FIFTH ANNUAL REPORT

OF THE

AGRICULTURAL EXPERIMENT STATION

OF THE

UNIVERSITY OF TENNESSEE

TO THE GOVERNOR

1892

KNOXVILLE, TENNESSEE.
1893.

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

THE AGRICULTURAL EXPERIMENT STATION

OF THE UNIVERSITY OF TENNESSEE.

BOARD OF CONTROL:

M. P. JARNAGIN, JOSEPH W. ALLISON.
O. P. TEMPLE, W. H. JACKSON,
HUGH G. KYLE.

TREASURER: JAMES COMFORT.

SECRETARY: J. W. GAUT.

THE STATION COUNCIL IS COMPOSED OF ITS OFFICERS:

PROF. F. LAMSON-SCRIBNER, Director and Botanist.
PROF. CHAS. F. VANDERFORD, Assistant Director.
DR. C. W. DABNEY, JR., Chemist.
R. L. WATTS, B. Ag., Horticulturist.
J. B. McBRYDE, Assistant Chemist.
C. E. CHAMBLISS, Librarian and Clerk to Director.

The Station has facilities for analyzing and testing fertilizers, cattle foods, milk and dairy products; seeds, with reference to their purity or germinating power; for identifying grasses and weeds, and studying forage plants; for investigating the diseases of fruits and fruit trees, grains and other useful plants.

The Station Bulletins and Reports will be sent, free of charge, to any farmer within the State.

Packages by express, to receive attention, should be *prepaid*.

All communications should be addressed to the

DIRECTOR OF THE
AGRICULTURAL EXPERIMENT STATION,
KNOXVILLE, TENN.

☞ The Experiment Station building, containing its offices, laboratories and museum, and the plant-house and horticultural department, are located on the University grounds, fifteen minutes walk from the Custom House in Knoxville. The Experiment farm, stables, milk laboratory, etc., are located one mile west of the University, on the Kingston pike. Farmers are cordially invited to visit the buildings and experimental grounds.

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

REPORT TO THE GOVERNOR.

Letter of Transmittal.

KNOXVILLE, TENN., April 14th, 1893.

To His Excellency, PETER TURNEY,

Governor of Tennessee.

SIR:—We have the honor to submit herewith the Fifth 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, and the Act of the General Assembly of Tennessee, approved March 28, 1887. 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 Secretary 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,

MILTON P. JARNAGIN, *Chairman of Board of Control.*

CHAS. W. DABNEY, JR., *President of the University.*

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

TREASURER'S REPORT.

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

Dr.		*Cr.*	
1891 and 1892—From July 1st to June 30th. To U. S. Treasury Draft for fiscal year ending June 30th, 1892 . . .	$15,000 00	Salaries	$ 7,607 68
		Heat, Light and Water .	401 82
		Publishing and Printing	530 62
		Apparatus and Supplies .	603 06
		Traveling Expenses . .	541 98
		Fertilizer Analysis . . .	258 05
		Library account . . .	229 78
		Stationery and Postage .	69 46
		Contingent account . .	269 43
		Labor account	1,658 58
		Building account . . .	750 00
		Farm account	789 49
		Horticultural account .	526 73
		Botanical account . . .	348 70
		Chemical account . . .	178 96
		Janitor account	234 66
	$15,000 00		$15,000 00

(Signed) 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 30th, 1892, 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.

(Signed) J. W. GAUT, F. A. R. SCOTT, S. B. LUTTRELL, } *Auditing Com.*

We hereby certify that Messrs. J. W. Gaut, S. B. Luttrell, and F. A. R. Scott are the authorized Auditing Committee of this Board of Trustees.

(Signed) CHAS. W. DABNEY, JR.,
President of the University of Tennessee.

(Signed) J. W. GAUT, *Secretary.*

(SEAL)

Subscribed and sworn to before me this 12th day of January, 1893.

(Signed) ARTHUR E. BROYLES,
Notary Public, Knox County, Tennessee.

(SEAL)

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 fifth annual report of its operations in detail, for the calendar year ending December 31, 1892, together with the Treasurer's report for the fiscal year ending June 30, 1892.

The working divisions of the Station are the same as reported last year.

The present staff of the Station is as follows:

F. LAMSON-SCRIBNER, *Director and Botanist.*
CHAS. F. VANDERFORD, *Assistant Director.*
CHAS. W. DABNEY, JR., *Chemist.*
J. BOLTON MCBRYDE, *Assistant Chemist.*
R. L. WATTS, *Horticulturist.*
C. E. CHAMBLISS, *Librarian and Clerk to Director.*

Mr. Paul F. Kefauver, Agriculturist, resigned the first of October; his duties have since been performed by the Assistant Director, Prof. C. F. Vanderford, and the Farm Foreman, Mr. T. F. Peck. Mr. C. E. Chambliss, a post graduate student in the University, was appointed to the position held by Miss E. E. Morris, who resigned early in the spring. In view of the proposed work on the flora of the State, which will involve much additional labor in the field as well as in the herbarium, an assistant in this division was engaged December 1.

The arrangement between the College and the Experiment Station whereby the latter was given control and charge of the College farm, as detailed in our last report, has been maintained.

At present everything connected with the Farm is under the immediate control of the Director or Assistant Director of the Experiment Station, and all the ordinary proceeds from the farm and from the Horticultural department are credited to a separate Station fund, to be appropriated as other funds, for maintaining the farm and the Horticultural department, each distinct, the Station guaranteeing the University, from these two sources, eleven hundred dollars.

The authority of the Station extends over 100 acres of the

College farm, being that part lying South of the Kingston road, and upon which are located the farm buildings and dairy.

The work in the several Divisions of the Station has been carried forward with very little interruption, and all has been accomplished possible with the means and force at command.

CHEMICAL DIVISION.

The chief work of this Division has been upon the typical virgin soils of the State, being a continuation of the work begun last year. Work for the State Commissioner of Agriculture in the analysis of commercial fertilizers has also been continued. The analytical work for the year is summarized as follows:

Samples of fertilizers	54
Samples of soils, (chemical analysis)	16
Samples of soils, (mechanical analysis)	8
Samples of ensilage	2
Samples of limestone	1
Samples of shale	1
Mineral specimens, (qualitative tests)	6
Soil samples prepared for analysis	80

The analyses of commercial fertilizers made during the period from August 25 to November 20, were made by Mr. C. C. Moore, Jr., who was employed especially for that purpose.

DIVISION OF FIELD AND FEEDING EXPERIMENTS.

The condition of the farm has made it necessary to spend much time in clearing up waste places and freeing the land from weeds. With the object of making the farm as nearly self-sustaining as possible, the herd of milch cows has received special attention, and experiments have been made to determine the most economical ration for milk production. The results of one of these feeding experiments are given in Bulletin No. 3 of Vol. IV. The want of a properly constructed barn, with the equipments necessary for accurate and economical work, has precluded experiments in many lines, desirable in themselves and of great interest to the people of the State.

The experiments with grasses grown in plots, referred to in our last report, have been maintained with much care. The data afforded by these pure grass cultures will be of great value to our farmers, and the growth here of the number of varieties cultivated affords an object lesson of interest and value to every farmer or student who will give it attention.

All operations upon the farm are most carefully recorded, and everything done is noted with a view to gaining all information possible, some of which can not fail of having practical value and general application.

Considerable time was spent during the summer collecting sam-

ples of the virgin soils of the State, a continuation of the work begun last year, but prosecuted in a more systematic manner. Fifteen type soils were taken in as many different localities, all selected so that they might represent the soils of large areas of the agricultural lands of the State. The study of these type soils, including both physical and chemical analyses, will be steadily pursued in order to develop the practical as well as theoretical value of such investigations.

DIVISION OF BOTANY AND HORTICULTURE.

The botanical work has been chiefly limited to the final preparation of the first part of a work on Tennessee Grasses, and the gathering of notes and material for the second part. Nearly eight hundred species of flowering plants have been added to the herbarium. This does not include several fascicles of fungi obtained from various sources. Work on the herbarium is now receiving special attention, having in view the publication in the near future of a list of Tennessee plants represented in it. About eighty species new to our State flora have been found and added to the collection during the past year, a number of these coming from West Tennessee, collected by S. M. Bain, of Jackson.

The Horticulturist has carried on experiments with tomatoes in the field and under glass, and has also made pot experiments with this vegetable with the view to ascertaining the value of certain chemically pure salts applied as fertilizers. Experiments in transplanting onions have been made, and the establishment of a small fruit plantation for experimental purposes has been accomplished. The work of the Horticulturist for the year in orchard, vineyard and garden is well set forth in Bulletin No. 4 of Vol. V.

BUILDINGS AND REPAIRS.

Several items of repairs and improvements have been made in the Station building, chief of which may be mentioned the overhauling and resetting of the steam heating apparatus and the finishing of a room on second floor, now used as a "dark room" in the photographic work.

The greenhouse is old and very much out of repair, and a better structure is very much needed for the proper conduct of the work in the Horticultural department.

The condition of the farm buildings is such as to demand immediate attention unless they can be replaced by new and more substantial structures. As they now stand their construction and their arrangement and fittings render them wholly unfit for that kind of scientific and economic work which the Station force is fully prepared to undertake and carry on.

BULLETINS.

Four Bulletins forming Vol. V, have been published during the year, covering 151 pages, illustrated by six full page plates and 72 figures scattered through the text. The contents of these Bulletins are as follows :

No. 1. Fruit Trees and Experiments with Vegetables.

No. 2. The Grasses of Tennessee—Part I.

No. 3. A contribution to the study of the Economies of Milk Production.

No. 4. Experiments with Fruit Trees and Vegetables.

Respectfully,

F. LAMSON-SCRIBNER,

Director.

REPORT OF THE CHEMICAL DIVISION.

JANUARY 16, 1893.

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

DEAR SIR:—The following brief report of the work of the Chemical Division of the Experiment Station for the year 1892 is respectfully submitted.

A study of the typical virgin soils of the State was the chief line of work adopted by the Chemical Division for the year of 1892, being a continuation of the work of the year before on the soils of East Tennessee and the Cumberland Plateau. Sixteen samples of soils were subjected to chemical analysis, eight to mechanical analysis, and thirty samples, collected during the summer by the Assistant Director, were carefully prepared for analysis. The regular work on soils was considerably delayed by work for the State inspection of fertilizers.

During the year, fifty-four samples of fertilizers were analyzed. Samples were received during the months of March, August, September, October and November. Mr. J. Bolton McBryde, Assistant Chemist, had charge of the laboratory and carried out most of the practical work. From August 25 to November 20, Mr. C. C. Moore, Jr., had charge of the fertilizer work, and made analyses of all samples received during that time.

Analyses of two samples of ensilage, one sample of shale, one sample of limestone, and qualitative tests of six mineral specimens, were also made during the year.

The analytical work may be summarized as follows:

Samples of fertilizers	54
Samples of soils (chemical analysis)	16
Samples of soils (mechanical analysis)	8
Samples of ensilage	2
Sample of limestone	1
Sample of shale	1
Mineral specimens (qualitative tests)	6
Soils samples prepared for analysis	30

The additional apparatus and supplies purchased for the Chemical Division during the year consisted of chemicals and apparatus for general laboratory use. A few books on chemistry were also purchased.

Respectfully,

(Signed.) CHAS. W. DABNEY, *Chemist.*

REPORT OF THE DIVISION OF FIELD AND FEEDING EXPERIMENTS.

JANUARY 16, 1893.

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

SIR:—I hand you herewith a report of the operations of the department of Field and Feeding Experiments of the Station from October 1, 1891, to December 31, 1892.

On the 1st of October, 1891, an arrangement was made by which the Station assumed the management of that part of the University lands South of the Kingston road, as below recited:

The College farm with all its buildings, stock, implements and other equipments as per inventory, is hereby turned over to the management of the Experiment Station under the following conditions:

I. The Experiment Station is to keep up the land, buildings, apparatus, tools, and stock to a condition fully equalling that in which they are received. The University reserves the privilege, after six months' notice, to take the farm back under its direct management, in which case the Experiment Station must return an equivalent amount of stock, produce, implements, etc., as hereby turned over to it, or pay such difference as may be adjudged proper by the Board of Trustees.

II. The Professor in Agriculture and his classes are to have all the privileges of the farm as heretofore, the farm being conducted so as to fitly illustrate farm methods and practices. Agricultural students shall have the privilege of occupying the farm houses and have the preference in the award of labor suitable for them at the usual or ordinary rates of compensation. Everything connected with the farm is to be under the direct control of the Director of the Station, or of the Assistant Director, and shall be maintained in accordance with the instructions of the Board of Control, as they may be given from time to time.

III. The Experiment Station shall defray all current expenses of the farm. The proceeds from the sale of the farm produce, increase or sale of stock, etc., shall be credited to a separate Station fund, to be appropriated as other funds for maintaining the farm, the Station guaranteeing the University one thousand dollars, to be paid at the close of the fiscal year.

IV. The Experiment Station shall maintain the Agricultural

Department Building, pay all the expenses of water, gas, fuel, lights, etc., and shall defray 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 and west to the road leading to the stable. The proceeds arising from the sale of horticultural produce, fruits, flowers, etc., shall be credited to the same Station fund as those derived from the farm, and will be appropriated for maintaining the Horticultural department—for labor, supplies, repairs—the Station guaranteeing the University one hundred dollars per annum, which, like the one thousand dollars from the farm, is to be paid absolutely.

V. All receipts from the farm or Horticultural department shall be paid over monthly, by the Director, to the bursar. The fund thus formed will be paid out by the Treasurer on warrants approved by the Director, as are other Station funds. All funds are to be appropriated semi-annually by the Board, on budget submitted, as heretofore.

Immediately upon the ratification of this agreement, the Assistant Director caused to be made an inventory of the live stock, supplies, tools, implements and apparatus on the farm October 1, 1891.

A careful survey of the farm itself, the buildings, fences, growing crops, the condition of the various fields was made, and the results of this survey were recorded at length in the *Farm Journal.*

The soil of the College farm is mainly a strong clay loam overlying magnesian limestone. About one half of the area is very hilly, in some places much broken; the remainder is second bottom land, lying between Third Creek and the Tennessee River. About six acres along the Creek is not fit for cultivation because of the steep declivity, and was overgrown by small trees, brush and briars; about two acres on the lower reach of the creek was so badly infested by wild onions as to be useless except for growing corn or other hoed crops, which could be harvested uncontaminated by this vile weed. Along the river a strip, some three hundred yards long by twenty to fifty feet wide, only a few feet above low-water level, and frequently overflowed, is mainly of sand, but quite productive when it can be cultivated in corn. Some years ago a belt of trees was encouraged to grow along the edge of the bottom lands adjoining this sandy strip, to protect the lands against washing away during very high water; this timber break has proven very effective, but was found overgrown with weeds, briars, sedges and underbrush. A portion of the lands on the southern end of the farm, probably twelve acres or more, is

subject to overflow during floods in the river. Effort has been been made, several years ago, to prevent the washing off the surface soil by planting a break of osage orange across the lower end of the farm; the osage plantation was a failure; nevertheless the few bushy plants that survived have evidently served a good purpose.

This College farm, lying in the bend of the river directly west of the city, and distant about one and one-half miles from the Custom House, will probably some day become desirable for city or suburban residences, or, because of its long line of river front, for factory sites or other business uses. At one time this probability was imminent, and I am informed that the question was seriously debated whether or not it was advisable to sell the farm and invest elsewhere. Mature consideration has resulted in the decision that this portion of the University lands shall be kept as the College farm, and improved as such.

Upon assuming direct control of the Station farm and its outfit, it was promptly decided that the first work to be done was to get rid of weeds, clear up the waste places, and put the farm in condition to maintain the herd of milch cows already established. The better to do this work, and at the same time make the farm as nearly as possible self-sustaining, the Station dairy was devoted exclusively to the production of milk, for which there is a good market in the city of Knoxville. As opportunity offered, carefully conducted feed tests were made, employing for that purpose selected cows from this herd. The results of one of these feeding experiments are given in Bulletin 3, Vol. V., of 1892. A great deal of valuable experimental work of this character ought to be and could be done by this Station. The want of a properly constructed barn, with the equipments necessary for accurate and economical work, the absence of an adequate supply of water, and other necessities of the situation as it now exists, have prevented the Assistant Director from attempting many lines of investigation desirable in themselves and of great interest to our people.

In December, 1891, a portion of the land directly north of the Station garden, about a half acre in extent, was prepared for a grass garden. Fifty plots, of exactly one square rod each, were laid off, permanently staked and made ready for seeding or for setting roots. This work was prosecuted steadily, and the entire number of plots were seeded or planted by the 13th of May, 1892. The selection of grasses to be grown was made with a view to determine, as far as can be done by careful cultivation of many varieties upon a given soil, which are the best of them for various purposes, and how best to grow them for such purposes. The difficulties

to be encountered in what may be termed "pure culture," the growing of plants true to name and without admixture of other plants, are well understood by every farmer. The several plots were in good condition when the extreme cold weather set in, and there is reason to hope that with the coming spring nearly every one of them will start into vigorous growth.

The system adopted upon the farm, whatever the character of work in hand, is such that all details of operations are carefully noted and recorded. It follows, therefore, that we are accumulating a large amount of valuable data which can be used for purposes of instruction to the students of the Agricultural course in the University, as well as for the information of the people generally.

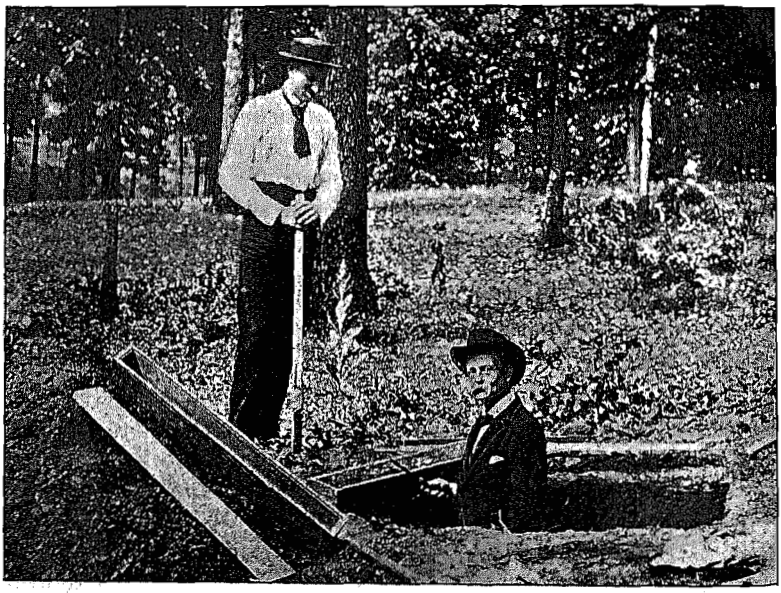
SPECIAL WORK.

During the month of July, 1892, samples of fifteen type soils were taken in as many different localities, these localities being selected so that the samples taken should represent large areas of agricultural lands of all sections of the State. This work was done at the request of Prof. E. W. Hilgard, special agent of the Agricultural Experiment Station Exhibit, Columbian Exposition, as a part of the exhibit to be made by the Experiment Stations. These soil samples, taken on a uniform plan and of uniform dimensions, are intended to represent the chief characteristic soils of the respective States. Maps showing the areas of occurrence of such soils as are represented by the samples are to accompany this collection.

Scientists differ in opinion as to the practical value of chemical analysis of soils. During the past ten years, the answers to the problems of plant nutrition have been sought along the line of organic chemistry. To the farmer, who asks how he shall apply a fertilizer for a given crop, the reply is now formulated more or less closely upon the chemical analysis of the plants to be grown, and upon the theory that an amount of certain constituents should be applied to each acre, so as to furnish at least as much of such constituents as would be required by the maximum crop expected. Continued investigation has shown that chemical actions and reactions, modified in many ways by the mechanical conditions, not only of the soil as usually understood, but of the sub-soil, and of the still deeper underlying stratum, are to be taken into the account. A new line of study, probably no less important than plant analysis, is therefore indicated. Soil physics presents many problems, the solution of which must result in a still further advance of scientific agriculture.

The type samples for this Station were taken in the following manner:

Boxes of uniform size, the inside dimensions of which are length 36 inches, width 3 inches, depth 3 inches, were provided with closely fitting tops put on with screws. At the point selected a pit was dug, three or four feet square and three and a half feet deep. On one side of the pit most free from roots was marked and cut out a prism of soil and sub-soil to fit the box as accurately as possible. The boxes were then pressed on the prism, and with a long knife or other convenient tool the earth was cut in slantingly from both sides, leaving a roof-shaped ridge projecting above the rim of the box. This projecting portion was shaved off and the lid screwed on. The soil prisms thus obtained show the soil, sub-soil and under stratum to an exact depth of three feet, every particle of the earth remaining in its original position with respect to the whole mass.



TAKING SOIL SAMPLE, MADISONVILLE, MONROE CO.

Each one of these soil samples was taken in duplicate. One set of these is for the Exhibit at Chicago in charge of Prof. E. W. Hilgard, the other set for the use of the Experiment Station here. In addition, samples of the soil proper and of the sub-soil in each locality were secured, also in duplicate. Of these one set was sent to Prof. Whitney, of the U. S. Department of Agriculture, who is

engaged in a series of mechanical analyses of soils; the other set is now in charge of the Station Chemist, who is making a chemical analysis thereof.

The type samples were taken as follows:

TENNESSEE SOILS.

1. MAGNESIAN LIMESTONE SOIL,—upper measure of Knox Dolomite.
Locality: Black Oak Ridge, Knox County.
Natural Growth: Forest; black oak, hickory, chestnut, etc.
Products: Cereals and grasses; orchards and small fruits upon new lands.
Remarks: A strong, durable soil, when properly handled. For orchard fruit or vineyards, should in most cases be underdrained.

2. MAGNESIAN LIMESTONE SOIL,—lower measures of Knox Dolomite.
Locality: Lyons View, Knox County.
Natural Growth: Forest; white oak, chestnut-oak, hickory, dogwood, etc.
Products: Cereals and grasses.
Remarks: Soil fertile and durable.

3. LIMESTONE SOIL,—mostly valley lands.
Locality: Lenoir City, Loudon County.
Natural Growth: Forest; white oak, walnut, poplar, hickory, elm, etc.
Products: All cereals and grasses.
Remarks: First class soil.

4. SHALE SOIL.
Locality: Madisonville, Monroe County.
Natural Growth: Forest; black oak, scrub oak, hackberry, hickory, walnut.
Products: Corn, other cereals and grasses.
Remarks: These soils cover a large area in East Tennessee; of variable character, depending upon the greater or less content of lime. A good soil under good management.

5. SANDY SOIL.
Locality: Chestnut Ridge, Greene County.
Natural Growth: Forest; chestnut, chinquapin, black oak, short leaf pine, etc.
Products: Corn and fine tobacco.
Remarks: A poor soil; all crops must be fertilized. The type of fine, bright tobacco soils.

6. LIMESTONE SOIL,—St. Louis (Coral Limestone).
Locality: Maxwell, Franklin County.

Natural Growth: Forest; post oak, red oak, hickory, persimmon, etc.
Products: Cereals, grasses, fruits, and vegetables.
Remarks: Excellent soil; wash easily, durable under good care.

7. SANDY SOIL,—mountain plateau.
Locality: Tracy City, Grundy County.
Natural Growth: Forest, scrub oak, pines.
Products: Potatoes, fruits and vegetables.
Remarks: These soils respond promptly upon fertilization.

8. SILICEOUS CLAYEY SOILS—of the "barrens."
Locality: Tullahoma, Coffee County.
Natural Growth: Forest; barren oak, black jack, with huckleberry, etc.
Products: Corn, potatoes, etc.
Remarks: Corn, oats, potatoes and small fruits are profitably grown by using fertilizers.

9. BLUE GRASS SOIL,— central basin lands.
Locality: Ewell's Station, Maury County.
Natural Growth: Forest; oaks, ash, elm, beech, maple, etc.
Products: All cereals, grasses, etc.
Remarks: Highly productive, very durable.

10. LIMESTONE SOIL,—(coral) St. Louis limestone.
Locality: Adair's Station, Robertson County.
Natural Growth: Forest; red oak, post oak, hickory, poplar, etc.
Products: Tobacco, wheat, corn and the meadow grasses.
Remarks: Very productive, easily washed.

11. SANDY CRETACEOUS SOIL.
Locality: One and one-half miles west of Camden, Benton County.
Natural Growth: Forest; post oak, black oak, chestnut, hickory, etc.
Products: Corn, tobacco, peanuts, fruits and vegetables.
Remarks: These lands are easy of cultivation, fertile when new, profitable under good management.

12. SANDY CLAY SOIL,—the "Flatwoods" clay.
Locality: One and one-fourth miles northeast of Huntingdon, Carroll County.
Natural Growth: Forest; hickory, poplar, post oak, persimmon, etc.
Products: Corn, cotton, fruit and market vegetables.
Remarks: Very productive when new; easily and rapidly improved under intelligent management.

