masters would have it.

MULCH MATERIALS.—Clover-halm, damaged ensilage, green weeds and straw from stubble-field, and sedge-grass were experimented with. Of the latter, sedge-grass, Mr. Kefauver says:

This material deserves special mention on account of cheapness, abundance in many sections, extent of land covered by a given amount—four loads per acre for grass or clover—and general efficiency. It is especially valuable and practicable for "galled" hillsides, or on thin land where it is desired to grow a crop of clover to turn under. It settles very close to the ground after the first rain, effectually prevents washing, and will *not* blow off after becoming once settled.

A list of the various materials used for mulch, in the order in which they rank in value: (1) clover-halm; (2) damaged ensilage; (3) green weeds and straw from stubble field; (4) sedge-grass; (5) briers, weeds and trash, from fence corners; (6) partially rotten straw; (7) straw; (8) Sorghum cane pomace; (9) dry weeds and trash from clover-fields in spring; (10) brush.

Fruit Trees at the Experiment Station.

BY R. L. WATTS.

Bulletin Vol. III, No. 5, December, 1890.—(*pp.* 73–92.)

The report covers:

1. General observations upon the fitness or adaptability of our State for fruit-growing, and the increasing demand for fruits in our home markets.

2. Tests of varieties on the Experiment Station grounds—limited to a statement of the condition of our young trees, and a brief description of the fruit of the varieties they represent.

3. Harvesting, packing, and marketing fruit. This we deem a most important subject to the fruit-grower from a business point of view, for the profitable disposal of his goods depends very largely upon its appearance when offered for sale.

There are in the Station orchard 51 varieties of apples, 33 of peaches, 33 of pears, 7 of nectarines, 8 of apricots, 20 of cherries, 27 of plums, and 3 of figs.

The character of all these fruits are briefly given, and the present condition of the trees noted.

It is difficult to draw any conclusions as to the varieties of apples best adapted to all sections of this State. Those that succeed in the mountainous districts may frequently fail in Middle and West Tennessee. A certain variety may not be adapted to all localities even in the same section; the Baldwin, for example, succeeds admirably in the Cumberland plateau, but is an undesirable sort in this locality..

The following varieties of our list have been grown successfully in various localities of East Tennessee: *Winesap, Yellow Bellflower, Rhode Island Greening, Rome Beauty, Northern Spy, Newtown Pippin, Early Strawberry, Carolina Red June, Ben Davis and Baldwin.**

The following varieties of pears have been grown successfully in various localities of East Tennessee: *Bartlett, Flemish Beauty, Seckel, Duchesse d'Angouleme, Beurre Anjou* and *Le Conte.* There are probably other good sorts that have been a success in various sections of the State.

The following varieties of peaches of our list have been productive in East Tennessee, when not destroyed by the frost: *Alexander, Early River, Foster, Oldmixon Freestone, Crawford's Early and Late.*

It is difficult to produce apricots in this country without protection. They blossom somewhat earlier than the peach, and hence the flowers are nearly always destroyed by the spring winds and frosts.

Of cherries, the *Black Tartarian, Napoleon, Early Richard, Governor Wood,* and probably other good varieties, have been grown successfully in this locality.

Index to Vols. I, II, and III.

Bulletin Vol. III, No 6, *December*, 1890.—(*pp.* 93-104).

Index to Volumes I, II, and III. of the Experiment Station Bulletins, including also a brief synopsis of the contents of the Specials, which were published under letters A, B, C, D, and E.

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*We take pleasure in inserting here and putting on record letters from two of our correspondents:

Director Agricultural Experiment Station, Knoxville, Tenn.:

SIR:—In response to request contained in your Bulletin No. 5, Vol. III, December, 1890, I have to report that the following varieties of apples succeed well with me: Early Harvest, Red Astrachan, Ben Davis, Fall Pippin, and Winesap. I have tried 13 of the varieties of peaches contained in your list, nearly all of which gave satisfactory results. Hale's Early, however, after the second year's bearing, invariably rotted on the trees. The peach crop is very uncertain, owing to spring frosts. I have intended for years to try mulching during winter to retard the budding of trees, but neglected to do so. Very respectfully,

Bailey, Tenn., Dec. 22, 1890. H. L. BEDFORD.

SIR:—Referring to your Bulletin No. 5, December, 1890, I have a small orchard, planted out in 1882 and 1884, and this year I had a good yield on my Beauty of Kent, Shockley, and Fallawnter, and that in spite of a heavy late frost in May. I got my trees from Bird, Dew & Co., of Knoxville. My Wild Goose Plum bears about every year. I have one tree of the Tetofsky apple, which has borne well for the last two seasons.

Rugby, Morgan co., Tenn., Jan. 2, 1891. W. F. G. WILSON, M. D.

OGDEN BROS. & CO., PRINTERS, KNOXVILLE, TENN.