13. YELLOW CLAY LOAM SOIL.
Locality: Humboldt, Gibson County.
Natural Growth: Forest; hickory, oaks, poplar, beech, sassafras, etc.
Products: The cereals, cotton, market fruits and vegetables.

Remarks: These soils are highly productive and very durable unless neglected.

14. YELLOW CLAY LOAM SOIL.

Locality: Somerville, Fayette County.

Natural Growth: Forest; oaks, hickories, sassafras, honey-locust, persimmon.

Products: Cotton and Corn.

Remarks: Good when new; productive for many years without fertilization. The type of best upland cotton soils.

15. LOESS SOIL,—the "Bluff loam."

Locality: Newbern, Dyer County.

Natural Growth: Forest; sweet-gum, black-gum, poplar, cherry maple, beech.

Products: All crops of the latitude, including cotton and tobacco.

Remarks: Unsurpassed in fertility and durability.

A complete study and examination, physical and chemical, of these samples must result in adding to our knowledge of the characteristics and capabilities of the soils represented.

Respectfully,

CHAS. F. VANDERFORD,

Assistant Director.

REPORT OF THE HORTICULTURIST.

JANUARY 7, 1893.

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

DEAR SIR:—I have the honor to submit the following report of the Horticultural work for the year of 1892:

FIELD EXPERIMENTS WITH TOMATOES.

The November Bulletin issued from this Division contained a brief report of work performed with tomatoes in the Station garden during the past season. About 1,300 plants were used in the fourteen distinct experiments tried, all of which were propagated in hot-beds and cold frames. The final results obtained were quite satisfactory, yet we deem it necessary to continue these operations in order to secure facts of greater value. Plans have been matured to repeat all former field experiments with tomatoes, and to initiate several new lines that deserve investigation. This vegetable is largely produced in Tennessee, and it should receive the careful attention of the Station.

EXPERIMENTS WITH TOMATOES UNDER GLASS.

The Station devoted part of its greenhouse last winter to the forcing of tomatoes. A condensed account of our researches was published in Bulletin No. 4, Vol. V, mentioned above, accompanied with two plates representing the plants as growing on the bench, and several ripe specimens picked from the same. We believe this interesting enterprise is worthy of extensive investigation. Considerable bench room is now being used in growing tomatoes, but the inferiority of the present greenhouse structure renders it impossible to maintain a suitable night temperature; hence our efforts cannot be very satisfactory.

POT EXPERIMENTS WITH FERTILIZERS ON TOMATOES.

Early in the year, several Wagner pots were secured with a view to ascertaining the value of certain chemically pure salts, or fertilizers, when applied to the tomato plant. Nitrogen, phosphoric acid and potash were added in solution, singly and combined in different proportions. The variation in the size of the mature plants indicated many interesting facts, but these tests will be repeated before publishing a report upon the results.

TRANSPLANTING ONIONS.

Our work on the transplanting of onions gave results which we trust will be of service to many gardeners in Tennessee. The increased profit to be gained through the practice of this recently advocated method, should be sufficient to induce onion growers to discard the old method, and adopt the new. Bulletin No. 4, Vol. V., contains a description of the practice, with a plate showing the great difference in size of transplanted bulbs and those not so treated. Further study will be made during the coming summer as to the best manner of growing and caring for the young plants.

ORCHARD FRUITS.

The orchard and vineyard are located on the south side of the University grounds, which slope gradually towards the river. Mention has been made as to the general treatment and condition of the young trees in former publications of the Station. The vineyard contains about three hundred and fifty vines and eighty-two varieties. Most of the vines have made a vigorous growth, and we may expect about one hundred of them to yield their first crop this year. Good trellises were recently constructed for the training of one hundred and twenty-five vines.

SMALL FRUITS.

The small fruit plantation established on the farm in March, 1892, has done well, and we hope to report on their fruiting qualities next fall. It embraces five varieties of gooseberries, ten of currants, twelve blackberries, twenty-one raspberries, and thirty strawberries.

THE HERBARIUM.

Some time has been devoted to collecting and preserving cultivated plants for the garden herbarium of the Horticultural department. It contains several hundred varieties of grapes and various ornamental trees, shrubs and plants, most of which were selected from specimens growing on the Station and University grounds.

THE GROUNDS.

Efforts have been made to beautify the grounds about the Station building and greenhouse, through the use of a good collection of ornamental plants. The extremely hot and dry weather of last summer was destructive to several trees and shrubs, adapted to a cooler climate, but these will be replaced by something that will endure hot weather and severe drouths to a greater extent.

PLANS FOR FUTURE WORK.

Besides the experiments already mentioned in this report, which will be carried out during the summer season, the Horticultural

APPENDIX.

DIVISION OF BOTANY AND HORTICULTURE.

FRUIT TREES AND EXPERIMENTS WITH VEGETABLES.

[*Condensed from Bulletin No. 1, Vol. 5.*]

I.—THE VINEYARD.

Our vineyard is located east of and adjoining the orchard. It has a southeast exposure, with a soil well suited to the vine. Before planting, the plat was prepared by making two applications of good manure, one in the fall and the other the next spring, which were plowed under each time. Large holes were then dug at intervals of eight feet, allowing six feet between the rows. Bone meal, leaf mould, and rotten manure were placed in the holes and thoroughly mixed with good soil. The first planting of 126 vines was made last spring, on the 16th of March. All of these grew finely during the summer. Over 200 vines were added in November and December, and we now have a vineyard of 311 vines, including 76 varieties.

The main objects in view are to determine the varieties best suited to this State, to make a comparative test of stock from northern and southern climates, to illustrate the different methods of pruning and training, and to study the best means of combating the various insect and fungous foes that attack the vine.

II.—THE BEST VARIETIES OF FRUITS FOR TENNESSEE.

The range of soil and climatic conditions of Tennessee are so broad that the Station cannot decide upon the fruits best adapted to each section. Some varieties succeed admirably in this section but are worthless in Middle and West Tennessee. Hence co-operation was sought, and the following questions were sent to prominent fruit growers throughout the State:

What are the three best winter apples for your locality? The three best summer apples? Autumn apples? Pears? Peaches? Grapes? Plums? Cherries?

CONCLUSIONS.

1. The best apples for Tennessee are usually of Southern origin.

2. The number of apples grown in Tennessee originated farther north is comparatively small.

3. The two most extensively grown and perhaps the finest winter apples are Limber Twig and Winesap.

4. Early Harvest, Red June, Horse and Summer Rose are the most popular summer varieties.

5. Fall Queen, Ben Davis, Maiden's Blush, Kinnard's Choice, Shockley and Buckingham are the best for autumn use in most localities.

6. There are many seedling fruits in Tennessee, the names of which are unknown, that are good varieties and should be largely disseminated.

7. The number of pears in cultivation is limited to Le Conte, Keiffer, Bartlett, Seckel, Clapp's Favorite, Bell, Duchesse, Flemish Beauty, Duchesse d'Angouleme, and a few others.

8. The native seedling peaches receive the most attention. Good cultivated varieties are Crawford's Early and Late, Heath, Indian, Snow, Stump the World and Mountain Rose.

9. The Concord grape is adapted to most localities. Other varieties reported as doing well are Ives, Moore's Early, Diamond, Scuppernong, Catawba, Delaware, Lutie, Norton's Virginia and Martha.

10. The Wild Goose plum is superior in all parts of the State.

11. Early May is the most popular cherry. Governor Wood, Black Heart, Early Richmond, and May Duke reported as good varieties.

III.—EXPERIMENTS WITH VEGETABLES.

Our vegetable garden is located on the College farm, one mile west of the Station. The soil is a clayey loam, with a southern exposure, sloping gradually towards the river. Over two hundred varieties were grown, side by side, with practically the same soil treatment and atmospheric conditions. The old and well known kinds were tested, with a few of more recent introduction. Full and complete notes have been kept upon the date of planting, germination, first blossom, first ripe fruit, productiveness, size, color, form, flavor, etc. Before planting, the germinating power of most of the seeds was determined, and a few words here upon the method and importance of seed testing, may be of some value.

SEED TESTING.

We deem this important and essential work, which should be done not only by the Experiment Station, but every farmer and

vegetable gardener should determine the germinating capacity of his seeds before planting.

The germinator or testor that we use is very simple and convenient in management. It has been in use at the New York Station for several years, and is commonly called the Geneva Tester. The apparatus consists of a copper box fourteen inches long by nine inches wide, and three and one-half inches deep, with a narrow copper shelf on each long side one-half inch below the top. On these shelves slide brass wires, which serve as supports for as many pockets or folds of canton flannel cloth. In the bottom of the box is one-half inch of water, but it does not touch the pockets, all the moisture reaching the seeds by a gradual absorption. The ends of the cloth dip into the water and carry moisture throughout its entire length by capillary action. A pane of glass covers the box, which is kept in a temperature of from seventy degrees to eighty degrees Fahrenheit. A box of the above size will hold fifty pockets. Fifty or one hundred seeds should be tested of each variety, running duplicates if possible. It is best to examine the seeds daily, remove, count and record all that have sprouted. With cabbage, tomatoes, lettuce and turnips, over half of the seeds will usually germinate in six days; but it is necessary to continue the test for two or three weeks in order to determine the exact percentage.

BEANS.

The seeds of fourteen varieties were sown April 17, in drills thirty feet long, or in hills four feet apart. Nearly all the varieties had vegetated by the 26th of April. Soon after they sprouted we received a good rain, which pushed them forward very rapidly, so the first flower appeared on the Mohawk May 24th, followed on the 25th and 26th by Burpee's Saddle Back, Early Six Weeks and Boston Market. The varieties that matured fruit first were Golden Wax and Blue Improved Butter. These were marketable June 10th, or fifty-four days from date of planting. Most of the varieties were marketable by the 20th of June, except pole beans that did not ripen until August, and these continued through October. Earliness is an important factor, as early varieties usually command better prices. The most productive bean we tried was King of the Garden, six hills of which yielded fifty-five pounds. Of the pole beans, Golden Cluster Wax made the best showing, from which we picked forty-six pounds. Taking all the favorable points into consideration, we would recommend the following bush varieties: Improved Early Red Valentine, Extra Early, Wardwell's Wax, and Golden Wax. Pole Beans: King of the Garden and Dreer's Improved.

BEETS.

Sixteen varieties were sown in drills April 16th. When the plants became large enough they were thinned out to about five inches. The following varieties gave the best results:

Bastian's Early Turnip, Bastian's Half-long Blood, Eclipse, Egyptian, Extra Early Bassano.

CABBAGE.

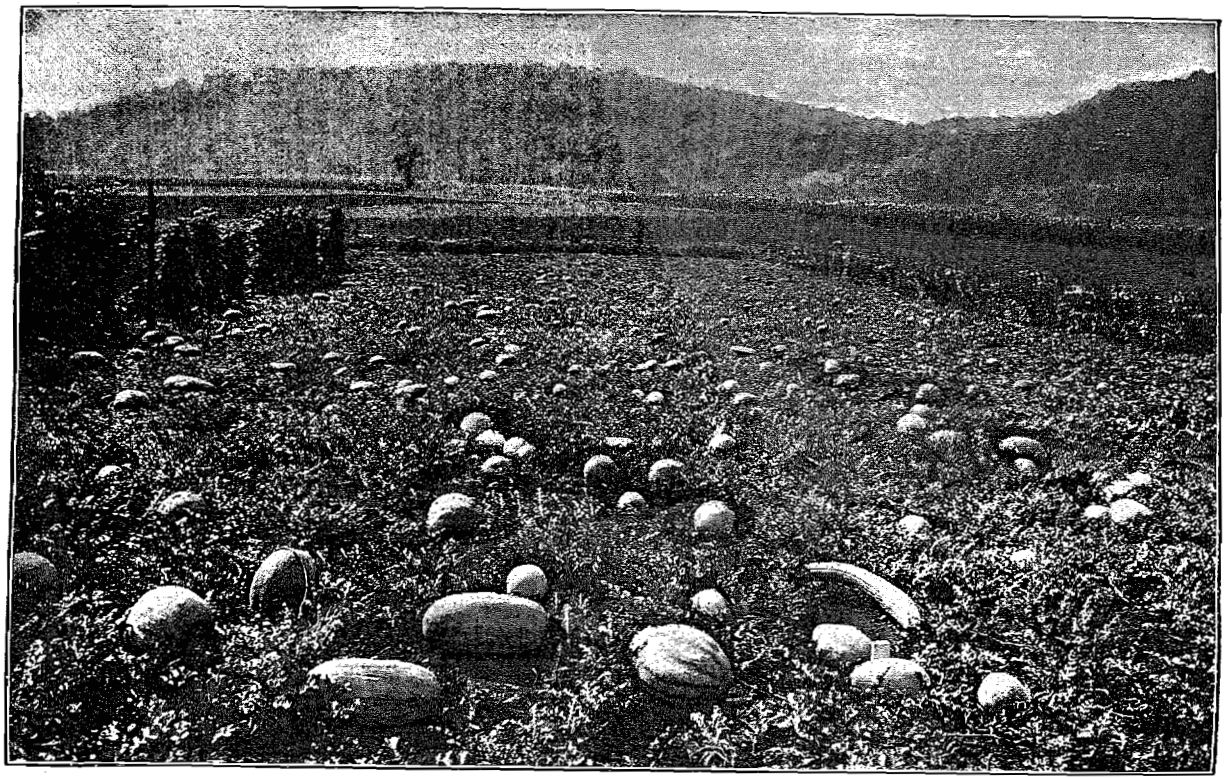
Seeds of twenty varieties of cabbage were sown in shallow boxes February 7th, and then placed in the hot bed. The seedlings from these were transplanted in the same kind of boxes March 12th, and set in the cold frame, which gave plants large enough for the garden by the 15th of April. Twenty plants of each variety were used, making rows three feet apart, allowing two and one-half feet between the plants. The weather was unusually dry after transplanting, hence we were compelled to water a few times until they became established. In spite of the dry weather the plants grew rapidly, and by the 8th of June they were ready for market.

The Early Jersey Wakefield was the first to mature. One day later we cut a head of Landreth's Earliest, and by the 11th the large variety of Wakefield gave another head. Henderson's Early summer was not far behind, for we cut a head from this on the 13th. Seven other varieties produced marketable specimens by the 20th of June.

The variety that produced most abundantly was one called Worldbeater, and we believe the name is well applied, since it exceeded all others in weight. We do not recommend this variety, however, because the heads are not firm. Other very productive varieties were: Nonsuch, Early Summer, Surehead, All Seasons, Burpee's All-head, Improved Flat Brunswick and Etampes. We recommend the following for early market: Early Wakefield, Early Flat Dutch, Early Summer, and Landreth's Earliest. For later cuttings, Etampes, Burpee's All-head, Nonsuch, and All Seasons. Many of the more common late varieties were not tested, some of which, very likely, are better adapted to our soils than those just mentioned.

CAULIFLOWER.

Cauliflower is treated in the same general manner as cabbage. We succeeded in growing fine plants which were transplanted in the garden April 23rd. About the time they commenced to head, an insect enemy, the Harlequin cabbage bug, *Murgantia histrionica*, attacked them, and in a few days it had spread over the entire patch. This insect feeds upon cruciferous plants, as cabbage, turnips, radishes and cauliflower. The beetle measures one-quarter inch in length, and is very easily recognized as it possesses distinct



EXPERIMENTS WITH MELONS.

markings of yellow, orange or red. In the adult stage it winters among refuse leaves, manure, or other material left in the field, and emerges early the next spring, when the eggs are deposited on the young plants. They soon hatch and the young commence their destructive work of sucking the sap from the leaves.

This insect spread over the entire patch in a few days. It is a most difficult enemy to combat, and no effectual remedy is known. The only insecticide that has any effect is kerosene emulsion. We applied this solution in different proportions, but with little success. The picking of the first brood that appears is the most ef fectual means. Its presence was not discovered in our patch, however, until several generations had been hatched; hence we were unable to check its depredations. Nearly all the plants were completely destroyed.

LETTUCE.

We tested sixteen varieties of lettuce. The young plants received the same treatment and care as was given the cabbage and cauliflower, except they were not taken to the garden until the 29th of April. Black-seeded Simson made the best showing. It produced heads thirteen inches in diameter, averaging about one pound each. Grand Rapids is quite productive, and possesses very fine, tender foliage. It is especially desirable for forcing purposes. The following kinds gave the best results: Black-seeded Simpson, Early Curled Simpson, Early Curled Silesia, Hanson, Sugar Loaf and Grand Rapids.

MELONS.

Plate II is reproduced from a photograph of our patch, taken about the time the melons commenced to ripen. The Watermelon seed was planted in hills, seven by eight feet apart, on the 17th of April. The soil was thoroughly enriched with rotten manure, a small quantity of a nitrogenous commercial fertilizer being added. A great many seeds failed to vegetate, but the stand was nearly sufficient to cover the ground with vines. From 165 vines we harvested 400 melons, weighing 5,039 pounds. The largest melon, a forty pound one, was cut from a variety called Boss. Striped Gypsey and Ironclad each produced one that weighed thirty-nine pounds. All of these melons possess good flavors and are excellent market varieties. The best flavored ones were Mountain Sweet, Green and Gold, and Dark Icing. Pride of Georgia, Cuban Queen, Striped Gypsey, Boss, and Scaly Bark are all standard melons.

The seeds of fourteen varieties of Muskmelons were planted in hills six feet apart April 17th. Five hundred and forty-one melons, weighing 1,438 pounds, were picked from 126 vines. Green Citron Netted was first to ripen, July 18th.

Netted Pineapple, Montreal Market, Hackensack and Golden Jenny were finely flavored. New Giant produced the largest specimen, which weighed 12¾ pounds. Thirty melons cut from this variety averaged five pounds each. Other good varieties are Miller's Cream, Emerald Gem, Bay View, Montreal Market and Baltimore.

PEAS.

Seed sown in drills April 11th, vegetated by the 24th. Extra Early Pioneer and Improved Daniel O'Rourke, gave edible peas June 1st, or forty six days from date of planting. These were followed a few days later by Tom Thumb, Lightning, Stratagem, Dreer's Eureka, Extra Early, and a few others. The largest yield was from Dwarf Blue Imperial, which had pods three inches long and three-quarters of an inch broad. We would recommend for early picking all of the above varieties, and McLean's Advance, and Dwarf Blue Imperial for later use.

RADISHES.

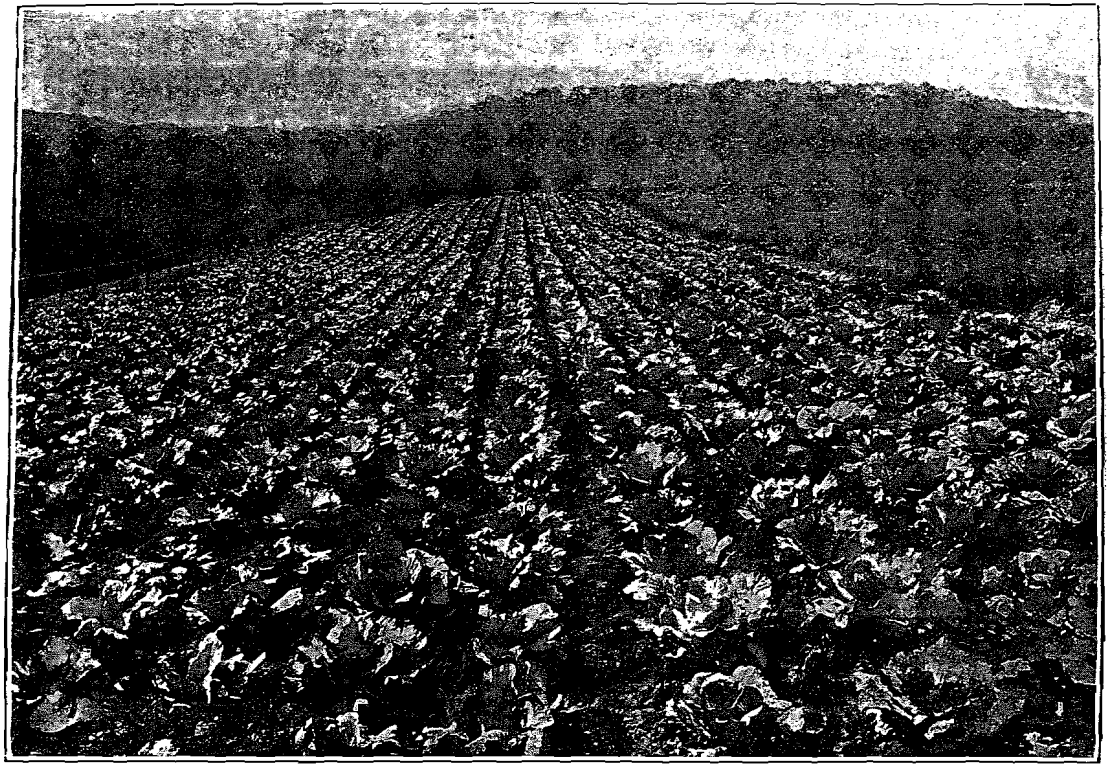
We tested twenty-seven varieties of Radishes. The seed was sown April 15th, and nine varieties were of marketable size by the 15th of May. Wood's Early Frame, a favorite variety with market gardeners, gave roots large enough for market on May 12th. Round White Forcing and a number of others were about two days later. All of the following varieties are very early and good for forcing purposes: Wood's Early Frame, Round White Forcing, Round Red Forcing, Cardinal Globe, White Box, Salzer's Twenty Day Forcing, and Early French Breakfast.

SWEET CORN.

Eight varieties of sweet corn were sown April 18th. All had fully vegetated by the 28th, and one sort, Crosby's Extra Early, furnished marketable ears on the 4th of July, followed in about a week later by Egyptian, Little Gem, Triumph and Roslyn Hybrid. Stowell's Evergreen and Marblehead may be mentioned as doing well.

TOMATOES.

Our tomato tests were most satisfactory in every respect. We tried twenty-five varieties. The seed was sown February 23rd in shallow boxes placed in the hot bed, seedlings from which were transplanted March 24th in the same kind of boxes, allowing two and five-eighth inches between the rows. The plants made a vigorous and healthy growth, and on the 24th of April we set them in the field, planting four feet apart. 35,330 sound tomatoes were picked from 327 vines, making a total weight of 3,557 pounds, or



A FIELD OF EARLY CABBAGE.

about seventy bushels. This yield is at the rate of 560 bushels per acre. A large percentage decayed before maturity, but these are not included in the above figures.

The Golden Queen was the most productive variety. From ten plants we harvested 810 specimens, weighing 170 pounds. We deem this one of the best varieties. It is smooth, seldom cracks, early to ripen, productive, and of a superior flavor. Ten vines of Yellow Pear yielded 5,950 tomatoes, weighing 138 pounds. Most of the common varieties gave good results, and it is impossible to say which ones deserve the highest recommendation. All of the following are good: Golden Queen, Yellow and Red Pear, Dwarf Champion, Livingston's Favorite, Cardinal, Livingston's Perfection, Optimus, Ignotum, Paragon and others.

IV.—THE CULTURE OF EARLY CABBAGE.

Every market gardener is familiar with the methods employed in the production of early cabbage. There are several good methods in use, and every gardener has his own special way, which he considers superior to all others. We practiced a method the past season that proved very successful and satisfactory, a brief description of which may be of general interest. The method is not by any means new, but has been used for many years by a large number of gardeners. The literature on this subject cannot be repeated too frequently.

Plate III shows the appearance of our patch just before we commenced cutting for market. The two varieties used were Early Jersey Wakefield and Henderson's Early Summer. The seed was sown January 10th, in shallow boxes 17x21 inches by 2½ inches deep, and placed in the hot bed. We used a light rich soil for the seed-bed and sowed enough to produce 1,000 plants in each box. The hot bed was made by excavating a cavity two feet deep, one-half foot larger in length and width than the frame to be used, and then filled it with fresh stable manure.

February 4th the seedlings were of good size for transplanting. The same kind of boxes were employed for this purpose. We set eighty plants in each box, being careful to get the rows straight. They were placed in the cold frame at once, which was constructed in the same manner as the hot bed except that no excavation was dug and no manure employed.

The soil designed for our plantation was so wet that it could not be gotten in proper condition before April 18th, when the plants were taken to the field. A good handful of guano was mixed in each hill. The plants were set in rows running at right angles to each other. This is more space than necessary, but it allowed

a better opportunity for horse cultivation, hoes not being used at all. We did not have rain for three weeks after transplanting, but only twenty-five out of 2,784 plants died from the effects of dry weather. This small loss was attributed to the large amount of soil left on the roots in cutting from the boxes. The first marketing was made June 8th. Quite a large number of heads decayed before maturity, hence only 2,335 heads were sold, making a total weight of 8,994 pounds. This is an average of nearly four pounds to the head.

The only insect enemy that attacked the plants was the cabbage worm or butterfly (*pieris rapæ.*) Little difficulty was met in combatting this pest. Insect powder or pyrethrum, applied with a small bellows about five times during the season, was sufficient and proved most satisfactory.

V.—THE FORCING OF LETTUCE.

The forcing of lettuce is well understood by most gardeners. There is nothing difficult or complex about the operation. We have thought, however, that a brief description here of the methods employed in its forcing may be of value or service to some who have not had so much experience with this vegetable.

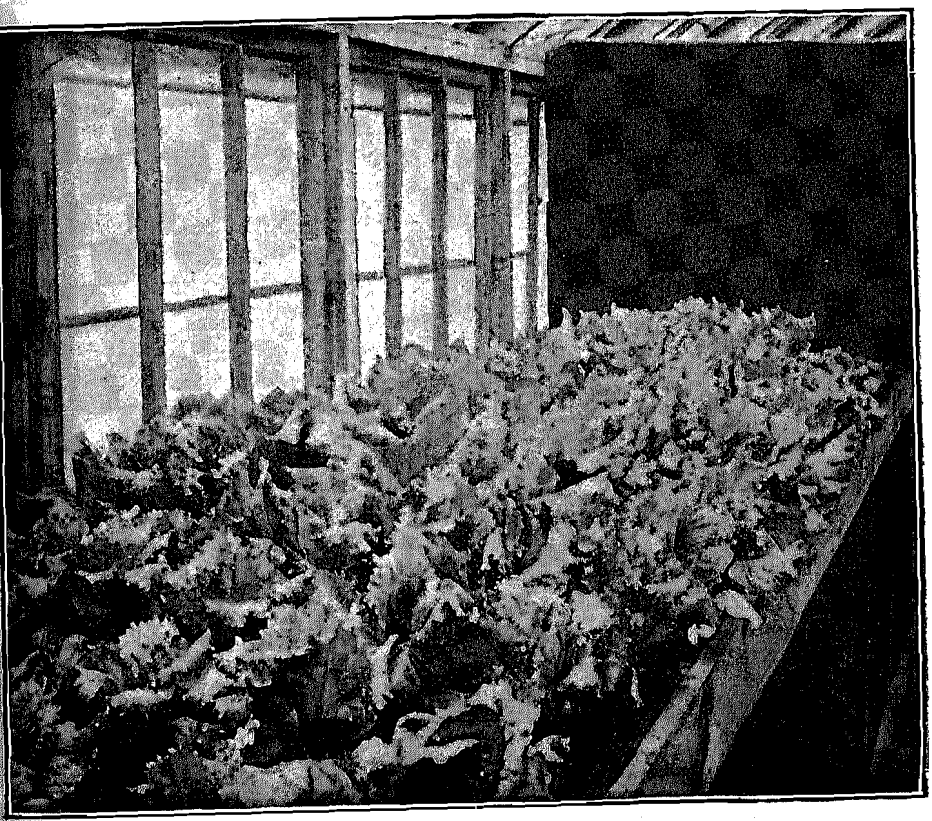
The seed was sown December 11th in boxes 17x21 inches by 2½ inches deep. The soil used for this purpose was thoroughly pulverized and put through a fine sieve. After filling the boxes and sowing either broadcast or in rows, fine soil was sieved over the seeds, burying them about one-fourth inch and firmed with a small block. Most of the seeds had vegetated by the 13th and 14th of December. Water was applied very sparingly until the young plants were pricked out into the same kind of boxes January 13th, setting them in rows one and one-half inches apart. At this transplanting, about one inch of old manure was placed in the bottom of each case, and then filled with good leaf-mould. The plants grew rapidly, and by the 5th of February we had good sized specimens for the bench. The greenhouse bench is three feet in width, and by erecting side boards we made it nine inches deep. A layer of rotten manure, measuring about three inches in depth, was placed in the bottom,and filled with good soil mixed with one-third its bulk of rotten manure. The plants were set seven inches apart Our photograph was taken April 1st, and April 9th we cut the crop for market.

Great care must be exercised in watering and regulating the temperature. Lettuce mildew, a very destructive fungous disease under favorable circumstances, may be produced or encouraged by improper watering or unsuitable temperature. This disease at-

tacked our crop very slightly. No very effective remedy is known. Evaporated sulphur is recommended.

We had some trouble with the aphis or green fly. A weak solution of tobacco emulsion, made by soaking refuse tobacco stems in water, proved effectual, but this remedy is destructive to the foliage. Tobacco powder strewn over the soil before planting will act as a good preventive.

Our greenhouse is not adapted to the forcing of lettuce, as the glass is too far from the plants. Houses for forcing purposes should be twenty or twenty-two feet wide, constructed with the glass very close to the benches, so that the plants will receive a large amount of sunlight, which is essential for a healthy and rapid growth.



EXPERIMENTS WITH FRUIT TREES AND VEGETABLES.

[Condensed from Bulletin No. 4, Vol. 5.]

I.—ORCHARD FRUITS.

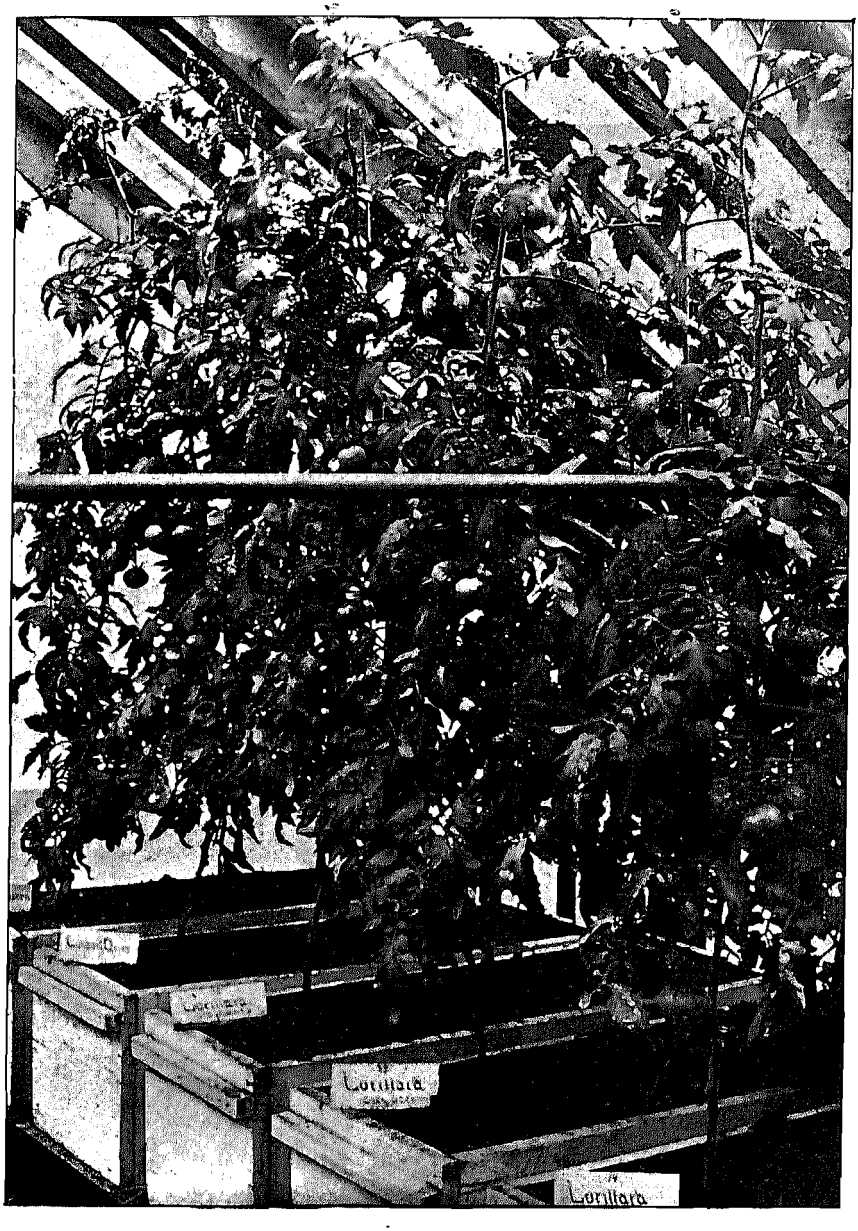
In the January Bulletin of 1891, clean cultivation was strongly advocated. This method, practiced with decided success in 1890 and 1891, was not repeated the past season. It has many commendable points, yet there are three serious difficulties which we have sought to overcome, namely: 1st, expense of continuous cultivation; 2nd, liability of soil on steep hills to wash; 3rd, injuries resulting to roots from the sun, when location slopes to the South. These difficulties were avoided by sowing cow peas early in May, which completely shaded the soil until September. The trees presented a healthier appearance the past summer than ever before. During the extremely hot, dry weather, the leaves preserved a rich green color.

It is five years since the Station orchard was established. In 1891 a small number of pears, peaches and plums bore fruit, but in such limited quantities that we did not report upon them.

APPLES:—Two varieties of apple matured fruit, namely, the Ben Davis and Jonathan. The Ben Davis is well known and cultivated throughout the State. Our tree is a strong, healthy, thrifty grower, but the half-gallon of apples which it produced were rather poor in quality. The Jonathan, a variety usually valuable for its medium-sized, juicy, yellow apples, yielded a dozen specimens of fair quality and size. Tree vigorous.

PEARS:—Five varieties of pears fruited. The Howell, a vigorous grower, made the best showing. In reports last year from fruit-culturists residing in all sections of the State, naming the sorts best adapted to their localities, the Bartlett was rarely omitted. Another well known and valuable pear for our State is the Kieffer. Doyenne White, the only dwarf tree that matured fruit, ripened pears in August.

PEACHES:—All of our peach trees blossomed profusely last spring, and only a very small percentage of the flowers were destroyed by frost. But after the peaches had grown for several weeks, rot attacked them, and for want of a proper spraying pump, no attempt was made to save the fruit by spraying, and the crop was lost.



FORCED TOMATOES.

Late varieties suffered most seriously; not a dozen specimens being harvested from this class.

PLUMS:—Of the twenty-seven varieties of plums on trial, only one, the Wild Goose, has fruited. This variety gave a fair crop last year, and this year the yield was very good. Fruit of fine quality, flesh firm, juicy, sugary and rich. Ripe July 1st. Tree very much larger and more vigorous than any other plum tree in the orchard. Trunk measures 4½ inches in diameter one foot above ground; tree 12 feet high with a top measuring 15 feet in diameter. The Wild Goose is decidedly the best plum for our State. In reports from practical fruit-growers this variety was almost invariably recommended as the best.

II.—TOMATO CULTURE UNDER GLASS.

The house used for making our experiments is a common glass structure, running northeast and southwest. Sunlight is very essential in the forcing of tomatoes, and it is important that the houses be built in locations where the plants will receive the greatest amount possible. The proper temperature is also an important element. About 60 degrees is a good night temperature, and from 70 degrees to 75 degrees for cloudy days. On bright sunny days, it frequently reached 90 degrees, but with no detrimental effects. We made it a rule, however, always to ventilate at 75 degrees. The heating apparatus employed was the Hitching's hot water boiler, with five four-inch pipes under each bench.

The seed may be sown in shallow boxes, transplanting once before permanent setting, or the plants may be propagated by cuttings. We practiced the latter method with satisfactory results. After a good root development had been made, and the plants measured eight or ten inches in height, they were set in boxes three feet long, with a depth and breadth of one foot. Three plants were placed in each box.

Two parts of leaf loam and one part of thoroughly decayed manure formed the composition of the soil used in nearly all the experiments. A few plants were forced in moderately rich soil, but these produced small and inferior fruit. The boxes above mentioned rested upon two narrow boards of the greenhouse bench, allowing four inches between the boxes. This arrangement not only secures a good bottom temperature, but permits the heat to enter the boxes on every side. Pieces of broken pots were placed over holes in the bottom of the boxes to aid in drainage.

The training of winter tomatoes must receive special attention. To neglect this operation means failure. Different methods were tried, but we decided upon the following system as being the best:

Three horizontal wires were stretched under and attached to the rafters, running the entire length of the bench. Each plant was supported by a strong perpendicular cord tied to the horizontal wires, and as the stem lengthened it was fastened to the main cord at intervals by means of bass or raffia. The plant was trained or pruned to one stem, accomplished by pinching off all axillary or lateral branches as soon as they appeared. When it attained a height of five feet, or reached the glass, further growth was stopped by pinching off the top. See plate IV.

Careful watering is important in the culture of all greenhouse plants, and the tomato demands particular attention in this respect. It requires a moist atmosphere during the early stages of growth, and must have a constant and regular supply of water. The red spider, its most dangerous and destructive insect enemy, is easily combated by means of frequent sprayings with water.

Artificial aid in pollinating the flowers seems to be necessary, or at least advantageous in securing a full setting of fruit. This may be done by transferring the pollen by means of a shallow receptacle into which the powder is jarred, or by gently tapping each flower with a small camel's hair brush. On bright, sunny days, perhaps this additional labor is unnecessary, but we believe the practice pays in every case.

We tried several varieties recommended for forcing, and found the Lorillard, a beautiful, solid red tomato, and the Golden Queen, valuable for its superior flavor, smoothness, solidity, and productiveness, to be the most desirable and satisfactory sorts. The Golden Queen gave the largest production. Some specimens weighed over five ounces, the average weight being about two and one-fourth ounces. With this yield the crop was a profitable one. Nearly all the tomatoes sold readily at the rate of fifty cents per pound. Plate V represents a few good specimens of winter forced tomato.

III.—FIELD EXPERIMENTS WITH TOMATOES.

The Acme was selected for nearly all the experiments. It is one of our best red tomatoes, and ranked third in production last year. Fruit large, handsome, smooth, solid and finely flavored. Seed was sown February 13th, in flats 2½ inches deep, and then placed in the hot bed. A thin layer of leaves was spread in the bottom of each box to secure good drainage, over which good, finely pulverized soil formed the seed bed. With proper watering and ventilation the seedlings grew rapidly and were large enough for transplanting in about a month. March 22nd, they were set in shallow boxes, allowing 2¾ inches between the plants. May 6th, we



FRUIT OF FORCED TOMATOES.

commenced setting in the garden, using ten plants in each plat, inserting them 3½ feet apart in the row and the rows 5 feet apart.

CUTTING BACK.

The object of pruning was to check the growth in leading shoots, thus inducing new branches to be thrown out near the roots, making the plants low, stocky and bushy. We commenced the operation soon after the plants had become well established, and repeated at intervals of three weeks, until half the crop had matured. About two inches of the tips were removed at each pruning. When the plants came into bearing, they were round and well formed, and we naturally expected a decided increase in yield.

But trimming did not hasten maturity or earliness except in one instance, when a day was gained. Trimming decreased the productiveness by weight in every case. It is doubtful whether cutting back is an advantage in this climate. Our experiments indicate that the practice is a disadvantage.

ONE, TWO OR THREE-STEM TRAINING.

Our objects were to secure data on the relative ripening periods and influence on the quality and quantity of the fruit. The plants were supported to stakes, by means of raffia, at intervals of a foot or more, and all side shoots pinched off as fast as they appeared. In case of one-stem pruning, the stocks grew very large, frequently measuring over an inch in diameter near the ground.

Ripe fruit was picked almost a week earlier on plants trained to two stems, but in very limited quantities. The bulk of the crop ripened sooner on the one-stem plants than on those trained to two stems, and there was little if any difference in the date of maturity in the two and three-stem plants. Most of fruit on the trained plants ripened very much earlier than that on vines not trained. Increase of earliness is of great importance, since early tomatoes always command good prices.

There was a regular increase in the number of fruits from one-stem plants to those not trained. But the fact most evident was the large size of individual tomatoes on the one and the two-stem plants, being a third larger than those harvested from the vines not trained. There was also a regular increase by weight of the unsound specimens, being the greatest on plants not trained. When plants are trained to one or two stems they should be set about fifteen inches apart in rows, and the rows three or three and one-half feet apart. If set in this manner the yield would be much greater than when grown at the usual distance and by the most commonly practiced methods. The advantages to be gained are increased earliness, improved quality of fruit and greater yield if planted at the proper distance.

SUPPORTS FOR PLANTS.

Besides the use of stakes, we employ wire, stretching between heavy posts driven in the soil at intervals of forty feet, and supported every six or seven feet with light stakes. Common tar cord answers the purpose equally well, and does not cut the plants so seriously. An A frame, erected between the rows, so that the plants could be trained on both sides, gave excellent results. Another low frame, that kept the plants about fourteen inches from the ground, proved quite satisfactory. A method extensively practiced in some parts of the State is to place fragments of brush under the vines before they begin to recline and spread, thus holding the fruit from the soil and reducing the percentage of rot. With this method we obtained the largest yield, but did not like the practice on account of unattractive and disorderly appearance of the brush and inconvenience of gathering.

EARLY AND LATE SETTING.

Most of our tomato plants were set in the field May 6th, but desiring to ascertain the effect of holding plants and setting at later dates, we reserved several boxes and watered the plants sparingly so that further growth would be retarded. May 16th a second planting was performed and another lot was inserted May 26th. Even May 6th is late planting for this locality.

Plants set May 6th ripened fruit twenty days earlier than those put out May 26th. The May 6th setting gave the largest yield, but plants set ten days later were not so productive as ones set on the 26th.

DEEP AND SHALLOW SETTING.

Several plants were used to determine the effect of deep and shallow setting. In one instance very deep holes were made, and the plants measuring ten inches in height were inserted so that about three inches of the tops remained above ground. In the second case, they were planted at medium depths, and another lot was set very shallow, not exceeding two inches in depth. Dry weather continued for two weeks after placing in the field, and the plants set very deep remained strong and vigorous, while the others lost their green healthy appearance.

This experiment showed no difference in the date of ripening. Productiveness was greatest with plants set a medium depth, while those set very shallow did not yield so well as the deeply set ones, the difference, however, being very small. Individual fruits were also larger on plants set at medium depth. Our experiments indicate that deep setting is unnecessary.

THE EFFECT OF LIQUID MANURE.

To determine the effect of manure liquor when a given amount is applied at the time of setting, or at intervals, several plants were subjected to various treatments. In one instance two quarts of liquor were poured upon each plant at the time of setting. One pint to each plant, used at intervals of three weeks, formed another trial. And thirdly, one pint was applied at intervals of one week from the date of first ripe fruit.

No definite conclusion could be drawn from the experiments. The plants on which manure liquor was not used were somewhat more productive.

ONE OR TWO TRANSPLANTINGS.

Tomatoes not transplanted ripened specimens nearly a month later than the transplanted ones. The yield was also greatly reduced, being less than half that of plants which received one shifting. One transplanting gave better results than two. Were pots used instead of flats, perhaps the result would be different.

CUTTINGS AND SEEDLINGS.

In the greenhouse experiments performed last winter, all the plants used were grown from cuttings. The yield was not so large as we had expected, and the question at one presented itself, had we made a mistake by employing cuttings. To determine this matter in our soil and climate, two lots of plants were set, one of good seedlings and the other of strong, well-rooted cuttings.

There was two days difference in the earliness. Seedlings produced the greatest number of tomatoes, which weighed a few pounds more than the product of cuttings, but individual specimens from cuttings averaged one-fifth more in weight.

OLD AND YOUNG PLANTS.

An experiment conducted with interest was a comparative test of young seedlings with old plants that had been carried through the winter. The old plants, wintered in flats and set three inches apart, had grown about eighteen inches in height and contained very few lower leaves. At the time of setting they were eight months old, and it was necessary to twine the roots about the hole in a spiral manner in order to make them stand erect. The first ripe fruit appeared on both lots July 19th. Thirty-eight more tomatoes were produced on the old plants, but the weight was the same in each case, being forty-seven pounds.

CUTTING BACK AT TRANSPLANTING.

Two years ago the writer attended a farmer's institute in this State, where a tomato grower made the statement that cutting back strong, vigorous plants at the time of setting in the field,

leaving only two or three inches of stem above ground, greatly increased the yield. Desiring to try this experiment, we treated twenty plants in the above manner, and set another plat containing the same number without cutting them back.

Tomato Plants:	First Ripe Fruit.	No. Fruits from ten plants.	Wt. Fruits from ten plants.	No. Fruits per lb.
Cut back at transplanting	July 21.	340	58	5.9
Not cut back at transplanting	July 10.	379	67	5.7

The results of the experiment were evident. Plants not cut back matured fruit earlier and gave a better yield.

PAPER BAGGING.

Two large plats were set apart for this trial. Tomatoes on plants in one plat were bagged soon after the fruit had formed, while those in the other were undisturbed. There was no difference in the date of ripening. Productiveness about the same, but percentage of decayed specimens was very much less in case of the bagging. Tomatoes were smoother and possessed a better color. The greatest advantage gained in this operation was the protection of the fruit from the sun, which caused many tomatoes not bagged to blister, thus rendering them unsalable.

VARIETY TESTS.

For the past season the following sorts gave the best results. Early Paragon, King Humbert, Dwarf Champion, Cardinal, Livingston's Beauty, Lorillard, Early Acme, Livingston's Favorite, Volunteer and Yellow Plum. The above varieties are arranged in order of their productiveness by weight.

CONCLUSIONS FROM OUR EXPERIMENTS

1. Cutting back the leading shoots at intervals during the growing season decreased the yield.

2. Training to one or two stems hastens maturity and secures fruit of superior size and quality.

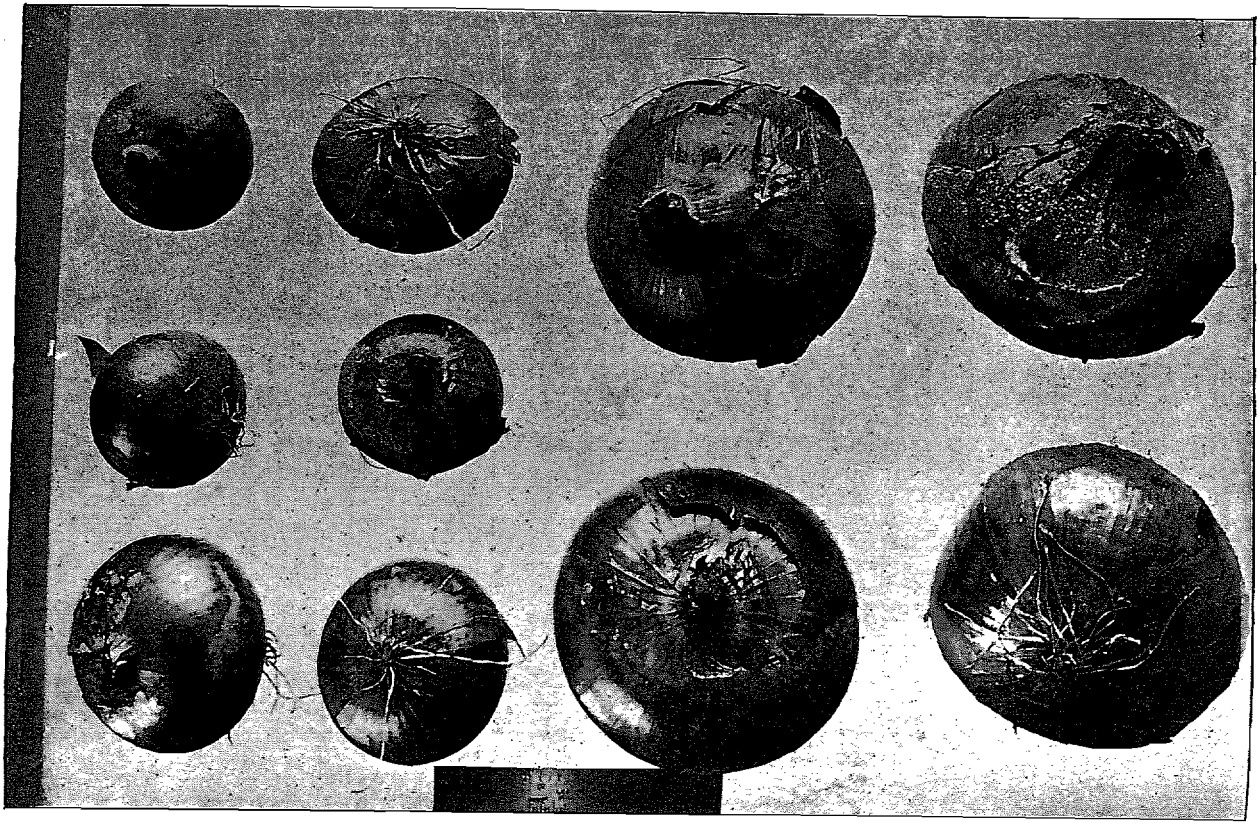
3. It is doubtful whether supports can be profitably used, except in training to one and two stems. Stakes and wire were most satisfactory.

4. Strong, stocky tomato plants should be set in the field as soon as the weather will permit. They ripen earlier and produce better.

5. Inserting plants at medium depths gave better results than very deep or very shallow setting.

6. The application of manure liquor made no appreciable difference in yield.

7. The practice of sowing seed in hills, without transplanting,



EXPERIMENTS WITH ONIONS.

should not be recommended. One transplanting in flats proved more satisfactory than two transplantings.

8. Seedlings produced slightly better by weight than cuttings, but individual fruits on cuttings were very much the larger.

9. Cutting back to three inches of the ground at time of transplanting decreased the yield.

10. Bagging improved the color and quality of fruit, and decreased the loss by rot and sun blistering. Value of system in practice depends upon the cost.

11. Varieties that made the best showing the past season were Early Paragon, King Humbert, Dwarf Champion, Cardinal, Livingston's Beauty, Lorillard, Early Acme, Livingston's Favorite, Volunteer and Yellow Plum.

IV.—TRANSPLANTING ONIONS.

The practice of transplanting onions was first brought to public notice early in 1890, by Mr. Greiner, of La Salle, N. Y. Prof. Green, of the Ohio Experiment Station, working independently, arrived at the same conclusions about the same date, but his article did not appear until after that of the former writer. Both of these authors strongly advocated the system which they had worked out, and through the frequent discussions in agricultural papers, it has become generally known throughout the country and practiced to a considerable extent. The advantages are so great that no farmer or gardener can afford to practice any other method.

The plan which we carried out the past season is described below:

The first sowing was made Feb. 25th, in shallow boxes placed in the hot-bed. A month earlier than this would be better. Light rich soil formed the bed for the seed which was sown moderately thick, in drills two inches apart. A month later, we pricked the small seedlings into flats.

Plate VI represents four transplanted onions and six which were grown in the usual manner. The photograph presented was taken from good specimens selected from a large number of each class. The plants and seed were inserted in the garden on the same date, and grown side by side in soil containing practically the same fertilizing ingredients. Transplanted specimens averaged three inches in diameter, weighing five ounces, while onions not transplanted measured about one and three-fourths inches in diameter, with a weight of one and one-fourth ounces. Bulbs grown according to the new method were about four times more productive than the onions which did not receive this treatment. The yield in the one case was at the rate of 823 bushels per acre, in the

other, 206 bushels. One thousand bushels per acre could readily be grown in suitable locations and under good management.

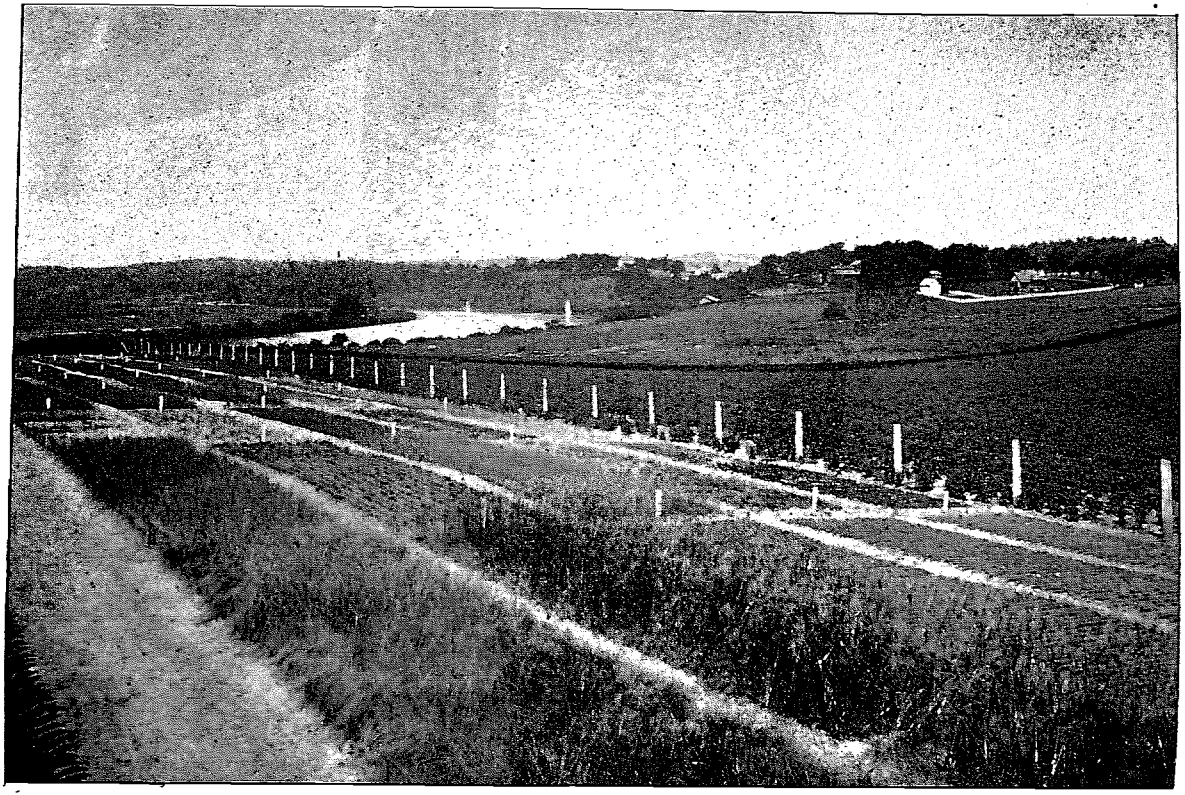
Close attention was given the plants in regard to ventilating and watering until they measured about three-eighths of an inch in diameter, at which time transplanting in the field was performed. Strong plants should be had, and it is important to start them early so that good seedlings may be ready for setting out on the first day that the weather and soil permits.

The operation of setting plants in the field is quite a task if large quantities are to be grown, and a thorough study should be made as to the most efficient method of handling them. Our plantation was so small that no accurate results could be obtained upon the time required to set a given area, but we quote the figures as given by Mr. Greiner. If they are set in rows one foot apart, and three or four inches apart in the row, it will require 150,000 plants per acre. Boys with some practice will set 2,000 to 3,000 plants a day, and skilled persons 4,000 to 5,000. The setting of one acre is thus equivalent to thirty to forty days work. This seems a large expenditure of labor on such a small area, but when we consider that under the new method there is no necessity of thinning and hand-weeding, and that the crop is more than doubled, sometimes tripled, (in our experiment quadrupled,) it becomes a most profitable investment.

The increased profits may readily be seen. Less seed is required under the new method, but there is an additional expense in nursing the young plants. Transplanting in the field is a laborious task, but not more so than thinning and hand-weeding when the seed is sown in the open ground. So up to the harvesting of the crop, there is very little, if any, difference in the expense account. Of course it will take more money to pull, barrel and market 800 than 200 bushels. Onions sold last year in the Knoxville markets, from November to May, for $2.75 to $3.75 per barrel of ten pecks, or $1.10 to $1.50 per bushel. Fifty cents as the total cost of producing and marketing is a high estimate. Over half the income, at this rate, would be net profit. If there is not a sufficient demand in this State for the supply, certainly there must be somewhere in the United States, for over 400,000 bushels of onions were imported from foreign countries from January to July, 1891.

Some of the most decided advantages in transplanting onions are:

1. The crop reaches maturity several weeks earlier.
2. An increase in yield from two to four times.
3 Better prices for the fine uniform bulbs.



GRASS PLOTS—STATION FARM.

A LIST OF THE NATIVE AND CULTIVATED GRASSES OF TENNESSEE.

[*Condensed from Bulletin No. 2, Vol. V.*]

The published English names and synonyms, as well as the botanical names, are given, the latter in alphabetical order; all the English or "common" names known to the writer are included, together with brief observations regarding the character and habits of the grasses enumerated. A number of species possessing no local or common names or agricultural value are omitted.

1. **Agropyrum caninum** *R. & S.*—Bearded Wheat-grass, Awned Wheat-grass.

This grass is recorded by Gattinger as occurring within the State in cultivated grounds, but not frequent. It is a native of the more Northern States, especially in the mountain regions. It differs from cultivated wheat in its more slender growth and perennial habit; and from its near relative, *A. repens*, in having a strictly fibrous root and longer-bearded flowers. We are not aware that its agricultural value has been tested.



Couch-grass, *Agropyrum repens*

2. **Agropyrum repens**, *Beauv.*—Couch-grass, Witch-grass, Quitch-grass, Quick-grass, Quack-grass, Quake-grass, Wheat-grass, Creeping Wheat-grass, Dog-grass, Dutch-grass, Durfa-grass, Durfee-grass, Devil's-grass, Chandler's-grass, Scutch-grass, Twitch-grass, Fin's-grass.

This, like *A. caninum*, is reported by Dr. Gattinger as occurring sparingly within the State in cultivated grounds. It is abundant in fields, etc., in the Eastern and Middle States, and although of considerable value for hay, its strong, creeping roots (really underground stems) which spread rapidly in all directions, render it a dangerous pest, hardly less difficult to eradicate than the well known Johnson-grass.

3. **Agrostis alba,** *Linn.*—Herd's-grass, Bent-grass, English Bent, White Bent, Bonnet-grass, White-top, Dew-grass, Fiorin, Marsh Bent-grass.



Red-top, *Agrostis alba.*

Herd's-grass has long been known to our farmers, and in its several forms is deemed especially valuable for permanent meadows and pastures where the land is not too dry. On good soil it yields well and makes excellent hay.

4. **Agrostis arachnoides,** *Ell.*—Spider Bent-grass.

This is a delicate, low-growing species, which Dr. Gattinger reports as being found on argillaceous soils, in the glades and highlands of Middle Tennessee. It has no agricultural value.

5. **Agrostis canina,** *Linn.*—Brown Bent, Dog's Bent, Mountain Red Top, Rhode Island Bent, Fine-top, Furze-top, Burden's-grass.

Our native forms of this species are low grasses, chiefly confined to the mountain region, growing sparingly in moist locations. The taller, cultivated form, is, we think, a European introduction, and its seeds may be obtained from New York or Philadelphia seedsmen. It makes a close sod and is considered valuable for permanent meadows or pastures.

6. **Agrostis elata,** *Trin.*—Southern Bent, Tall Thin-grass.

This is a common native species, growing usually in dry soil, in open woods or along thicket borders, attaining the height of two or three feet. It is a late growing species, not usually blooming before October. It has no recognized agricultural value.

7. **Agrostis perennans,** *Tuck.*—Thin-grass.

This is a common grass, of delicate habit, growing in moist, open woods aud shaded places, but does not appear until the early autumn months, flowering in September and October. Of little agricultural value.

8. **Agrostis scabra,** *Willd.*—Rough Bent, Fly-away-grass, Tickle-grass, Hair-grass, Fool-hay.

Rough Bent is one of the most common of our native species of Agrostis, usually growing in dry soil, in old fields and along road ways. It has very fine root-leaves, comparatively short stems, and a very large, loosely flowered panicle. It is not considered of any agricultural value.

9. **Agrostis stolonifera,** *Linn.*—Creeping Bent, Fiorin.

This is simply one of the forms of *Agrostis alba* (see above,) with low, spreading stems and a rather dense habit of growth. It is particularly valuable as a pasture grass.

10. **Agrostis vulgaris,** *With.*—Herd's-grass, Bent, Fine-top, Fine Bent, Rhode Island Bent, Furze-top, Tall Red-Top, Burden's-grass, Red-top, Summer Dew-grass, Borden's-grass.

This is not recognized as being botanically distinct from *Agrostis alba*, already noted.

11. **Alopecurus aristulatus,** *Michx.*—Wild Water Fox-tail.

A grass of low habit, occasionally found along the borders of ponds and ditches, blooming in May. It has a head something like Timothy, only very much smaller. We are not aware that it forms any considerable element in our native forage.



Meadow Fox-tail.—*Alopecurus pratensis.*

12. **Alopecurus pratensis,** *Linn.*—Meadow Fox-tail, English Fox-tail.

A valuable grass for moist meadows and pastures, particlarly on account of its earliness, often blooming in April. It has been introduced here from Europe along with other cultivated grasses, and is deserving of more attention than it appears to have received.

13. **Andropogon argyræus,** *Schult.*—Silver Beard-grass.

A native species, found occasionally along the borders of woods, less common in open fields. It grows to the height of two or three feet, and is noticeable for its silvery-white "heads," which appear in September.



Wood-grass. *Andropogon nutans.*

14. **Andropogon macrourus,** *Michx.*—Brook-grass, Cluster-flowered Beard-grass.

This is rather a stout-growing species, similar in habit to broom sedge, but more robust, and although pretty generally distributed over the State, it is far less common than that grass. It blooms from September to October.

15. **Andropogon nutans,** *Linn.*—Indian-grass, Reed-grass, Wild Oat-grass, Bushy Blue-stem, Wood-grass.

This is a stout, perennial grass, four to six feet high, growing in dry soil, along borders of fields, or open woods. It rarely occurs in sufficient abundance to be of any value, and when it has bloomed, its stems are too stout and woody to be eaten by stock. It is not to be recommended for cultivation.

There are two well-marked varieties of this grass found

within the State. The more common one is the *Sorghum avenaceum* of Chapman (*Andropogon nutans* L. var. *avenaceus*, Hackel.) The other, less frequently seen, is *Sorghum nutans* of Chapman, (*Andropogon nutans* L. var. *Linnæanus*, Hackel.) This last is distinguished by its longer beards (awns), much more loosely flowered, darker-colored, and nodding panicles.

16. Andropogon provincialis, *Lam.*—Big Blue-stem, Finger-spiked Beard-grass, Finger-spiked Wood-grass, Finger-spiked Indian-grass, Blue-stem, Blue-joint, Blue Bent (in R. I.), Blue-grass, Turkey-foot.



Blue Bent. *Andropogon provincialis.*

This is a strong-growing, native grass, found throughout the State in dry soil, though rarely seen in cultivated lands. In some sections of the country it is valued both for hay and pasture. When young it is readily eaten by stock, the stems being very leafy, but after flowering, the stems become hard and woody, and of little value. In certain soils, or under certain conditions, this grass might be worth cultivating. It grows to the height of three or four feet, and, like all the Andropogons, blooms late in the season.

17. Andropogon scoparius, *Michx.*—Little Blue-stem, Indian-grass, Purple Wood-grass, Wire-grass, Brown-grass, White Bent, Broom Sedge, Broom-grass.

This is a comparatively slender grass, growing to the height of one or two and a half feet, frequenting old fields and the borders of woods, particularly in the mountain districts. It has some value as a native forage plant, and by some is known as "mountain sedge." Distinct from *Andropogon Virginicus.*

18. Andropogon Sorghum, *Brot.* Subspecies **sativus,** Hack.—Includes the cultivated varieties of Sorghum.

A number of varieties are cultivated here, either for the production of molasses, or for silage.

19. Andropogon Sorghum, *Brot.*, var. **Halapensis,** *Hack.*—Johnson-grass, Cuba-grass, St. Mary's-grass, False Guinea-grass, Mean's-grass, Guinea-grass (see *Panicum jumentorum*), Egyptian Millet, Egyptian-grass, Green Valley-grass, Alabama Guinea-grass, Australian Millet, Morocco Millet, Evergreen Millet, Arabian Millet, Syrian-grass. (*Sorghum Halapense.*)



Johnson-grass. *Andropogon Sorghum, var. Halapensis.*

Johnson-grass is now pretty well known in Tennessee, having been introduced quite generally over the State. There are a few who still regard it as a valuable grass for hay, and certainly its yield is

very large; but there are a great many more who are ready to offer a handsome reward to any one who will free their lands from this species. It has strong, underground stems, which grow deeply, taking the soil completely. This habit makes Johnson-grass exceedingly difficult to eradicate, for the least fragment of these underground stems, if left in the soil, serves to produce a new plant. Unless we wish to give the land up forever to this grass, we should not think of cultivating it.

20. Andropogon Virginicus, *Linn.*—Broom Sedge, Broom-grass, Virginia Beard-grass, Sedge-grass.



Sweet Vernal grass. *Anthoxanthum odoratum.*

There is probably no native grass better known to our farmers than this, and, although when quite young it affords excellent grazing, it is on the whole, one of our worst weeds, rendering the formation of permanent meadows almost impossible. Constant tillage seems to be our only means of keeping this grass from occupying our land.

21. Anthoxanthum odoratum *Linn.*—Sweet Vernal-grass, Sweet-scented Vernal-grass, Sweet-scented Spring-grass, Sweet-scented-grass, Vernal-grass.

A low, slender perennial with a close, narrow "head." This grass has been introduced from Europe, and is valued on account of its earliness and sweet odor when dry. It can only be recommended in mixtures for pasture.

22. Aristida dichotoma, *Michx.*—Poverty-grass.

A low and much branched annual, common in dry, sterile soil, or open fields. Wholly worthless.

23. Aristida purpurascens, *Poir.*—Beard-grass.

Allied to the last and growing in similar situations, but taller and much less branched. Of no value.

24. Arrhenatherum avenaceum, *Beauv.*—Tall Oat-grass, False Oat-grass, Tall Meadow-Oat-grass, Evergreen-grass, Oat-grass, Grass-of-the-Andes, French Rye-grass.

A highly valued grass, both for winter grazing and for hay. It has been introduced into this country from Europe, where it is regarded as one of the best fodder grasses. As it stands in rather loose tufts, it is best to mix the seed with those of other grasses in order to thicken the sward. It grows rapidly, blooms early, and when cut, dries out readily, and when dry, keeps well. It is not regarded as a suitable grass for moist soils.

25. **Arundinaria macrosperma**, *Michx.*—Cane, Large Cane (*A. gigantea, Chapm.*)

Dr. Gattinger reports this grass as growing "along the large streams of the State." It ranges in height from ten to forty feet, with a diameter of from ½ in. to 3 in. The plants bloom but once, and when the seeds mature, the cane dies. These canes are used for many purposes, such as for making fishing rods, scaffolds for drying cotton, splits for baskets, mats, etc. When young and tender, the leaves and stems are readily eaten by stock.

26. **Arundinaria macrosperma**, var. **suffruticosa**, *Munro.*—Small Cane, Reed, Switch Cane.

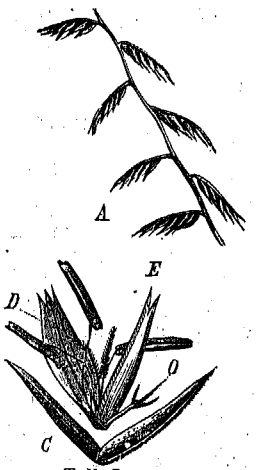
Similar in habit to Arundinaria gigantea, but smaller in size and more generally distributed over the eastern part of the State, and ocasionally found in swamps high up on the mountains.

27. **Asprella Hystrix**, *Willd.*—Bottle Brush, Hedge-hog grass.

A rather slender grass, three to four feet high, occasionally seen here in moist woodlands. Of no value.

28. **Avena flavescens**, *Linn.*—Yellow Oat-grass.

Yellow Oat-grass forms loose tufts, eighteen inches to two feet high. It has only recently been introduced into this country, and its seeds placed on the market. It grows well on almost all kinds of soil, and a good yield is tolerably certain. It is especially valuable for permanent pastures. The seeds are light, weighing only about five pounds to the bushel. It should only be used in mixtures, as when sown alone the product is small.



Tall Grama.
Bouteloua racemosa.

29. **Bouteloua racemosa**, *Lag.*—Tall Grama, Hairy Mesquit, Muskit-grass. (*B. curtipendula.*)

This valuable pasture grass has been found at several points within the State. It is a tufted perennial, one to three feet high, and forms a dense sod, which resists well the tramping of stock. It is deserving attention, and we believe that in many places our pastures would be greatly improved by its introduction.

30. **Briza media**, *Linn.*—Quaking-grass.

A pretty annual grass, sometimes cultivated for ornament, and for winter bouquets. Of no agricultural value.

31. Bromus ciliatus, *Linn.*—Swamp Chess, Fringed Brome-grass.

A native grass, frequent in open wood-lands, growing to the height of three to five feet, with drooping panicles. It is a perennial, but has no recognized agricultural value.

32. Bromus inermis, *Leyss.*—Hungarian Brome-grass, Couch Brome, Awnless Brome-grass.

This is a recently introduced grass from Europe, of considerable promise both for hay and pasture. It is strongly stoloniferous and quickly makes a thick, firm sward. It has grown exceedingly well in our grass plots, and young plants from fall-sown seed survived the winter when many other varieties were destroyed by frosts. The strong perennial character of this Brome-grass, and its unusual drought-resisting powers, are qualities which recommend it to many portions of the State. It thrives well on dry loose soil, but, of course, the better the soil the greater the yield. Its nutritive value is comparatively low, and in undertaking its cultivation the fact that it produces long underground stolons, which are difficult to eradicate from the soil, should be kept in mind.

33. Bromus mollis, *Linn.*—Soft Chess, Soft Brome-grass.



Chess.
Bromus secalinus

A European grass sometimes met with in cultivated grounds. It is an annual and a weed, similar in character to the next.

34. Bromus racemosus, *Linn.*—Smooth Brome-grass, Upright Chess.

More common than the last, but with smooth leaves and spikelets, often mistaken for Cheat.

35. Bromus secalinus, *Linn.*—Chess, Cheat, Willard's Brome-grass.

This is an annual introduced from Europe, and is more or less abundant in grain fields over the State, and should be classed as a troublesome weed. The idea that Cheat or Chess is degenerated wheat is simply an idea without any foundation in fact. Cheat seeds will produce Cheat, and only Cheat, and it is certain that wherever these plants appear, they were preceded by the seed, which may have been introduced with the grain, or brought by birds or animals from other fields.

36. Bromus unioloides, *Willd.*—Rescue-grass, Schrader's Brome-grass, Australian Oats, Australian Prairie-grass.



Small Reed-grass. *Calamagrostis Canadensis.*

This annual grass has been introduced into this State and cultivated in some places. It grows to the height of two or three feet, and yields a large amount of forage, and makes fairly good hay. It is well adapted here to winter grazing, and possesses some value on that account.

37. Calamagrostis Canadensis.—Blue-joint-grass, Sand-grass, Red-top Canadian Small-Reed, Fowl Meadow-grass.

A native grass, but limited to the higher mountains of East Tennessee. Of no agricultural value here.

38. Calamagrostis Nutalliana.—Reed Bent-grass, Wild Oats. (*Calamagrostis coarctata* is the same.)

39. Cenchrus tribuloides, *Linn.*—Sand-bur, Sand-spur, Hedge-hog-grass, Bur-grass, Cock-spur-bur.

Reported as occurring along the sandy banks of the Mississippi River. It is a low, much-branched grass, with a short "head," which is made up of a number of burs that are covered with sharp, stiff spines. It is a vile weed.

40. Cinna arundinacea, *Linn.*—Indian Reed, Wood Reed-grass, Sweet Reed.

A tall, leafy grass, three to seven feet high, frequent in shaded swamps and damp woods, and sometimes found along streams in wet meadows. For such places it may possess some agricultural value.

41. Cinna pendula, *Trin.*—Slender Reed-grass, Drooping Reed-grass.



Bermuda-grass. *Cynodon Dactylon*

A much more slender grass than the last, and apparently limited to the cold mountain woods in the upper and eastern part of the State. Of no agricultural value.

42. Cynodon Dactylon, *Pers.*—Bermuda-grass, Reed-grass, Scutch-grass, Dog's-tooth-grass, Wire-grass.

This is another of those grasses with a dual character, a most valuable plant under certain conditions, and a veritable pest when growing where it is not wanted. It is too well known to need any description, and we will only add that we regard it as a valuable pasture-grass for the eastern

part of the State at least, but its introduction into new land should be made with caution on account of its habit of taking complete possession of the soil, and the difficulty presented in exterminating it. It is strictly a summer grass here, for its leaves and stems are turned brown by the first frosts of autumn. It is propagated by means of sets or rooting stems. These are chopped up with a cutting-knife, and then sown broadcast or dropped in shallow furrows and lightly covered with earth. For holding steep banks, or binding sandy soil subject to wash, this grass is especially valuable.

43. Cynosurus cristatus.—Crested Dog's-tail-grass.

This is a perennial grass, recently introduced into this country from Europe, where it is used in mixtures to form bottom grass either in hay or in pastures. It possesses a highly nutritive value, and succeeds well in almost any kind of soil excepting those which are very sandy, and as it is deep rooted, it withstands drought better than some other species, and it is said to thrive well in shade. It is doubtless of some value in lawn mixtures.

44. Dactylis glomerata, *Linn.*—Orchard-grass, Rough Cock's-foot.



Orchard-grass.
Dactylis glomerata.

This is one of the best known and most popular of our cultivated grasses. It will grow well on any soil excepting that which is very wet. It grows well in the shade, no grass being equal to it in this respect, excepting perhaps the rough-stalked meadow-grass. In pastures it affords a good bite earlier than any other grass excepting the meadow foxtail. It affords a great amount of aftermath, being exceeded in this respect only by Kentucky blue-grass. Owing to its habit of growing in clumps or tussocks, the land should be seeded heavily, using two and a half or three bushels to the acre. When sown with other grasses, its tendency to form tussocks is very much diminished, and we would recommend that clover, or possibly red top, always be mixed with our orchard-grass. Although not adding materially to the bulk of hay produced, they will improve its quality and help make a much better sward.

45. Danthonia compressa, *Austin.*—Tennessee Oat-grass, Mountain Oat-grass.

This is a common grass upon our higher mountains, and forms the chief bulk of the forage on the so-called "balds." It was fully described and figured in Bulletin No. 4, Vol. II.

46. Danthonia sericea, *Nutt.*—Silky Oat-grass, Taller Wild Oat-grass, Silky-flowered Oat-grass.

While *Danthonia compressa* appears to prefer a moist or damp situation, *Danthonia sericea* is found in very dry soil on the lower foot-hills and along the crests of ridges and bluffs so frequent in the eastern part of the State. This species grows to the height of two or three feet, is soft-hairy all over, and is of a much stouter habit than *Danthonia compressa,* but it does not appear to form a sod, and our attempts at cultivating it have been unsuccessful.

47. Danthonia spicata, *Beauv.*—Wild Oat-grass, White-top, Old Fog, June-grass, Poverty-grass.

Danthonia spicata is common in dry, thin soils, and its presence is usually indicative of impoverished lands. It resembles very much *Danthonia compressa,* but does not usually grow so tall, and its leaves are much shorter and more curly. It is a grass of no agricultural value.

48. Deschampsia flexuosa, *Griseb.*—Hair-grass, Wood Hair-grass.

We have seen this grass on Roane Mountain and on Lookout Mountain, and probably it may be found upon all the mountains of East Tennessee. The slender stems are one to three feet high, and the leaves, which are chiefly at the base, are very slender, almost thread-like. It is a grass of no agricultural value.

49. Diarrhena Americana, *Beauv.*—Twin-grass.

"Rich soil amongst rocks, here and there."—(Gattinger.) A perennial native grass with rather strong, running root-stocks, which throw up unbranched culms, two to three feet high. Of no value.

50. Eatonia obtusata, *Gray.*—Early Bunch-grass, Prairie-grass.

A form of this grass is reported by Gattinger as occurring in the "Highlands." We do not know that it has any agricultural merits.

51. Eatonia Pennsylvanica, *Gray.*—Eaton's grass.

This is a native species which we have occasionally seen growing here in moist meadows. It is usually of a paler green than other grasses, and stands out conspicuously among them on this account. It grows to the height of two or three feet, and has a rather long and narrow panicle. There is another species of Eatonia (*E. Dudleyi*) which is common in our woods, blooming in April or early in May. Its stems are much more slender than those in the other species, and its leaves are

shorter, being rarely more than two or three inches long. Of no agricultural value.

52. **Eleusine Indica,** *Gærtn.*—Goose-grass, Dog's-tail grass, Yard-grass, Crow-foot grass, Wire-grass, Crab-grass, Crop-grass, Dog's-tooth grass, Buzzard-grass.

This is an exceedingly common annual growing in dooryards and cultivated grounds, particularly in rich soils. The stems are somewhat flattened, many springing from a single root, and each terminated by two to several spikes, which stand out like the fingers of a hand or the toes of a crow's foot.

Crow-foot grass, or yard-grass, are the names which are usually applied to this species. It is only rarely called crab-grass, which name really belongs to *Panicum sanguinale.* Some authors have spoken of it as being nutritious, and good for grazing or soiling and for hay, but we have always regarded it as a weed, and sometimes a troublesome one.

53. **Elymus Canadensis,** *Linn.*—Canada Lyme-grass, Wild Rye, Terrell-grass.



Lyme-grass. *Elymus Canadensis.*

This grass is frequently met with in low thickets along streams, and in rich, open woods. It has a leafy stem, three to five feet high, with a more or less nodding head, which resembles that of rye. It is a perennial, of no agricultural value here.

54. **Elymus striatus,** *Willd.*—Dennett-grass, Slender Hairy Lyme-grass.

This grass grows in similar situations with the last, but is more slender and not so tall. The head is smaller and decidedly more bristly in appearance.

55. **Elymus Virginicus,** *Linn.*—Lyme-grass, Smooth Rye-grass, Terrell grass, Wild Rye, Virginia Lyme-grass.

This species is much more common than the two last named, growing in low meadows and in rich soil, along the banks of rivers and streams. The stems are leafy, two or three feet high, with erect spikes or heads, three to five inches long. Although presenting an appearance of a grass of good quality, we doubt its being worth cultivating. It forms no sward, although its roots are perennial, and by the time it blooms, the lower leaves on the stalks are all dead.

56. **Eragrostis Frankii,** *Meyer.*—Short-stalked Meadow-grass.

A diffusely-branched annual grass, three to eight inches high, often met with in low, sandy grounds. It is remarkable for its strong, disagreeable odor. Of no agricultural value

57. Eragrostis major, *Host.*—Stink-grass, Pungent Meadow-grass

A rather showy, much branched annual grass, introduced into this country from Europe, and common here in rich cultivated soils, about gardens, etc. The more or less spreading stems are one to two and a half feet long, and when fresh, the whole plant emits a sharp, unpleasant odor.

58. Eragrostis minor, *Host.*—Candy-grass, Strong scented Meadow-grass, Stink-grass.

This, like the last, is a foreign importation, and by some it is regarded only as a variety of *Eragrostis major*. It possesses the same habit and characters, differing only in its smaller size and narrower spikelet. A weed.

59. Eragrostis pectinacea, *Gray.*—Meadow Comb-grass.

A native grass of rather attractive appearance, with large diffuse panicles, which are often gathered for dry bouquets. It is frequent here in dry, sandy soil, in open grounds and along the borders of fields or woods.

60. Eragrostis pilosa, *Linn.*—Slender Meadow-grass.

A slender grass, six inches to a foot high, found occasionally here in dry, sandy soil. Of no value.

61. Eragrostis Purshii, *Schrad.*—Southern Spear-grass, Southern Eragrostis.

More common than the last, found along the borders of walks in towns, and not uncommon in cultivated lands. Of no value.

62. Eragrostis reptans, *Nees.*—Creeping Meadow-grass.

A low, creeping species, found only in dry, sandy soil. Of no value.

63. Eragrostis tenuis, *Gray.*—Branching Spear-grass.

Taller than the other species of Eragrostis, with a rather narrow and elongated panicle and long and somewhat rigid leaves. Like the other species, it grows in sandy soils, and is without agricultural value.

64. Erianthus saccharoides. *Michx.*—Plume-grass, Woolly Beard-grass, Foxtail.

This is a tall, stout grass, four to six feet high, and of striking appearance. It is found in various parts of the State, but it is far from being common. The showy panicle is from five to ten inches long, and is of a silvery white, or, more often, purplish color. Of no agricultural value.

65. Euchlæna luxurians.—Teosinte, Gautemala-grass.

A grass recently introduced into cultivation from Central

America. It is a very tall and rapid-growing plant, with stalks resembling those of Indian corn, but it tillers at the base like wheat, so that the yield of forage from a comparatively small amount of seed is enormous. It affords a great amount of green fodder, allowing many cuttings during the season, and it may prove valuable for silage.



Teosinte.
Euchlæna luxuriana.

66. Festuca duriuscula, *Linn.*—Hard Fescue.

This is one of the forms of sheep's fescue of rather small size, and of little value except in pastures, and here chiefly because it will thrive on comparatively poor and sandy soil, unfit for the growth of better grasses.

67. Festuca elatior, *Linn*—Tall Fescue, Tall Meadow Fescue, English Blue-grass, Randall-grass, Evergreen-grass.



Tall Meadow Fescue. *Festuca elatior.*

This grass is very justly receiving much attention from farmers in the State. It is an exceedingly valuable grass, either for mowing or pasture. It is productive on soils which are not too dry, and being of long duration, it is especially valuable for permanent meadows. It thrives best on moist soils which are rich in humus, whether marls or clays. It presents several varieties, one of which is known as *Festuca pratensis* and the other *Festuca arundinacea.* The last is a very vigorous-growing form, and has done exceedingly well in our experimental plots. In amount of forage produced we have grown nothing equal to it among those species suitable for hay.

68. Festuca nutans, *Willd.*—Nodding Fescue.

This is a native species of fescue which is common in open rocky woods, or along the woody borders of moist meadows. Its stems are rather slender, usually about three feet high, with a loosely flowered and drooping panicle. Of little agricultural value, probably not worth cultivating.

69. Festuca ovina, *Linn.*—Sheep's Fescue, Pinon-grass (in Nevada), Pine Bunch-grass.



Sheep's Fescue.—*Festuca ovina.*

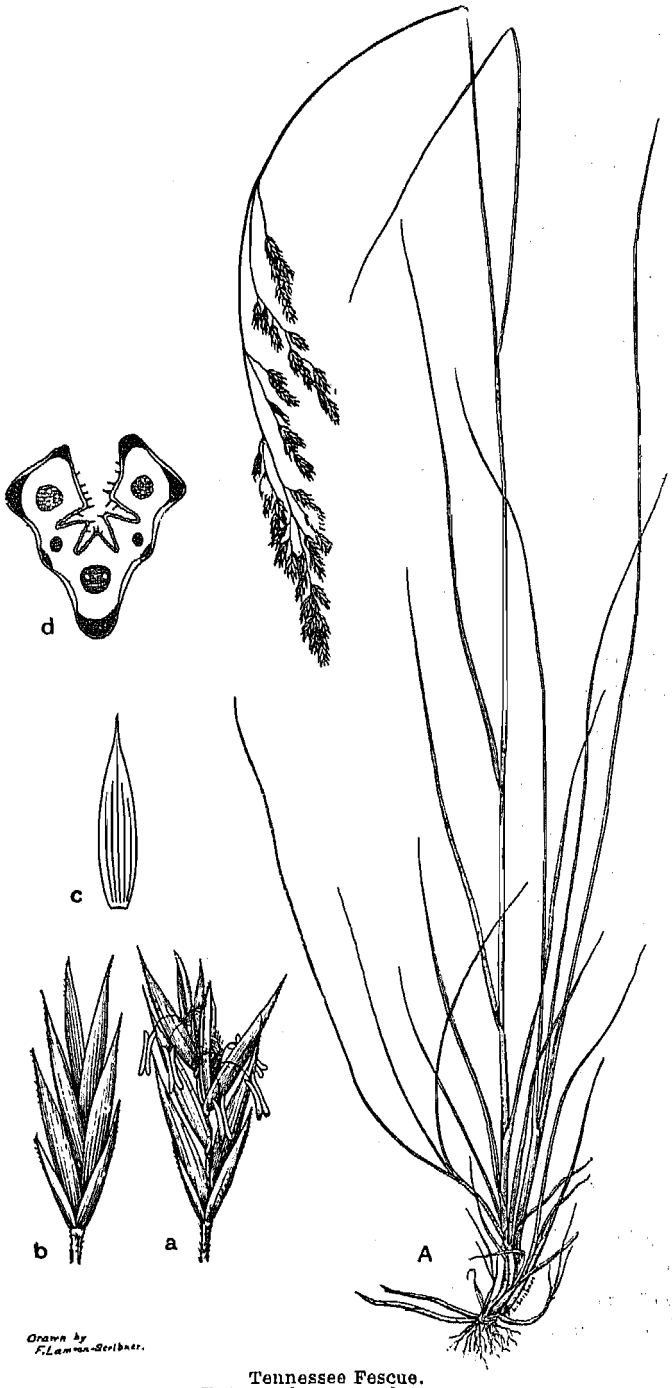
This grass has been sparingly introduced here in cultivation. It is of some value as a bottom grass when sown with species which do not from their habit of growth fully occupy the soil, and it is also valuable for sheep pastures. It thrives well here, even on soils which are of poor quality. "Its appropriate place in cultivation is on light, dry soils, especially those which are poor, shallow, and silicious. In such cases, it is a great boon to the agriculturist." (Stebler & Schrœter.)

70. Festuca pratensis, *Linn.*—Meadow Fescue, Randall-grass.

This is only a variety of *Festuca elatior* (see above,) being somewhat smaller than that species, with a narrower and fewer-flowered panicle.

71. Festuca rubra, *L.* var. **glaucescens.** Tennessee Fescue, Glaucous Creeping Fescue.

This grass was described and figured in Vol. IV, No. 1, of our Station Bulletins, (p. 24, plate III.) It is closely related to the



Tennessee Fescue.
Festuca rubra, var. *glaucescens*.

Red or Creeping Fescue of Europe and our more Northern States, and possesses a similar habit of growth. It is an excellent turf-forming grass, and will doubtless withstand well the tramping of stock. It remains green the year round, being little affected by drought or severe winter weather. It grows to the height of one or two feet, has a great mass of fine root-leaves, and may be recommended for pastures, especially upon worn-out soils and hill-slopes.

72. Festuca tenella, Slender Fescue.

This is a native annual species, six inches or a foot high, growing only in very dry and sandy soil, along road sides, etc.

73. Glyceria aquatica, *Sm.*—Reed Meadow-grass, White Spear-grass.

A stout grass with upright culms, three to five feet high, growing along the margins of streams and in very wet meadows. Native, but apparently not common; Gattinger records only one locality, and up to the present time I have not observed it within the State. It is a good grass for fodder where it grows spontaneously (*Glyceria grandis*), S. Watson.)

74. Glyceria fluitans, *R. Br.*—Floating Manna-grass, Common Manna-grass.

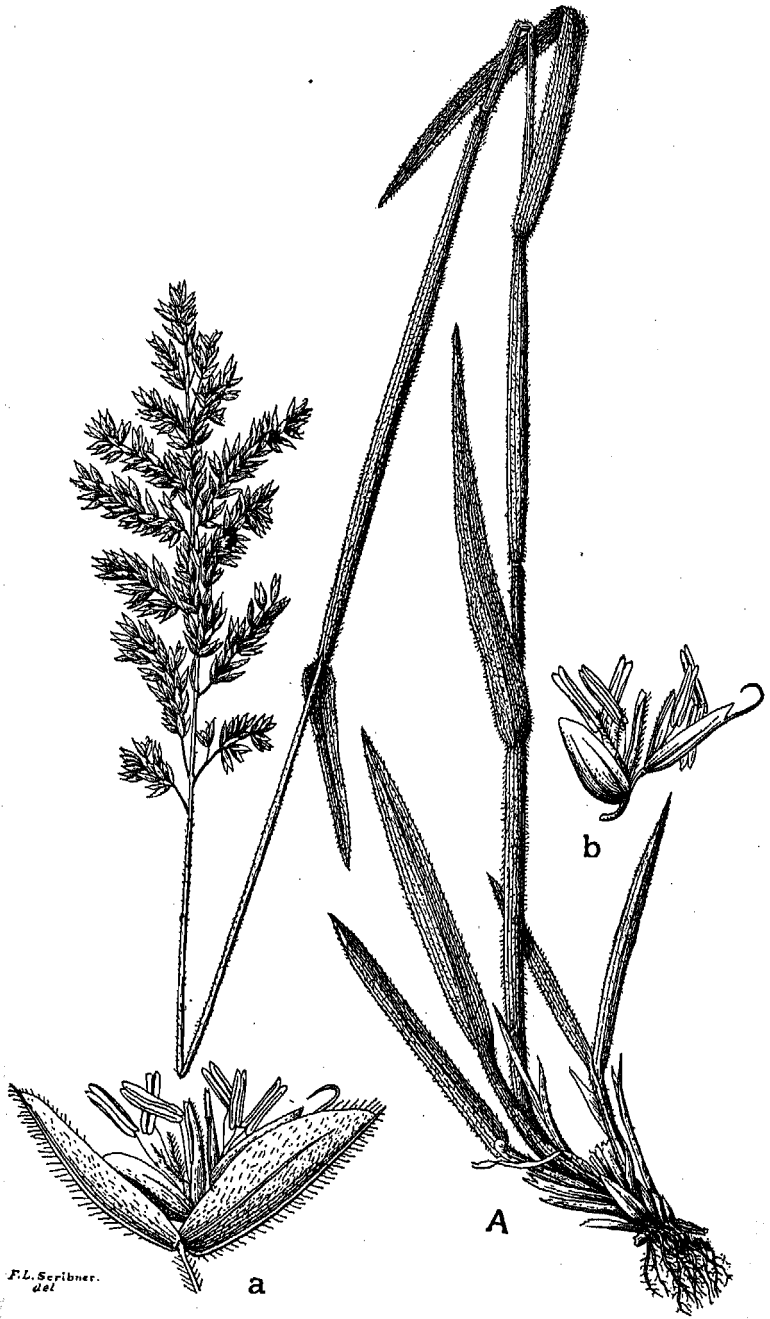
This is a very widely distributed species, and is probably to be found within the State, although not yet recorded as occurring here. It grows in similar situations with *G. aquatica*, but is more slender in habit and has a more elongated and fewer-flowered panicle, with long and narrow spikelets.

75. Glyceria nervata, *Trin.*—Fowl Meadow-grass, Meadow Spear-grass, Nerved Manna-grass.

This is our most common species, frequent in moist meadows and along streams. It is a leafy perennial grass, one to three feet high, with a loose and nodding panicle. Of some agricultural value, where it grows naturally, and for such locations may be worth cultivating. *Glyceria acutiflora*, Torr., *Glyceria pallida*, Trin., *and Glycera elongata*, are other species of this genus found in Tennessee, all growing in marshy or very wet places; the last named is found only upon the higher mountains in the eastern part of the State.

76. Gymnopogon racemosus, *Beauv.*—Naked Beard-grass.

A rather common grass in open pine woods and sandy soil along thicket borders. The clustered, wiry stems spring from a short perennial root-stalk, and bear numerous short and rather broad leaves. Blooms in August and September. Of no agricultural value.



Velvet-grass.
Holcus lanatus.

77. **Gynerium argenteum.**—Pampas-grass.

A well known ornamental grass, cultivated for its large and handsome silvery white panicles or "plumes."

78. **Holcus lanatus,** *Linn.*—Velvet-grass, Velvet Meadow Soft-grass, Velvet Mesquit, Velvet Lawn-grass, Wooly Soft-grass, White Timothy, Yorkshire White, Yorkshire Fog, Salem-grass, Feather-grass, Calf-kill, Hungarian Blue-grass.

This grass is covered with soft, whitish hairs, so that to the touch it feels somewhat like velvet. It is a European grass, but is to be found here and there over the State, having been introduced with the seed of other grasses. Owing to its light color it is striking in appearance, and is said to be a valuable grass for light thin soils which are unsuited to the growth of more valuable sorts. It should only be sown in mixtures. (See page 55.)

79. **Hordeum pratense,** *Huds.*—Wild Barley, Squirrel-tail-grass.

A native species of barley-grass growing to the height of six to eighteen inches, and reported by Gattinger as common on thin lands. It is probably an annual, and is of little or no agricultural value.

80. **Leersia oryzoides,** *Sw.*—Rice Cut-grass, Rice-grass, Cut-grass, False Rice, White-grass, European Cut-grass, Prickle-grass.

A common grass along streams and wet borders of thickets. It has very rough leaves and a whitish panicle, which expands in August. Of no value in agriculture.

81. **Leersia Virginica,** *Willd.*—Virginia Cut-grass, White-grass, Small-flowered White-grass.

Common, and growing in similar situations with the last. It is more slender and delicate in its habit than Rice-grass, but is equally valueless.

82. **Leptocloa mucronata,** *Kunth.*—Feather-grass.

An annual weed common in rich cultivated grounds and gardens. It grows to the height of two to four feet, has rather broad leaves and a long, terminal, somewhat feather-like panicle (panicle-like raceme.)

83. **Lolium Italicum,** *Braun.*—Italian Rye-grass.

An excellent grass for rich and rather moist lands. It is a very rapid grower, forms a dense turf, and in Europe is regarded as one of the best grasses for mowing. On heavy clays or on any very dry soil it does not do well, but on good calcareous loams, or marls, or on moist, loamy sands when the soil is in good condition, the yield is large, and "no other grass repays manuring so well." It lasts only for two or three years.



Rye-grass. *Lolium perenne.*

84. **Lolium perenne,** *L.*—Perennial Rye-grass, Ray-grass, English Rye-grass, Darnel.

This is a perennial, as is indicated by its name, and has been cultivated in England for more than two hundred years, making it one of the oldest of cultivated fodder grasses. It differs from Italian Rye-grass in being distinctly stoloniferous, its darker green leaves which are simply folded (not rolled) in the bud, and beardless head or spike.

Perennial Rye-grass is less tall than the Italian, and is probably not so valuable a grass for this region. In moist, cool climates it is a most excellent pasture grass for heavy soils. "Its duration depends very much on the nature of the soil and the climate; on dry light soils, it disappears after the second year; while in moist climates, on good heavy soils, it will persist for seven years, or even longer." (Stebler & Schrœter.)



Bearded-Darnel.—*Lolium temulentum.*

85. **Lolium temulentum,** *Linn.*—Darnel, Poison Rye-grass, Bearded Darnel.

An annual grass from Europe, occasionally found in grain fields. It may be recognized by its general resemblance to *Lolium Italicum.* The grain of this species "contains a narcotic principle, soluble in ether, which causes eruptions, trembling, and confusion of sight in man and in flesh-eating animals, but it does not affect swine or horned cattle." —("True Grasses.")



Nimble Will. *Muhlenbergia diffusa.*

86. **Muhlenbergia capillaris,** *Kth.*—Sea-side Hair-grass, Muhlenberg's Hair-Grass.

An upright species with unbranched or simple stems two feet high, very long and rather rigid leaves, and a diffuse, usually purplish panicle. Grows in tufts in dry sandy soil, pine woods, etc. Of no agricultural value.

87. **Muhlenbergia diffusa,** *Schreb* —Nimble Will, Wire grass, Drop seed-grass.

A common and well known grass growing on dry hills, in woods, and especially in shaded waste grounds about dwellings. It has a slender, wiry, diffusely-branched and leafy stem, six to eighteen inches high. It is an exceedingly difficult grass to mow, and the turf it forms is equally difficult to break up. Of comparatively little or no agricultural value.

88. **Muhlenbergia glomerata,** *Trin.*—Muhlenberg's-grass, Satin-grass, Wild Timothy.

An upright usually less branched grass than the last, two to three feet high, with a densely flowered narrow panicle two to four inches long. The root-stock is very tough, and closely covered with thickened scales. It usually grows in low grounds, and makes a fair "wild hay," although when mature the stems are quite hard. In some of the Western States it is "recommended as an excellent grass for forage."

89. **Muhlenbergia Mexicana,** *Trin.*—Drop-seed grass, Wood-grass, Knot-root-grass.

Similar in value and habit to the last, but usually more branched and with a looser-flowered panicle. Grows in sandy soil along the borders of thickets and rivers, doing good service in the latter place by binding the sands with its strong creeping root-stocks.

90. **Panicum agrostoides,** *Muhl.*—Panic Bent-grass, Munro-grass, Red-top Panic-grass.

This is a native, tall, branched and leafy grass, with a "head" somewhat resembling red top. It grows along the banks of creeks and borders of ponds, and often yields a considerable and fairly good native hay. It is reported to have been cultivated in some of the Southern States, and "valued highly wherever known." In low, moist and rather rich meadows its cultivation may be profitable. It is deserving trial in such locations.

91. **Panicum capillare,** *Linn.*—Old Witch-grass, Fool Hay.



Barn-yard grass.—*Panicum Crus-galli.*

A very common native, annual grass, presenting several varieties. All are worthless. It frequents cultivated fields, sometimes becoming a troublesome weed.

92. **Panicum Crus-galli,** *Linn.*—Barn-grass, Barn-yard-grass, Cock's-foot, Water-grass, Large Crow-foot-grass.

A well known rank-growing annual, common in rich cultivated lands, especially around dwellings. Some apparently native forms are found along water-courses, &c. It seeds freely, makes rapid growth during the latter part of summer, and on bottom lands yields abundantly. It sometimes affords the farmer a good crop of fair hay from land which but for the spontaneous growth of this grass would have yielded him nothing. In many sections this Panicum is only regarded as a weed.

93. Panicum filiforme, *L.*—Slender Crab-grass.

A native, annual grass, common in sandy soils, particularly in old fields, flowering in July and August. It is closely related to Crab-grass, and much resembles that grass, but is less diffusely branched and spreading, and is much more slender in all its parts. Of no agricultural value.

94. Panicum jumentorum, *Pers.*—Guinea-grass, St. Mary's grass, (*P. maximum*, Jacq., is the same.)

This grass was long ago introduced into America, presumably from Africa, and has for many years been cultitated in trophical South America and the islands of the West Indies. In those regions it is spoken of as being "a splendid pasture grass, growing to the height of twelve feet, forming dense tufts, and being propagated by the rhizome" (Eggers.) It has been introduced into some of the Gulf States, particularly Florida, where it is highly valued. Few plants yield a larger amount of fodder, and it may be cut as often as once a month during the season of growth. If allowed to grow to full size it becomes coarse and unfit for forage. Its stems are killed by the first frosts of autumn, and it seeds only in the warmest parts of the States bordering on the Gulf. Its habit of growing in bunches at once distinguishes this grass from Johnson grass, with which it has been confounded by some.



Guinea-grass. *Panicum jumentorum.*

95. Panicum miliaceum, *Linn.*—Millet.

A coarse grass with a rather large, drooping and loosely-flowered panicle, occasionally found in the older settlements in cultivated fields and waste grounds about dwellings. It formed one of the food-grains of pre-historic times, and is still cultivated in China and Japan, and in limited areas in Europe. The grasses generally known here as Millet belong to the genus *Setaria*, which see.

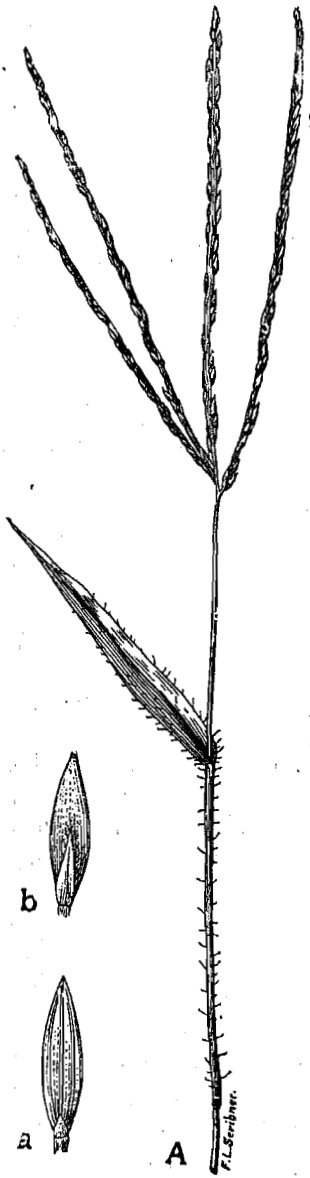
96. Panicum molle, *Sw.* (*P. barbinode.*)—Para-grass, Spanish grass.

A strong growing perennial South American grass, which has long been cultivated in the West Indies, where it is esteemed for pastures. It has recently been introduced into some of the Gulf States. We do not know of any attempts having been made to grow it in this State. It might succeed and prove a valuable forage plant in lower Middle and West Tennessee.

97. Panicum proliferum, *Lam.*—Sprouting Crab-grass.

A common grass, with rather coarse spreading or ascending

much-branched stems two to four feet long. It is often abundant in cultivated fields, springing up with common Crab-grass, and forming sometimes no inconsiderable part of the "poor man's hay." While occasionally useful in the way here indicated, it must be regarded more as a weed than as a hay plant.



Crab-grass.
Panicum sanguinale.

98. Panicum sanguinale, *Linn.*—Crab-grass, Finger-grass, Hairy Finger-grass, Manna-grass, Polish-Millet.

A well known annual grass, common everywhere in cultivated fields. It is a troublesome weed in gardens and among hoed crops, but in grain fields, after harvesting, it frequently springs up in such quantity as to yield one, or even two, good cuttings of hay. This spontaneous growth affords excellent pasturage, as well as hay of the first quality if properly cured. Chemical analyses show that crab-grass is richer in albuminoids and carbohydrates than either timothy or orchard-grass, and, assuming timothy hay to be worth $10 per ton, crab-grass hay would be worth $11.40. This is based on chemical analyses made here in 1890.

99. Panicum Texanum, *Buckl.*—Texas Millet, Bottom-grass, Colorado-grass, River-grass, Goose-grass, Buffalo-grass, Austin-grass.

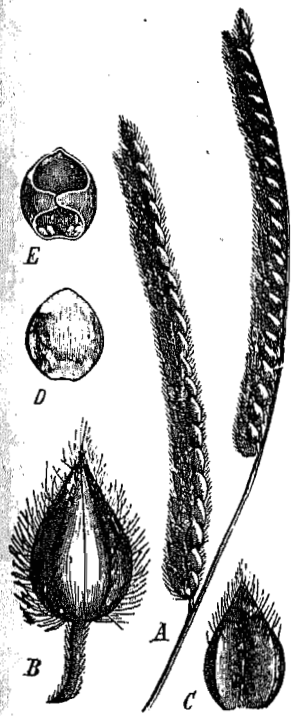
An annual grass, common in certain parts of Texas, where it is apparently indigenous, and where, too, it is highly valued for hay, and its cultivation forms a profitable industry. It is a rapid grower, and on rich sandy soils will yield three tons per acre, and in favorable seasons may be cut three times. It is similar in its habits to crab-grass, and ground that has once become seeded with it will yield crops year after year, these springing up after the removal of the regular crops of corn or grain. It has been grown here at the station success-

fully, the summer heat and drought having no effect upon it. The stems are branching, leafy, two to four or five feet long (sometimes reaching a length of ten feet), and the production of seed, which affords excellent food for poultry, is abundant.

100. **Panicum virgatum**, *Linn.*—Switch grass, Wild Red top, Black Bent.

A tall perennial species, usually growing in clumps three to five feet high. Gattinger records it as occurring in moist, sandy soil along the Cumberland river and on the highlands and barrens at Tullahoma. The young plants furnish good grazing for stock, but by the time it blooms the stems become hard, and useless for fodder. We do not regard it as worthy of cultivation.

101. **Paspalum dilatatum**, *Poir.*—Hairy-flowered Paspalum.



Hairy-flowered Paspalum.
Paspalum dilatatum.

This grass occurs in the Middle and Western part of the State, and where abundant, affords excellent pasturage. It is a perennial, and is particularly valuable as yielding late summer and autumn feed, during which period it makes its principal growth.

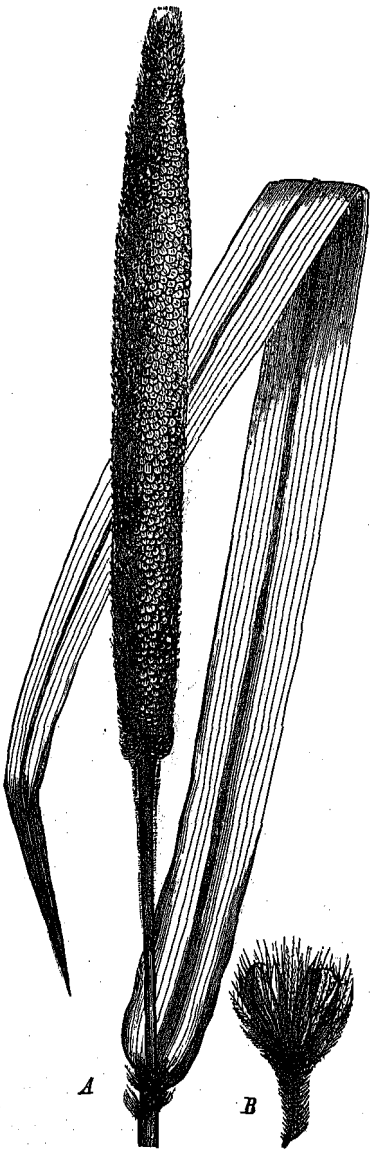
102. **Paspalum distichum**, *Linn.* — Knot-grass, Joint-grass.

A low, creeping grass, closely resembling Bermuda-grass in its habit and appearance. It frequents sandy soil along the margins of ponds and river banks, and often does good service in binding the sands liable to wash. It is recommended as a good grass for covering the soils of "sink holes."

103. **Paspalum purpurascens**, *Ell.* — Bull-grass, Purple Paspalum.

This is a strong-growing, much-branched species, which appears to be rare within the State. We have it from one locality only in East Tennessee. The commonest species of this genus (*Paspalum*) are the smooth Paspalum (*P. lævе*) and the Slender Paspalum (*P. setaceum*). The former has here much the same value as *Paspalum dilatatum* noted above. It is a vigorous growing, succulent grass, with rather large smooth seeds. It is often found intermixed with blue-grass, which it succeeds by four or five weeks, coming into full force after that has nearly disappeared.

104. Pennisetum spicatum, *Willd.*—Pearl Millet, Japan Millet, Cat-tail Millet, East India Millet, Horse Millet, Egyptian Millet, Indian Millet, African Millet, African Cane.



Pearl Millet.
Pennisetum spicatum.

This millet grows three to six feet high, and has a dense cylindrical erect "head" (panicle), five inches to a foot long. It is rarely cultivated here, and those who know it hold it in little esteem.

105. Phalaris arundinacea, *Linn.*—Reed Canary-grass, Ribbon-grass.

A rather tall, leafy perennial, with a narrow panicle, growing naturally along the borders of streams and in low wet grounds. It is not common here, nor is it of any special agricultural value. There is a variety of this grass with striped leaves, which is sometimes cultivated in gardens as an ornamental plant, and is known as ribbon-grass.

106. Phalaris Canariensis, *Linn.*—Canary-grass.

A species introduced into this country from Europe, and sometimes cultivated in the vicinity of our larger cities for its seed, which is used for bird food. It grows to the height of one or two feet, and has a very compact oval or oblong panicle or "head."

107. Phalaris intermedia, *Bosc.*—Southern Canary-grass, California Timothy, Reed Canary-grass, American Canary-grass, Stewart's Canary-grass, Gilbert's Relief-grass.

This is a taller and stouter-growing species than the last, with a longer and narrower "head." We have no positive record of

its occurrence within the State, but it grows in South Carolina and in the States along the Gulf, where it is held in some estimation for winter grazing.

108. Phleum pratense, *Linn.*—Timothy, Herd's-grass (in New England), Cat's-tail grass, Tame Timothy.

One of the best known and most extensively cultivated grasses for hay, sown either alone or mixed with red top. It succeeds best on moist loams, or clays. On very dry ground the yield is



Timothy.
Phleum pratense.

apt to be light; on such soils the base of the stem is often thickened and bulb-like. This grass is a native of Europe, and possibly also of this country, but it is generally supposed to have been introduced here. It is recorded as having been first cultivated in the Carolinas by Timothy Hansen about the middle of the last century.



Texas Blue-grass.
Poa arachnifera.

109. Poa alsodes. *Gray.*—Wood spear-grass.

A rather slender, native "blue-grass," found sparingly on the higher mountains and along the water-courses in the more mountainous districts. It has here no agricultural value.

110. Poa annua, *Linn.*—Early Meadow-grass, Annual Meadow-grass, Dwarf Meadow-grass, Low Spear-grass, Spear-grass, May-grass, Goose-grass, Suffolk-grass.

A low (three to ten inches) annual species, common everywhere in door yards and waste places, blooming from February to November. It is a European grass, but has long been established in this country and become thoroughly naturalized. It is tender and palatable to stock, and its abundance makes it of some agricultural value, as affording an early bite for cattle before other grasses have made any considerable growth.

111. Poa arachnifera, *Torr.*—Texas Blue-grass.

This grass was first discovered in Texas, where it is native, and is now being cultivated in several of the Southern States. It has strong, creeping roots (*rhizomes*), and forms a dense turf. It is especially well-adapted for permanent pastures. Owing to the unusual wooliness of the seeds, it is easiest propagated by root-cuttings. Both seeds and root-cuttings may be obtained from the leading seedsmen of New York or Philadelphia. It remains green here throughout the year, and blooms during the latter part of April or early in May. This grass appears to be dicœcious; the florets in the fertile plants are very woolly, while those of the male or staminate plants are naked. (In Bulletin No. 1, of Vol. IV., we gave a full-page figure of this blue-grass, and spoke more in detail as to its merits.)



English Blue-grass *Poa compressa.*

112. Poa compressa, *Linn.*—Blue-grass, Smaller Blue-grass, Flat-stalked Blue-grass, Flat-stalked Meadow-grass, Creeping Poa, Creeping Spear-grass, Wire-grass.

A native of Europe, this grass has become thoroughly naturalized here. Its low habit of growth, strongly compressed or flattened stems and narrow panicle, are characters which enable one to readily distinguish this from Kentucky Blue-grass. It is also more decidedly creeping, and will grow well upon the thinnest and apparently the most sterile soils. There is perhaps no better pasture grass than this for dry and poor soils.

113. Poa flexuosa, *Muhl.*—Southern Spear-grass.

A native grass, one to three feet high, found occasionally in woods. Not sufficiently abundant to deserve special notice.

114. Poa pratensis, *Linn.*—Kentucky Blue-grass, Blue-grass, Green-grass, June-grass (in New England), Smooth or Smooth-stalked Meadow-grass, Spear-grass, English-grass, Brown-top-grass.

A well known native perennial grass, with creeping underground stolons and upright smooth stems two to four feet high. It has been called the "King of pasture grasses in the Central Basin of Tennessee," and "whoever has Blue-grass has the basis for all agricultural prosperity." It is not so well adapted for hay as for pasture, but it makes an excellent bottom grass for the meadow. Here it remains green throughout the year, excepting in severe winter seasons, and blooms in May. *Poa pratensis* is common to both Europe and America, and grows "wild" in this country from Alaska southward along the Rocky Mountains to Arizona, and in the Eastern part of the continent to the Gulf States. It is only in good soils that it yields well, doing best on those which are strongly calcareous.



Kentucky Blue-grass.
Poa pratensis.

115. Poa serotina, *Ehrh.*—False Red-top, Fowl Meadow-grass, Duck-grass, Swamp Wire-grass.

This species is a native of the Northern States, growing in low meadows and along streams. It appears to be a grass of excellent quality, growing to the height of two or three feet, and is pronounced a good grass for moist meadows. It is being cultivated at the Experiment Station with the view of testing its value for this portion of the State.

116. Poa trivialis, *Linn.*—Rough Meadow-grass, Rough-stalked Meadow-grass, Green-grass, Orchiston-grass (in England), Common Meadow-grass.

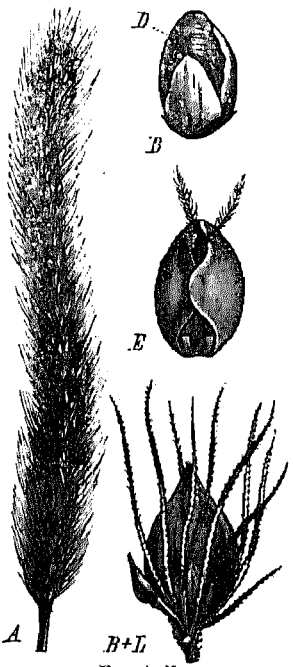
A grass similar in habit to *Poa pratensis*, but with the horizontal branches at the base on the surface (not under ground) and the flowering stems rough to the touch just below the panicle. It has been cultivated for a long time in England, whence it has been introduced into this country. It is not very well known in Tennessee. It succeeds best where the soil and climate are moist, and can hardly be recommended for this State.

117. Setaria Germanica, *Beauv.*—German Millet, Hungarian-grass Bristly Fox-tail.

This is regarded by botanists as only a variety of the Italian, Millet (*Setaria Italica*), and is only found here in cultivation or

perhaps springing up from seed on land where cultivated the season previous. The German differs from the Italian Millet in having a more dense or compact and usually erect panicle or "head."

118. **Setaria glauca,** *Beauv.*—Fox-tail, Yellow Fox-tail, Bottle-grass, Puss-grass, Pigeon-grass, Summer-grass.



Fox-tail.
Setaria glauca.

This is a well-known weed, growing everywhere in cultivated grounds. It sends up a number of stems from a single root, each bearing a cylindrical panicle or "head," the bristles of which have a decided yellowish hue.

119. **Setaria Italica,** *Kunth.*—Italian Millet, Bengal-grass, Cat-tail Millet, Golden Millet, Missouri Millet, etc.

This exists here only in cultivation. It is distinguished from the German Millet by its larger, longer, more loosely-flowered and usually nodding panicles. The millets of this class, that is species or varieties of *Setaria*, are ready to cut sixty to sixty-five days from time of sowing. When cut just as heading out, and before blooming, they make a valuable and safe forage, but in more advanced stages the feeder should be exceedingly careful, for when ripe, these millets act injuriously upon the kidneys. They are the refuge of the poor farmer whose other forage crops have failed. They are grown here for the seed, and the product is often used as bird and poultry food.

120. **Setaria verticillata,** *Beauv.*—Bristly Fox-tail.

An introduced grass, similar in habit to the next, but only rarely found. It is peculiar in having the bristles roughened or barbed downwards, so that the heads (panicles) often become entangled with each other, or readily adhere to passing objects.

121. **Setaria viridis,** *Beauv.*—Green Fox-tail, Pigeon-grass, Green Pigeon-grass, Puss-grass, Bottle-grass, Wild Millet.

An introduced grass which has become a common weed in all cultivated grounds, growing along with the yellow fox-tail, which it resembles in habit. It begins to bloom a few weeks earlier (latter part of May or first days of June) than the yellow

fox-tail, has more numerous and smaller flowers and green bristles—at least the bristles do not give a yellowish hue to the panicle.

122. Sorghum cernuum, *Host.*—Chicken Corn, Guinea Corn, White Egyptian Corn.

This is treated as a variety of *Andropogon sorghum* by Hackel. It is a tall and strong growing grass, and just below the densely-flowered panicle the stalk is abruptly bent or recurved so that the panicle points downward. It is largely cultivated in tropical and Northern Africa, and in some parts of Southern Asia, where it is used as a cereal. It is only occasionally grown here, and is highly valued as a food for poultry.

123. Sorghum saccharatum, *Pers.*—Sweet Sorghum, Chinese Sugar-Cane, African Cane, Broom Corn.

This is regarded by Hackel as only a variety of *Andropogon Sorghum.* The variety which is cultivated here as Broom Corn he names var. *technicus.*

124. Sorghum vulgare, *Pers.*—Under *Sorghum vulgare* we find the following: Sorghum, Sugar-Cane, Broom Corn, Indian Millet, Chinese Wheat, Ivory Wheat, Pampas Rice, Chinese Sugar-Cane, African Corn, Guinea Corn, Duora or Durra Corn, Chocolate Corn, Great Millet, Oregon Rice.

This has been reduced by Hackel to a variety of *Andropogon Sorghum,* characterized by its light colored and rather compact panicles. There appears to be much confusion in our literature as regards the "common" names applied to the varieties of Sorghum.

125. Spartina cynosuroides, *Willd.*—Cord-grass, Fresh-water Cord-grass, Marsh-grass, Bull-grass, Thatch-grass, Slough-grass.

This grass occurs in West Tennessee (Gattinger.) It is a native perennial, three to six feet high, growing in rich soil along river banks and borders of lakes. It is said to make excellent hay for horses when cut in good season. In regions where it grows abundantly, as along the Mississippi bottoms, it has been used for making a coarse kind of paper. We do not regard it as worth cultivating.

126. Sporobolus asper, *Kunth.*—Prairie-grass.

Two or three forms of this native perennial grass are found within the State. It has very long and very slender leaves, and the flowers are usually concealed within the leaf-sheaths. It grows in dry and sterile soil, but apparently is of no agricultural value.

127. **Sporobolus Indicus,** *R. Br.*—Carpet-grass, Smut-grass, Drop-seed-grass.

An introduced grass which has become pretty widely distributed over the State, growing in scattered tufts or patches about dwellings or in old door-yards. Its stems, which grow one to three feet high, are tough and wiry. Its flowers are crowded in a long and slender panicle which, as the season advances, often becomes overgrown by a fungus, and appears as if attacked by smut. Of no agricultural value whatever.

128. **Sporobolus vaginæflorus,** *Vasey.*—Southern Poverty-grass, Prairie-grass.

A common native annual, growing in dry sterile soil. Of no value.

129. **Stipa avenacea,** *Linn.*—Black Oat-grass, Feather-grass.

A slender grass growing in open woods along dry ridges, etc. It has a graceful open panicle and long-bearded (awned) flowers. Of no value in agriculture.

130. **Triodia cupræa,** *Jacq.*—False Red-top, Tall Red-top, Fall Red-top, Purple-top.

A tall, native perennial frequent in dry, sandy fields. It is a showy grass three to five feet high, blooming from August to October. Apparently of no agricultural value.

131. **Tripsacum dactyloides,** *Linn.*—Gama-grass, Sesame-grass, Bull-grass.



Gama-grass
Tripsacum dactyloides

This grass is occasionally seen in rich soils along rivers and creeks. It grows in large tufts, producing a great mass of broad leaves, which, when young and succulent, are eaten with avidity by stock. The roots are strong and somewhat creeping; the stems are solid and grow from three to seven feet high. The flowers are in slender spikes, these standing singly, or more often, two to three together. When abundant, gama affords a large amount of natural forage, and is valuable to this extent.

132. **Triticum Polonicum,** *Linn.*—Polish-Wheat, Wild-goose Wheat, Montana Rye, Giant Rye.

A striking species, with large flattened spikes or "heads." It is cultivated to some extent in Europe, but very rarely, excepting as a curiosity, in this country. The grain is long and slender, resembling that of rye, but the yield is small, as there are few kernels in a head.

133. **Triticum sativum,** *Linn.*—Wheat.

To this species belong all our cultivated varieties of wheat, for an account of which the reader is referred to Hackel's "True Grasses," or to the Fourth Annual Report of the New York Agricultural Experiment Station, (1885).

134. **Uniola gracilis,** *Michx.*—Slender Spike-grass.

A slender, native perennial, with narrow, dark-green leaves, and a long and slender panicle. It grows to the height of two to four feet, blooming in July and August. Of no agricultural value.

135. **Uniola latifolia,** *Michx.*—Broad-leaved Spike-grass, Wild Fescue, Wild Oats.

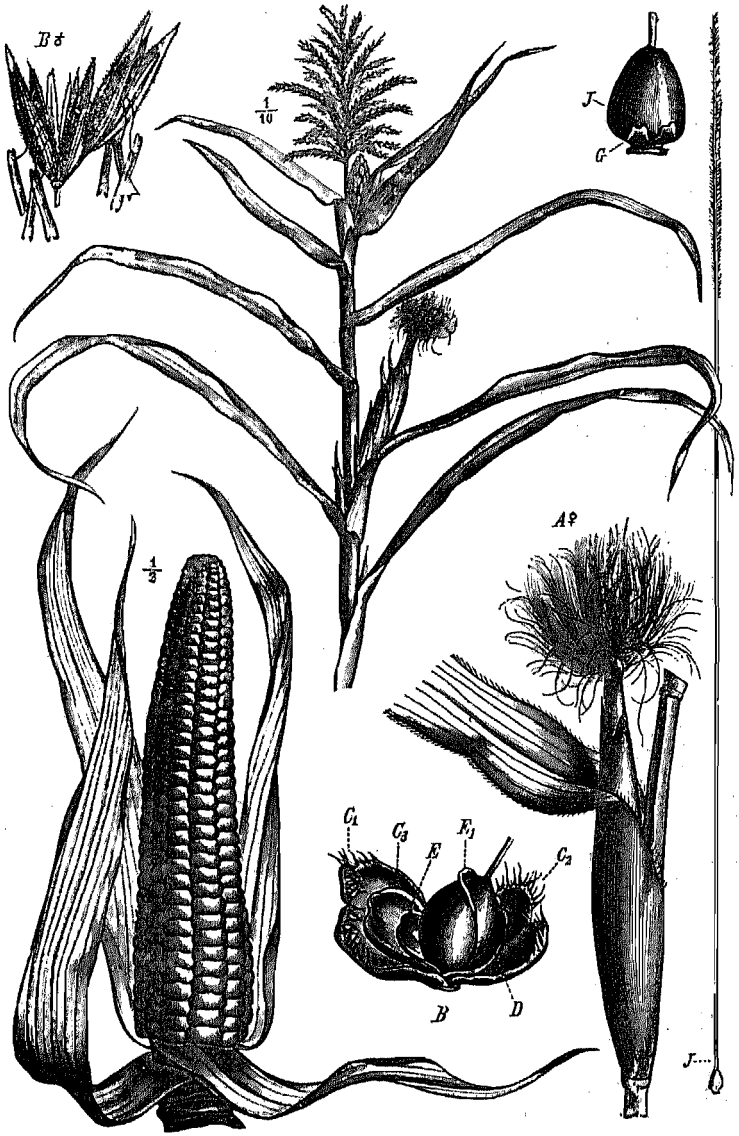
This is a strong-rooted native perennial, with broad leaves and a nodding, large-flowered panicle. It grows in damp places along streams and thicket borders, and is sometimes gathered for winter bouquets. Of no value excepting for ornamental purposes.

136. **Zea Mays,** *Linn.*—Indian Corn or Maize.

Only known as a cultivated cereal, and believed to have come originally from Central or tropical America. Sixty or more varieties are known, differing in size, and especially in the form, color and size of the kernels.

137. **Zizania aquatica,** *Michx.*—Tuscarora Rice, Water Oats, Water Rice, Wild Rice, Indian Rice.

A tall reed-like grass, which may be found in the Western part of the State, growing in marshy places along the river bottoms and around ponds. It is more common farther north. The grain was formerly gathered by the natives and used as a cereal.



Indian Corn.
Zea Mays.

ALPHABETICAL LIST

Of the common names applied to the grasses in the preceding enumeration of the grasses of Tennessee. The numbers refer to the species named.

African Cane, 104.
African Sugar Cane, 123.
Alabama Guinea-grass, 19.
American Canary-grass, 107.
Andes, Grass-of-the, 24.
Annual Meadow-grass, 110.
Arabian Millet, or Arabian Evergreen Millet, 19.
Austin-grass, 99.
Australian Millet, 19.
Australian Oats, 36.
Australian Prairie-grass, 36.
Awned Wheat-grass, 1.

Barley-grass, Wild, 79.
Barn grass, 92.
Barn-yard grass, 92.
Beard-grass, 13, 16, 23.
Beard-grass, Finger-spiked, 16.
Beard-grass, Naked, 76.
Beard-grass, Silver, 13.
Beard-grass, Virginia, 20.
Beard-grass, Woolly, 64.
Bearded Darnel, 85.
Bearded Wheat-grass, 1.
Bengal-grass, 119.
Bent-grass, or Bent, 3, 10.
Bent, Blue, 16.
Bent, Brown, 5.
Bent, Creeping, 9.
Bent, Dog's, 5.
Bent, English, 3.
Bent, Fine, 10.
Bent, Marsh, 3.
Bent-grass, Panic, 90.
Bent, Reed, 37.
Bent, Rhode Island, 3, 10.
Bent, Rough, 8.
Bent, Southern, 6.
Bent, Spider, 4.
Bent, White, 3, 17.
Bermuda-grass, 42.
Big Blue-stem, 16.
Black Bent, 100.
Black Oat-grass, 129.
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Blue-grass, 16, 112, 114.
Blue-grass, English, 67, 112.
Blue-grass, Kentucky, 112.
Blue-grass, Smaller, 114.
Blue-grass, Texas, 111.
Blue joint-grass, 16, 37.
Blue-stem, 16.
Blue-stem, Big, 16.
Blue-stem, Bushy, 15.
Blue-stem, Little, 17.
Bonnet-grass, 3.
Borden's grass, 10.
Bottle-grass, 118, 121.
Bottle-Brush-grass, 27.
Bottom-grass, 99.
Branching Spear-grass, 63.
Bristly Foxtail, 117, 120.
Brome-grass, 6, 31.
Brome-grass, Fringed, 31.
Brome-grass, Smooth, 34.
Brook-grass, 14.
Broom Corn, 123, 124.
Broom-grass, 17, 20.
Broom Sedge, 17, 20.
Brown Bent-grass, 5.
Brush, Bottle, 27.
Bull-grass, 103, 125, 131.
Bunch-grass, Early, 50.
Bur-grass, 39.
Burden's-grass, 5, 10.
Bushy Blue-stem, 15.
Buzzard-grass (local), 52.

Calf-kill, 78.
Canada Lyme-grass, 53.
Canadian Small-Reed, 37.
Canary-grass, 105–7.
Canary-grass, Reed, 105.
Canary-grass, Southern, 107.
Canary-grass, Stewart's, 107.
Candy-grass, 58.
Cane, 25.
Cane, African, 104.
Cane, Chinese Sugar, 123, 124.
Cane, Large, 25, 26.
Cane, Small, 26.
Cane, Sugar, 124.
Carpet-grass, 125.
Cat's-tail-grass, 108.
Cat-tail Millet, 104, 119.
Chandler's-grass, 2.
Cheat, 35.
Chess, 35.
Chess, Soft, 33.
Chess, Swamp, 31.
Chess, Upright, 34.
Chicken Corn, 122.
Chinese Sugar Corn, 123, 124.
Chinese Wheat, 124.
Chocolate Corn, 124.

Cock's-foot, Rough, 44.
Cluster-flowered Beard-grass, 14.
Cock's-foot, 92.
Cockspur Bur, 39.
Comb-grass, Meadow, 59.
Common Manna-grass, 74.
Common Meadow-grass, 116.
Cord-grass, Freshwater, 125.
Corn, Broom, 123.
Corn, Chicken, 122.
Corn, Chocolate, 124.
Corn, Doura, 124.
Corn, Guinea, 122.
Corn, Indian, 137.
Corn, White Egyptian, 122.
Couch-grass, 2.
Crab-grass, 52, 98.
Crab-grass, Slender, 93.
Crab-grass, Sprouting, 97.
Creeping Bent-grass, 9.
Creeping Meadow-grass, 62.
Creeping Poa, 112.
Creeping Spear-grass, 112.
Creeping Wheat-grass, 2.
Crested Dog's-tail-grass, 43.
Crop-grass, 43.
Crow-foot-grass, 52.
Cuba-grass, 19.
Cut-grass, 80.
Cut-grass, European, 80.
Cut-grass, Rice, 80.
Cut-grass, Virginia, 81.

Darnel, 85.
Darnel, Bearded, 85.
Dennett-grass, 54.
Devil's-grass, 2.
Dew-grass, 2.
Dew-grass, 3.
Dew-grass, Summer, 10.
Dog or Dog's-grass, 2.
Dog's Bent, 5.
Dog's-tail-grass, 52.
Dog's-tail-grass, Crested, 43.
Dog's-tooth-grass, 42, 52.
Doura Corn, 124.
Drooping Reed-grass, 41.
Drop-seed-grass, 87, 89, 127.
Duck-grass, 115.
Durfa or Durfee-grass, 2.
Durra Corn, 124.
Dutch-grass, 2.
Dwarf Meadow-grass, 110.

Early Bunch-grass, 50.
Early Meadow-grass, 110.
East Indian Millet, 104.
Eaton's-grass, 51.
Egyptian-grass, 19.
Egyptian Millet, 19, 104.
English-grass, 114.
English Bent-grass, 3.
English Blue-grass, 67.
English Fox-tail, 12.
English Rye or Ray-grass, 84.
European Cut-grass, 80.
Evergreen-grass, 24, 67.
Evergreen Millet, 19.

Fall Marsh-grass, 125.
Fall Red-top, 130.
False Guinea-grass, 19.
False Oat-grass, 24.
False Red-top, 115.
False Rice, 80.
Feather-grass, 78, 82.
Fescue-grass, 67.
Fescue, Hard, 66.
Fescue, Meadow, 70.
Fescue, Nodding, 68.
Fescue, Sheep's, 69.
Fescue, Tall, 67.
Fescue, Tall Meadow, 67.
Fescue, Wild, 135.
Fibrous-rooted Wheat-grass, 1.
Fin's grass, 2.
Fine Bent, 10.
Fine Top, 5, 10.
Finger-grass, 98.
Finger-grass, Hairy, 98.
Finger-spiked Beard-grass, 16.
Finger-spiked Indian-grass, 16.
Finger-spiked Wood-grass, 16.
Fiorin, 3, 9.
Flat-stalked or Flat-stemmed-grass, 112.
Flat-stalked Blue-grass, 112.
Floating Manna-grass, 74.
Fly-away-grass, 8.
Fog, Old, 47.
Fool-hay, 8, 91.
Fowl Meadow-grass, 37, 75, 115.
Fox-tail, 12, 14, 64, 118.
Fox-tail, Bristly, 117, 120.
Fox-tail, English, 12.
Fox-tail, Green, 121.
Fox-tail, Meadow, 12.
Fox-tail, Yellow, 118.
French Rye-grass, 24.
Fresh-water Cord-grass, 125.
Fringed Brome-grass, 31.
Furze-top, 5, 10.

Gama-grass, 131.
German Millet, 117.
Gilbert's Relief-grass, 107.
Glaucous Creeping Fescue, 71.
Golden Millet, 119.
Golden Oat-grass, 28.
Goose-grass, 52, 99, 110.
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Grama, Tall, 29.
Grass-of-the-Andes, 24.
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Green Pigeon-grass, 121.
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Gautemala-grass, 65.
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Guinea-grass, Alabama, 19.
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Hair-grass, 8, 48, 86.
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Hair-grass, Wood, 48.
Hairy Finger-grass, 98.
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Indian-grass, Finger-spiked, 16.
Indian-grass, Oat-like, 15.
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June-grass, 47, 114.

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Knot-grass, 102.
Knot-root grass, 89.

Large Cane, 25.
Large Crow-foot grass, 92.
Lawn-grass, Velvet, 78.
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Lyme-grass, 55.
Lyme-grass, Canada, 53.
Lyme-grass, Slender Hairy, 54.
Lyme-grass, Virginian, 55.

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Manna-grass, Common, 74.
Manna-grass, Nerved, 75.
Marsh-grass, 125.
Marsh-grass, Fall, 125.
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May-grass, 110.
Meadow-grass, Annual, 110.
Meadow-grass, Common, 116.
Meadow-grass, Creeping, 62.
Meadow-grass, Dwarf, 110.
Meadow-grass, Early, 110.
Meadow-grass, Flat-stalked, 112.
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Meadow-grass, Pungent, 57.
Meadow-grass, Reed, 73.
Meadow-grass, Rough-stalked, 116.
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Meadow-grass, Short-stalked, 56.
Meadow-grass, Slender, 60.
Meadow-grass, Smooth, 114.
Meadow-grass, Smooth-stalked, 114
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Meadow Comb-grass, 59.
Meadow Fescue, 70.
Meadow Fox-tail, 12.
Meadow Soft-grass, 78.
Meadow Soft-grass, Velvet, 78.
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Munro-grass, 90.
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Naked Beard-grass, 76.
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Oat-grass, Black, 129.
Oat-grass, False, 24.
Oat-grass, Golden, 28.
Oat-grass, Mountain, 45.
Oat-grass, Silky-flowered, 46.
Oat-grass, Spiked Wild, 47.
Oat-grass, Tall, 24.
Oat-grass, Tall Meadow, 24.
Oat-grass, Taller Wild, 46.
Oat-grass, Tennessee, 45.
Oat-grass, Wild, 45, 46, 47.
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Pungent Meadow-grass, 57.
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Puss-grass, 118, 121.
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Quaking-grass, 30.
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Randall-grass, 67.
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Red-top, Tall, 10, 130.
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Reed-grass, Small, 37.
Reed, Sweet, 40.
Reed-grass, Wood, 40.
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Reed Meadow-grass, 73.
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Rice, False, 80.
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DIVISION OF FIELD AND FEEDING EXPERIMENTS.

A CONTRIBUTION TO THE STUDY OF THE ECONOMIES OF MILK PRODUCTION.

BY C. F. VANDERFORD.

The feeding experiments hereinafter detailed were arranged and carried out:

1. To compare results of feeding such a grain ration as can be produced upon the ordinary Tennessee farm with results of feeding a ration of materials to be purchased, in whole or in part, in market; in other words, to determine the comparative economy of feeding home-grown stuff or of exchanging a part of the products of the farm for other materials of higher nutritive values.

2. To determine the average feed-cost of milk produced by cows of different breeds under like conditions and management.

3. To compare the producing capacity of full bred and of grade cows fed a like ration per 1,000 pounds live weight.

Sixteen cows, of which six were Jerseys, two Holsteins and eight grades, were selected for the experiment. The cows were divided into two classes, so that the two should be as closely as possible of equal merit as to breeding, and as nearly as might be of the same total live weight, total daily yield of milk, and number of days in milk, at beginning of test.

The eight cows of class A averaged 5 years 3 months of age, 92 days in lactation, and were giving at beginning of test 139.81 pounds of milk daily. The eight cows of class B averaged 5 years 6 months of age, 90 days in lactation, and were giving 143.87 pounds of milk daily at beginning of test.

CLASS A.—8 COWS.

No.	Name of Cow	Breed	Age, Years	Last Calf Dropped	Daily yield of Milk at beginning of Tests, Pounds
1	Annie Signal	Jersey	6	October 24, 1891	33.62
2	Richland Daisy	Jersey	4	September 3, 1891	15.05
3	Iuka	Jersey	6	August 17, 1891	12.25
4	Sister	Grade Jersey	3	October 2, 1891	10.93
5	Spotty	Grade Jersey	6	August 5, 1791	14.65
6	Mary	Grade Holstein	3	August 1, 1891	19.30
7	Queen	Grade Holstein	11	July 25, 1891	20.10
8	Aaggie Lucille 2d	Holstein	3	August 3, 1891	13.91

CLASS B.—8 COWS.

9	Mamelle	Jersey	7	September 3, 1891	15.80
10	Patti	Jersey	5	August 25, 1891	14 71
11	Rosa	Jersey	10	June 20, 1891	11.81
12	Parker	Grade Jersey	6	September 8, 1891	24.64
13	May	Grade Jersey	6	October 21, 1891	21.56
14	Ella	Grade Jersey	3	August 18, 1891	14.10
15	Eva	Grade Holstein	3	September 3, 1891	22.16
16	Filices	Holstein	4	August 21, 1891	19.09

On the 21st day of November, 1891, silo No. 1, sorghum and pea-vines, was opened, and this ensilage was fed during the first period of the test. The station herd was at this time put upon winter feed, and a preliminary period of five days was allowed to prepare the cows of Classes A and B for the experiment. The results for the first period of 35 days, beginning November 26 and ending December 30, are given in Tables I and II.

During this first period of thirty-five days, the daily ration consumed by the cows of Class A was, for each 1,000 pounds of live weight, 30 pounds of ensilage (sorghum and pea-vines), valued at $2 per ton of 2,000; 5.22 pounds of hay (mixed, as produced on the farm), valued at $8 per ton; 3 pounds of cotton-seed meal, cost $24 per ton; and 5 pounds of wheat bran, cost $20 per ton. Cost per daily ration, for each 1,000 pounds live weight, 13.69 cents.

For the same period the daily ration consumed by the cows of Class B was, for each 1,000 pounds of live weight, 30 pounds of ensilage, 5.12 pounds of hay, and 10 pounds of a mixture of equal weights of corn and oats ground together of value $18 per ton. Cost per daily ration, per 1,000 pounds live weight, 14.05 cents.

The herd was milked and fed at 3:30 A. M. and 2 P. M. throughout the test. Frequent determinations of the per cent. of butter-fat were made, using the Babcock tester, the average results of which are given in the tables. No butter was made; the entire milk product was sold to customers in the city of Knoxville.

The live weights given in the tables were ascertained by three weighings on consecutive days as the cows were turned out of the barn at about 3 P. M.

I.—FIRST PERIOD—35 DAYS, NOVEMBER 26 TO DECEMBER 30, 1891.

No.	Name of Cow	Daily Yield of Milk. Pounds.	Average per cent. of Butter-fat	Live Weight Nov. 26.	Live Weight Dec. 30.	Days in Lactation at begini'g of Tests
1	Annie Signal.....	32.45	5.16	952	955	32
2	Richland Daisy.....	15.70	6.08	785	733	83
3	Iuka.....	12.96	5.68	680	685	100
4	Sister.....	10.16	6.20	860	852	54
5	Spotty.....	15.83	5.38	810	795	112
6	Mary.....	21.66	3.30	905	940	116
7	Queen.....	20.56	4.25	925	908	123
8	Aaggie Lucille 2d..	16.81	3.82	705	785	114
		146.13	4.82	6622	6653	
9	Mamelle.....	12.79	5.64	865	865	83
10	Patti.....	16.09	6.25	725	690	92
11	Rosa.....	14.26	4.30	830	830	158
12	Parker.....	24.73	3.20	845	800	78
13	May.....	22.76	4.24	950	925	35
14	Ella.....	16.28	2.90	760	775	99
15	Eva.....	23.40	3.30	930	925	83
16	Filices.....	21.88	3.15	1000	1040	96
		152.19	3.96	6905	6850	

II —FIRST PERIOD—35 DAYS, NOVEMBER 26 TO DECEMBER 30, 1891.

No.	Name of Cow	Cost of Feed 35 Days Dollars.	Total Pounds of Milk	Feed Cost per Gallon of Milk, Cents.	Total Pounds Butter-fat	Feed Cost per pound of Butter-fat, Cents.
1	Annie Signal.....	4 86	1,135.75	3.67	58.60	8.29
2	Richland Daisy.....	4 02	549.50	6.27	33.41	12.03
3	Iuka.....	3 44	453.50	6.49	25.76	13.35
4	Sister	4 02	355.56	9.69	22.04	18.24
5	Spotty	4 02	554.00	6.23	29.81	13.49
6	Mary	4 23	758.13	4.78	24.26	17.44
7	Queen	4 23	719.56	5.04	30.58	13.86
8	Aaggie Lucille 2d..	3 44	588.50	5 01	22.48	15.30
		32 26	5,114.50	5.41	246.04	13.10
9	Mamelle	4 36	447.50	8.35	25.24	17.27
10	Patti.....	3 50	563.06	5.33	35.19	9.95
11	Rosa.....	4 16	499.00	7.14	21.46	19.38
12	Parker.....	4 36	865.44	4.32	27.69	15.75
13	May	4 36	796.69	4.69	33.78	12.91
14	Ella.....	3 50	569.81	5.26	16.52	21.19
15	Eva.....	4 36	819.06	4.56	27.03	16.87
16	Filices	4 92	766.13	5.50	24.13	20.39
		33 52	5,326.69	5.39	211.04	15.88

During the second period of thirty-five days, the daily ration consumed by the cows of Class A was, for each 1,000 pounds of live weight, 30.46 pounds of ensilage of corn, valued at $2 per ton; 6.04 pounds of mixed hay, valued at $8 per ton; and 10 pounds of equal weights of corn and oats ground together, valued at $19 per ton. Cost for daily ration, per 1,000 pounds live weight, 14.96 cents.

For the same period the daily ration consumed by the cows of Class B was, for each 1,000 pounds of live weight, 28.75 pounds of ensilage; 5.9 pounds of mixed hay; 3 pounds of cotton-seed meal, at $24 per ton; and 5 pounds of wheat bran, at $21 per ton. Cost per daily ration for 1,000 pounds live weight, 14.08 cents.

III.—SECOND PERIOD, 35 DAYS, DEC. 31, 1891, TO FEBRUARY 3, 1892.

No.	Name of Cow	Daily Yield of Milk Pounds.	Average per cent. of Butter-fat	Live Weight Dec. 29, '91	Live Weight Feb. 3, '92.	Days in Lactation at begin'g of Test
1	Annie Signal	27.32	4.57	955	915	67
2	Richland Daisy	13.67	5.78	733	735	118
3	Iuka	11.27	5.90	685	685	135
4	Sister	7.71	4.96	852	910	89
5	Spotty	15.13	4.85	795	825	147
6	Mary	19.50	3.48	940	960	151
7	Queen	18.87	4.35	908	870	158
8	Aaggie Lucille 2d.	16.00	2.98	785	750	149
		129.47	4.47	6653	6650	
9	Mamelle	14.02	5.77	865	915	115
10	Patti	12.62	6.43	690	690	125
11	Rosa	8.31	5.33	830	835	193
12	Parker	20.50	4.22	800	805	113
13	May	20.44	4.52	925	935	70
14	Ella	15.33	3.48	775	788	134
15	Eva	20.78	3.18	925	960	115
16	Filices	20.79	3.00	1040	1107	131
		132.79	4.26	6850	7035	

IV.—SECOND PERIOD—35 DAYS, DEC. 31, 1891, TO FEB. 3, 1892.

No.	Name of Cow	Cost of Feed, 35 Days. Dollars.	Total Pounds of Milk	Feed Cost per Gallon of Milk. Cents	Total Pounds of Butter-fat	Feed Cost per pound of Butter-fat. Cents
1	Annie Signal	5.08	956.19	4.55	43.71	11.62
2	Richland Daisy	4.28	478.56	7.66	27.66	15.47
3	Iuka	3.75	394.37	4.60	23.27	16.11
4	Sister	4.48	270.00	14.22	13.39	33.46
5	Spotty	4.50	529.63	7.28	25.69	17.52
6	Mary	4.49	682.44	5.64	23.75	18.90
7	Queen	4.48	660.56	5.81	28.73	15.59
8	Aaggie Lucille 2d	3.76	559.60	5.76	16.68	17.09
		34.82	4,531.44	6.58	202.88	17.16
9	Mamelle	4.07	490.56	7.11	28.30	14.38
10	Patti	3.36	441.63	6.52	28.40	11.83
11	Rosa	4.07	290.87	11.99	15.50	26.26
12	Parker	4 25	717.56	5.08	30.28	14.03
13	May	4.07	715.31	4.88	32.33	12.59
14	Ella	3.35	536.63	5.35	18.67	17.94
15	Eva	4.26	727.44	5.02	23.13	18.42
16	Filices	4.88	727.75	5 75	21.83	22.35
		32.31	4,647.75	5.96	198.44	16.28

Analyses of the ensilage used in the experiment were made by the Station Chemist. For the cotton-seed meal the analysis by J. B. McBryde, given below, was used. The nutritive values of all other feed stuffs employed were estimated from averages of analyses as stated in the compilation of Dr. Jenkins, published 1891.

1.—Analysis of Ensilage of Pea Vines and Sorghum.

(J. B. McBryde, Asst. Chemist.)

Moisture	67.99
Dry Matter	32.01
	100.00

		Dry Matter.
Proteins	2.98	9 31
Crude fat	1.80	5 68
Nitrogen—free Extract	16.55	51.70
Crude fiber	7.11	22.21
Ash	3.57	11.15
	32.01	100.00

2.—Analysis of Ensilage of Corn.
(J. B. McBryde, Asst. Chemist.)

Moisture	81.45
Dry Matter	18.55
	100.00

		Dry Matter.
Proteins	1.18	6.36
Crude fat	1.06	5.72
Nitrogen—free Extract	9.19	49.51
Crude fiber	5.65	30.46
Ash	1.47	7.95
	18.55	100.00

3.—*Analysis of Cotton-Seed Meal.
(J. B. McBryde, Asst. Chemist.)

Moisture	7.47
Dry Matter	92.53
	100.00

		Dry Matter.
Proteins	47.30	51.12
Crude fat	9.26	10.01
Nitrogen—free Extract	24.40	26.37
Crude fiber	4.53	4.90
Ash	7.04	7.60
	92.53	100 00

The nutritive values of the rations fed may be stated as follows:

FIRST PERIOD, CLASS A.

	Dry Matter.	DIGESTIBLE. Proteins.	Carb.-hydrates.
30 lbs. Ensilage (Sorghum and Pea-Vines)	9.60	0.67	6.19
5.22 pounds Hay	4.41	0.19	2.38
3 [illegible] pounds Cotton-seed Meal	2.78	1.21	1.43
5 [illegible] pounds Wheat Bran	4.39	0.59	2.56
	21.18	2.66	12.56

Nutritive ratio, 1 ; 4.7.

FIRST PERIOD, CLASS B.

	Dry Matter.	DIGESTIBLE. Proteins.	Carb.-hydrates.
30 lbs. Ensilage (Sorghum and Pea-Vines)	9.60	0.67	6.19
5.12 pounds Hay	4 33	0.18	2.33
5 pounds Corn, 5 pounds Oats, ground together	8.93	0.86	6.62
	22.86	1.71	15.14

Nutritive ratio, 1 : 8.9.

SECOND PERIOD, CLASS A.

	Dry Matter.	DIGESTIBLE. Proteins.	Carb.-hydrates.
30.46 pounds Ensilage (corn)	5.65	0.27	3.64
6.04 pounds Hay	5.10	0.21	2.74
5 pounds Corn, 5 pounds Oats, ground together	8.93	0.86	6.64
	19.68	1.34	13.02

Nutritive ratio, 1 : 9.7.

*Bulletin No. 5, Vol. IV, Tenn. Experiment Station.

SECOND PERIOD, CLASS B.

	DIGESTIBLE.		
	Dry Matter.	Proteins.	Carb.-hydrates.
28.75 pounds Ensilage (corn)	5.33	0.25	3 44
5.9 pounds Hay	4.98	0.21	2.69
3 pounds Cotton-seed Meal	2 78	1.21	1.43
5 pounds Wheat Bran	4.39	0.59	2.56
	17.48	2.26	10.12

Nutritive ratio, 1: 4.5.

The space at disposal for this Bulletin does not permit a careful discussion of the figures here presented. It may be suggested, however, that we have in the results of this test some reason to believe that, while the conclusions of Dr. Emil Wolff can be very safely followed as guides for further experiment, they cannot be accepted as standards under all conditions.

During the first period of thirty-five days, the eight cows of Class A consumed

	Nitrogen. (N)	Phos. Acid. (P_2O_5)	Potash. (K_2O)
7,000 pounds Ensilage (Sorghum and Pea-vines) } containing	33.60	8.40	34.30
1,480 pounds Hay "	18.50	6.96	30.78
686 25 pounds Cotton-seed Meal "	41.38	17.02	11.60
1,093.75 pounds Wheat Bran "	27.12	33.14	17.06
	120.60	65.52	93.74
And gave 5,114.5 pounds of milk, containing	35.80	15.30	8.70
	84.80	50.22	85.04

As the live weight of the eight cows had increased during the thirty-five days less than one-half of one per cent., it may be assumed that, of the manurial value of the food consumed by them, only that contained in the milk, all of which was sold, was lost to the farm.

During the first period the eight cows of Class B consumed

	Nitrogen. (N)	Phos. Acid. (P_2O_5)	Potash. (K_2O)
7,000 pounds Ensilage (Sorghum and Pea-vines) } containing	33.60	8.40	34.30
1,480 pounds Hay "	18.50	6 96	30.78
1,129.6 pounds Corn "	19.88	7.68	4.52
1,129.6 pounds Oats "	21.80	8.02	5.87
	93.78	31.06	75.47
And gave 5,326.7 pounds of milk, containing	37.39	15.98	9.00
	56.39	15.08	66.47

The cost of feed for first period for Class A was	$32 26
The value of the manure, assuming nitrogen at 17 cents, phosphoric acid at 6 cents, and potash at 5 cents per pound, was	21 67
Making *net* feed cost of 5,114.5 pounds of milk, or 1.77 cents per gallon of 8.57 pounds	$10 59
The cost of feed for first period for Class B was	$33 52
The value of the manure was	13 81
Making *net* for cost of 5.326.7 pounds of milk, or 3.17 cents per gallon	$19 71

During the second period of the feeding experiment the cows of Class A were fed the grain ration given to cows of Class B during the first period, and *vice versa*. It was necessary to use corn ensilage of rather inferior quality. The poor quality of this corn ensilage was due to the fact that the growing corn was left too thick upon the ground, and made but little grain.

The eight cows of Class A consumed

	Nitrogen.	Phos. Acid.	Potash.
7,043.65 pounds of Corn Ensilage, containing.....	13.38	6.33	22.54
1,480 pounds of Hay.....	18.50	6.96	30.78
1,150.62 pounds of Corn.....	20.25	7.82	4.60
1,150.62 pounds of Oats.....	22.21	8.17	5.98
	74.34	29.28	63.90
And gave 4,531.4 pounds of milk, containing.....	31.72	13.59	7.66
	42.62	15.69	56.24

The cows of Class B consumed during the second period

	Nitrogen.	Phos. Acid.	Potash.
7,043.75 pounds of Corn Ensilage, containing.....	13.38	6.33	22.54
1,480 pounds of Hay..... "	18.50	6.96	30.78
686.25 pounds of Cotton-seed Meal "	41.38	17.02	11.60
1,093.75 pounds of Wheat Bran..... "	27.12	33.14	17.06
	100.38	63.45	81.98
And gave 4,647.7 pounds of milk, containing.....	32.53	13.94	7.85
	67.85	49.51	74.13

The cost of feed for second period for Class A was.....	$34 82
The value of the manure was.....	11 00
Making *net* feed cost of 4,531.4 pounds of milk, or 4.5 cents per gallon of 8.57 pounds.....	$23 82
The cost of feed for second period of Class B was.....	$32 31
The value of the manure was.....	18 21
Making *net* feed cost of 4,647.7 pounds of milk, or 2.6 cents per gallon	$14 10

Yield of milk of the sixteen cows first 35 days.....	10,441	pounds.
" " " " " " second 35 days.....	9,179	"
Total cost of feed of the sixteen cows first 35 days.....	$65 78	
" " " " " " second 35 days.....	67 13	
Net " " " " " first 35 days.....	30 30	
" " " " " " second 35 days.....	37 92	
Total live weight of the sixteen cows at beginning of experiment	13,527	pounds.
" " " " " " " end of 70 days.....	13,685	"

The cows of the entire herd were in excellent health and condition throughout.

In the Tables II and IV, the totals of butter-fat were calculated from the percentages ascertained by frequent tests with the Babcock tester. The average of butter-fat in butter being taken at 84.39 per cent.,* one pound of butter-fat represents 1.185 pounds of

*Average of 802 analyses of butter. Chemische Zusammensetzung der menschlichen Nahrungs—und Genussmittel. Dr. J. Konig. Berlin, 1889.—p. 309.

butter. During the 70 days, if the milk had been converted into butter, the total product would have been 1,018.27 pounds. As no appreciable quantity of nitrogen, phosphoric acid or potash is contained in butter, the *net* feed-cost might be taken for naught.

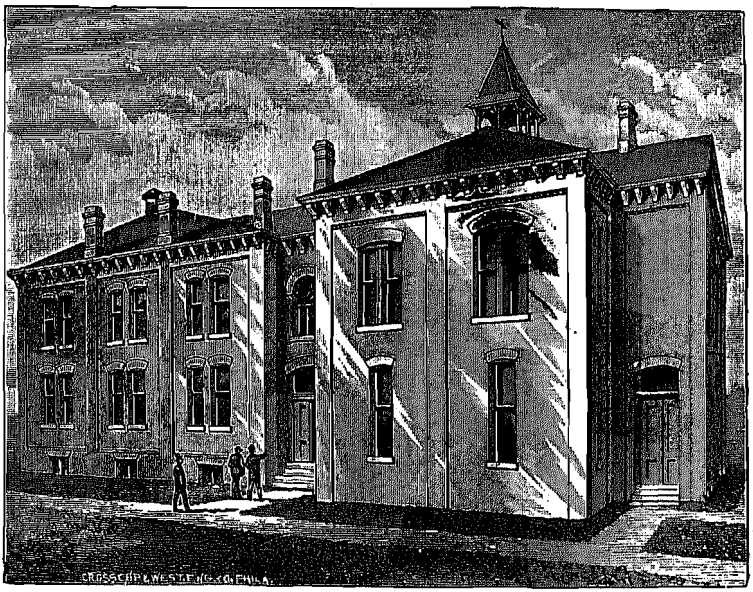
A few practical conclusions may be fairly stated:

Dairying in Tennessee, whether for milk production or for butter making, can be made highly profitable under good management.

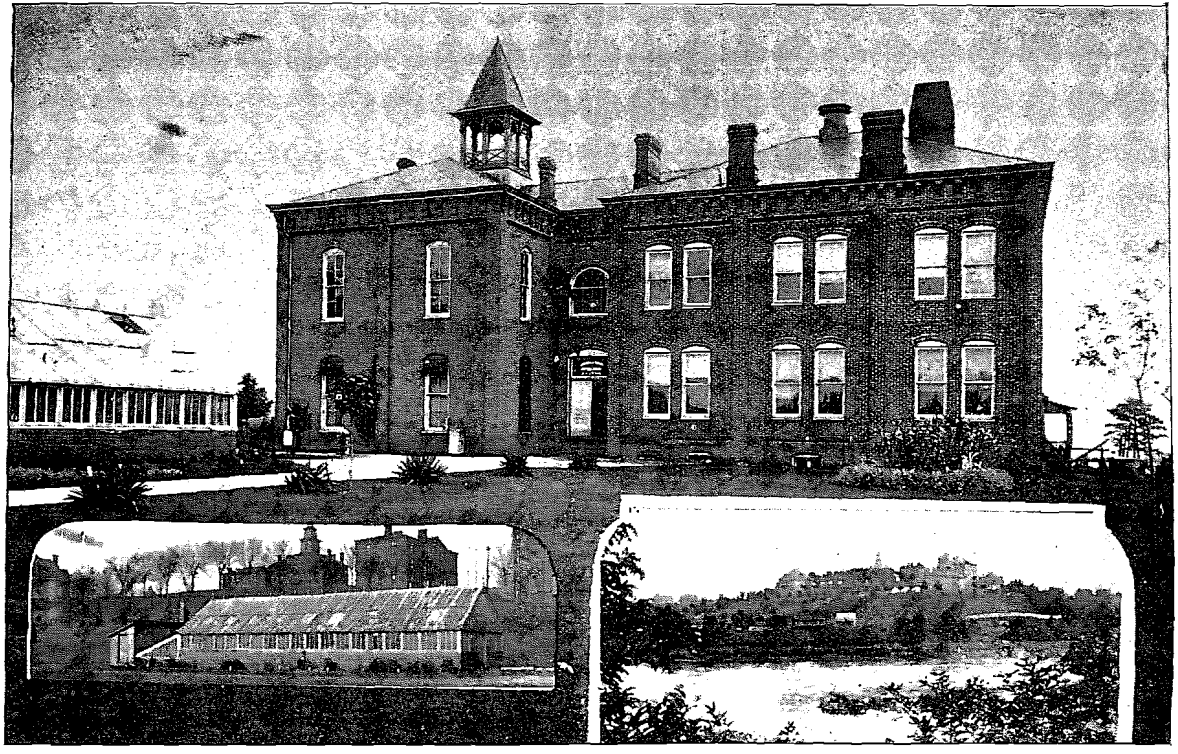
For winter dairying the silo is indispensable.

It *pays* to purchase, at ordinary market prices, such food stuffs as cotton-seed meal and wheat bran, not only to increase the product of the dairy, but as a means of maintaining, and, when butter alone is sold, of increasing the fertility of the farm.

It will always pay the dairyman to weigh and to test carefully the product of each cow of his herd, so that he may know how and whence his profits or his losses come.



AGRICULTURAL EXPERIMENT STATION.



GREENHOUSE. GENERAL VIEW OF GROUNDS.

AGRICULTURAL EXPERIMENT STATION.

APPENDIX A.

HISTORY AND ORGANIZATION OF THE AGRICULTURAL EXPERIMENT STATION.

The so-called "Hatch Experiment Station Act," under which this Station was established, is already too well known to need lengthy explanation; but it is necessary to refer to a few points in the Act in order to explain the relations of the Experiment Station to the State and to the United States. The preamble of this Act states (see p 91) that its purpose was "To aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with Agriculture, and to promote scientific investigation and experiment respecting the principles and applications of Agricultural Science." In order to carry this out, the Act provided that there should be established, "under the direction of the College or Agricultural Department of Colleges in each State or Territory, in accordance with the provisions of the Act approved July 2, 1862, entitled, "An Act donating public lands to the several States and Territories which may provide Colleges for the benefit of Agriculture and the Mechanic Arts; a department to be known and designated as "An Agricultural Experiment Station."

This new institution was thus to be established under the direction of the College, or the Agricultural Department of the College, already established in the State under the Act of July 2, 1862, commonly known as the "Land-grant Act." This, and the other donations for this purpose, were made "subject to the Legislative assents of the several States and Territories to the purpose of said "grants."

In accordance with this Act of Congress, the General Assembly of Tennessee passed an Act on the 28th of March, 1887, accepting the donation and bestowing it upon the Agricultural College of the University of Tennessee, as it was bound to do, and instructing the Board of Trustees of the said University to carry out all the purposes of the said Act of Congress.

Impressed with the importance of establishing closer relations between the farming interests of the State and their Agricultural College, the Board of Trustees had, in June, 1882, established an Agricultural Experiment Station upon the basis of its Agricul-

tural Department of the College of that time. At that time, this action of the Board of Trustees exhibited a most progressive and commendable spirit. There were then very few Experiment Stations in this country, and though the Station established by the Board was at first very inadequately supported, this action secured the State of Tennessee the credit of having started one of the first five of these institutions in America, which have since proved so useful that they secured this magnificent recognition from the United States Congress. The action of the Board of Trustees referred to, deserves, therefore, to be noted in the history of Agricultural Science and Education. The resolution of the Board establishing this Station, on June 8, 1882, states that the object of the Experiment Station was to be "the promotion of the Agricultural interests of Tennessee by practical and scientific experimentation and investigation."

When the Act of Congress referred to was passed, in March, 1887, the comptroller of the Treasury ruled that a separate provision would have to be made in the regular appropriation bills of Congress for the support of these Stations. As this had not been done by the Congress just adjourned, it was necessary to wait until the next session of Congress So it was that, though the Tennessee Experiment Station was organized under Act of Congress in July, 1887, it had to suspend its proceedings in large part until the



VIEW IN PLANT HOUSE

Spring of 1888, when the first funds were actually received under the Act.

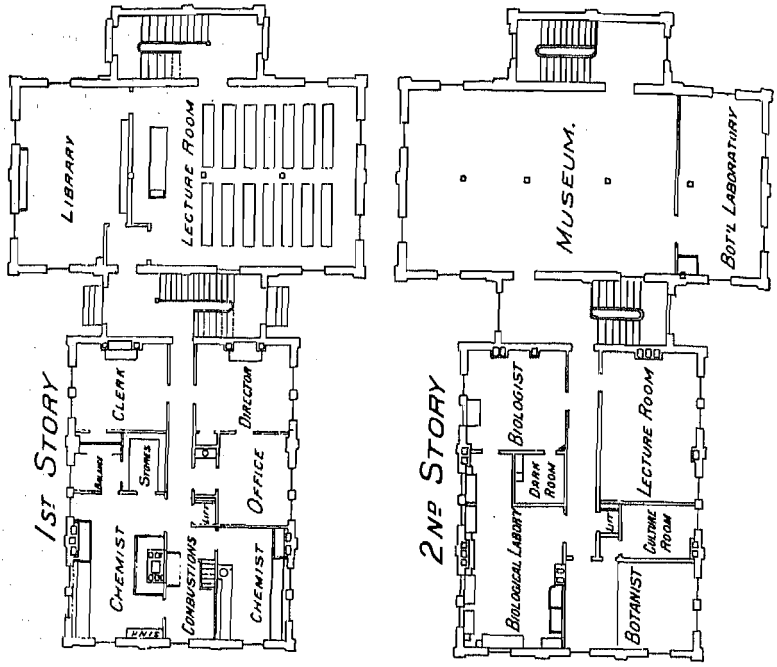
The old Experiment Station of the University of Tennessee never had any building, or even apartments of its own, no laboratories or scientific apparatus, no stock or utensils, no land or equipments of any kind. It occupied such rooms in the University buildings as could be provided for it, and used the instruments, stock and land of the Agricultural College. Analyses were made by the chemist in the close quarters afforded by the College laboratory.

An Experiment Station of the kind projected in the Act of Congress, could not possibly be carried on in such quarters and under such circumstances. It must have a building for chemical, botanical and biological laboratories, for a library and for offices and workrooms. It should have stables, plant and tool houses, and other experimental farm buildings. Facilities for strictly scientific work were the first to be provided.

The University had undertaken to erect a building for its Agricultural Department some years before. This was a simple structure of brick 30x60 feet, two stories high, and divided off into two apartments below and one above, which were connected by a large hall and staircase. This building had never been entirely completed, though it was occupied by the Agricultural Department for several years. It was decided to make a large addition to this building and complete the whole for the exclusive uses of the Experiment Station and the Agricultural Department of the University. The addition is sixty-two by fifty feet, with an entrance and staircase hall connecting it with the older building, two stories high, over a large, well lighted and dry basement. Exterior decoration has been less considered; solidity, adaptation to the ends in view, perfect lighting, ventilation and heating were aimed at. No more was expended in the structure proper than was necessary for permanence, solidity and a neat exterior. The building is furnished with gas, water, electrical and steam-heating apparatus.

The floor plans show the location and arrangement of the apartments. The chemist has two laboratories, furnished and equipped with desks, hoods, water, gas, steam and other apparatus, a combustion room, and a chemical store-room. There are offices for the Director and the Assistant Director, and a laboratory for microscopical work, all on the first floor. There is also on this floor a large assembly or lecture room, together with a library and reading room.

On the second floor are laboratories of the Botanist, the office



FLOOR PLAN—AGRICULTURAL EXPERIMENT STATION BUILDING.

and laboratory of the Biologist, a large Museum Hall for these departments and that of Agriculture.

The corner-stone of the new building was laid by the President and members of the East Tennessee Farmer's Association while in session in Knoxville, in May, 1888; and the building was finished about the first of November following

A very large proportion of the first appropriation available was at once used in providing scientific apparatus, books, furniture, and the other necessary facilities for work in the various laboratories, and, as demanded, additions have been made from year to year until now there are few institutions of the kind better equipped throughout.

The Station was organized with a Director and three sub-departments of Divisions, arranged to present the leading lines of agricultural investigation, namely:

1st. Division of Field and Feeding Experiments.
2nd. Division of Chemistry.
3rd. Division of Botany and Horticulture.
4th. Division of Entomology.*

The Station is under the immediate supervision of a Director and Board of Control, or Committee of five members of the Board of Trustees of the University.

* Not provided for at this date.

APPENDIX B.

THE SO-CALLED "HATCH EXPERIMENT STATION ACT."

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science, there shall be established, under the direction of the college or colleges, or agricultural department of colleges, in each State or Territory established, or which may hereafter be established, in accordance with the provisions of an act approved July 2, 1862, entitled, "An act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts," or any of the supplements to said act, a department to be known and designated as an "Agricultural Experiment Station;" *Provided,* That in any State or Territory in which two said colleges have been or may be so established, the appropriation hereinafter made to such State or Territory shall be equally divided between such colleges, unless the legislature of such State or Territory shall otherwise direct.

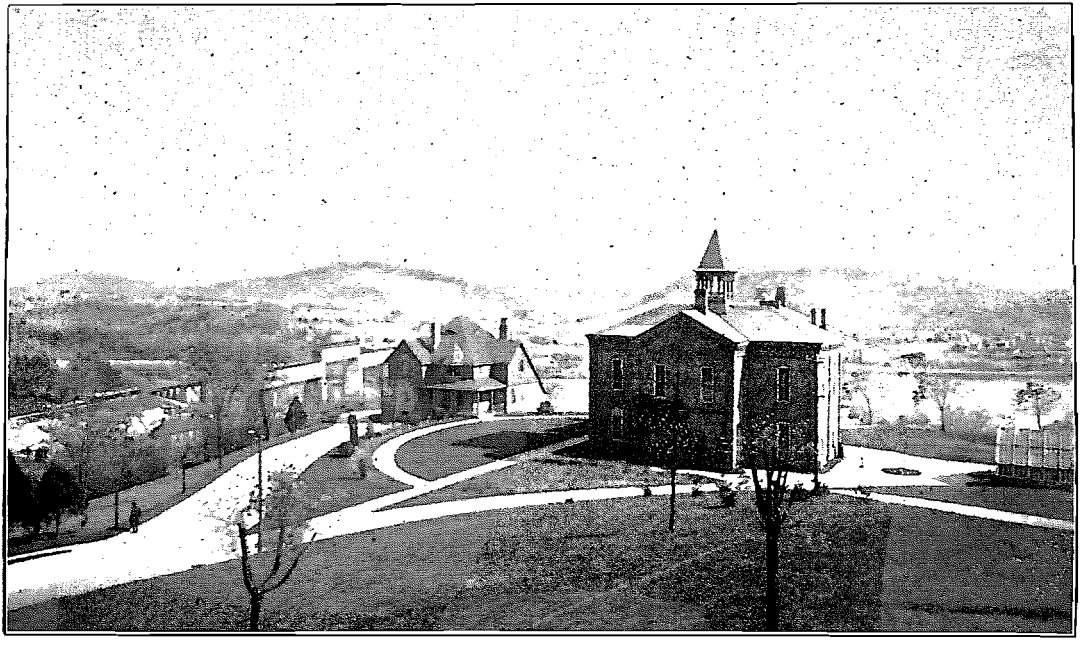
SEC. 2. That it shall be the object and duty of said Experiment Stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese, and such other researches or experiments bearing directly on the agricultural industry of

the United States as may in each be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories.

SEC. 3. That in order to secure, as far as practicable, uniformity of methods and results in the work of said Stations, it shall be the duty of the United States Commissioner of Agriculture to furnish forms, as far as practicable, for the tabulation of results of investigation or experiments; to indicate, from time to time, such lines of inquiry as to him shall seem most important; and, in general, to furnish such advice and assistance as will best promote the purposes of this act. 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.

SEC. 4. That bulletins or reports of progress shall be published at said Stations at least once in three months, one copy of which shall be sent to each newspaper in the States or Territories in which they are respectively located, and to such individuals actually engaged in farming as may request the same, and as far as the means of the Station will permit. Such bulletins or reports and the annual reports of said Stations shall be transmitted in the mails of the United States free of charge for postage, under such regulations as the Postmaster General may from time to time prescribe.

SEC. 5. That for the purpose of paying the necessary expenses of conducting investigations and experiments, and printing and distributing the results, as hereinbefore prescribed, the sum of fifteen thousand dollars per annum is hereby appropriated to each State, to be especially provided for by Congress in the appropriations from year to year, and to each Territory entitled under the provisions of section eight of this act, out of any money in the Treasury proceeding from the sales of public lands, to be paid in quarterly payments, on the first day of January, April, July and October in each year to the treasurer or other officer duly appointed by the governing boards of said college to receive the same, the first payment to be made on the first day of October, eighteen hundred and eighty-seven; *Provided, however*, That out of the first annual appropriation so received by any station an amount not exceeding one-fifth may be expended in the erection, enlargement or repair of a building or buildings necessary for carrying on the work of such station; and thereafter an amount not exceed-



EXPERIMENT STATION, LOOKING SOUTH.

ing five per centum of such annual appropriation may be so expended.

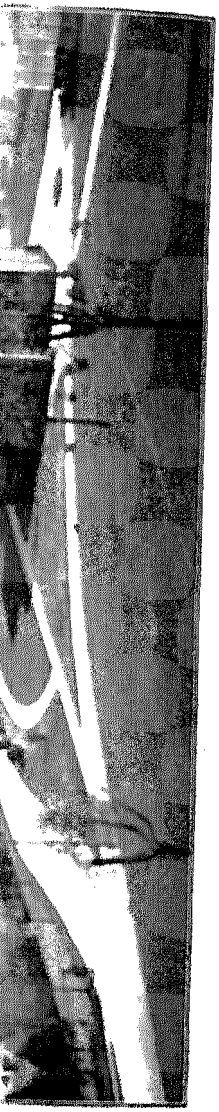
SEC. 6. That whenever it shall appear to the Secretary of the Treasury, from the annual statement of receipts and expenditures of any of said stations, that a portion of the preceding annual appropriation remains unexpended, such amount shall be deducted from the next succeeding annual appropriation to such station, in order that the amount of money appropriated to any station shall not exceed the amount actually and necessarily required for its maintenance and support.

SEC. 7. That nothing in this act shall be construed to impair or modify the legal relation existing between any of the said colleges and the government of the States and Territories in which they are respectively located.

SEC. 8. That in States having colleges entitled under this section to the benefits of this act, and having also Agricultural Experiment Stations established by law, separate from said colleges, such States shall be authorized to apply such benefits to experiments at Stations so established by such States; and in case any State shall have established, under the provisions of said act of July 2d aforesaid, an Agricultural Department or Experimental Station, in connection with any University, College or institution not distinctively an agricultural college or school, and such State shall have established or shall hereafter establish a separate agricultural college or school, which shall have connected therewith an experimental farm or station, the legislature may apply, in whole or in part, the appropriation by this act made to such separate agricultural college or school; and no legislature shall by contract, express or implied, disable itself from so doing.

SEC. 9. That the grants of money authorized by this act are made subject to the legislative assent of the several States and Territories to the purposes of said grants: *Provided*, that payments of such installments of the appropriation herein made as shall become due to any State before the adjournment of the regular session of its legislature meeting next after the passage of this act, shall be made upon the assent of the Governor thereof, duly certified to the Secretary of the Treasury.

SEC. 10. Nothing in this act shall be held or construed as binding the United States to continue any payments from the Treasury to any or all States or institutions mentioned in this act, but Congress may at any time amend, suspend, or repeal any or all the provisions of this act.



APPENDIX C.

LAWS OF TENNESSEE, 1887.

AN ACT empowering the Treasurer of the University of Tennessee to accept and apply certain grants of money authorized by an Act of the United States Congress, approved March 3d, 1887, and entitled "An Act to establish Agricultural Experiment Stations in connection with the Colleges established in the several States under the provisions of an Act approved July 2d, 1862, and of Acts supplementary thereto."

SECTION 1. *Be it enacted by the General Assembly of the State of Tennessee*, That the State of Tennessee hereby assents to the conditions of An Act of the United States Congress, approved March 3, 1887, entitled "An Act to establish Agricultural Experiment Stations in connection with the Colleges established in the several States under the provisions of An Act approved July 2d, 1862, and of Acts supplementary thereto," and authorizes the Treasurer of the University of Tennessee to accept any grants of money authorized by that Act in the State of Tennessee, and to give his official receipt for the same.

SEC. 2. *Be it further enacted*, That said grants of money to Tennessee shall, as a part of the Agricultural Fund, be committed to the Trustees of the University of Tennessee, now in charge of the State Experiment Station, there to be applied as the said Act of Congress directs, and all results and expenditures shall be reported in accordance with the provisions of the Act making the grants which is hereby accepted.

SEC. 3. *Be it further enacted*, That all laws in conflict with this Act be, and the same are hereby repealed.

Passed March 28th, 1887.

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The Secretary of State, - - - - - - - - - - *Ex-Officio.*
The Superintendent of Public Instruction, - - - - - *Ex-Officio.*

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Robert H. Armstrong,	Milton P. Jarnagin,
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Address:

Knoxville, Tenn., U. S. A.

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